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$$\begin{split} &\Sigma\text{-7-Series AC Servo Drive} \\ &\Sigma\text{-7S SERVOPACK} \\ &Command Option Attachable Type \\ &with DeviceNet Module \\ &Product Manual \end{split}$$

SERVOPACK Model: SGD7S Option Module Model: SGDV-OCA04A, -OCA05A

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MANUAL NO. SIEP S800001 70N		

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About this Manual

This manual provides information required to select Σ -7S Command Option Attachable-Type SERVOPACKs with DeviceNet Modules for Σ -7-Series AC Servo Drives, and to design, perform trial operation of, tune, operate, and maintain the Servo Drives.

Read and understand this manual to ensure correct usage of the Σ -7-Series AC Servo Drives.

Keep this manual in a safe place so that it can be referred to whenever necessary.

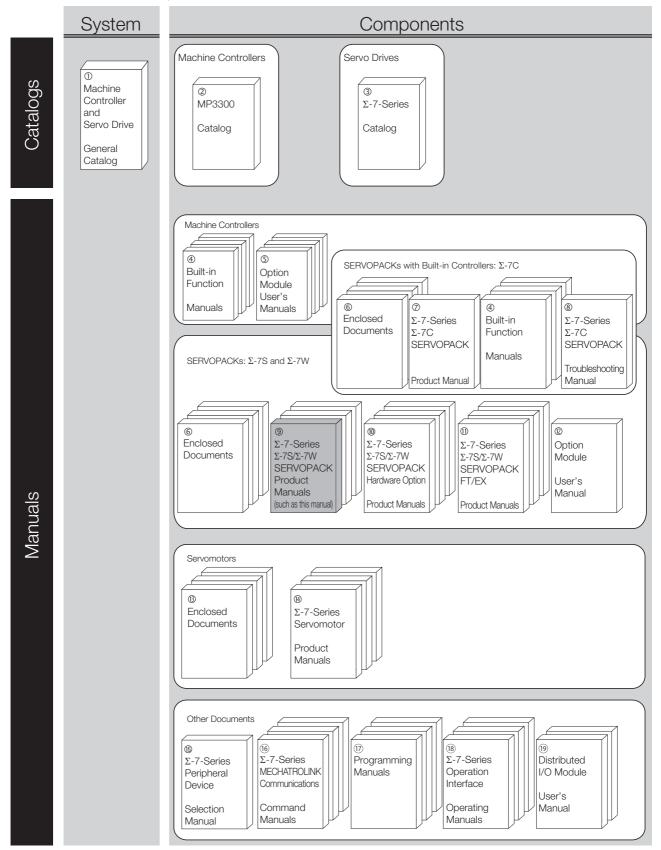
Outline of Manual

The contents of the chapters of this manual are described in the following table. Refer to these chapters as required.

Chapter	Chapter Title	Contents
1	Basic Information	Provides basic information, including an introduction to the DeviceNet Modules, the names of parts, and combinations with Servomotors.
2	Selecting a SERVOPACK	Provides information required to select SERVOPACKs, such as specifi- cations, block diagrams, dimensional drawings, and connection exam- ples.
3	Installation	Provides information on installing SERVOPACKs and DeviceNet Modules in the required locations.
4	Wiring and Connections	Provides information on wiring and connecting SERVOPACKs and DeviceNet Modules to power supplies and peripheral devices.
5	Basic Functions That Require Set- ting before Operation	Describes the basic functions that must be set before you start servo system operation. It also describes the setting methods.
6	Application Functions	Describes the application functions that you can set before you start servo system operation. It also describes the setting methods.
7	Trial Operation and Actual Opera- tion	Provides information on the flow and procedures for trial operation and convenient functions to use during trial operation.
8	Tuning	Provides information on the flow of tuning, details on tuning functions, and related operating procedures.
9	Monitoring	Provides information on monitoring SERVOPACK product information and SERVOPACK status.
10	Fully-Closed Loop Control	Provides detailed information on performing fully-closed loop control with the SERVOPACK.
11	Safety Functions	Provides detailed information on the safety functions of the SERVO- PACK.
12	DeviceNet Functions	Provides details on settings required to use the DeviceNet functions.
13	DeviceNet Communications	Provides details on DeviceNet communications.
14	Maintenance	Provides information on the meaning of, causes of, and corrections for alarms and warnings.
15	Parameter Lists	Provides information on the parameters.
16	Appendices	Provides corresponding SERVOPACK and SigmaWin+ function names.

Related Documents

The relationships between the documents that are related to the Servo Drives are shown in the following figure. The numbers in the figure correspond to the numbers in the table on the following pages. Refer to these documents as required.



Classification	Document Name	Document No.	Description
① Machine Controller and Servo Drive General Catalog	Machine Controller and AC Servo Drive Solutions Catalog		Describes the features and application examples for combi- nations of MP3000-Series Machine Controllers and Σ-7- Series AC Servo Drives.
② MP3300 Catalog	Machine Controller MP3300	KAEP C880725 03	Provides detailed information on MP3300 Machine Controllers, including features and specifica- tions.
③ Σ-7-Series Catalog	AC Servo Drives Σ -7 Series	KAEP S800001 23	Provides detailed information on Σ -7-Series AC Servo Drives, including features and specifications.
۵	Σ-7-Series AC Servo Drive Σ-7C SERVOPACK Motion Control User's Manual	SIEP S800002 03	Provides detailed information on the specifications, system con- figuration, and application meth- ods of the Motion Control Function Modules (SVD, SVC4, and SVR4) for Σ -7-Series Σ -7C SERVOPACKs.
⊕ Built-in Function Manuals	Machine Controller MP3000 Series Communications User's Manual	SIEP C880725 12	Provides detailed information on the specifications, system con- figuration, and communications connection methods for the Ethernet communications that are used with MP3000-Series Machine Controllers and Σ -7- Series Σ -7C SERVOPACKs.
	Machine Controller MP2000 Series Communication Module User's Manual	SIEP C880700 04	
© Option Module User's Manuals	Machine Controller MP2000 Series 262IF-01 FL-net Communication Module User's Manual	SIEP C880700 36	Provide detailed information on the specifications and commu- nications methods for the Com munications Modules that can be mounted to MP3000-Series Machine Controllers and Σ-7-
	Machine Controller MP2000 Series 263IF-01 EtherNet/IP Communication Module User's Manual	SIEP C880700 39	Series Σ -7C SERVOPACKs.
	Machine Controller MP2000 Series I/O Module User's Manual	SIEP C880700 34	Provide detailed information on
	Machine Controller MP2000 Series Analog Input/Analog Output Mod- ule AI-01/AO-01 User's Manual	SIEP C880700 26	the specifications and commu- nications methods for the I/O Modules that can be mounted to MP3000-Series Machine Controllers and Σ -7-Series Σ -7C
	Machine Controller MP2000 Series Counter Module CNTR-01 User's Manual	SIEP C880700 27	SERVOPACKs.

			Continued from previous page.
Classification	Document Name	Document No.	Description
	Σ-7-Series AC Servo Drive Σ-7S, $Σ$ -7W, and $Σ$ -7C SERVOPACK Safety Precautions	TOMP C710828 00	Provides detailed information for the safe usage of Σ -7-Series SERVOPACKs.
	$\begin{array}{l} \Sigma \text{-V-Series} / \Sigma \text{-V-Series} \\ \text{for Large-Capacity Models} / \\ \Sigma \text{-7-Series} \\ \text{Safety Precautions} \\ \text{Option Module} \end{array}$	TOBP C720829 00	Provides detailed information for the safe usage of Option Mod- ules.
	Σ -V-Series/ Σ -V-Series for Large-Capacity Models/ Σ -7-Series Installation Guide Command Option Module	TOBP C720829 01	Provides detailed procedures for installing the Command Option Module in a SERVOPACK.
© Enclosed Documents	$\begin{array}{l} \Sigma \text{-V-Series} \\ \text{for Large-Capacity Models} \\ \Sigma \text{-7-Series} \\ \text{Installation Guide} \\ \text{Fully-closed Module} \end{array}$	TOBP C720829 03	Provides detailed procedures for installing the Fully-closed Mod- ule in a SERVOPACK.
	Σ-V-Series/Σ-V-Series for Large-Capacity Models/ Σ-7-Series Installation Guide Safety Module	TOBP C720829 06	Provides detailed procedures for installing the Safety Module in a SERVOPACK.
	$\begin{array}{l} \Sigma \text{-V-Series} \\ \text{for Large-Capacity Models} \\ \Sigma \text{-7-Series} \\ \text{Installation Guide} \\ \text{INDEXER Module} \end{array}$	TOBP C720829 02	Provides detailed procedures for installing the INDEXER Module in a SERVOPACK.
	$\begin{array}{l} \Sigma \text{-V-Series} \\ \text{for Large-Capacity Models} \\ \Sigma \text{-7-Series} \\ \text{Installation Guide} \\ \text{DeviceNet Module} \end{array}$	TOBP C720829 07	Provides detailed procedures for installing the DeviceNet Module in a SERVOPACK.
 Ø Σ-7-Series Σ-7C SERVOPACK Product Manual 	Σ-7-Series AC Servo Drive Σ-7C SERVOPACK Product Manual	SIEP S800002 04	Provides detailed information on selecting Σ -7-Series Σ -7C SERVOPACKs; installing, connecting, setting, testing in trial operation, and tuning Servo Drives; writing, monitoring, and maintaining programs; and other information.
$^{\textcircled{8}}$ Σ-7-Series Σ-7C SERVOPACK Troubleshooting Manual	Σ-7-Series AC Servo Drive Σ-7C SERVOPACK Troubleshooting Manual	SIEP S800002 07	Provides detailed troubleshoot- ing information for Σ -7-Series Σ -7C SERVOPACKs.

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Classification	Document Name	Document No.	Description
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with MECHATROLINK-4 Communications References Product Manual	SIEP S800002 31	
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with MECHATROLINK-III Communications References Product Manual	SIEP S800001 28	
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with MECHATROLINK-II Communications References Product Manual	SIEP S800001 27	Provide detailed information on
 ⑨ Σ-7-Series Σ-7S/Σ-7W SERVOPACK Product Manuals 	Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with Analog Voltage/Pulse Train References Product Manual	SIEP S800001 26	selecting Σ -7-Series Σ -7S and Σ -7W SERVOPACKs; installing, connecting, setting, testing in trial operation, tuning, monitoring, and maintaining Servo
	Σ -7-Series AC Servo Drive Σ -7S SERVOPACK Command Option Attachable Type with INDEXER Module Product Manual	SIEP S800001 64	Drives; and other information.
	Σ -7-Series AC Servo Drive Σ -7S SERVOPACK Command Option Attachable Type with DeviceNet Module Product Manual	This manual (SIEP S800001 70)	
Σ Ν C	$\begin{array}{l} \Sigma \text{-}7\text{-}Series \text{ AC Servo Drive} \\ \Sigma \text{-}7W \text{ SERVOPACK with} \\ \text{MECHATROLINK-III} \\ \text{Communications References} \\ \text{Product Manual} \end{array}$	SIEP S800001 29	
$ $	Σ -7-Series AC Servo Drive Σ -7S/ Σ -7W SERVOPACK with Hardware Option Specifications Dynamic Brake Product Manual	SIEP S800001 73	Provide detailed information on Hardware Options for Σ -7-
	Σ -7-Series AC Servo Drive Σ -7W/ Σ -7C SERVOPACK with Hardware Option Specifications HWBB Function Product Manual	SIEP S800001 72	Series SERVOPACKs.

Classification	Document Name	Document No.	Continued from previous page. Description
Classification	$ \begin{array}{c} \Sigma \mbox{-7-Series AC Servo Drive} \\ \Sigma \mbox{-7S SERVOPACK with} \\ \mbox{FT/EX Specification for Indexing} \\ \mbox{Application} \\ \mbox{Product Manual} \end{array} $	SIEP S800001 84	Description
	Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with FT/EX Specification for Tracking Application Product Manual	SIEP S800001 89	
	$\begin{array}{l} \Sigma \mbox{-}7\mbox{-}Series \mbox{ AC Servo Drive} \\ \Sigma \mbox{-}7S \mbox{ SERVOPACK with} \\ \mbox{FT/EX Specification} \\ \mbox{for Application with Special Motor,} \\ \mbox{SGM7D Motor} \\ \mbox{Product Manual} \end{array}$	SIEP S800001 91	
	Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with FT/EX Specification for Press and injection Molding Application Product Manual	SIEP S800001 94	
	Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with FT/EX Specification for Transfer and Alignment Application Product Manual	SIEP S800001 95	- Provide detailed information or
Σ -7-Series Σ -7S/ Σ -7W SERVOPACK FT/EX Product Manuals	Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with FT/EX Specification for Torque/Force Assistance for Conveyance Application Product Manual	SIEP S800002 09	the FT/EX Option for Σ -7-Series SERVOPACKs.
	Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with FT/EX Specification for Cutting Application Feed Shaft Motor Product Manual	SIEP S800002 10	
	Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with FT/EX Specification for Three-Point Latching for Conveyance Application Product Manual	SIEP S800002 17	
	Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with FT/EX Specification for Semi-/Fully-Closed Loop Control Online Switching for Conveyance Application Product Manual	SIEP S800002 27	
	Σ -7-Series AC Servo Drive Σ -7W SERVOPACK with FT/EX Specification for Gantry Applications Product Manual	SIEP S800002 29	

			Continued from previous page.
Classification	Document Name	Document No.	Description
© Option Module User's Manual	AC Servo Drives Σ-V Series/Σ-V Series for Large-Capacity Models/ Σ-7 Series User's Manual Safety Module	SIEP C720829 06	Provides detailed information required for the design and maintenance of a Safety Mod- ule.
® Enclosed Documents	AC Servo Drive Rotary Servomotor Safety Precautions	TOBP C230260 00	Provides detailed information for the safe usage of Rotary Servo- motors and Direct Drive Servo- motors.
Enclosed Documents	AC Servomotor Linear Σ Series Safety Precautions	TOBP C230800 00	Provides detailed information for the safe usage of Linear Servo- motors.
	Σ-7-Series AC Servo Drive Rotary Servomotor Product Manual	SIEP S800001 36	
[®] Σ-7-Series Servomotor Product Manuals	Σ-7-Series AC Servo Drive Linear Servomotor Product Manual	SIEP S800001 37	Provide detailed information on selecting, installing, and connecting the Σ -7-Series Servomotors.
	Σ-7-Series AC Servo Drive Direct Drive Servomotor Product Manual	SIEP S800001 38	
[®] Σ-7-Series Peripheral Device Selection Manual	Σ-7-Series AC Servo Drive Peripheral Device Selection Manual	SIEP S800001 32	 Provides the following information in detail for Σ-7-Series Servo Systems. Cables: Models, dimensions, wiring materials, connector models, and connection specifications Peripheral devices: Models, specifications, diagrams, and selection (calculation) methods
© Σ-7-Series MECHATROLINK Communications Command Manuals	Σ-7-Series AC Servo Drive MECHATROLINK-II Communications Command Manual	SIEP S800001 30	Provides detailed information on the MECHATROLINK-II commu- nications commands that are used for a Σ -7-Series Servo System.
	Σ-7-Series AC Servo Drive MECHATROLINK-III Communications Standard Servo Profile Command Manual	SIEP S800001 31	Provides detailed information on the MECHATROLINK-III communications standard servo profile commands that are used for a Σ -7-Series Servo System.
	Σ-7-Series AC Servo Drive MECHATROLINK-4 Communications Standard Servo Profile Command Manual	SIEP S800002 32	Provides detailed information on the MECHATROLINK-4 commu- nications standard servo profile commands that are used for a Σ -7- Series Servo System.
[®] Programming Manuals	Machine Controller MP3000 Series Ladder Programming Manual	SIEP C880725 13	Provides detailed information on the ladder programming specifi- cations and instructions for MP3000-Series Machine Con- trollers and Σ -7-Series Σ -7C SERVOPACKs.
	Machine Controller MP3000 Series Motion Programming Manual	SIEP C880725 14	Provides detailed information on the motion programming and sequence programming specifi- cations and instructions for MP3000-Series Machine Con- trollers and Σ -7-Series Σ -7C SERVOPACKs.

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Classification	Document Name	Document No.	Description
[®] Σ-7-Series Operation Interface Operating Manuals	System Integrated Engineering Tool MPE720 Version 7 User's Manual	SIEP C880761 03	Describes in detail how to oper- ate MPE720 version 7.
	Σ-7-Series AC Servo Drive Digital Operator Operating Manual	SIEP S800001 33	Describes the operating proce- dures for a Digital Operator for a Σ -7-Series Servo System.
	AC Servo Drive Engineering Tool SigmaWin+ Operation Manual	SIET S800001 34	Provides detailed operating pro- cedures for the SigmaWin+ Engineering Tool for a Σ -7- Series Servo System.
C	MECHATROLINK-III Compatible I/O Module User's Manual	SIEP C880781 04	Describes the functions, specifi- cations, operating methods, and MECHATROLINK-III communi- cations for the Remote I/O Mod- ules for MP2000/MP3000- Series Machine Controllers.
I/O Module User's Manual	MECHATROLINK-4 Compatible I/O Module User's Manual	SIEP C880782 01	Describes the functions, specifi- cations, operating methods, and MECHATROLINK-4 communi- cations for the Remote I/O Mod- ules for MP3000-Series Machine Controllers.

Using This Manual

◆ Technical Terms Used in This Manual

The following terms are used in this manual.

Term	Meaning
Servomotor	A Σ-7-Series Rotary Servomotor, Direct Drive Servomotor, or Linear Servomotor.
Rotary Servomotor	A generic term used for a Σ -7-Series Rotary Servomotor (SGM7M, SGM7J, SGM7A, SGM7P, SGM7G, or SGMMV) or a Direct Drive Servomotor (SGM7E, SGM7F, SGMCV, or SGMCS). The descriptions will specify when Direct Drive Servomotors are excluded.
Linear Servomotor	A Σ-7-Series Linear Servomotor (SGLG, SGLF, or SGLT).
SERVOPACK	A Σ -7-Series Σ -7S Command Option Module Attachable-Type Servo Amplifier.
Servo Drive	The combination of a Servomotor and SERVOPACK.
Servo System	A servo control system that includes the combination of a Servo Drive with a host controller and peripheral devices.
servo ON	Supplying power to the motor.
servo OFF	Not supplying power to the motor.
base block (BB)	Shutting OFF the power supply to the motor by shutting OFF the base current to the power transistor in the SERVOPACK.
servo lock	A state in which the motor is stopped and is in a position loop with a position reference of 0.
Main Circuit Cable	One of the cables that connect to the main circuit terminals, including the Main Circuit Power Supply Cable, Control Power Supply Cable, and Servomotor Main Circuit Cable.
SigmaWin+	The Engineering Tool for setting up and tuning Servo Drives or a computer in which the Engineering Tool is installed.

◆ Differences in Terms for Rotary Servomotors and Linear Servomotors

There are differences in the terms that are used for Rotary Servomotors and Linear Servomotors. This manual primarily describes Rotary Servomotors. If you are using a Linear Servomotor, you need to interpret the terms as given in the following table.

Rotary Servomotors	Linear Servomotors
torque	force
moment of inertia	mass
rotation	movement
forward rotation and reverse rotation	forward movement and reverse movement
CW and CCW pulse trains	forward and reverse pulse trains
rotary encoder	linear encoder
absolute rotary encoder	absolute linear encoder
incremental rotary encoder	incremental linear encoder
unit: min ⁻¹	unit: mm/s
unit: N⋅m	unit: N

Notation Used in this Manual

Notation for Reverse Signals

The names of reverse signals (i.e., ones that are valid when low) are written with a forward slash (/) before the signal abbreviation.

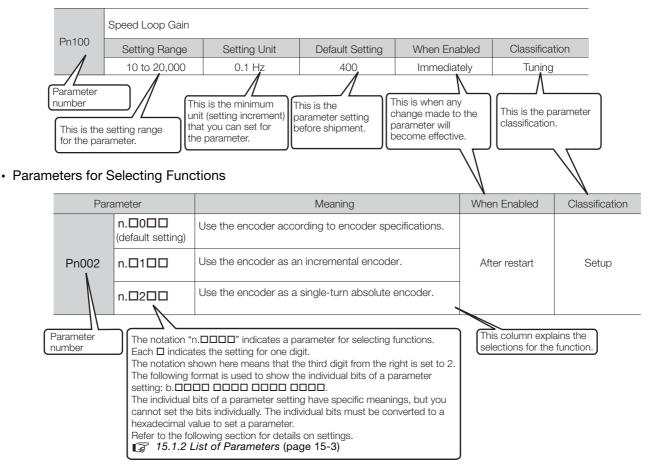
Notation Example

BK is written as /BK.

Notation for Parameters

The notation depends on whether the parameter requires a numeric setting (parameter for numeric setting) or requires the selection of a function (parameter for selecting functions).

· Parameters for Numeric Settings



Notation Example



	Digit Notation			Numeric Value Notation
n.0 0 0 0	Notation	Meaning	Notation	Meaning
	Pn002 = n.□□□X	Indicates the first digit from the right in Pn002.	Pn002 = n.□□□1	Indicates that the first digit from the right in Pn002 is set to 1.
	Pn002 = n.□□X□	Indicates the second digit from the right in Pn002.	Pn002 = n.□□1□	Indicates that the second digit from the right in Pn002 is set to 1.
	Pn002 = n.□X□□	Indicates the third digit from the right in Pn002.	Pn002 = n.⊡1⊡⊡	Indicates that the third digit from the right in Pn002 is set to 1.
	Pn002 = n.X□□□	Indicates the fourth digit from the right in Pn002.	Pn002 = n.1□□□	Indicates that the fourth digit from the right in Pn002 is set to 1.

Engineering Tools Used in This Manual

This manual uses the interfaces of the SigmaWin+ for descriptions.

♦ Trademarks

- QR code is a trademark of Denso Wave Inc.
- DeviceNet is a trademark of the ODVA (Open DeviceNet Vendor Association, Inc.).
- Other product names and company names are the trademarks or registered trademarks of the respective company. "TM" and the ® mark do not appear with product or company names in this manual.

Visual Aids

The following aids are used to indicate certain types of information for easier reference.

Ì
Important

Indicates precautions or restrictions that must be observed. Also indicates alarm displays and other precautions that will not result in machine damage.



Indicates definitions of difficult terms or terms that have not been previously explained in this manual.

Example Indicates operating or setting examples.

(Information) Indicates supplemental information to deepen understanding or useful information.

Safety Precautions

♦ Safety Information

To prevent personal injury and equipment damage in advance, the following signal words are used to indicate safety precautions in this document. The signal words are used to classify the hazards and the degree of damage or injury that may occur if a product is used incorrectly. Information marked as shown below is important for safety. Always read this information and heed the precautions that are provided.

• Indicates precautions that, if not heeded, are likely to result in loss of life, serious injury, or fire.

• Indicates precautions that, if not heeded, could result in loss of life, serious injury, or fire.

• Indicates precautions that, if not heeded, could result in relatively serious or minor injury, or in fire.

NOTICE

• Indicates precautions that, if not heeded, could result in property damage.

◆ Safety Precautions That Must Always Be Observed

General Precautions

- Read and understand this manual to ensure the safe usage of the product.
- Keep this manual in a safe, convenient place so that it can be referred to whenever necessary. Make sure that it is delivered to the final user of the product.
- Do not remove covers, cables, connectors, or optional devices while power is being supplied to the SERVOPACK.

There is a risk of electric shock, operational failure of the product, or burning.

- Use a power supply with specifications (number of phases, voltage, frequency, and AC/DC type) that are appropriate for the product. There is a risk of burning, electric shock, or fire.
- Connect the ground terminals on the SERVOPACK and Servomotor to ground poles according to local electrical codes (100 Ω or less for a SERVOPACK with a 100-VAC or 200-VAC power supply, and 10 Ω or less for a SERVOPACK with a 400-VAC power supply). There is a risk of electric shock or fire.
- Do not attempt to disassemble, repair, or modify the product. There is a risk of fire or failure. The warranty is void for the product if you disassemble, repair, or modify it.

- The SERVOPACK heat sinks, regenerative resistors, External Dynamic Brake Resistors, Servomotors, and other components can be very hot while power is ON or soon after the power is turned OFF. Implement safety measures, such as installing covers, so that hands and parts such as cables do not come into contact with hot components. There is a risk of burn injury.
- For a 24-VDC power supply, use a power supply device with double insulation or reinforced insulation.

There is a risk of electric shock.

- Do not damage, pull on, apply excessive force to, place heavy objects on, or pinch cables. There is a risk of failure, damage, or electric shock.
- The person who designs the system that uses the hard wire base block safety function must have a complete knowledge of the related safety standards and a complete understanding of the instructions in this document.
 There is a risk of injury, product damage, or machine damage.
- Do not use the product in an environment that is subject to water, corrosive gases, or flammable gases, or near flammable materials.
 - There is a risk of electric shock or fire.

NOTICE

- Do not attempt to use a SERVOPACK or Servomotor that is damaged or that has missing parts.
- Install external emergency stop circuits that shut OFF the power supply and stops operation immediately when an error occurs.
- In locations with poor power supply conditions, install the necessary protective devices (such as AC reactors) to ensure that the input power is supplied within the specified voltage range. There is a risk of damage to the SERVOPACK.
- Use a Noise Filter to minimize the effects of electromagnetic interference. Electronic devices used near the SERVOPACK may be affected by electromagnetic interference.
- Always use a Servomotor and SERVOPACK in one of the specified combinations.
- Do not touch a SERVOPACK or Servomotor with wet hands. There is a risk of product failure.

Storage Precautions

• Do not place an excessive load on the product during storage. (Follow all instructions on the packages.)

There is a risk of injury or damage.

NOTICE

- Do not install or store the product in any of the following locations.
 - Locations that are subject to direct sunlight
 - · Locations that are subject to ambient temperatures that exceed product specifications
 - Locations that are subject to relative humidities that exceed product specifications
 - · Locations that are subject to condensation as the result of extreme changes in temperature
 - · Locations that are subject to corrosive or flammable gases
 - · Locations that are near flammable materials
 - · Locations that are subject to dust, salts, or iron powder
 - Locations that are subject to water, oil, or chemicals
 - · Locations that are subject to vibration or shock that exceeds product specifications
 - Locations that are subject to radiation
 - If you store or install the product in any of the above locations, the product may fail or be damaged.

Transportation Precautions

- Transport the product in a way that is suitable to the mass of the product.
- Do not use the eyebolts on a SERVOPACK or Servomotor to move the machine. There is a risk of damage or injury.
- When you handle a SERVOPACK or Servomotor, be careful of sharp parts, such as the corners. There is a risk of injury.
- Do not place an excessive load on the product during transportation. (Follow all instructions on the packages.)

There is a risk of injury or damage.

NOTICE

- Do not hold onto the front cover or connectors when you move a SERVOPACK. There is a risk of the SERVOPACK falling.
- A SERVOPACK or Servomotor is a precision device. Do not drop it or subject it to strong shock. There is a risk of failure or damage.
- Do not subject connectors to shock. There is a risk of faulty connections or damage.
- If disinfectants or insecticides must be used to treat packing materials such as wooden frames, plywood, or pallets, the packing materials must be treated before the product is packaged, and methods other than fumigation must be used.

Example: Heat treatment, where materials are kiln-dried to a core temperature of 56°C for 30 minutes or more.

If the electronic products, which include stand-alone products and products installed in machines, are packed with fumigated wooden materials, the electrical components may be greatly damaged by the gases or fumes resulting from the fumigation process. In particular, disinfectants containing halogen, which includes chlorine, fluorine, bromine, or iodine can contribute to the erosion of the capacitors.

• Do not overtighten the eyebolts on a SERVOPACK or Servomotor. If you use a tool to overtighten the eyebolts, the tapped holes may be damaged.

Installation Precautions

 Install the Servomotor or SERVOPACK in a way that will support the mass given in technical documents.
 Install SERVOPACKs, Servomotors, regenerative resistors, and External Dynamic Brake Resistors on nonflammable materials. Installation directly onto or near flammable materials may result in fire.
 Provide the specified clearances between the SERVOPACK and the control panel as well as with other devices. There is a risk of fire or failure.
 Install the SERVOPACK in the specified orientation. There is a risk of fire or failure.
 Do not step on or place a heavy object on the product. There is a risk of failure, damage, or injury.
 Do not allow any foreign matter to enter the SERVOPACK or Servomotor. There is a risk of failure or fire.

NOTICE

- Do not install or store the product in any of the following locations.
 - Locations that are subject to direct sunlight
 - · Locations that are subject to ambient temperatures that exceed product specifications
 - Locations that are subject to relative humidities that exceed product specifications
 - · Locations that are subject to condensation as the result of extreme changes in temperature
 - · Locations that are subject to corrosive or flammable gases
 - · Locations that are near flammable materials
 - · Locations that are subject to dust, salts, or iron powder
 - Locations that are subject to water, oil, or chemicals
 - · Locations that are subject to vibration or shock that exceeds product specifications
 - Locations that are subject to radiation
 - If you store or install the product in any of the above locations, the product may fail or be damaged.
- Use the product in an environment that is appropriate for the product specifications. If you use the product in an environment that exceeds product specifications, the product may fail or be damaged.
- A SERVOPACK or Servomotor is a precision device. Do not drop it or subject it to strong shock. There is a risk of failure or damage.
- Always install a SERVOPACK in a control panel.
- Do not allow any foreign matter to enter a SERVOPACK or a Servomotor with a Cooling Fan and do not cover the outlet from the Servomotor's cooling fan. There is a risk of failure.

Wiring Precautions

• Do not change any wiring while power is being supplied. There is a risk of electric shock or injury.

- Wiring and inspections must be performed only by qualified engineers. There is a risk of electric shock or product failure.
- Check all wiring and power supplies carefully. Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures. If a short-circuit failure occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident that may result in death or injury.
- Connect the AC and DC power supplies to the specified SERVOPACK terminals.
 - Connect an AC power supply to the L1, L2, and L3 terminals and the L1C and L2C terminals on the SERVOPACK.
 - Connect a DC power supply to the B1/ \oplus and \ominus 2 terminals and the L1C and L2C terminals on the SERVOPACK.

There is a risk of failure or fire.

 If you use a SERVOPACK with the Dynamic Brake Hardware Option, connect an External Dynamic Brake Resistor that is suitable for the machine and equipment specifications to the specified terminals.

There is a risk of unexpected operation, machine damage, burning, or injury when an emergency stop is performed.

Wait for at least six minutes after turning OFF the power supply (with a SERVOPACK for a 100-VAC input, wait for at least nine minutes) and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the power supply terminals while the CHARGE lamp is lit after turning OFF the power supply because high voltage may still remain in the SERVOPACK. There is a risk of electric shock. Observe the precautions and instructions for wiring and trial operation precisely as described in this document. Failures caused by incorrect wiring or incorrect voltage application in the brake circuit may cause the SERVOPACK to fail, damage the equipment, or cause an accident resulting in death or injury. • Check the wiring to be sure it has been performed correctly. Connectors and pin layouts are sometimes different for different models. Always confirm the pin layouts in technical documents for your model before operation. There is a risk of failure or malfunction. Connect wires to power supply terminals and motor connection terminals securely with the specified methods and tightening torque. Insufficient tightening may cause wires and terminal blocks to generate heat due to faulty contact, possibly resulting in fire. • Use shielded twisted-pair cables or screened unshielded multi-twisted-pair cables for I/O Signal Cables and Encoder Cables. • The maximum wiring length is 3 m for I/O Signal Cables, and 50 m for Encoder Cables or Servomotor Main Circuit Cables. Observe the following precautions when wiring the SERVOPACK's main circuit terminals. • Turn ON the power supply to the SERVOPACK only after all wiring, including the main circuit terminals, has been completed. If a connector is used for the main circuit terminals, remove the main circuit connector from the SER-VOPACK before you wire it. • Insert only one wire per insertion hole in the main circuit terminals. When you insert a wire, make sure that the conductor wire (e.g., whiskers) does not come into contact with adjacent wires. Install molded-case circuit breakers and other safety measures to provide protection against short circuits in external wiring. There is a risk of fire or failure.

NOTICE

- Whenever possible, use the Cables specified by Yaskawa.
 If you use any other cables, confirm the rated current and application environment of your model and use the wiring materials specified by Yaskawa or equivalent materials.
- Securely tighten connector screws and lock mechanisms. Insufficient tightening may result in connectors falling off during operation.
- Do not bundle power lines (e.g., the Main Circuit Cable) and low-current lines (e.g., the I/O Signal Cables or Encoder Cables) together or run them through the same duct. If you do not place power lines and low-current lines in separate ducts, separate them by at least 30 cm. If the cables are too close to each other, malfunctions may occur due to noise affecting the low-current lines.
- Install a battery at either the host controller or on the Encoder Cable. If you install batteries both at the host controller and on the Encoder Cable at the same time, you will create a loop circuit between the batteries, resulting in a risk of damage or burning.
- When connecting a battery, connect the polarity correctly. There is a risk of battery rupture or encoder failure.

Operation Precautions

WARNING Before starting operation with a machine connected, change the settings of the switches and parameters to match the machine. Unexpected machine operation, failure, or personal injury may occur if operation is started before appropriate settings are made. • Do not radically change the settings of the parameters. There is a risk of unstable operation, machine damage, or injury. Install limit switches or stoppers at the ends of the moving parts of the machine to prevent unexpected accidents. There is a risk of machine damage or injury. For trial operation, securely mount the Servomotor and disconnect it from the machine. There is a risk of injury. • Forcing the motor to stop for overtravel is disabled when the Jog, Origin Search, or Easy FFT utility function is executed. Take necessary precautions. There is a risk of machine damage or injury. When an alarm occurs, the Servomotor will coast to a stop or stop with the dynamic brake according to the SERVOPACK Option and settings. The coasting distance will change with the moment of inertia of the load and the resistance of the External Dynamic Brake Resistor. Check the coasting distance during trial operation and implement suitable safety measures on the machine. • Do not enter the machine's range of motion during operation. There is a risk of injury. • Do not touch the moving parts of the Servomotor or machine during operation. There is a risk of injury. CAUTION • Design the system to ensure safety even when problems, such as broken signal lines, occur. For example, the CCW-OT and CW-OT signals are set in the default settings to operate on the safe side if a signal line breaks. Do not change the polarity of this type of signal. • When overtravel occurs, the power supply to the motor is turned OFF and the brake is released. If you use the Servomotor to drive a vertical load, set the Servomotor to enter a zero-clamped state after the Servomotor stops. Also, install safety devices (such as an external brake or counterweight) to prevent the moving parts of the machine from falling. • Always turn OFF the servo before you turn OFF the power supply. If you turn OFF the main cir-

- cuit power supply or control power supply during operation before you turn OFF the servo, the Servomotor will stop as follows:
- If you turn OFF the main circuit power supply during operation without turning OFF the servo, the Servomotor will stop abruptly with the dynamic brake.
- If you turn OFF the control power supply without turning OFF the servo, the stopping method that is used by the Servomotor depends on the model of the SERVOPACK. For details, refer to the manual for the SERVOPACK.
- If you use a SERVOPACK with the Dynamic Brake Hardware Option, the Servomotor stopping methods will be different from the stopping methods used without the Option or with other Hardware Options. For details, refer to the following manual.
 - Ω Σ-7-Series Σ-7S/Σ-7W SERVOPACK with Dynamic Brake Hardware Option Specifications Product Manual (Manual No.: SIEP S800001 73)
- Do not use the dynamic brake for any application other than an emergency stop. There is a risk of failure due to rapid deterioration of elements in the SERVOPACK and the risk of unexpected operation, machine damage, burning, or injury.

NOTICE When you adjust the gain during system commissioning, use a measuring instrument to monitor the torque waveform and speed waveform and confirm that there is no vibration. If a high gain causes vibration, the Servomotor will be damaged guickly. • Do not frequently turn the power supply ON and OFF. After you have started actual operation, allow at least one hour between turning the power supply ON and OFF (as a guideline). Do not use the product in applications that require the power supply to be turned ON and OFF frequently. The elements in the SERVOPACK will deteriorate quickly. • An alarm or warning may occur if communications are performed with the host controller while the SigmaWin+ or Digital Operator is operating. If an alarm or warning occurs, it may interrupt the current process and stop the system. • After you complete trial operation of the machine and facilities, use the SigmaWin+ to back up the settings of the SERVOPACK parameters. You can use them to reset the parameters after SERVOPACK replacement. If you do not copy backed up parameter settings, normal operation may not be possible after a faulty SERVOPACK is replaced, possibly resulting in machine or equipment damage. Maintenance and Inspection Precautions DANGER

• Do not change any wiring while power is being supplied. There is a risk of electric shock or injury.

• Wiring and inspections must be performed only by qualified engineers. There is a risk of electric shock or product failure.

• Wait for at least six minutes after turning OFF the power supply (with a SERVOPACK for a 100-VAC input, wait for at least nine minutes) and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the power supply terminals while the CHARGE lamp is lit after turning OFF the power supply because high voltage may still remain in the SERVOPACK.

There is a risk of electric shock.

 Before you replace a SERVOPACK, back up the settings of the SERVOPACK parameters. Copy the backed up parameter settings to the new SERVOPACK and confirm that they were copied correctly.

If you do not copy backed up parameter settings or if the copy operation is not completed normally, normal operation may not be possible, possibly resulting in machine or equipment damage.

NOTICE

 Discharge all static electricity from your body before you operate any of the buttons or switches inside the front cover of the SERVOPACK. There is a risk of equipment damage.

Troubleshooting Precautions

 If the safety device (molded-case circuit breaker or fuse) installed in the power supply line operates, remove the cause before you supply power to the SERVOPACK again. If necessary, repair or replace the SERVOPACK, check the wiring, and remove the factor that caused the safety device to operate.

There is a risk of fire, electric shock, or injury.

• The product may suddenly start to operate when the power supply is recovered after a momentary power interruption. Design the machine to ensure human safety when operation restarts. There is a risk of injury.

- When an alarm occurs, remove the cause of the alarm and ensure safety. Then reset the alarm or turn the power supply OFF and ON again to restart operation. There is a risk of injury or machine damage.
- If the Servo ON signal is input to the SERVOPACK and an alarm is reset, the Servomotor may suddenly restart operation. Confirm that the servo is OFF and ensure safety before you reset an alarm.

There is a risk of injury or machine damage.

- Always insert a magnetic contactor in the line between the main circuit power supply and the main circuit power supply terminals on the SERVOPACK so that the power supply can be shut OFF at the main circuit power supply.
 If a magnetic contactor is not connected when the SERVOPACK fails, a large current may flow, possibly resulting in fire.
- If an alarm occurs, shut OFF the main circuit power supply. There is a risk of fire due to a regenerative resistor overheating as the result of regenerative transistor failure.
- Install a ground fault detector against overloads and short-circuiting or install a molded-case circuit breaker combined with a ground fault detector.
 There is a risk of SERVOPACK failure or fire if a ground fault occurs.
- The holding brake on a Servomotor will not ensure safety if there is the possibility that an external force (including gravity) may move the current position and create a hazardous situation when power is interrupted or an error occurs. If an external force may cause movement, install an external braking mechanism that ensures safety.

Disposal Precautions

 Correctly discard the product as stipulated by regional, local, and municipal laws and regulations. Be sure to include these contents in all labelling and warning notifications on the final product as necessary.



General Precautions

- Figures provided in this document are typical examples or conceptual representations. There may be differences between them and actual wiring, circuits, and products.
- The products shown in illustrations in this document are sometimes shown without covers or protective guards. Always replace all covers and protective guards before you use the product.
- If you need a new copy of this document because it has been lost or damaged, contact your nearest Yaskawa representative or one of the offices listed on the back of this document.
- This document is subject to change without notice for product improvements, specifications changes, and improvements to the manual itself.
 We will update the document number of the document and issue revisions when changes are made.
- Any and all quality guarantees provided by Yaskawa are null and void if the customer modifies the product in any way. Yaskawa disavows any responsibility for damages or losses that are caused by modified products.

Warranty

Details of Warranty

Warranty Period

The warranty period for a product that was purchased (hereinafter called the "delivered product") is one year from the time of delivery to the location specified by the customer or 18 months from the time of shipment from the Yaskawa factory, whichever is sooner.

Warranty Scope

Yaskawa shall replace or repair a defective product free of charge if a defect attributable to Yaskawa occurs during the above warranty period.

This warranty does not cover defects caused by the delivered product reaching the end of its service life and replacement of parts that require replacement or that have a limited service life.

This warranty does not cover failures that result from any of the following causes.

- Improper handling, abuse, or use in unsuitable conditions or in environments not described in product catalogs or manuals, or in any separately agreed-upon specifications
- · Causes not attributable to the delivered product itself
- Modifications or repairs not performed by Yaskawa
- Use of the delivered product in a manner in which it was not originally intended
- Causes that were not foreseeable with the scientific and technological understanding at the time
 of shipment from Yaskawa
- Events for which Yaskawa is not responsible, such as natural or human-made disasters

Limitations of Liability

- Yaskawa shall in no event be responsible for any damage or loss of opportunity to the customer that arises due to failure of the delivered product.
- Yaskawa shall not be responsible for any programs (including parameter settings) or the results of program execution of the programs provided by the user or by a third party for use with programmable Yaskawa products.
- The information described in product catalogs or manuals is provided for the purpose of the customer purchasing the appropriate product for the intended application. The use thereof does not guarantee that there are no infringements of intellectual property rights or other proprietary rights of Yaskawa or third parties, nor does it construe a license.
- Yaskawa shall not be responsible for any damage arising from infringements of intellectual property rights or other proprietary rights of third parties as a result of using the information described in catalogs or manuals.

♦ Suitability for Use

- It is the customer's responsibility to confirm conformity with any standards, codes, or regulations that apply if the Yaskawa product is used in combination with any other products.
- The customer must confirm that the Yaskawa product is suitable for the systems, machines, and equipment used by the customer.
- Consult with Yaskawa to determine whether use in the following applications is acceptable. If use in the application is acceptable, use the product with extra allowance in ratings and specifications, and provide safety measures to minimize hazards in the event of failure.
 - Outdoor use, use involving potential chemical contamination or electrical interference, or use in conditions or environments not described in product catalogs or manuals
 - Nuclear energy control systems, combustion systems, railroad systems, aviation systems, vehicle systems, medical equipment, amusement machines, and installations subject to separate industry or government regulations
 - Systems, machines, and equipment that may present a risk to life or property
 - Systems that require a high degree of reliability, such as systems that supply gas, water, or electricity, or systems that operate continuously 24 hours a day
 - Other systems that require a similar high degree of safety
- Never use the product for an application involving serious risk to life or property without first ensuring that the system is designed to secure the required level of safety with risk warnings and redundancy, and that the Yaskawa product is properly rated and installed.
- The circuit examples and other application examples described in product catalogs and manuals are for reference. Check the functionality and safety of the actual devices and equipment to be used before using the product.
- Read and understand all use prohibitions and precautions, and operate the Yaskawa product correctly to prevent accidental harm to third parties.

Specifications Change

The names, specifications, appearance, and accessories of products in product catalogs and manuals may be changed at any time based on improvements and other reasons. The next editions of the revised catalogs or manuals will be published with updated code numbers. Consult with your Yaskawa representative to confirm the actual specifications before purchasing a product.

Compliance with UL Standards, EU Directives, UK Regulations, and Other Safety Standards

Certification marks for the standards for which the product has been certified by certification bodies are shown on nameplate. Products that do not have the marks are not certified for the standards. Refer to the Servomotor manual for compliant standards of Servomotors.

North American Safety Standards (UL)



Product	Model	North American Safety Standards (UL File No.)
SERVOPACK	SGD7S	UL 61800-5-1 (E147823) CSA C22.2 No.274

EU Directives

CE			
Product	Model	EU Directive	Harmonized Standards
		Machinery Directive 2006/42/EC	EN ISO 13849-1: 2015 EN IEC 62061 EN 61800-5-2
SERVOPACK	SGD7S	EMC Directive 2014/30/EU	EN 55011 Group 1, Class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Low Voltage Directive 2014/35/EU	EN 61800-5-1
		RoHS Directive 2011/65/EU (EU)2015/863	EN IEC 63000

Note: 1. We declared the CE Marking based on the harmonized standards in the above table.

2. These products are for industrial use. In home environments, these products may cause electromagnetic interfer-

ence and additional noise reduction measures may be necessary.

♦ UK Conformity Assessed (UKCA)



Product	Model	UK Regulations	Designated Standards
		Supply of Machinery (Safety) Regulations S.I. 2008/1597	EN ISO 13849-1: 2015 EN IEC 62061 EN 61800-5-2
		Electromagnetic Compati- bility Regulations S.I. 2016/1091	EN 55011 Group 1, Class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
SERVOPACK	SGD7S	Electrical Equipment (Safety) Regulations S.I. 2016/1101	EN 61800-5-1
		Restriction of the Use of Certain Hazardous Sub- stances in Electrical and Electronic Equipment Reg- ulations S.I. 2012/3032	EN IEC 63000

Note: We declared the UKCA marking based on the designated standards in the above table.

Safety Standards

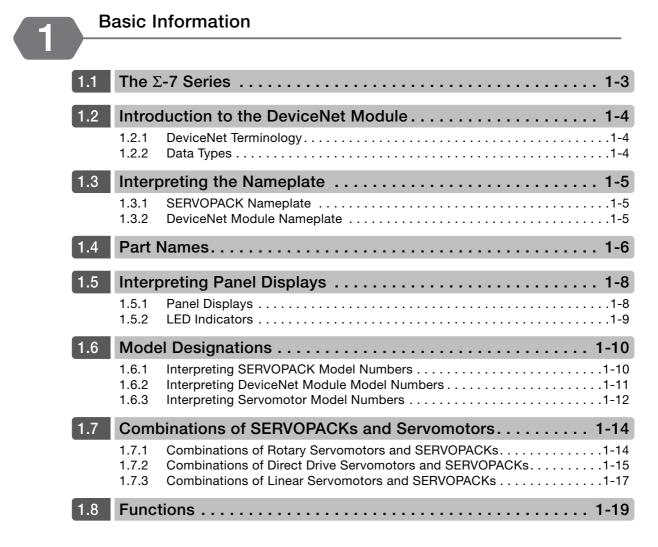
Product	Model	Safety Standards	Standards
SERVOPACK		Safety of Machinery	EN ISO 13849-1: 2015 EN 60204-1
	SGD7S	Functional Safety	EN 61508 series EN IEC 62061 EN 61800-5-2
		Functional Safety EMC	EN 61326-3-1 EN 61000-6-7

Safety Parameters

Item	Standards	Performa	nce Level
Safety Integrity Level	EN 61508	SIL3	
Salety integrity Level	EN IEC 62061	maximum SIL 3	
Mission Time	EN 61508	10 years	20 years
Probability of Dangerous Failure per Hour	EN 61508 EN IEC 62061	$\begin{array}{l} PFH = 4.04 \times 10^{-9} [1/h] \\ (4.04\% \text{ of SIL3}) \end{array}$	$\begin{array}{l} {\sf PFH}=4.05\times10^{-9}[1/h]\\ (4.05\% \text{ of SIL3}) \end{array}$
Performance Level	EN ISO 13849-1	PLe (Category 3)	
Mean Time to Dangerous Failure of Each Channel	EN ISO 13849-1	MTTFd: High	
Average Diagnostic Coverage	EN ISO 13849-1	DCavg: Medium	
Stop Category	EN 60204-1	Stop category 0	
Safety Function	EN 61800-5-2	STO	
Hardware Fault Tolerance	EN 61508	HFT = 1	
Subsystem	EN 61508	В	

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Revision History

Basic Information

This chapter provides basic information, including an introduction to the DeviceNet Modules, the names of parts, and combinations with Servomotors.

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1.1 The Σ -7 Series

The Σ -7-Series SERVOPACKs are designed for applications that require frequent high-speed and high-precision positioning. The SERVOPACK will make the most of machine performance in the shortest time possible, thus contributing to improving productivity.

The Σ -7-Series Command Option Attachable-Type SERVOPACKs can be combined with Σ -V-Series Option Modules to achieve the required control capabilities.



This manual describes the application of a Command Option Attachable-Type SERVOPACK used in combination with a DeviceNet Module.

1.2.1 DeviceNet Terminology

Note

1.2 Introduction to the DeviceNet Module

A DeviceNet Module can be attached only to a Command Option Attachable-Type SERVOPACK.

You can attach the DeviceNet Module to a Command Option Attachable-Type SERVOPACK to use the SERVOPACK as a slave in DeviceNet communications.*

This will allow you to send positioning references and origin return commands from the host device that functions as the DeviceNet master.

There are two models of DeviceNet Modules. Each has a different power supply method.

- DeviceNet Module driven by control power supply: Power is supplied to this DeviceNet Module from the control power supply of the SERVOPACK.
- DeviceNet Module driven by external power supply: Power is supplied to this DeviceNet Module from the communications power supply on the DeviceNet communications cable.
- * DeviceNet communications are used worldwide as a global standard for FA field network communications. DeviceNet communications allow you to easily communicate between a wide range of devices from different vendors.

1.2.1 DeviceNet Terminology

Term	Meaning
ODVA	Open DeviceNet Vendor Association: This vendor association was established to promote DeviceNet, a CAN field network.
CAN	Controller Area Network: The CAN protocol was created by the ISO to standard- ize serial communications.
CCW	Counterclockwise.
CW	Clockwise.
I/O communications	One of the communications methods that is used for DeviceNet communica- tions. Data is sent and received cyclically with relatively high priority.
Explicit message communications	One of the communications methods that is used for DeviceNet communica- tions. You can change or read attributes, but priority is relatively low.

The following table lists the DeviceNet terms that are used in this manual.

1.2.2 Data Types

The following table describes the data types that are used in this manual.

Data Type	Description
BOOL	Boolean data, which has one of two logical values, TRUE or FALSE
USINT	Unsigned 8-bit integer
UINT	Unsigned 16-bit integer
UDINT	Unsigned 32-bit integer
INT	Signed 16-bit integer
DINT	Signed 32-bit integer
WORD	16-bit bit string
STRING	Text string of single-byte characters*

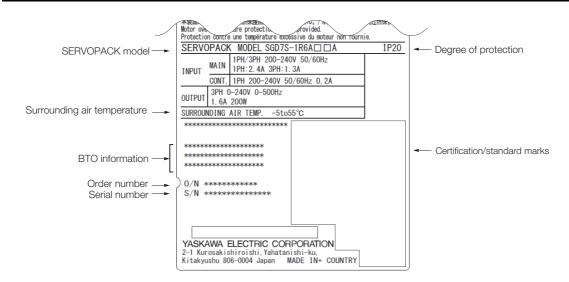
* The data size depends on the length of the text string.

1.3.1 SERVOPACK Nameplate

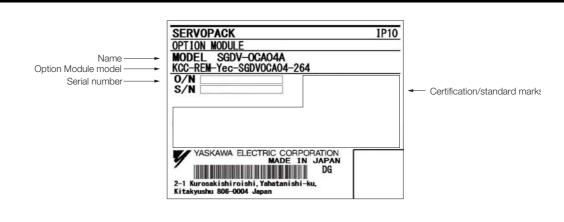
1.3 Interpreting the Nameplate

The following basic information is provided on the nameplate.

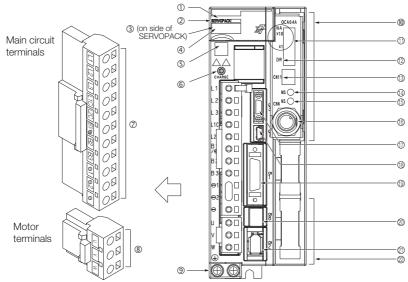
1.3.1 SERVOPACK Nameplate

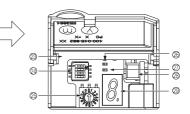


1.3.2 DeviceNet Module Nameplate



1.4 Part Names





	(F) OB (9-		
No.	Name	Description	Reference
1	Front Cover	_	_
2	Input Voltage	_	_
3	Nameplate	Indicates the SERVOPACK model and ratings.	page 1-5
4	Model	The model of the SERVOPACK.	page 1-10
5	QR Code	The QR code that is used by the MechatroCloud service.	_
6	CHARGE	Lit while the main circuit power is being supplied. Note: Even if you turn OFF the main circuit power supply, this indicator will be lit as long as the internal capacitor remains charged. Do not touch the main circuit or motor terminals while this indicator is lit. Doing so may result in electric shock.	_
Ø	Main Circuit Terminals	The terminals depend on the main circuit power supply input specifications of the SERVOPACK.	page 4-11
8	Servomotor Terminals (U, V, and W)	The connection terminals for the Servomotor Main Circuit Cable (power line).	page 4-26
9	Ground Terminal (🔔)	The ground terminals to prevent electric shock. Always connect this terminal.	_
10	DeviceNet Module	_	_
1	Rotary Switches (NA x10 and x1)	Use these switches to set the node address for DeviceNet communications.	page 13-3
(12)	Rotary Switch (DR)	Use this switch to set the baud rate for DeviceNet com- munications.	page 13-4
(13)	I/O Signal Connector (CN11)	Not used.	-
14	MS Indicator	Shows the status of the Module.	pogo 1 0
(15)	NS Indicator	Shows the status of the DeviceNet network.	page 1-9
16	DeviceNet Communications Connector (CN6)	Used to connect to devices that comply with DeviceNet specifications.	page 4-48
17	Serial Communications Con- nector (CN3)	Used to connect to the Digital Operator (a peripheral device).	page 4-50
18	Computer Connector (CN7)	A USB connector to connect a computer.	page 4-50
(19)	I/O Signal Connector (CN1)	Connects to sequence I/O signals.	page 4-36
20	Safety Connector (CN8)	Connects to a safety function device.	page 4-41
20	Encoder Connector (CN2)	 Rotary Servomotor: Connects to the encoder in the Servomotor. Linear Servomotor: Connects to a Serial Converter Unit or linear encoder. 	page 4-26
22	Fully-Closed Option Module	Connected to perform fully-closed control.	_

Continued on next page.

Continued from previous page.

No.	Name	Description	Reference
23	Serial Number	_	-
24	DIP Switch	Not used.	-
25	Rotary Switch	Not used.	-
26	PWR	Lights when the control power is being supplied.	-
Ø	COM	Not used. (Never lit.)	-
28	Analog Monitor Connector (CN5)	You can use a special cable (peripheral device) to monitor the motor speed, torque reference, or other values.	page 4-50
29	Panel Display	Displays the servo status with a seven-segment display.	-

1.5.1 Panel Displays

1.5 Interpreting Panel Displays

1.5.1 Panel Displays

You can check the Servo Drive status on the panel display of the SERVOPACK. Also, if an alarm or warning occurs, the alarm or warning number will be displayed.

Interpreting Status Displays

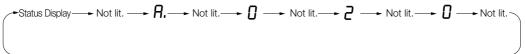
The status is displayed as described below.

Display	Meaning	Display	Meaning
	Rotation Detection Display Lit if the Servomotor speed is higher than the setting of Pn502 or Pn581 and not lit if the speed is lower than the setting. (The default set- ting is 20 min ⁻¹ or 20 mm/s.)	8	Reference Input Display Lit while a reference is being input.
8	Base Block Display Lit during the base block state (servo OFF). Not lit while the servo is ON.		Connected Display Lit while there is a connection.

Alarm and Warning Displays

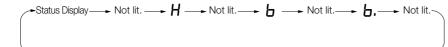
If there is an alarm or warning, the display will change in the following order.

Example: Alarm A.020



Hard Wire Base Block Active Display

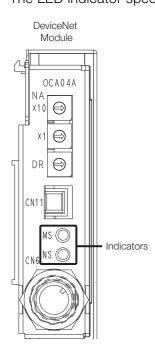
If a hard wire base block (HWBB) is active, the display will change in the following order.



1.5.2 LED Indicators

1.5.2 LED Indicators

The DeviceNet Module is equipped with two LED indicators: a Module status indicator to indicate the status of the DeviceNet Module, and a network status indicator to indicate the status of DeviceNet communications. Both of these indicators use two-color LEDs (red and green). The LED indicator specifications conform to the ODVA DeviceNet Specification Release 2.0.



Module Status (MS) Indicator

The MS indicator shows the status of the DeviceNet Module.

Indicator	Status
Not lit.	The SERVOPACK's control power supply is turned OFF.
Lit green.	The SERVOPACK is operating normally.
Flashing green.	The SERVOPACK is initializing.
Flashing red.	Minor SERVOPACK failure.*
Lit red.	Major SERVOPACK failure.*
Alternately flashing red and green.	The SERVOPACK is performing self-diagnosis.

* Refer to the following chapter for details.

Chapter 14 Maintenance

Network Status (NS) Indicator

The NS indicator shows the status of DeviceNet communications.

Indicator	Status
Not lit.	The SERVOPACK's control power supply is turned OFF or the SERVOPACK is not online.
Flashing green.	The SERVOPACK is online but it is not connected to the master.
Lit green.	The SERVOPACK is online and it is connected to the master.
Flashing red.	Connection to the master has timed out.*
Lit red.	A fatal error has occurred in DeviceNet communications.*

* Refer to the following chapter for details.

G Chapter 14 Maintenance

Basic Information

1.6.1 Interpreting SERVOPACK Model Numbers

Model Designations .6 Interpreting SERVOPACK Model Numbers 1.6.1 SGD7S 001000 B _ А 00А 4th 5th+6th 7th 3th+9th+10th . 11th+12th+13th 1st+2nd+3rd Σ -7-Series dia digi diaits diaits diaits diaits Σ-7S SERVOPACKs Maximum Applicable Hardware Options 8th+9th+10th digits Specification 1st+2nd+3rd digits 4th digit Voltage Motor Capacity Voltage Code Specification Code Specification Applicable Code Specification Models R70*1 0.05 kW 200 VAC А None 100 VAC R90*1 0.1 kW F Without options All models 000 1R6*1 0.2 kW SGD7S-R70A 5th+6th digits Interface*3 2R8*1 0.4 kW to -330A Rack-mounted 3R8 0.5 kW Code Specification SGD7S-R70F 001 5R5*1 0.75 kW E0 Command option attachable type to -2R8F 7R6 1.0 kW SGD7S-470A Three-Duct-ventilated to -780A 1.5 kW Phase 120^{*2} 7th digit Design Revision Order 200 VAC 002 Varnished All models 180 2.0 kW А Single-phase, 200-VAC 200 3.0 kW 800 SGD7S-120A power supply input 330 5.0 kW SGD7S-R70A 470 6.0 kW to -2R8A No dvnamic brake 550 7.5 kW SGD7S-R70F 020*4 to -2R8F 590 11 kW SGD7S-3R8A External dynamic 780 15 kW brake resistor to -780A R70 0.05 kW Single-R90 0.1 kW Phase 2R1 0.2 kW 100 VAC 2R8 0.4 kW 11th+12th+13th digits FT/EX Specification

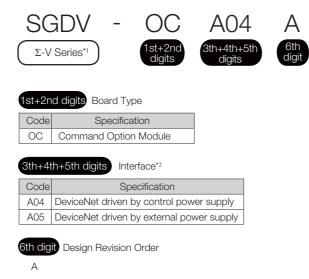
Code	Specification
None	None
000	NONE

1	14th digit BTO Specification*5					
	Code	Specification				
	None	None				
	В	BTO specification				

- *1. You can use these models with either a single-phase or three-phase input.
- *2. A model with a single-phase, 200-VAC power supply input is available as a hardware option (model: SGD7S-120A00A008).
- *3. The same SERVOPACKs are used for both Rotary Servomotors and Linear Servomotors.
- *4. Refer to the following manual for details.
- Ω Σ-7-Series AC Servo Drive Σ-7S/Σ-7W SERVOPACK with Dynamic Brake Hardware Option Specifications Product Manual (Manual No.: SIEP S800001 73)
- *5. The BTO specification indicates if the SERVOPACK is customized by using the MechatroCloud BTO service. This service is available on the e-mechatronics website. This service is available in Japan only. You need a BTO number to order SERVOPACKs with customized specifications. Refer to the following catalog for details on the BTO specification.
 C Servo Drives Σ-7 Series (Manual No.: KAEP S800001 23)

1.6.2 Interpreting DeviceNet Module Model Numbers

1.6.2 Interpreting DeviceNet Module Model Numbers



- *1. $\Sigma\text{-}V\text{-}Series$ Modules are used with $\Sigma\text{-}7\text{-}Series$ SERVOPACKs.
- *2. The same DeviceNet Modules are used for both Rotary Servomotors and Linear Servomotors.

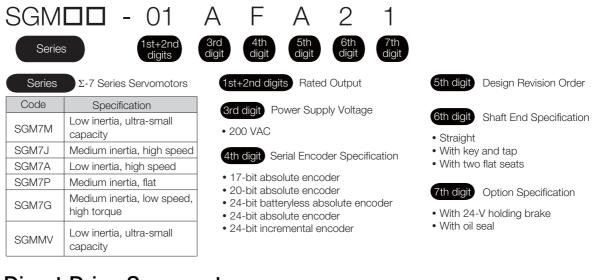
1.6.3 Interpreting Servomotor Model Numbers

1.6.3 Interpreting Servomotor Model Numbers

This section outlines the model numbers of Σ -7-series Servomotors. Refer to the relevant manual in the following list for details.

- $\prod \Sigma$ -7-Series Rotary Servomotor Product Manual (Manual No.: SIEP S800001 36)
- Ω Σ-7-Series Linear Servomotor Product Manual (Manual No.: SIEP S800001 37)
- $\prod \Sigma$ -7-Series Direct Drive Servomotor Product Manual (Manual No.: SIEP S800001 38)

Rotary Servomotors



Direct Drive Servomotors

Medium capacity, with core inner rotor

SGMCS

SGM		-	02	В		З	С)	1	1	
Series	s		st+2nd digits	3rd digit		4th digit	5th dig	n it	6th digit	7th digit	
Series	Σ-7 Serie	es Serv	romotors			1st	t+2nd	digits	Ratec	l Torque	E
Code	de Specification										
SGM7E	Small capacity, coreless inner rotor				3rd digit Servomotor Outer				e		
SGM7F	Small capacity, inner rotor with core Medium capacity, with core inner rotor							Diameter			•
SGIVI7F					or	4th digit					•
SGMCV	Small capa	acity, w	rith core i	nner rotor				Spe	cificatio	٦	
001400	Small capa	acity, co	oreless in	ner rotor							Q.

5th digit Design Revision Order

- 6th digit Flange Specification
- Cable drawn to load sideCable drawn to non-load side

7th digit Option Specification

• High mechanical precision

1.6.3 Interpreting Servomotor Model Numbers

Linear Servomotors									
SG		30	А	05	0	С	Ρ		
Serie	es 1st 2nd digit			3rd	digit	on			
Seri	Series Σ-7 Series Servomotors 2nd digit Moving Coil/Magnetic Way							Way	
1 et d	igit Servomotor Type	Ī	Co	de (Specif	fication			
131.0	1st digit Servomotor Type				W Moving Coil				
Code	Specification		W2	2	loving	9 0011			
G	Coreless models		М	N	laano	tic Way	,		
F	Models with F-type iron core		M2	2	agric		<u>_</u>		
Т	Models with T-type iron core								
			3rd c	digit on					

The specifications for the 3rd digit on depend on the Servomotor type.

1.7.1 Combinations of Rotary Servomotors and SERVOPACKs

1.7 Combinations of SERVOPACKs and Servomotors

1.7.1 Combinations of Rotary Servomotors and SERVOPACKs

Rotary Servor	Rotary Servomotor Model		SERVOPACK Model SGD7S-
SGM7M	SGM7M-A1A	11 W	36073-
(Low Inertia, Ultra-	SGM7M-A2A	22 W	
small Capacity), 3000 min ⁻¹	SGM7M-A3A	33 W	1R6A or 2R1F
	SGM7J-A5A	50 W	R70A or R70F
	SGM7J-01A	100 W	R90A or R90F
SGM7J	SGM7J-C2A	150 W	
(Medium Inertia, Small Capacity),	SGM7J-02A	200 W	— 1R6A or 2R1F
3,000 min ⁻¹	SGM7J-04A	400 W	2R8A or 2R8F
	SGM7J-06A	600 W	E D E A
	SGM7J-08A	750 W	
	SGM7A-A5A	50 W	R70A or R70F
	SGM7A-01A	100 W	R90A or R90F
	SGM7A-C2A	150 W	
	SGM7A-02A	200 W	— 1R6A or 2R1F
	SGM7A-04A	400 W	2R8A or 2R8F
	SGM7A-06A	600 W	EDEA
SGM7A	SGM7A-08A	750 W	— 5R5A
(Low Inertia, Small Capacity),	SGM7A-10A	1.0 kW	1004
3,000 min ⁻¹	SGM7A-15A	1.5 kW	— 120A
	SGM7A-20A	2.0 kW	180A
	SGM7A-25A	2.5 kW	2004
	SGM7A-30A	3.0 kW	200A
	SGM7A-40A	4.0 kW	2204
	SGM7A-50A	5.0 kW	— 330A
	SGM7A-70A	7.0 kW	550A
	SGM7P-01A	100 W	R90A or R90F
SGM7P	SGM7P-02A	200 W	2R8A or 2R1F
(Medium Inertia, Flat),	SGM7P-04A	400 W	2R8A or 2R8F
3,000 min ⁻¹	SGM7P-08A	750 W	5R5A
	SGM7P-15A	1.5 kW	120A
	SGM7G-03A	300 W	3R8A
	SGM7G-05A	450 W	SHOA
	SGM7G-09A	850 W	7R6A
	SGM7G-13A	1.3 kW	120A
SGM7G	SGM7G-20A	1.8 kW	180A
(Medium Inertia, Medium Capacity),	SGM7G-30A	2.9 kW ^{*1}	330A
1,500 min ⁻¹	SGM7G-44A	4.4 kW	0004
	SGM7G-55A	5.5 kW	470A
	SGM7G-75A	7.5 kW	550A
	SGM7G-1AA	11 kW	590A
	SGM7G-1EA	15 kW	780A
SGMMV ^{*2}	SGMMV-A1A	10 W	
(Low Inertia, Ultra-	SGMMV-A2A	20 W	
small Capacity), 3,000 min ⁻¹	SGMMV-A3A	30 W	1R6A or 2R1F

1.7.2 Combinations of Direct Drive Servomotors and SERVOPACKs

- *1. 2.4 kW when using the Servomotor with a SGD7S-200A SERVOPACK.
- *2. The SGMMV Servomotor is an older model. When purchasing a new Servomotor, we recommend selecting a SGM7M Servomotor.

1.7.2 Combinations of Direct Drive Servomotors and SERVOPACKs

Direct Drive Servomotor Model		Rated Torque	Instantaneous	SERVOPACK Mod	
		[N·m]	Maximum Torque [N·m]	SGD7S-	
	SGM7E-02B	2	6		
	SGM7E-05B	5	15	2R8A or 2R1F	
	SGM7E-07B	7	21		
	SGM7E-04C	4	12		
SGM7E	SGM7E-10C	10	30	-	
(Small Capacity, Coreless, Inner	SGM7E-14C	14	42	2R8A or 2R8F	
Rotor)	SGM7E-08D	8	24	ZROA UI ZROF	
	SGM7E-17D	17	51		
	SGM7E-25D	25	75		
	SGM7E-16E	16	48	5054	
	SGM7E-35E	35	105	- 5R5A	
	SGM7F-02A	2	6	2084 or 2015	
	SGM7F-05A	5	15	2R8A or 2R1F 2R8A or 2R8F	
	SGM7F-07A	7	21		
	SGM7F-04B	4	12		
SGM7F	SGM7F-10B	10	30		
(Small Capacity, With Core, Inner	SGM7F-14B	14	42	5R5A	
Rotor)	SGM7F-08C	8	24	2R8A or 2R8F	
,	SGM7F-17C	17	51	5R5A	
	SGM7F-25C	25	75	7R6A	
	SGM7F-16D	16	48	5R5A	
	SGM7F-35D	35	105	7R6A* or 120A	
	SGM7F-45M	45	135	7R6A	
SGM7F	SGM7F-80M	80	240	1004	
Medium Capacity,	SGM7F-80N	80	240	- 120A	
With Core, Inner	SGM7F-1AM	110	330	180A	
Rotor)	SGM7F-1EN	150	450	0004	
	SGM7F-2ZN	200	600	200A	
	SGMCV-04B	4	12	0001 0005	
	SGMCV-10B	10	30	- 2R8A or 2R8F	
	SGMCV-14B	14	42	5R5A	
SGMCV (Small Capacity,	SGMCV-08C	8	24	2R8A or 2R8F	
With Core, Inner	SGMCV-17C	17	51	5R5A	
Rotor)	SGMCV-25C	25	75	7R6A	
	SGMCV-16D	16	48	5R5A	
	SGMCV-35D	35	105	7R6A* or 120A	

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1.7.2 Combinations of Direct Drive Servomotors and SERVOPACKs

Continued from pre					
Direct Drive Servomotor Model		Rated Torque	Instantaneous	SERVOPACK Model	
		[N·m]	Maximum Torque [N·m]	SGD7S-	
	SGMCS-02B	2	6		
	SGMCS-05B	5	15	2R8A or 2R1F	
	SGMCS-07B	7	21		
	SGMCS-04C	4	12		
SGMCS	SGMCS-10C	10	30		
(Small Capacity, Coreless, Inner	SGMCS-14C	14	42	2R8A or 2R8F	
Rotor)	SGMCS-08D	8	24		
	SGMCS-17D	17	51		
	SGMCS-25D	25	75		
	SGMCS-16E	16	48	5R5A	
	SGMCS-35E	35	105	JUDA	
	SGMCS-45M	45	135	7R6A	
SGMCS	SGMCS-80M	80	240	1004	
(Medium Capacity,	SGMCS-80N	80	240	120A	
With Core, Inner	SGMCS-1AM	110	330	180A	
Rotor)	SGMCS-1EN	150	450	2004	
	SGMCS-2ZN	200	600	200A	

* Use derated values for this combination. Refer to the following catalog for information on derating values. \square AC Servo Drives Σ -7 Series (Catalog No.: KAEP S800001 23)

1.7.3 Combinations of Linear Servomotors and SERVOPACKs

1.7.3 Combinations of Linear Servomotors and SERVOPACKs

		Rated Force	Instantaneous	SERVOPACK Model
Linear Ser	vomotor Model	[N]	Maximum Force [N]	SGD7S-
	SGLGW-30A050C	12.5	40	R70A or R70F
	SGLGW-30A080C	25	80	
SGLG (Coreless), Used with Stan- dard-Force Mag-	SGLGW-40A140C	47	140	- R90A or R90F
	SGLGW-40A253C	93	280	1R6A or 2R1F
	SGLGW-40A365C	140	420	2R8A or 2R8F
	SGLGW-60A140C	70	220	1R6A or 2R1F
	SGLGW-60A253C	140	440	2R8A or 2R8F
netic Way	SGLGW-60A365C	210	660	5R5A
	SGLGW-90A200C	325	1300	120A
	SGLGW-90A370C	550	2200	180A
	SGLGW-90A535C	750	3000	200A
	SGLGW-40A140C	57	230	1R6A or 2R1F
SGLG	SGLGW-40A253C	114	460	2R8A or 2R8F
(Coreless),	SGLGW-40A365C	171	690	3R8A
Used with High- Force Magnetic Way	SGLGW-60A140C	85	360	1R6A or 2R1F
	SGLGW-60A253C	170	720	3R8A
	SGLGW-60A365C	255	1080	7R6A
	SGLFW-20A090A	25	86	
	SGLFW-20A120A	40	125	1R6A or 2R1F
	SGLFW-35A120A	80	220	_
	SGLFW-35A230A	160	440	3R8A
	SGLFW-50A200B	280	600	5R5A
	SGLFW-50A380B		4000	
	SGLFW-1ZA200B	560	1200	120A
	SGLFW-1ZA380B	1120	2400	200A
	SGLFW2-30A070A	45	135	
	SGLFW2-30A120A	90	270	- 1R6A or 2R1F
SGLF		180	540	3R8A
(With F-type Iron	SGLFW2-30A230A*	170	500	2R8A or 2R8F
Cores)	SGLFW2-45A200A	280	840	5R5A
			1680	180A
	SGLFW2-45A380A*	560	1500	120A
	SGLFW2- 90A200A□1	560	1680	
	SGLFW2- 90A200A□L	896	1680	- 120A
	SGLFW2-90A380A	1120	3360	200A
	SGLFW2-90A560A	1680	5040	330A
	SGLFW2-1DA380A	1680	5040	200A
	SGLFW2-1DA560A	2520	7560	330A

Basic Information

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Continued on next page.

1.7.3 Combinations of Linear Servomotors and SERVOPACKs

Continued from previous page					
		Rated Force	Instantaneous	SERVOPACK Model	
Linear Servomotor Model		[N]	Maximum Force [N]	SGD7S-	
	SGLTW-20A170A	130	380	3R8A	
	SGLTW-20A320A	250	760	7R6A	
	SGLTW-20A460A	380	1140	120A	
	SGLTW-35A170A	220	660	5R5A	
	SGLTW-35A170H	300	600	- 0n0A	
	SGLTW-35A320A	440	1320	120A	
SGLT (With T-type Iron	SGLTW-35A320H	600	1200	1204	
Cores)	SGLTW-35A460A	670	2000	180A	
,	SGLTW-40A400B	670	2600	TOUA	
	SGLTW-40A600B	1000	4000	330A	
	SGLTW-50A170H	450	900	5R5A	
	SGLTW-50A320H	900	1800	120A	
	SGLTW-80A400B	1300	5000	330A	
	SGLTW-80A600B	2000	7500	550A	

* The force depends on the SERVOPACK that is used with the Servomotor.

1.8 Functions

This section lists the functions provided by SERVOPACKs. Refer to the reference pages for details on the functions.

· Functions Related to the Machine

Function	Reference
Power Supply Type Settings for the Main Circuit and Control Circuit	page 5-13
Automatic Detection of Connected Motor	page 5-15
Motor Direction Setting	page 5-16
Linear Encoder Pitch Setting	page 5-17
Writing Linear Servomotor Parameters	page 5-18
Selecting the Phase Sequence for a Linear Servomotor	page 5-22
Polarity Sensor Setting	page 5-24
Polarity Detection	page 5-25
Overtravel Function and Settings	page 5-28
Holding Brake	page 5-30
Motor Stopping Methods for Servo OFF and Alarms	page 5-34
Resetting the Absolute Encoder	page 5-47
Setting the Origin of the Absolute Encoder	page 5-50, page 12-5
Setting the Regenerative Resistor Capacity	page 5-53
Operation for Momentary Power Interruptions	page 6-5
SEMI F47 Function	page 6-6
Setting the Motor Maximum Speed	page 6-8
Software Limits and Settings	page 6-16
Multiturn Limit Setting	page 6-19
Adjustment of Motor Current Detection Signal Offset	page 6-30
EXSTOP (External Stop Input) Signal	page 6-34
Overheat Protection	page 6-35
Speed Ripple Compensation	page 8-60
Current Control Mode Selection	page 8-73
Current Gain Level Setting	page 8-73
Speed Detection Method Selection	page 8-73
Fully-Closed Loop Control	page 10-1
Safety Functions	page 11-1
External Latches	

• Functions Related to the Host Controller

Function	Reference
Electronic Gear Settings	page 5-40
Servo Alarm (ALM) Signal	page 6-3
Warning (/WARN) Signal	page 6-3
/S-RDY (Servo Ready) Signal	page 6-4
Encoder Divided Pulse Output	page 6-9
Selecting Torque Limits	page 6-17
Vibration Detection Level Initialization	page 6-26
Alarm Reset	page 14-43
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Function	Reference
Setting the Position Deviation Overflow Alarm Level	page 8-7

Functions to Achieve Optimum Motions

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Tuning-less Function	page 8-11
Autotuning without a Host Reference	page 8-23
Autotuning with a Host Reference	page 8-34
Custom Tuning	page 8-42
Anti-Resonance Control Adjustment	page 8-51
Vibration Suppression	page 8-56
Gain Selection	page 8-66
Friction Compensation	page 8-69
Gravity Compensation	page 8-71
Backlash Compensation	page 8-74
Model Following Control	page 8-86
Compatible Adjustment Functions	page 8-89
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• Functions for Trial Operation during Setup

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Trial Operation for the Servomotor without a Load	page 7-6
Program Jogging	page 7-12
Origin Search	page 7-18
Test without a Motor	page 7-20
Monitoring Machine Operation Status and Signal Waveforms	page 9-7

• Functions for Inspection and Maintenance

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Write Prohibition Setting for Parameters	page 5-8
Initializing Parameter Settings	page 5-10
Automatic Detection of Connected Motor	page 5-15
Monitoring Product Information	page 9-2
Monitoring Product Life	page 9-2
Alarm History Display	page 14-44
Alarm Tracing	page 9-16

DeviceNet Functions

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Origin Returns	page 12-3
Positioning	page 12-6
Positioning after Continuous Operation	page 12-13
Special Functions	page 12-16
Programmed Operation	page 13-23

Selecting a SERVOPACK

This chapter provides information required to select SERVOPACKs, such as specifications, block diagrams, dimensional drawings, and connection examples.

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2.1.1 Ratings

2.1 Ratings and Specifications

This section gives the ratings and specifications of SERVOPACKs.

2.1.1 Ratings

Three-Phase, 200 VAC

Ν	lodel SGI	D7S-	R70A	R90A	1R6A	2R8A	3R8A	5R5A	7R6A	120A	180A	200A	330A
Maximum Applicable Motor Capacity [kW]			0.05	0.1	0.2	0.4	0.5	0.75	1.0	1.5	2.0	3.0	5.0
	uous Outp t [Arms]	out	0.66	0.91	1.6	2.8	3.8	5.5	7.6	11.6	18.5	19.6	32.9
	aneous M Current [/		2.1	3.2	5.9	9.3	11	16.9	17	28	42	56	84
	Power S	upply				200 VA	AC to 24	40 VAC	, 50 Hz	/60 Hz			
Main Circuit	Permitte Fluctuati	d Voltage on					-15	% to +1	0%				
Onoun	Input Cu [Arms]*	rrent	0.4	0.8	1.3	2.5	3.0	4.1	5.7	7.3	10	15	25
	Power S	upply				200 VA	AC to 2	40 VAC	, 50 Hz	/60 Hz			
Con- trol		ermitted Voltage luctuation -15% to +10%											
	Input Cu [Arms]*	Input Current [Arms]*		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.25	0.25	0.3
Power Supply Capacity [kVA]*			0.2	0.3	0.5	1.0	1.3	1.6	2.3	3.2	4.0	5.9	7.5
	Main Circ Loss [W]	cuit Power	5.0	7.0	11.9	22.5	28.5	38.9	49.2	72.6	104.2	114.2	226.6
Power	Control (Power L		12	12	12	12	14	14	14	15	16	16	19
Loss*		Regenera- stor Power	-	-	-	-	8	8	8	12	12	12	36
	Total Pov [W]	wer Loss	17.0	19.0	23.9	34.5	50.5	60.9	71.2	97.6	136.2	146.2	281.6
Rege	Built-In Regen-	Resis- tance $[\Omega]$	-	_	_	_	40	40	40	20	12	12	8
nera- tive	erative Resis- tor	Capacity [W]	-	_	-	-	40	40	40	60	60	60	180
Resis- tor	Minimum Allowable External Resis- tance [Ω]		40	40	40	40	40	40	40	20	12	12	8
Overvo	Itage Cate	egory		1	1	1	1		1	1	1	1	L

* This is the net value at the rated load.

2.1.1 Ratings

	Model SGD7S-	470A	550A	590A	780A				
Maximum Applic	able Motor Capacity [kW]	6.0	7.5	11	15				
Continuous Outp	out Current [Arms]	46.9	54.7	58.6	78.0				
Instantaneous M	aximum Output Current [Arms]	110	130	140	170				
	Power Supply	200) VAC to 240 V	/AC, 50 Hz/60	Hz				
Main Circuit	Permitted Voltage Fluctuation		-15% to	o +10%					
Olioun	Input Current [Arms] ^{*1}	29	37	54	73				
	Power Supply	200) VAC to 240 V	/AC, 50 Hz/60	Hz				
Control	Permitted Voltage Fluctuation		-15% to +10%						
	Input Current [Arms] ^{*1}	0.3	0.3	0.4	0.4				
Power Supply Ca	apacity [kVA] ^{*1}	10.7	14.6	21.7	29.6				
		Continued on next page.							
	Main Circuit Power Loss [W]	271.7	326.9	365.3	501.4				
	Control Circuit Power Loss [W]	21	21	28	28				
Power Loss ^{*1}	External Regenerative Resistor Unit Power Loss [W]	180 ^{*2}	350 ^{*3}	350 ^{*3}	350 ^{*3}				
	Total Power Loss [W]	292.7	347.9	393.3	529.4				
	Resistance $[\Omega]$	6.25 ^{*2}	3.13 ^{*3}	3.13 ^{*3}	3.13 ^{*3}				
External Regen- erative Resistor	Capacity [W]	880*2	1760 ^{*3}	1760 ^{*3}	1760 ^{*3}				
Unit	Minimum Allowable External Resistance $[\Omega]$	5.8	2.9	2.9	2.9				
Overvoltage Cate	egory		II						

 $\ast 1.$ This is the net value at the rated load.

*2. This value is for the optional JUSP-RA04-E Regenerative Resistor Unit.

*3. This value is for the optional JUSP-RA05-E Regenerative Resistor Unit.

Single-Phase, 200 VAC

Model SGD7S-				R90A	1R6A	2R8A	5R5A	120A			
Maximum Applicable Motor Capacity [kW]			0.05	0.1	0.2	0.4	0.75	1.5			
Continuous O	utput Current [Arm	s]	0.66	0.91	1.6	2.8	5.5	11.6			
Instantaneous	Maximum Output	Current [Arms]	2.1	3.2	5.9	9.3	16.9	28			
	Power Supply			200 VA	C to 240 \	/AC, 50 H	z/60 Hz				
Main Circuit	Permitted Voltage	Fluctuation			-15% to	o +10%					
	Input Current [Arn	ns]*	0.8	1.6	2.4	5.0	8.7	16			
	Power Supply			200 VA	C to 240 \	/AC, 50 H	z/60 Hz	<u> </u>			
Control	Control Permitted Voltage Fluctuation			-15% to +10%							
	Input Current [Arms]*		0.2	0.2	0.2	0.2	0.2	0.25			
Power Supply	Power Supply Capacity [kVA]*			0.3	0.6	1.2	1.9	4.0			
	Main Circuit Powe	er Loss [W]	5.0	7.1	12.1	23.7	39.2	71.8			
	Control Circuit Po	12	12	12	12	14	16				
Power Loss*	Built-in Regenerat Power Loss [W]	_	-	-	-	8	12				
	Total Power Loss	[W]	17.0	19.1	24.1	35.7	61.2	103.8			
	Built-In	Resistance $[\Omega]$	-	-	-	-	40	12			
Regenera- tive Resistor	Regenerative Resistor	Capacity [W]	_	-	-	-	40	60			
	Minimum Allowab Resistance [Ω]	40	40	40	40	40	12				
Overvoltage C	Overvoltage Category				I						

* This is the net value at the rated load.

2.1.1 Ratings

270 VDC

Model SGD7S-			R90A	1R6A	2R8A	3R8A	5R5A	7R6A	120A		
Maximum Appli	cable Motor Capacity [kW]	0.05	0.1	0.2	0.4	0.5	0.75	1.0	1.5		
Continuous Ou	tput Current [Arms]	0.66	0.91	1.6	2.8	3.8	5.5	7.6	11.6		
Instantaneous I [Arms]	Maximum Output Current	2.1	3.2	5.9	9.3	11.0	16.9	17.0	28.0		
	Power Supply			27	OVDC to	o 324 V	DC				
Main Circuit	Permitted Voltage Fluctuation		-15% to +10%								
	Input Current [Arms] ^{*1}	0.5	1.0	1.5	3.0	3.8	4.9	6.9	11		
	Power Supply	270 VDC to 324 VDC									
Control	Permitted Voltage Fluctuation	-15% to +10%									
	Input Current [Arms] ^{*1}	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2*2		
Power Supply (Capacity [kVA] ^{*1}	0.2	0.3	0.6	1	1.4	1.6	2.3	3.2		
	Main Circuit Power Loss [W]	4.4	5.9	9.8	17.5	23.0	30.7	38.7	55.8		
Power Loss ^{*1}	Control Circuit Power Loss [W]	12	12	12	12	14	14	14	15		
	Total Power Loss [W]	16.4	17.9	21.8	29.5	37.0	44.7	52.7	70.8		
Overvoltage Category					I						

*1. This is the net value at the rated load.

*2. The value is 0.25 Arms for the SGD7S-120AE0A008.

	Model SGD7S-	180A	200A	330A	470A	550A	590A	780A		
Maximum Appl	icable Motor Capacity [kW]	2.0	3.0	5.0	6.0	7.5	11.0	15.0		
Continuous Ou	tput Current [Arms]	18.5	19.6	32.9	46.9	54.7	58.6	78.0		
Instantaneous Maximum Output Current [Arms]			56.0	84.0	110	130	140	170		
	Power Supply			270 VI	DC to 32	4 VDC				
Main Circuit	Permitted Voltage Fluctuation	-15% to +10%								
	Input Current [Arms]*	14	20	34	36	48	68	92		
	Power Supply	270 VDC to 324 VDC								
Control	Permitted Voltage Fluctuation	-15% to +10%								
	Input Current [Arms]*	0.25	0.25	0.3	0.3	0.3	0.4	0.4		
Power Supply	Capacity [kVA]*	4.0	5.9	7.5	10.7	14.6	21.7	29.6		
	Main Circuit Power Loss [W]	82.7	83.5	146.2	211.6	255.3	243.6	343.4		
Power Loss*	Control Circuit Power Loss [W]	16	16	19	21	21	28	28		
	Total Power Loss [W]	98.7	99.5	165.2	232.6	276.3	271.6	371.4		
Overvoltage Ca										

* This is the net value at the rated load.

2.1.2 DeviceNet Module Power Loss

Single-Phase, 100 VAC

	Model SGD7S-	R70F	R90F	2R1F	2R8F				
Maximum App	blicable Motor Capacity [kW]	0.05	0.1	0.2	0.4				
Continuous O	utput Current [Arms]	0.66	0.91	2.1	2.8				
Instantaneous	Maximum Output Current [Arms]	2.1	3.2	6.5	9.3				
	Power Supply	100) VAC to 120 V	/AC, 50 Hz/60	Hz				
Main Circuit	Permitted Voltage Fluctuation		-15% to	o +10%					
	Input Current [Arms]*	1.5	2.5	5	10				
	Power Supply	100 VAC to 120 VAC, 50 Hz/60 Hz							
Control	Permitted Voltage Fluctuation	-15% to +10%							
	Input Current [Arms]*	0.38	0.38	0.38	0.38				
Power Supply	Capacity [kVA]*	0.2	0.3	0.6	1.4				
	Main Circuit Power Loss [W]	5.3	7.8	14.2	26.2				
Power Loss*	Control Circuit Power Loss [W]	12	12	12	12				
	Total Power Loss [W]	17.3	19.8	26.2	38.2				
Regenera- tive ResistorMinimum Allowable Resistance $[\Omega]$		40	40	40	40				
Overvoltage C	Category								

* This is the net value at the rated load.

2.1.2 DeviceNet Module Power Loss

The power supply method and power loss of a DeviceNet Module depend on the model of the DeviceNet Module.

SGDV-OCA04A (Interface: Driven by Control Power Supply)

The specifications of the SGDV-OCA04A DeviceNet Module are given in the following table.

Item	Specification			
nem	DeviceNet Communications Section	Control Section		
Power Supply Method	Supplied from the DeviceNet communications cable.	Supplied from the control power supply of a Command Option Attachable-Type SERVOPACK.		
Minimum Operating Voltage	11 VDC			
Maximum Operating Voltage	25 VDC	Included in the current consumption of the Command Option Attachable-Typ		
Maximum Operating Current	25 mA	SERVOPACK.		
Maximum Power Loss	625 mW]		

SGDV-OCA05A (Interface: Driven by External Power Supply)

The specifications of the SGDV-OCA05A DeviceNet Module are given in the following table.

Item	Specification			
nem	DeviceNet Communications Section	Control Section		
Power Supply Method	Supplied from the DeviceNet communications cable.			
Minimum Operating Voltage	11 VDC			
Maximum Operating Voltage	25 VDC			
Maximum Operating Current	100 mA for 24-VDC power supply 200 mA for 11-VDC power supply			
Maximum Power Loss	2.4 W			

2.1.3 SERVOPACK Overload Protection Characteristics

2.1.3 SERVOPACK Overload Protection Characteristics

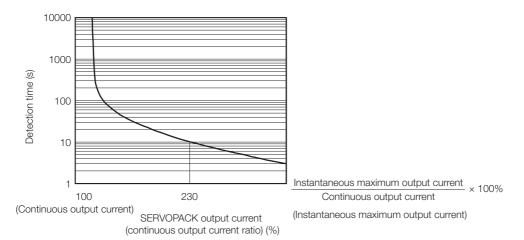
The overload detection level is set for hot start conditions with a SERVOPACK surrounding air temperature of 55°C.

An overload alarm (A.710 or A.720) will occur if overload operation that exceeds the overload protection characteristics shown in the following diagram (i.e., operation on the right side of the applicable line) is performed.

The actual overload detection level will be the detection level of the connected SERVOPACK or Servomotor that has the lower overload protection characteristics.

In most cases, that will be the overload protection characteristics of the Servomotor.

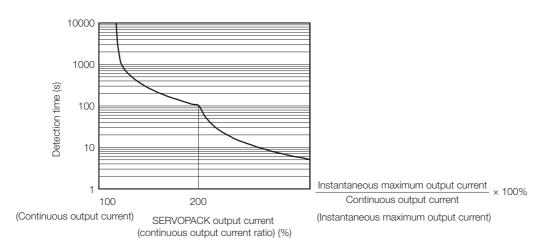
• SGD7S-R70A, -R90A, -1R6A, -2R8A, -R70F, -R90F, -2R1F, and -2R8F



Note: The above overload protection characteristics do not mean that you can perform continuous duty operation with an output of 100% or higher.

For a Yaskawa-specified combination of SERVOPACK and Servomotor, maintain the effective torque within the continuous duty zone of the torque-motor speed characteristic of the Servomotor.

 SGD7S-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, -330A, -470A, -550A, -590A, and -780A



Note: The above overload protection characteristics do not mean that you can perform continuous duty operation with an output of 100% or higher.

For a Yaskawa-specified combination of SERVOPACK and Servomotor, maintain the effective torque within the continuous duty zone of the torque-motor speed characteristic of the Servomotor.

2.1.4 Specifications

2.1.4 Specifications

Item		Specification		
Control Method		IGBT-based PWM control, sine wave current drive		
	With Rotary Servomotor	Serial Encoders:17 bits (absolute encoder), 20 bits or 24 bits (incre- mental encoder/absolute encoder), or 22 bits (abso- lute encoder)		
Feedback	With Linear Servomotor	 Absolute linear encoder (The signal resolution depends on the absolute linear encoder.) Incremental linear encoder (The signal resolution depends on the incremental linear encoder or Serial Converter Unit.) 		
	Surrounding Air Temperature	0°C to 55°C		
	Storage Temperature Surrounding Air Humidity	-20°C to 85°C 90% relative humidity max. (with no freezing or condensation)		
	Storage Humidity	90% relative humidity max. (with no freezing or condensation)		
	Vibration Resistance	4.9 m/s ²		
	Shock Resistance	19.6 m/s ²		
Environ- mental	Degree of Protection	Degree IP20		SERVOPACK Model: SGD7S- 1R6A, 2R8A, 3R8A, 5R5A, 7R6A, 120A,
Conditions		IP10	R70F, R90F, 2R1F, 2R8F 120A00A008, 180A, 200A, 330A, 470A, 550A, 590A, 780A	
	Pollution Degree	2Must be no corrosive or flammable gases.Must be no exposure to water, oil, or chemicals.Must be no dust, salts, or iron dust.		
	Altitude	1,000 m max.		
	Others			CK in the following locations: Locations sub ise, strong electromagnetic/magnetic fields,
Compliant Standards		Refer to the following section for details. Compliance with UL Standards, EU Directives, UK Regulations, and Other Safety Standards on page xxvi		
		Mounting		SERVOPACK Model: SGD7S-
		Base-mounted		All Models
Mounting		Rack-mounted		R70A, R90A, 1R6A, 2R8A, 3R8A, 5R5A, 7R6A, 120A, 180A, 200A, 330A, R70F, R90F, 2R1F, 2R8F
		Duct-ven	tilated	470A, 550A, 590A, 780A
	Speed Control Range	1:5000 (At the rated torque, the lower limit of the must not cause the Servomotor to stop.)		
Perfor- mance		±0.01% of rated speed max. (for a load fluctuation of 0% to 100%)		
	Coefficient of Speed	0% of rated speed max. (for a voltage fluctuation of ±10%)		
	Fluctuation ^{*1}	$\pm 0.1\%$ of rated speed max. (for a temperature fluctuation of 25°C ± 25 °C)		
	Torque Control Preci- sion (Repeatability)	±1%		
	Soft Start Time Setting	0 s to 10 s (Can be set separately for acceleration and deceleration.)		

The specifications when the DeviceNet Module is combined with a Command Option Attachable-Type SERVOPACK are given in the following table.

Continued on next page.

2.1 Ratings and Specifications

2.1.4 Specifications

Continued from previous page.

ltom			Continued from previous page.	
Item			Specification	
I/O Signals	Encoder Divided Pulse Output		Phase A, phase B, phase C: Line-driver output Number of divided output pulses: Any setting is allowed.	
	Overheat Protection Input		Number of input points: 1 Input voltage range: 0 V to +5 V	
	Sequence Input Signals	Fixed Inputs	Allowable voltage range: 24 VDC ±20% Number of input points: 4 (Input method: Sink inputs or source inputs)	
			Input Signals CCW-OT (CCW Drive Prohibit Input) signal CW-OT (CW Drive Prohibit Input) signal /HOME (Origin Signal Input) signal EXSTOP (External Stop Input) signal Positive or negative logic can be changed in the parameters. 	
	Sequence Output Signals	Fixed Output	Allowable voltage range: 5 VDC to 30 VDC Number of output points: 4 (A photocoupler output (isolated) is used.)	
			Output Signals • ALM (Servo Alarm Output) signal • /WARN (Warning Signal Output) signal • /BK (Brake) signal • /S-RDY (Servo Ready Output) signal	
Communi-	Digital Operator Communi- cations (CN3)	Inter- faces	Digital Operator (JUSP-OP05A-1-E)	
cations	USB Com-	Interface	Personal computer (with SigmaWin+)	
	munica- tions (CN7)	Commu- nica- tions Standard	Conforms to USB2.0 standard (12 Mbps).	
Diaralay ia (SERVOPACK		CHARGE and PWR indicators, and one-digit seven-segment display	
Displays/ Indicators	DeviceNet Module		Refer to the following section for details.	
	L		Continued on payt page	

Continued on next page.

2.1.4 Specifications

Continued from previous page.

Item			Specification	
	Reference Method	Opera- tion Specifi- cations	Positioning via DeviceNet communications.	
		Refer- ence Inputs	DeviceNet communications Commands: Movement references (positioning or speed) and origin returns	
		Acceler- ation/ Deceler- ation Methods	Linear, asymmetrical, exponential, and S-curve acceleration/decelera- tion	
	Position Control Functions	Operat- ing Methods	Simple positioning, origin returns, continuous operation, and switching to positioning	
Operating Methods		Fully- Closed Loop Control	Supported.	
	Built-in Functions	Position Data Latching	Position data can be latched on phase C, the origin signal, or an exte nal signal.	
		Commu- nica- tions Methods	DeviceNet I/O communications and explicit messages	
		Topology	Multidrop or T-branching ^{*2}	
	DoviceNet	Baud Rate	125 kbps, 250 kbps, or 500 kbps (Set on rotary switch (DR).)	
	DeviceNet Communi- cations	Cables	Special cables (OMRON DCA1-5CN02F1 Cable with Connectors or the equivalent.)	
		Maxi- mum Number of Nodes	64 nodes (including the master, Maximum number of slaves: 63)	
		Node Address Setting	0 to 63 (Set on NA x10 and x1 rotary switches.)	
Analog Monitor (CN5)			Number of points: 2 Output voltage range: ±10 VDC (effective linearity range: ±8 V) Resolution: 16 bits Accuracy: ±20 mV (Typ) Maximum output current: ±10 mA Settling time (±1%): 1.2 ms (Typ)	
Dynamic Brake (DB)			Activated when a servo alarm or overtravel (OT) occurs, or when the power supply to the main circuit or servo is OFF.	
Regenerative Processing			 Built-in (An external resistor must be connected to the SGD7S-470A to -780A.) Refer to the following manuals for details. Σ-7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32) 	
Overtravel (OT) Prevention		n	Stopping with a dynamic brake (DB), coasting to a stop, performing a hard stop, or smooth stop (decelerating to a stop) for a CCW-OT (CCW Drive Prohibit Input) signal or CW-OT (CW Drive Prohibit Input) signal.	
Protective Functions			Overcurrent, overvoltage, low voltage, overload, regeneration error, etc.	
Utility Functions			Gain adjustment, alarm history, jogging, origin search, etc.	

Continued on next page.

2.1 Ratings and Specifications

2.1.4 Specifications

Continued from previous page.

Item		Specification	
	Inputs	/HWBB1 and /HWBB2: Base block signals for Power Modules	
Safety	Output	EDM1: Monitors the status of built-in safety circuit (fixed output).	
Functions	Compliant Standards ^{*3}	ISO13849-1 PLe (Category 3), IEC61508 SIL3	
Applicable Option Modules		Fully-Closed Module Note: You cannot use a Safety Module if you are using a DeviceNet Module.	

*1. The coefficient of speed fluctuation for load fluctuation is defined as follows:

Coefficient of speed fluctuation = $\frac{\text{No-load motor speed} - \text{Total-load motor speed}}{\text{Rated motor speed}} \times 100\%$

*2. Externally connected terminating resistance is required.

*3. Always perform risk assessment for the system and confirm that the safety requirements are met.

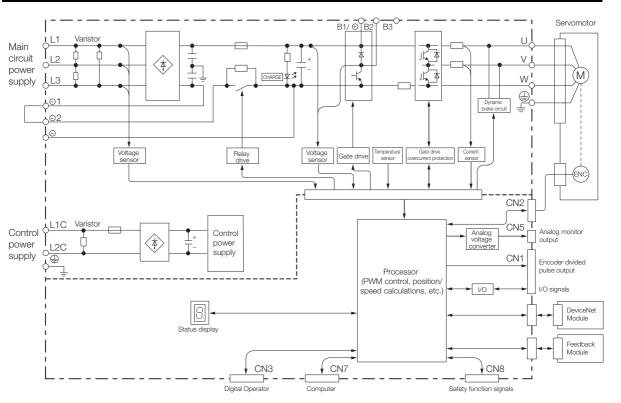
The following table gives the specifications of the DeviceNet Module.

Item		Specification		
		SGDV-OCA04A	SGDV-OCA05A	
Mounting Location		Mounted to the side of a Command Option Attachable-Type SER- VOPACK.		
Power Supply Method	Control Section	Supplied from the control power supply of a Command Option Attachable-Type SERVOPACK.	Supplied from the DeviceNet communications cable.	
Method	DeviceNet Communi- cations Section	Supplied from the DeviceNet communications cable.		
Current Consumption	Control Section	Included in the current consump- tion of the Command Option Attachable-Type SERVOPACK.	For 24-VDC power supply: 100 mA max., for 11-VDC power supply: 200 mA max.	
	DeviceNet Communi- cations Section	25 mA max.		

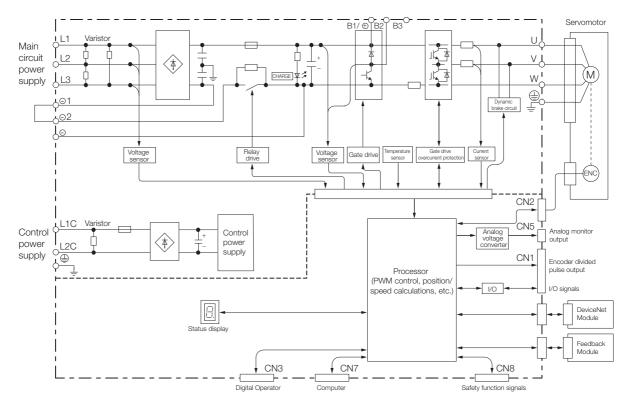
2.2.1 SGD7S-R70A, -R90A, and -1R6A

2.2 Block Diagrams

2.2.1 SGD7S-R70A, -R90A, and -1R6A

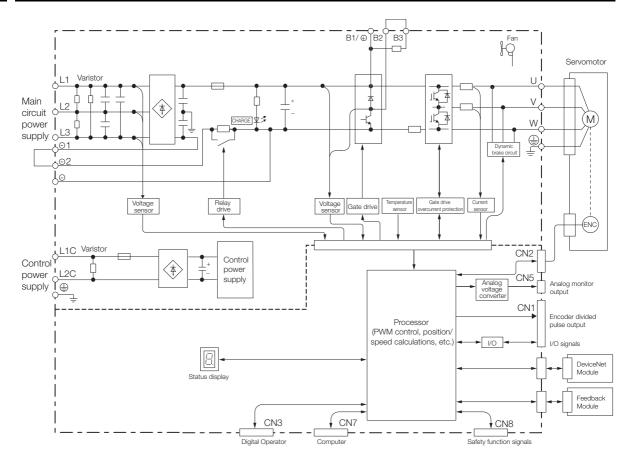


2.2.2 SGD7S-2R8A



2.2.3 SGD7S-3R8A, -5R5A, and -7R6A

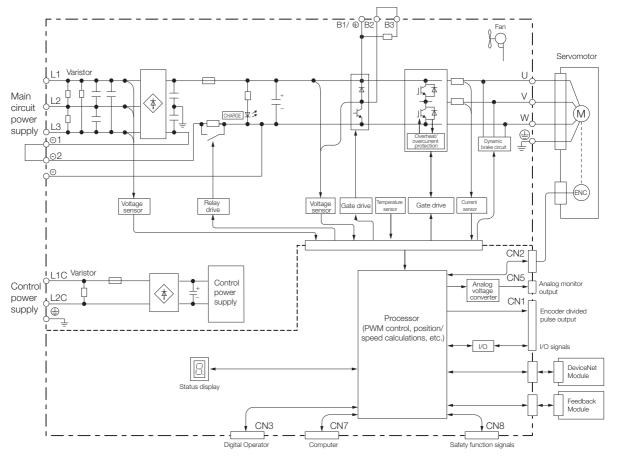
2.2.3 SGD7S-3R8A, -5R5A, and -7R6A



2.2.4 SGD7S-120A

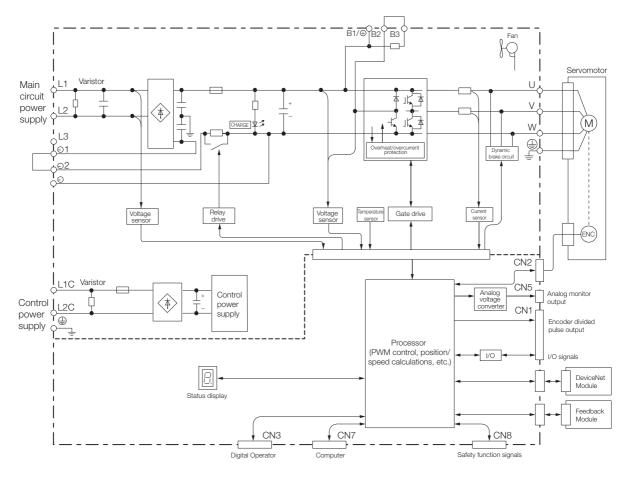
2.2.4 SGD7S-120A

• Standard Specifications: Three-Phase, 200-VAC Power Supply Input



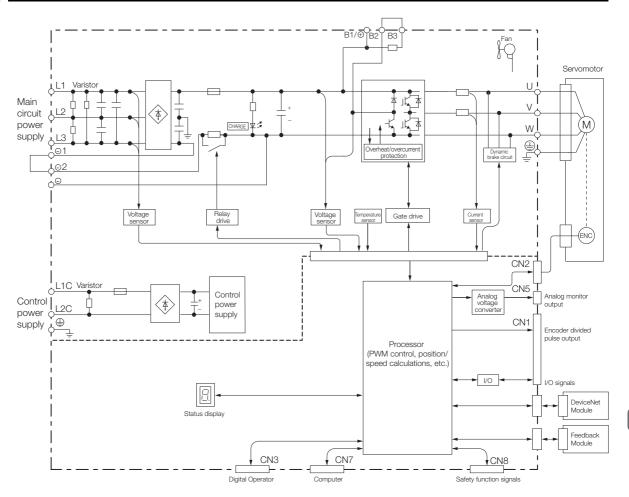
2.2.4 SGD7S-120A

Optional Specifications: Single-Phase, 200-VAC Power Supply Input (SERVOPACK Model: SGD7S-120AE0A008)



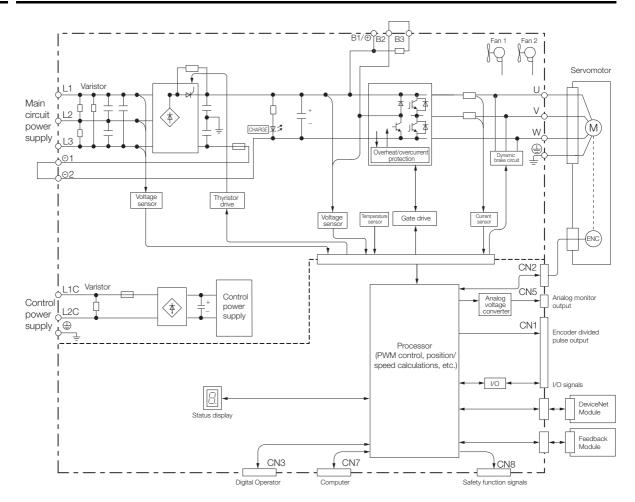
2.2.5 SGD7S-180A and -200A

2.2.5 SGD7S-180A and -200A



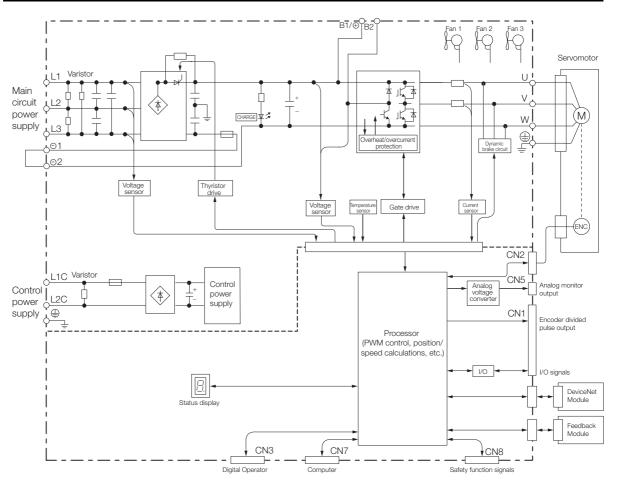
2.2.6 SGD7S-330A

2.2.6 SGD7S-330A



2.2.7 SGD7S-470A and -550A

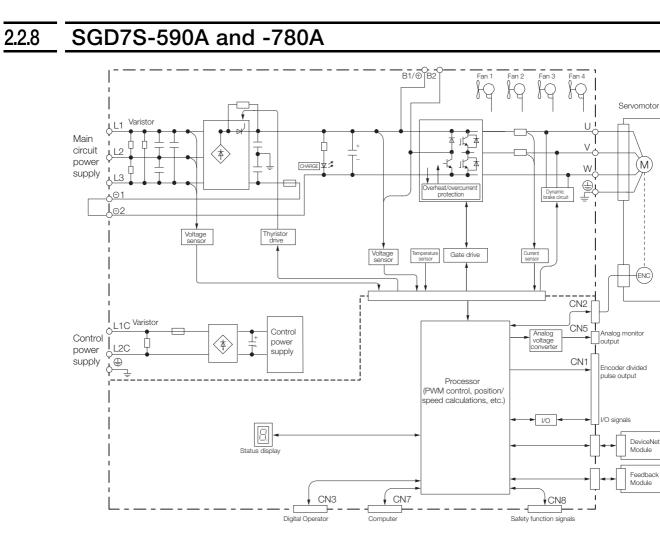
2.2.7 SGD7S-470A and -550A



2

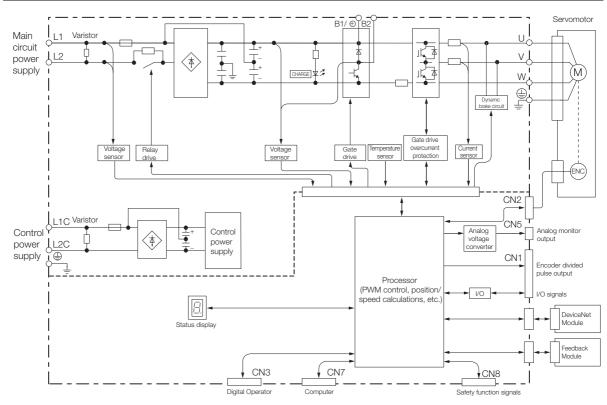
2-17

2.2.8 SGD7S-590A and -780A

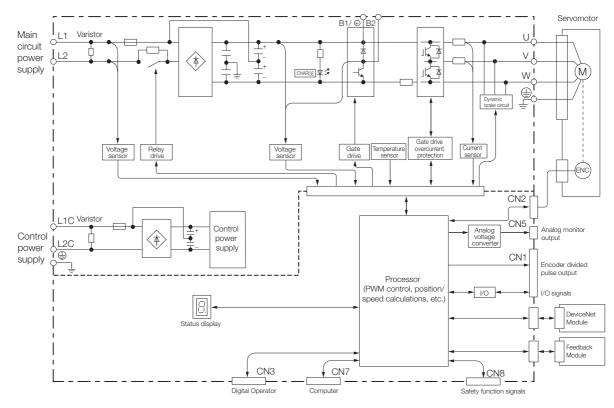


2.2.9 SGD7S-R70F, -R90F, and -2R1F





2.2.10 SGD7S-2R8F



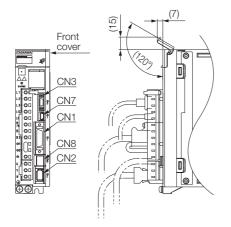
2.3.1 Front Cover Dimensions and Connector Specifications

2.3 External Dimensions

2.3.1 Front Cover Dimensions and Connector Specifications

The front cover dimensions and panel connector section are the same for all models. Refer to the following figures and table.

• Front Cover Dimensions



Connector Specifications

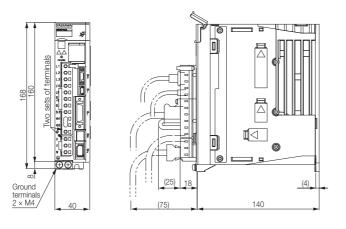
Connector No.	Model	Number of Pins	Manufacturer
CN1	10226-59A3MB	26	3M Japan Ltd
CN2	3E106-0220KV	6	3M Japan Ltd
CN3	HDR-EC14LFDTN- SLD-PLUS	14	Honda Tsushin Kogyo Co., Ltd.
CN7	2172034-1	5	Tyco Electronics Japan G.K.
CN8	1981080-1	8	Tyco Electronics Japan G.K.

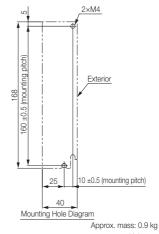
Note: The above connectors or their equivalents are used for the SERVOPACKs.

2.3.2 SERVOPACK External Dimensions

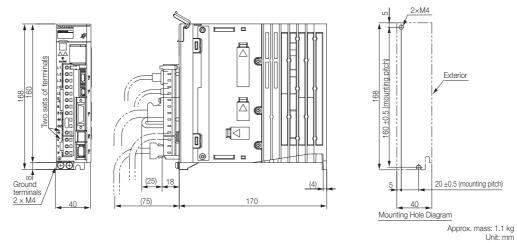
Base-mounted SERVOPACKs

• Three-phase, 200 VAC: SGD7S-R70A, -R90A, and -1R6A



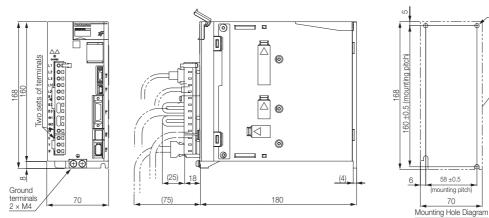


Unit: mm



• Three-phase, 200 VAC: SGD7S-2R8A; Single-phase, 100 VAC: SGD7S-R70F, -R90F, and -2R1F

• Three-phase, 200 VAC: SGD7S-3R8A, -5R5A, and -7R6A; Single-phase, 100 VAC: SGD7S-2R8F



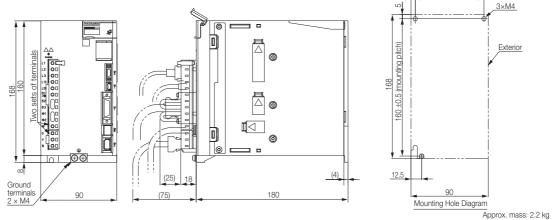
Approx. mass: SGD7S-3R8A, -5R5A, -7R6A: 1.6 kg SGD7S-2R8F: 1.5 kg Unit: mm

80±0.5 (mounting pitch)

3×M4

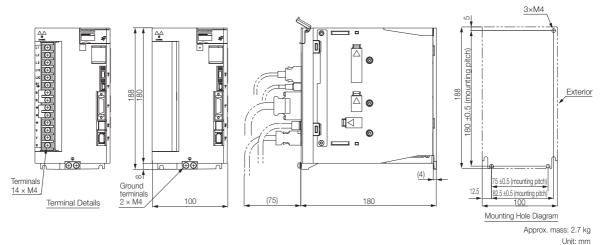
Exterior

• Three-phase, 200 VAC: SGD7S-120A

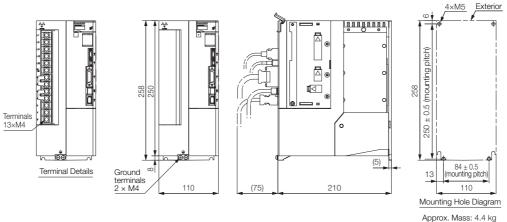


Approx. mass: 2.2 kg Unit: mm

Three-phase, 200 VAC: SGD7S-180A and -200A; Single-phase, 200 VAC: SGD7S-120AE0A008

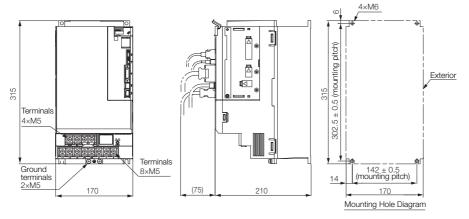


• Three-phase, 200 VAC: SGD7S-330A



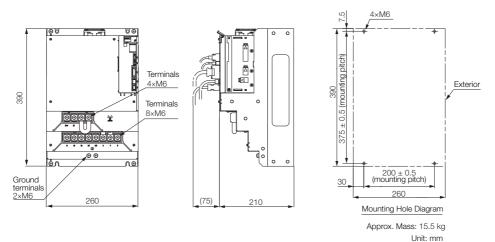
Unit: mm

• Three-phase, 200 VAC: SGD7S-470A and -550A



Approx. Mass: 8.2 kg Unit: mm

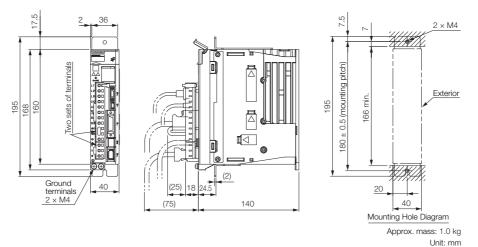
• Three-phase, 200 VAC: SGD7S-590A and -780A



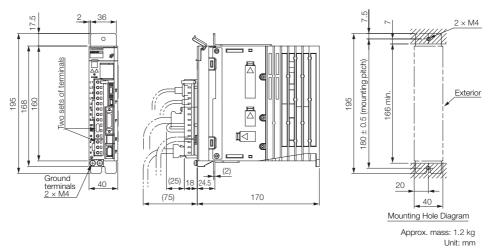
Rack-mounted SERVOPACKs

Hardware Option Code: 001

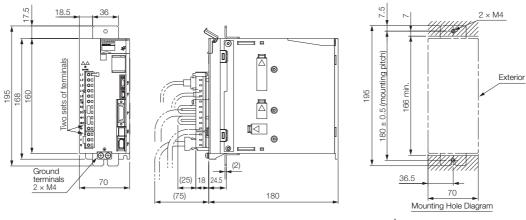
• Three-phase, 200 VAC: SGD7S-R70A, -R90A, and -1R6A



 Three-phase, 200 VAC: SGD7S-2R8A; Single-phase, 100 VAC: SGD7S-R70F, -R90F, and -2R1F

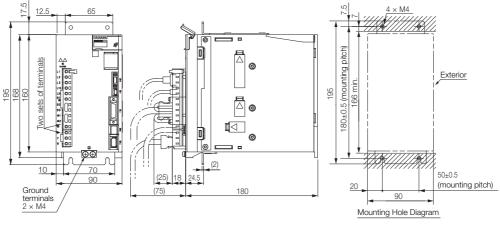


 Three-phase, 200 VAC: SGD7S-3R8A, -5R5A, and -7R6A; Single-phase, 100 VAC: SGD7S-2R8F



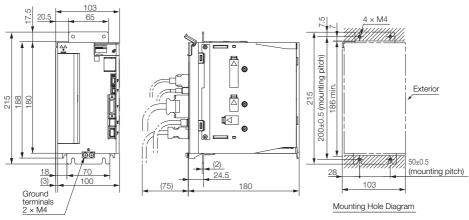
Approx. mass: SGD7S-3R8A, -5R5A, -7R6A: 1.7 kg SGD7S-2R8F: 1.6 kg Unit: mm

Three-phase, 200 VAC: SGD7S-120A



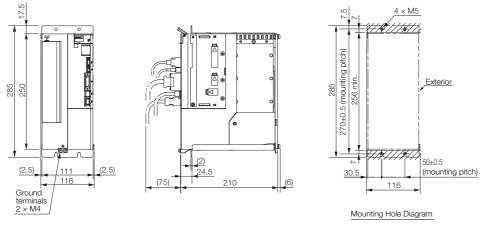
Approx. mass: 2.3 kg Unit: mm

• Three-phase, 200 VAC: SGD7S-180A and -200A



Approx. mass: 2.8 kg Unit: mm

• Three-phase, 200 VAC: SGD7S-330A

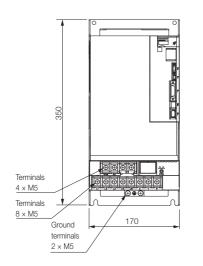


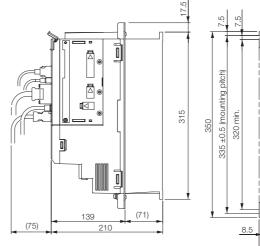
Approx. mass: 4.9 kg Unit: mm

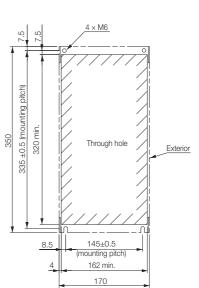
Duct-ventilated SERVOPACKs

Hardware Option Code: 001

• Three-phase, 200 VAC: SGD7S-470A and -550A





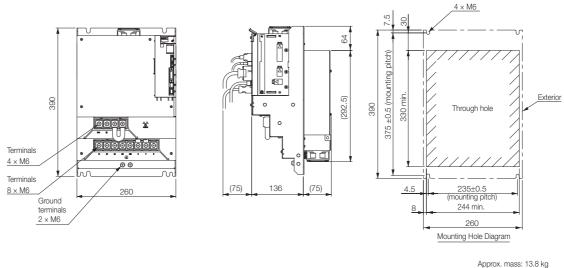


Mounting Hole Diagram

Approx. mass: 8.4 kg Unit: mm

2.3.3 DeviceNet Module External Dimensions and Connector Specifications

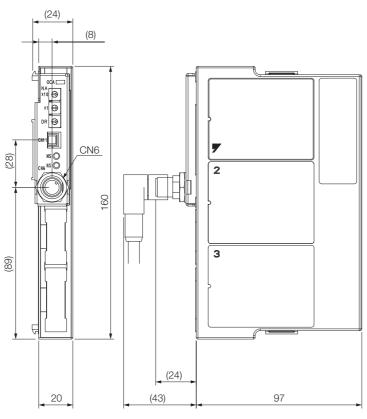
• Three-phase, 200 VAC: SGD7S-590A and -780A



pprox. mass: 13.8 kg. Unit: mm

2.3.3 DeviceNet Module External Dimensions and Connector Specifications

External Dimensions



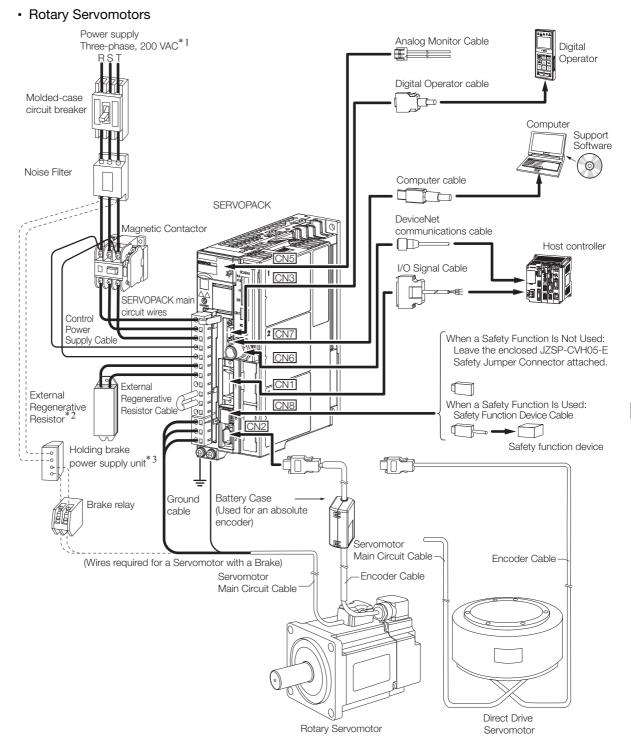
Approx. mass: 0.3 kg Unit: mm

Connector Specifications

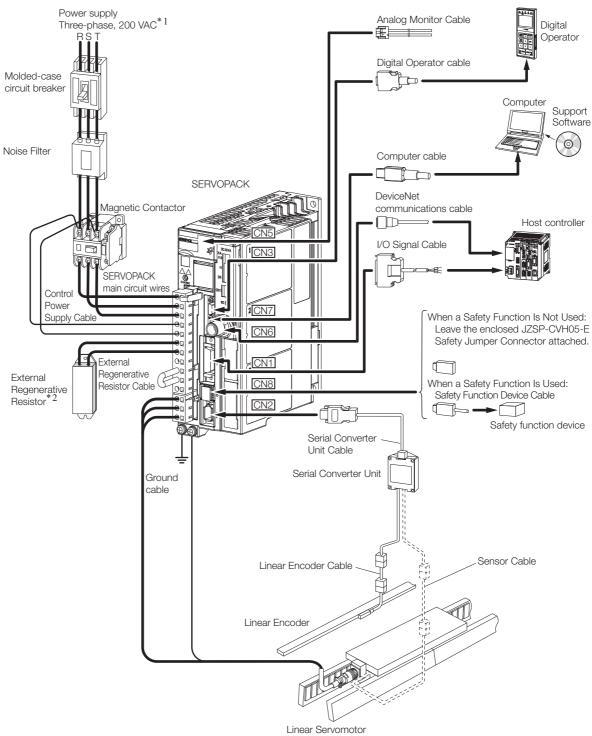
Device Label	Model	Number of Pins	Manufacturer
CN6	CM02-8DR5P-CF	5	DDK Ltd.

Note: The above connector or an equivalent is used.

2.4 Examples of Standard Connections between SERVOPACKs and Peripheral Devices



- *1. This example is for a SERVOPACK with a three-phase, 200-VAC power supply input. The pin layout of the main circuit connector depends on the voltage.
- *2. External Regenerative Resistors are not provided by Yaskawa.
- *3. The power supply for the holding brake is not provided by Yaskawa. Select a power supply based on the holding brake specifications.
 - If you use a 24-V brake, install a separate power supply for the 24-VDC power supply from other power supplies, such as the one for the I/O signals of the CN1 connector. If the power supply is shared, the I/O signals may malfunction.



Linear Servomotors

- *1. This example is for a SERVOPACK with a three-phase, 200-VAC power supply input. The pin layout of the main circuit connector depends on the voltage.
- *2. External Regenerative Resistors are not provided by Yaskawa.

Installation

3

This chapter provides information on installing SERVO-PACKs and DeviceNet Modules in the required locations.

3.1	Instal	lation Precautions
3.2	Mount	ing the DeviceNet Module to the SERVOPACK3-3
3.3	Moun	ting Types and Orientation
3.4	Moun	ting Hole Dimensions
3.5	Moun	ting Interval
3.5	Moun 3.5.1 3.5.2	Installing One SERVOPACK in a Control Panel 3-6 Installing More Than One SERVOPACK
3.5	3.5.1	Installing One SERVOPACK in a Control Panel 3-6
3.5	3.5.1 3.5.2	Installing One SERVOPACK in a Control Panel 3-6 Installing More Than One SERVOPACK

3.1 Installation Precautions

Refer to the following section for the ambient installation conditions. 2.1.4 Specifications on page 2-7

Installation Near Sources of Heat

Implement measures to prevent temperature increases caused by radiant or convection heat from heat sources so that the ambient temperature of the SERVOPACK meets the ambient conditions.

■ Installation Near Sources of Vibration

Install a vibration absorber on the mounting surface of the SERVOPACK so that the SERVO-PACK will not be subjected to vibration.

Other Precautions

Do not install the SERVOPACK in a location subject to high temperatures, high humidity, water drops, cutting oil, excessive dust, excessive dirt, excessive iron powder, corrosive gasses, or radioactivity.

3.2 Mounting the DeviceNet Module to the SERVOPACK

Install the DeviceNet Module correctly according to the installation procedures that are included with it.

Ω Σ-V-Series/Σ-V-Series for Large-Capacity Models/Σ-7-Series Installation Guide Command Option Module (Manual No.: TOBP C720829 01)

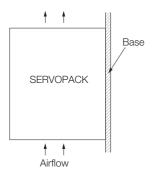
3.3 Mounting Types and Orientation

The SERVOPACKs come in the following mounting types: base-mounted, rack-mounted, and duct-ventilated types. Regardless of the mounting type, mount the SERVOPACK vertically, as shown in the following figures.

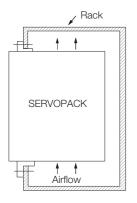
Also, mount the SERVOPACK so that the front panel is facing toward the operator.

Note: Prepare two to four mounting holes for the SERVOPACK and mount it securely in the mounting holes. (The number of mounting holes depends on the capacity of the SERVOPACK.)

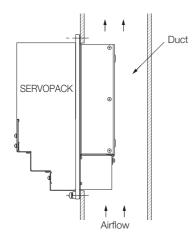
Base-mounted SERVOPACK



Rack-mounted SERVOPACK



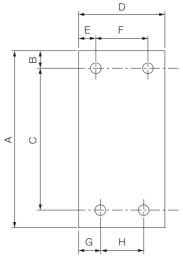
• Duct-ventilated SERVOPACK



3.4 Mounting Hole Dimensions

Use mounting holes to securely mount the SERVOPACK to the mounting surface.

Note: To mount the SERVOPACK, you will need to prepare a screwdriver that is longer than the depth of the SERVOPACK.



• Σ -7-series Mounting Hole Dimensions

SERVOPACK Model		Dimensions (mm)							Screw	Number	
SERVO	SERVOPACK Model		В	С	D	Е	F	G	Н	Size	of Screws
	R70A, R90A, 1R6A	168	5	160 ±0.5	40	35	-	25	-	M4	2
	2R8A, R70F, R90F, 2R1F	168	5	160 ±0.5	40	5	-	25	-	M4	2
	3R8A, 5R5A, 7R6A, 2R8F	168	5	160 ±0.5	70	6	58 ±0.5	64	-	M4	3
SGD7S-	120A	168	5	160 ±0.5	90	5	80 ±0.5	12.5	-	M4	3
	180A, 200A, 120AE0A008	188	5	180 ±0.5	100	95	-	12.5	75 ±0.5	M4	3
	330A	258	6	250 ±0.5	110	5	100 ±0.5	13	84 ±0.5	M5	4
	470A, 550A	315	6	302.5 ±0.5	170	14	142 ±0.5	14	142 ±0.5	M6	4
	590A, 780A	390	7.5	375 ±0.5	260	30	200 ±0.5	30	200 ±0.5	M6	4

• Σ-V-series-Compatible Mounting Hole Dimensions

If you are replacing a Σ -V-Series SERVOPACK with a Σ -7-Series SERVOPACK, you can also use the mounting holes that were used for the Σ -V-Series SERVOPACK. Refer to the following table.

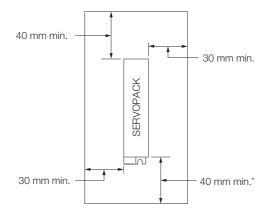
	SERVOPACK Model		Dimensions (mm)							Screw	Number
SERVO			В	С	D	Е	F	G	Н	Size	of Screws
	R70A, R90A, 1R6A	168	5	150 ±0.5	40	35	-	35	-	M4	2
	2R8A, R70F, R90F, 2R1F	168	5	150 ±0.5	40	5	-	35	-	M4	2
00070	3R8A, 5R5A, 7R6A, 2R8F	168	5	150 ±0.5	70	6	58 ±0.5	6	-	M4	3
SGD7S-	120A	168	5	150 ±0.5	90	5	80 ±0.5	5	-	M4	3
	180A, 200A, 120AE0A008	188	5	170 ±0.5	100	95	-	5	90 ±0.5	M4	3
	330A	250	6	238.5 ±0.5	110	5	100 ±0.5	5	100 ±0.5	M5	4
	470A, 550A, 590A, 780A			g compatibili ⁄a. Contact y						nt is not	provided

3.5.1 Installing One SERVOPACK in a Control Panel

3.5 Mounting Interval

3.5.1 Installing One SERVOPACK in a Control Panel

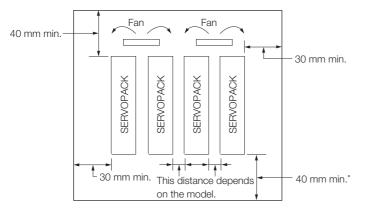
Provide the following spaces around the SERVOPACK.



* For this dimension, ignore items protruding from the main body of the SERVOPACK.

3.5.2 Installing More Than One SERVOPACK in a Control Panel

When multiple SERVOPACKs are installed close together in an enclosed space, natural convection may provide insufficient air circulation to distribute heat uniformly through the space, resulting in the air surrounding the SERVOPACKs to locally exceed the surrounding air temperature range. In this case, you must take measures to disperse the localized hot spots, such as by using fans. When using fans, install them as shown below.



* For this dimension, ignore items protruding from the main body of the SERVOPACK.

The space required on the right side of a SERVOPACK (when looking at the SERVOPACK from the front) depends on the SERVOPACK models. Refer to the following table.

SERVOPACK Model		Space on Right Side	Cooling Fan Installation Conditions 10 mm above SERVOPACK's Top Surface
SGD7S-	R70A, R90A, 1R6A, 2R8A, 3R8A, 5R5A, 7R6A, R70F, R90F, 2R1F, 2R8F	1 mm min.	Air speed: 0.5 m/s min.
	120A, 180A, 200A, 330A, 470A, 550A, 590A, 780A	10 mm min.	Air speed: 0.5 m/s min.

Note: When option modules are mounted on SERVOPACKs, the SERVOPACK installation conditions will depend on the option modules that are mounted. For details, refer to the manual for option module.

3.6 Monitoring the Installation Environment

You can use the SERVOPACK Installation Environment Monitor parameter to check the operating conditions of the SERVOPACK in the installation environment.

You can check the SERVOPACK installation environment monitor with either of the following methods.

- Using the SigmaWin+: Life Monitor Installation Environment Monitor SERVOPACK
- Panel Operator or Digital Operator: Un025 (Installation Environment Monitor [%])

Implement one or more of the following actions if the monitor value exceeds 100%.

- Lower the surrounding temperature.
- · Decrease the load.

Information The value of the SERVOPACK Installation Environment Monitor parameter will increase by about 10% for each 10°C increase in the ambient temperature.



Always observe the surrounding air temperature given in the SERVOPACK environment conditions. Even if the monitor value is 100% or lower, you cannot use a SERVOPACK in a location that exceeds the specified surrounding air temperature.

3.7 EMC Installation Conditions

This section gives the recommended installation conditions that were used for EMC certification testing.

The EMC installation conditions that are given here are the conditions that were used to pass testing criteria at Yaskawa. The EMC level may change under other conditions, such as the actual installation structure and wiring conditions. These Yaskawa products are designed to be built into equipment. Therefore, you must implement EMC measures and confirm compliance for the final equipment.

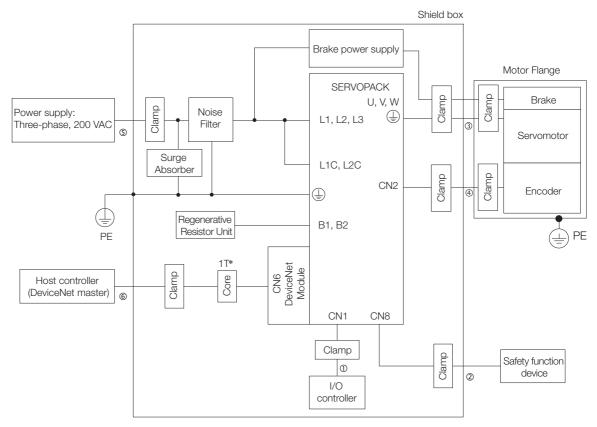
The compliant standards are EN 55011 Group 1, Class A, EN 61000-6-2, EN 61000-6-4, and EN 61800-3 (Category C2, Second environment).



• In a domestic environment, this product may cause radio interference in which case supplementary mitigation measures may be required.

• This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

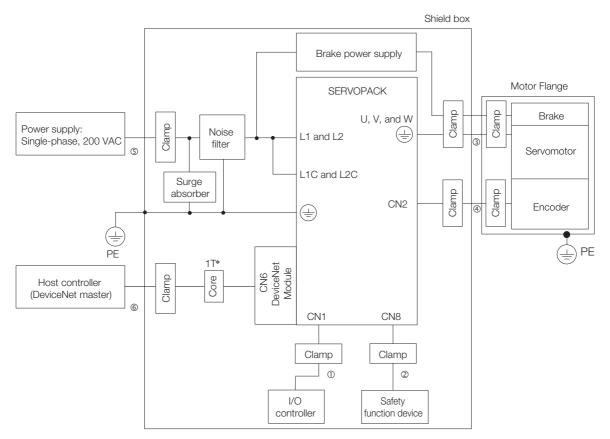
• Three-Phase, 200 VAC



* 1T: 1 turn

Symbol	Cable Name	Specification
1	I/O Signal Cable	Shielded cable
2	Safety Function Device Cable	Shielded cable
3	Servomotor Main Circuit Cable	Shielded cable
4	Encoder Cable	Shielded cable
\$	Main Circuit Power Cable	Shielded cable
6	DeviceNet Communications Cable	Shielded cable

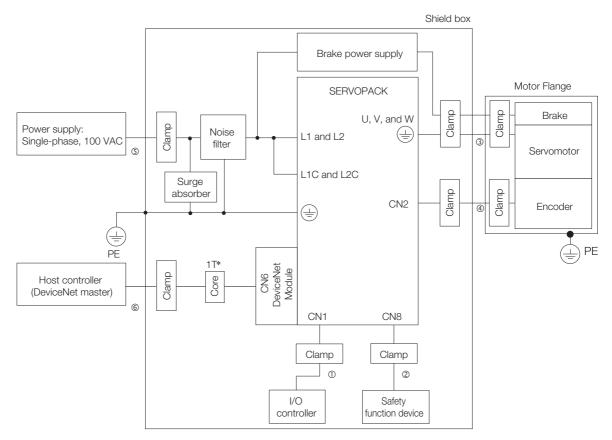
• Single-Phase, 200 VAC



* 1T: 1 turn

Symbol	Cable Name	Specification
0	I/O Signal Cable	Shielded cable
0	Safety Function Device Cable	Shielded cable
3	Servomotor Main Circuit Cable	Shielded cable
4	Encoder Cable	Shielded cable
5	Main Circuit Power Cable	Shielded cable
6	DeviceNet Communications Cable	Shielded cable

• Single-Phase, 100 VAC



* 1T: 1 turn

Symbol	Cable Name	Specification
1	I/O Signal Cable	Shielded cable
2	Safety Function Device Cable	Shielded cable
3	Servomotor Main Circuit Cable	Shielded cable
4	Encoder Cable	Shielded cable
5	Main Circuit Power Cable	Shielded cable
6	DeviceNet Communications Cable	Shielded cable

Wiring and Connections

This chapter provides information on wiring and connecting SERVOPACKs and DeviceNet Modules to power supplies and peripheral devices.

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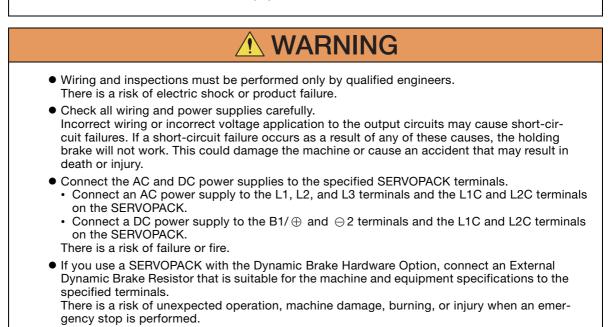
4.1.1 General Precautions

4.1 Wiring and Connecting SERVOPACKs

4.1.1 General Precautions

🚹 DANGER

• Do not change any wiring while power is being supplied. There is a risk of electric shock or injury.



4.1.1 General Precautions

• Wait for at least six minutes after turning OFF the power supply (with a SERVOPACK for a 100-VAC input, wait for at least nine minutes) and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the power supply terminals while the CHARGE lamp is lit after turning OFF the power supply because high voltage may still remain in the SERVOPACK. There is a risk of electric shock.	
 Observe the precautions and instructions for wiring and trial operation precisely as described in this document. Failures caused by incorrect wiring or incorrect voltage application in the brake circuit may cause the SERVOPACK to fail, damage the equipment, or cause an accident resulting in death or injury. 	
 Check the wiring to be sure it has been performed correctly. Connectors and pin layouts are sometimes different for different models. Always confirm the pin layouts in technical documents for your model before operation. There is a risk of failure or malfunction. 	
• Connect wires to power supply terminals and motor connection terminals securely with the specified methods and tightening torque. Insufficient tightening may cause wires and terminal blocks to generate heat due to faulty contact, possibly resulting in fire.	
 Use shielded twisted-pair cables or screened unshielded multi-twisted-pair cables for I/O Signal Cables and Encoder Cables. 	
 The maximum wiring length is 3 m for I/O Signal Cables, and 50 m for Encoder Cables or Servomotor Main Circuit Cables. 	
 Observe the following precautions when wiring the SERVOPACK's main circuit terminals. Turn ON the power supply to the SERVOPACK only after all wiring, including the main circuit is minals, has been completed. If a connector is used for the main circuit terminals, remove the main circuit connector from the SERVOPACK before you wire it. Insert only one wire per insertion hole in the main circuit terminals. When you insert a wire, make sure that the conductor wire (e.g., whiskers) does not come int contact with adjacent wires. 	he
 Install molded-case circuit breakers and other safety measures to provide protection against short circuits in external wiring. There is a risk of fire or failure. 	
NOTICE	
 Whenever possible, use the Cables specified by Yaskawa. If you use any other cables, confirm the rated current and application environment of your model and use the wiring materials specified by Yaskawa or equivalent materials. Securely tighten cable connector screws and lock mechanisms. Insufficient tightening may result in cable connectors falling off during operation. Do not bundle power lines (e.g., the Main Circuit Cable) and low-current lines (e.g., the I/O Signal Cables or Encoder Cables) together or run them through the same duct. If you do not 	

- Do not bundle power lines (e.g., the Main Circuit Cable) and low-current lines (e.g., the I/O Signal Cables or Encoder Cables) together or run them through the same duct. If you do not place power lines and low-current lines in separate ducts, separate them by at least 30 cm. If the cables are too close to each other, malfunctions may occur due to noise affecting the lowcurrent lines.
- Install a battery at either the host controller or on the Encoder Cable. If you install batteries both at the host controller and on the Encoder Cable at the same time, you will create a loop circuit between the batteries, resulting in a risk of damage or burning.
- When connecting a battery, connect the polarity correctly. There is a risk of battery rupture or encoder failure.

4.1.1 General Precautions



- Use a molded-case circuit breaker or fuse to protect the main circuit. The SERVOPACK connects directly to a commercial power supply; it is not isolated through a transformer or other device. Always use a molded-case circuit breaker or fuse to protect the servo system from accidents involving different power system voltages or other accidents.
- Install an earth leakage breaker. The SERVOPACK does not have a built-in ground fault protective circuit. To configure a safer system, install a ground fault detector against overloads and short-circuiting, or install a ground fault detector combined with a molded-case circuit breaker.
- Do not turn the power supply ON and OFF more than necessary.Do not use the SERVOPACK for applications that require the power supply to turn ON and
- OFF frequently. Such applications will cause elements in the SERVOPACK to deteriorate. • After you have started actual operation, allow at least one hour between turning the power
- supply ON and OFF (as a guideline).

To ensure safe, stable application of the servo system, observe the following precautions when wiring.

• Use the cables specified by Yaskawa. Design and arrange the system so that each cable is as short as possible.

Refer to the following manual or catalog for information on the specified cables. \square AC Servo Drives Σ -7 Series (Catalog No.: KAEP S800001 23)

Ω Σ-7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)

• The signal cable conductors are as thin as 0.2 mm² or 0.3 mm². Do not subject them to excessive bending stress or tension.

4.1.2 Countermeasures against Noise

 \bigcirc

4.1.2 Countermeasures against Noise

The SERVOPACK is designed as an industrial device. It therefore provides no measures to prevent radio interference. The SERVOPACK uses high-speed switching elements in the main circuit. Therefore peripheral devices may be affected by switching noise. Important If the equipment is to be used near private houses or if radio interference is a problem, take

countermeasures against noise.

The SERVOPACK uses microprocessors. Therefore, it may be affected by switching noise from peripheral devices.

To prevent the noise from the SERVOPACK or the peripheral devices from causing malfunctions of any devices, take the following countermeasures against noise as required.

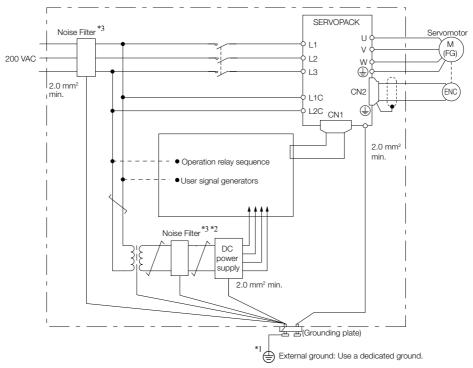
- Install the input reference device and Noise Filter as close to the SERVOPACK as possible.
- Always install a Surge Absorber for relays, solenoids, and Magnetic Contactor coils.
- Do not place the following cables in the same duct or bundle them together. Also, separate the cables from each other by at least 30 cm.
 - •Main Circuit Cables and I/O Signal Cables
 - •Main Circuit Cables and Encoder Cables
- Do not share the power supply with an electric welder or electrical discharge machine. If the SERVOPACK is placed near a high-frequency generator, install Noise Filters on the input side on the Main Circuit Power Supply Cable and Control Power Supply Cable even if the same power supply is not shared with the high-frequency generator. Refer to the following section for information on connecting Noise Filters.
- Noise Filters on page 4-7
- Implement suitable grounding measures. Refer to the following section for information on grounding measures.

3 4.1.3 Grounding on page 4-9

4.1.2 Countermeasures against Noise

Noise Filters

You must attach Noise Filters in appropriate places to protect the SERVOPACK from the adverse effects of noise. The following is an example of wiring for countermeasures against noise.



*1. For the ground wire, use a wire with a thickness of at least 2.0 mm² (preferably, flat braided copper wire).

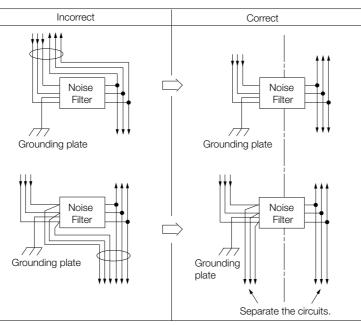
- *2. Whenever possible, use twisted-pair wires to wire all connections marked with $\underline{\frown}$.
- *3. Refer to the following section for precautions when using Noise Filters.

4.1.2 Countermeasures against Noise

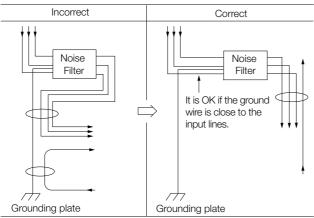
Noise Filter Wiring and Connection Precautions

Always observe the following precautions when wiring or connecting Noise Filters.

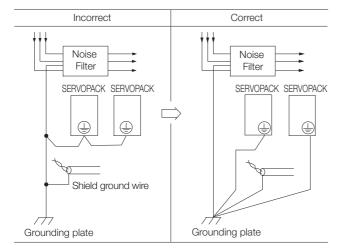
• Separate input lines from output lines. Do not place input lines and output lines in the same duct or bundle them together.



• Separate the Noise Filter ground wire from the output lines. Do not place the Noise Filter ground wire, output lines, and other signal lines in the same duct or bundle them together.

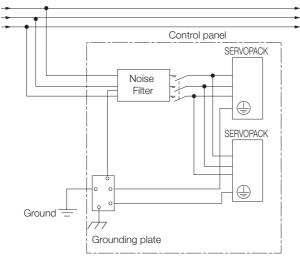


• Connect the Noise Filter ground wire directly to the grounding plate. Do not connect the Noise Filter ground wire to other ground wires.



4.1.3 Grounding

• If a Noise Filter is located inside a control panel, first connect the Noise Filter ground wire and the ground wires from other devices inside the control panel to the grounding plate for the control panel, then ground the plate.



4.1.3 Grounding

Implement grounding measures as described in this section. Implementing suitable grounding measures will also help prevent malfunctions, which can be caused by noise.

Observe the following precautions when wiring the ground cable.

- Ground the SERVOPACK to a resistance of 100 Ω or less.
- Be sure to ground at one point only.
- Ground the Servomotor directly if the Servomotor is insulated from the machine.

Motor Frame Ground or Motor Ground

If you ground the Servomotor through the machine, a current resulting from switching noise can flow from the main circuit of the SERVOPACK through the stray capacitance of the Servomotor. To prevent this, always connect the FG terminal of the Servomotor Main Circuit Cable connected to the Servomotor to the ground terminal (a) on the SERVOPACK. Also be sure to ground the ground terminal (a). Always connect the shield wire of the Encoder Cable connected to the Servomotor to the connector case (shell).

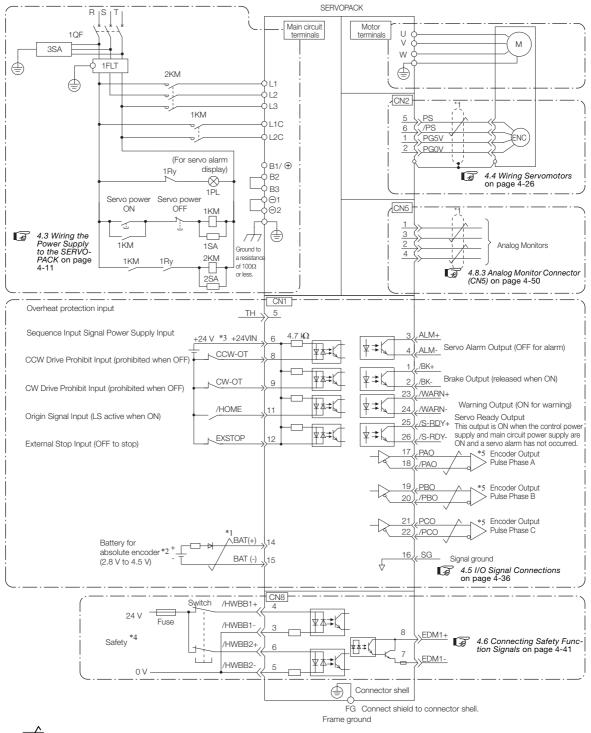
Ground both the Moving Coil and Magnetic Way of a Linear Servomotor.

Noise on I/O Signal Cables

If noise enters the I/O Signal Cable, connect the shield of the I/O Signal Cable to the connector shell to ground it. If the Servomotor Main Circuit Cable is placed in a metal conduit, ground the conduit and its junction box. For all grounding, ground at one point only.

4.2 Basic Wiring Diagrams

This section provide the basic wiring diagrams. Refer to the reference sections given in the diagrams for details.



- *1. \checkmark represents twisted-pair wires.
- *2. Connect these when using an absolute encoder. If the Encoder Cable with a Battery Case is connected, do not connect a backup battery.
- *3. The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.
- *4. Refer to the following chapter if you use a safety function device.
 - G Chapter 11 Safety Functions
 - If you do not use the safety function, insert the Safety Jumper Connector (provided as an accessory) into CN8 when you use the SERVOPACK.
- *5. Always use line receivers to receive the output signals.
- Note: If you use a 24-V brake, install a separate power supply for the 24-VDC power supply from other power supplies, such as the one for the I/O signals of the CN1 connector. If the power supply is shared, the I/O signals may malfunction.

4.3.1 Terminal Symbols and Terminal Names

4.3 Wiring the Power Supply to the SERVOPACK

Refer to the following manual or catalog for information on cables and peripheral devices. \square AC Servo Drives Σ -7 Series (Catalog No.: KAEP S800001 23)

~~~  $\Sigma$ -7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)

## 4.3.1 Terminal Symbols and Terminal Names

Use the main circuit connector on the SERVOPACK to wire the main circuit power supply and control circuit power supply to the SERVOPACK.

## 

• Wire all connections correctly according to the following table and specified reference information. There is a risk of SERVOPACK failure or fire if incorrect wiring is performed.

The SERVOPACKs have the following four types of main circuit power supply input specifications.

#### • Three-Phase, 200-VAC Power Supply Input

| Terminal<br>Symbols | Terminal Name                                                                | Specifications and Reference                                                                                                                                                                                                                                                                                                  |                                                                                                              |  |
|---------------------|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--|
| L1, L2,<br>L3       | Main circuit power<br>supply input terminals<br>for AC power supply<br>input | Three-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz                                                                                                                                                                                                                                                                    |                                                                                                              |  |
|                     | Control power sup-                                                           | AC power supply                                                                                                                                                                                                                                                                                                               | Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz                                                  |  |
| L1C, L2C            | ply terminals                                                                | DC power<br>supply                                                                                                                                                                                                                                                                                                            | L1C: 270 VDC to 324 VDC, -15% to +10%, L2C: 0 VDC<br>or<br>L2C: 270 VDC to 324 VDC, -15% to +10%, L1C: 0 VDC |  |
|                     |                                                                              | 🕞 4.3.5 V                                                                                                                                                                                                                                                                                                                     | Viring Regenerative Resistors on page 4-23                                                                   |  |
|                     | Regenerative Resis-<br>tor terminals                                         | ■ For SGD7S-R70A, -R90A, -1R6A, and -2R8A<br>If the regenerative capacity is insufficient, connect an External Regener-<br>ative Resistor between B1/⊕ and B2.<br>The External Regenerative Resistor is not included. Obtain it separately.                                                                                   |                                                                                                              |  |
| B1/⊕,<br>B2, B3     |                                                                              | ■ For SGD7S-3R8A,- 5R5A, -7R6A, -120A, -180A, -200A, and -330A<br>If the internal regenerative resistor is insufficient, remove the lead or<br>short bar between B2 and B3 and connect an External Regenerative<br>Resistor between B1/⊕ and B2.<br>The External Regenerative Resistor is not included. Obtain it separately. |                                                                                                              |  |
|                     |                                                                              | ■ For SGD7S-470A, -550A, -590A, and -780A<br>Connect a Regenerative Resistor Unit between B1/⊕ and B2. Obtain a<br>Regenerative Resistor Unit separately. These models do not have a B3<br>terminal.                                                                                                                          |                                                                                                              |  |
|                     | DC Reactor termi-                                                            | 4.3.6 Wiring Reactors for Harmonic Suppression on page 4-25                                                                                                                                                                                                                                                                   |                                                                                                              |  |
| ⊖1, ⊖2              | nals for power sup-<br>ply harmonic<br>suppression                           | These term<br>monic supp                                                                                                                                                                                                                                                                                                      | inals are used to connect a DC Reactor for power supply har-<br>pression.                                    |  |
| $\ominus$           | -                                                                            | None. (Do not connect anything to this terminal.)                                                                                                                                                                                                                                                                             |                                                                                                              |  |

#### 4.3.1 Terminal Symbols and Terminal Names

| Terminal<br>Symbols | Terminal Name                                                                  | Specifications and Reference                                                                                                                                                                                                                                                                                              |                                                                                                              |
|---------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| L1, L2              | Main circuit power<br>supply input termi-<br>nals for AC power<br>supply input | Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz                                                                                                                                                                                                                                                               |                                                                                                              |
| L1C, L2C            | Control power sup-                                                             | AC<br>power<br>supply                                                                                                                                                                                                                                                                                                     | Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz                                                  |
|                     |                                                                                | DC<br>power<br>supply                                                                                                                                                                                                                                                                                                     | L1C: 270 VDC to 324 VDC, -15% to +10%, L2C: 0 VDC<br>or<br>L2C: 270 VDC to 324 VDC, -15% to +10%, L1C: 0 VDC |
|                     |                                                                                |                                                                                                                                                                                                                                                                                                                           | 5 Wiring Regenerative Resistors on page 4-23                                                                 |
| B1/⊕, B2,           | Regenerative Resis-<br>tor terminals                                           | ■ For SGD7S-R70A, -R90A, -1R6A, and -2R8A<br>If the regenerative capacity is insufficient, connect an External Regenera-<br>tive Resistor between B1/⊕ and B2.<br>The External Regenerative Resistor is not included. Obtain it separately.                                                                               |                                                                                                              |
| B3                  |                                                                                | <ul> <li>■ For SGD7S-5R5A and -120AE0A008</li> <li>If the internal regenerative resistor is insufficient, remove the lead or short bar between B2 and B3 and connect an External Regenerative Resistor between B1/⊕ and B2.</li> <li>The External Regenerative Resistor is not included. Obtain it separately.</li> </ul> |                                                                                                              |
| ⊖1, ⊝2              | DC Reactor termi-<br>nals for power sup-<br>ply harmonic<br>suppression        | <ul> <li>4.3.6 Wiring Reactors for Harmonic Suppression on page 4-25</li> <li>These terminals are used to connect a DC Reactor for power supply harmonic suppression.</li> </ul>                                                                                                                                          |                                                                                                              |
| L3, ⊖               | _                                                                              | None. (Do not connect anything to these terminals.)                                                                                                                                                                                                                                                                       |                                                                                                              |

#### • Single-Phase, 200-VAC Power Supply Input

You can use a single-phase, 200-V power supply input with the following models. • SGD7S-R70A, -R90A, -1R6A, -2R8A, -5R5A

If you use a single-phase, 200-VAC power supply input for the SERVOPACK's main circuit power supply, set parameter Pn00B to n. 11 (Use a three-phase power supply input as a single-phase power supply input). Refer to the following section for details.

**Information** You do not need to change the setting of Pn00B to n. **D**1**D** (Use a three-phase power supply input as a single-phase power supply input) for a SERVOPACK with a single-phase 200-VAC power supply input (model number: SGD7S-120AE0A008).

#### • DC Power Supply Input

| Terminal<br>Symbols             | Terminal Name                                            | Specifications and Reference                                                                                                                                                                     |                                                                                                              |
|---------------------------------|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
|                                 | Control power sup-<br>ply terminals                      | AC power supply                                                                                                                                                                                  | Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz                                                  |
| L1C, L2C                        |                                                          | DC power supply                                                                                                                                                                                  | L1C: 270 VDC to 324 VDC, -15% to +10%, L2C: 0 VDC<br>or<br>L2C: 270 VDC to 324 VDC, -15% to +10%, L1C: 0 VDC |
| B1/⊕                            | Main circuit power                                       | 270 VDC to 324 VDC, -15% to +10%                                                                                                                                                                 |                                                                                                              |
| ⊖2                              | supply input termi-<br>nals for DC power<br>supply input | 0 VDC                                                                                                                                                                                            |                                                                                                              |
| L1, L2, L3,<br>B2, B3,<br>⊖1, ⊖ | -                                                        | <ul> <li>None. (Do not connect anything to these terminals.)</li> <li>Note: 1. SGD7S-470A to 780A do not have a B3 terminal.</li> <li>2. SGD7S-330A to 780A do not have a ⊖ terminal.</li> </ul> |                                                                                                              |

If you use a DC power supply input to the SERVOPACK, make sure to set parameter Pn00E to n. DDD1 (DC power supply input supported) before inputting the power supply. Refer to the following section for details.

5.2.1 AC Power Supply Input/DC Power Supply Input Setting on page 5-13

4.3.1 Terminal Symbols and Terminal Names

| Terminal<br>Symbols | Terminal Name                                                             | Specifications and Reference                                                                                                                                                           |
|---------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| L1, L2              | Main circuit power supply<br>input terminals for AC<br>power supply input | Single-phase, 100 VAC to 120 VAC, -15% to +10%, 50 Hz/60 Hz                                                                                                                            |
| L1C, L2C            | Control power supply termi-<br>nals                                       | Single-phase, 100 VAC to 120 VAC, -15% to +10%, 50 Hz/60 Hz                                                                                                                            |
|                     |                                                                           | 4.3.5 Wiring Regenerative Resistors on page 4-23                                                                                                                                       |
| B1, B2              | Regenerative Resistor termi-<br>nals                                      | If the regenerative capacity is insufficient, connect an External Regenerative Resistor between B1/⊕ and B2. The External Regenerative Resistor is not included. Obtain it separately. |

#### • Single-Phase, 100-VAC Power Supply Input

You can use a single-phase, 100-VAC power supply input with the following models. • SGD7S-R70F, -R90F, -2R1F, and -2R8F

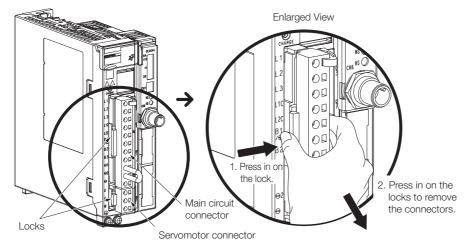
4.3.2 Wiring Procedure for Main Circuit Connector

## 4.3.2 Wiring Procedure for Main Circuit Connector

#### Required Items

| Required Item                               | Remarks                                                                                                                           |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| Spring Opener or Flat-<br>blade Screwdriver | <ul> <li>Spring Opener<br/>SERVOPACK accessory<br/>(You can also use model 1981045-1 from Tyco Electronics Japan G.K.)</li> </ul> |
| blade Screwdriver                           | Flat-blade screwdriver<br>Commercially available screwdriver with tip width of 3.0 mm to 3.5 mm                                   |

#### 1. Remove the main circuit connector and motor connector from the SERVOPACK.



2. Remove the sheath from the wire to connect.



**3.** Open the wire insertion hole on the terminal connector with the tool. There are the following two ways to open the insertion hole. Use either method.

| ①Using a Spring Opener                                                 | <sup>2</sup> Using a Flat-blade Screwdriver                                                                 |
|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|
| Open the insertion hole with the Spring Opener as shown in the figure. | Firmly insert a flat-blade screwdriver into the screwdriver insertion hole to open the wire insertion hole. |
| Spring Opener<br>Wire                                                  |                                                                                                             |

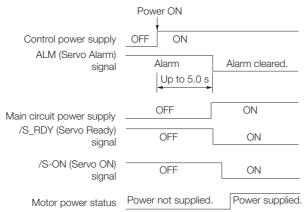
- 4. Insert the conductor into the wire insertion hole. Then, remove the Spring Opener or flatblade screwdriver.
- 5. Make all other connections in the same way.
- 6. When you have completed wiring, attach the connectors to the SERVOPACK.

4.3.3 Power ON Sequence

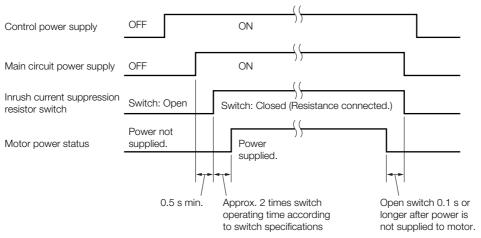
## 4.3.3 Power ON Sequence

Consider the following points when you design the power ON sequence.

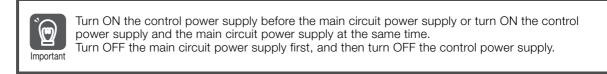
• The ALM (Servo Alarm) signal is output for up to five seconds when the control power supply is turned ON. Take this into consideration when you design the power ON sequence, and turn ON the main circuit power supply to the SERVOPACK when the ALM signal is OFF (alarm cleared).



- Information If the servo ON state cannot be achieved by turning ON the /S\_ON signal, the /S\_RDY signal is not ON. Check the status of the /S\_RDY signal. Refer to the following section for details.
- If you use a DC power supply input with any of the following SERVOPACKs, use the power ON sequence shown below: SGD7S-330A, -470A, -550A, -590A, or -780A.



- Design the power ON sequence so that main circuit power supply is turned OFF when an ALM (Servo Alarm) signal is output.
- Make sure that the power supply specifications of all parts are suitable for the input power supply.
- Allow at least 1 s after the power supply is turned OFF before you turn it ON again.



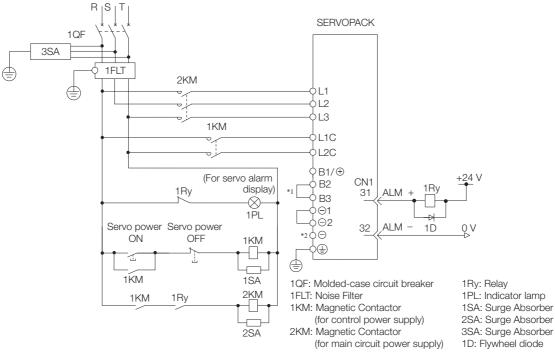
## 

• Even after you turn OFF the power supply, a high residual voltage may still remain in the SERVOPACK. To prevent electric shock, do not touch the power supply terminals after you turn OFF the power. When the voltage is discharged, the CHARGE indicator will turn OFF. Make sure the CHARGE indicator is OFF before you start wiring or inspection work.

#### 4.3.4 Power Supply Wiring Diagrams

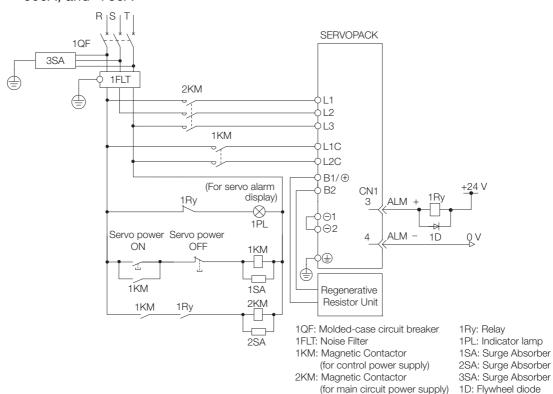
#### Using Only One SERVOPACK

• Wiring Example for Three-Phase, 200-VAC Power Supply Input: SGD7S-R70A, -R90A, -1R6A, -2R8A, -3R8A, -5R5A, -7R6A, -120A, -180A, -200A, or -330A

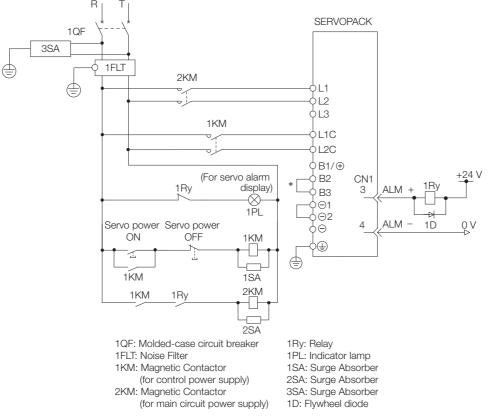


 You do not have to connect B2 and B3 for the following models: SGD7S-R70A, SGD7S-R90A, SGD7S-1R6A, and SGD7S-2R8A. Do not connect them.

\*2. A SGD7S-330A SERVOPACK does not have a - terminal.



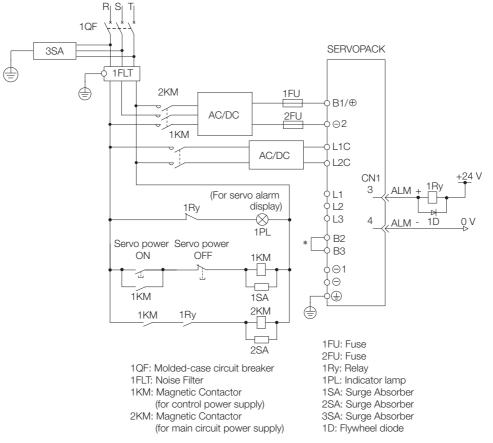
• Wiring Example for Three-Phase, 200-VAC Power Supply Input: SGD7S-470A, -550A, -590A, and -780A



#### • Wiring Example for Single-Phase, 200-VAC Power Supply Input

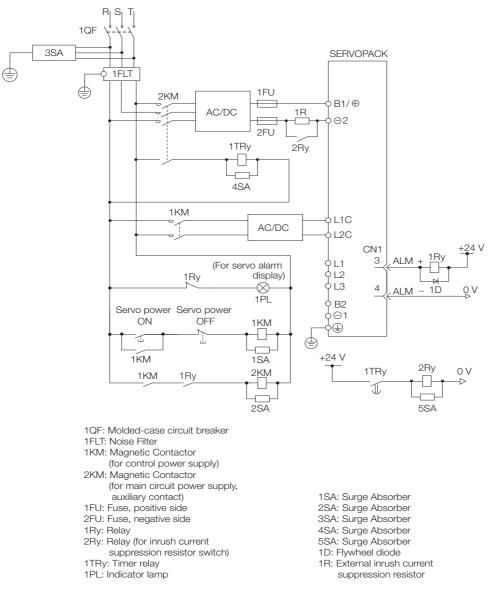
\* You do not have to connect B2 and B3 for the following models: SGD7S-R70A, SGD7S-R90A, SGD7S-1R6A, and SGD7S-2R8A. Do not connect them.

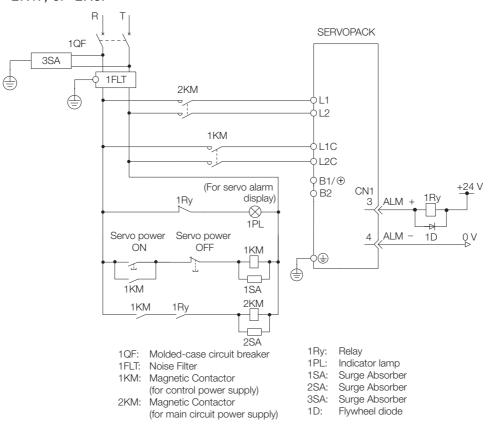
• Wiring Example for DC Power Supply Input: SGD7S-R70A, -R90A, -1R6A, -2R8A, -3R8A, -5R5A, -7R6A, -120A, -180A, or -200A



\* You do not have to connect B2 and B3 for the following models: SGD7S-R70A, SGD7S-R90A, SGD7S-1R6A, and SGD7S-2R8A. Do not connect them.

 Wiring Example for DC Power Supply Input: SGD7S-330A, -470A, -550A, -590A, and -780A





• Wiring Example for Single-Phase, 100-VAC Power Supply Input: SGD7S-R70F, -R90F, -2R1F, or -2R8F

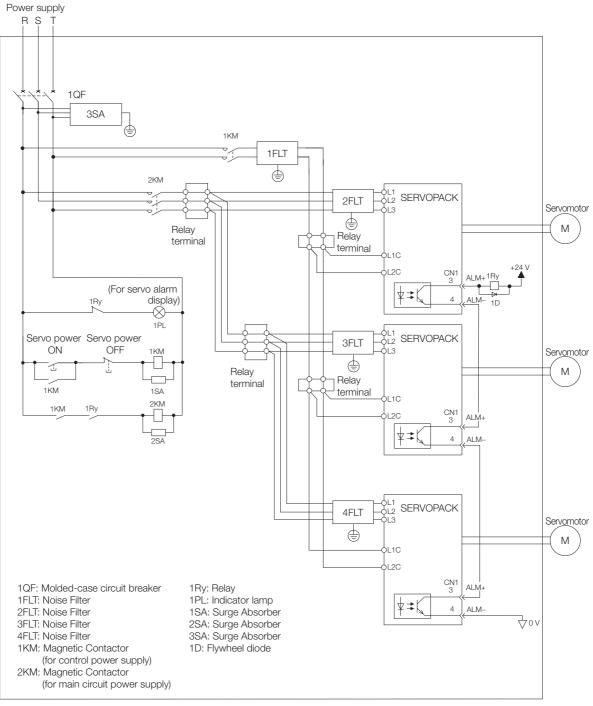
## Using More Than One SERVOPACK

Connect the ALM (Servo Alarm) output for these SERVOPACKs in series to operate the alarm detection relay (1RY).

When a SERVOPACK alarm is activated, the ALM output signal transistor turns OFF.

The following diagram shows the wiring to stop all of the Servomotors when there is an alarm for any one SERVOPACK.

More than one SERVOPACK can share a single Noise Filter. However, always select a Noise Filter that has a large enough capacity to handle the total power supply capacity of all the SERVOPACKs. Be sure to consider the load conditions.



To comply with UL/cUL standards, you must install a branch circuit protective device at the power supply input section to each SERVOPACK. Refer to the following manual for details.  $\square \Sigma$ -7-Series  $\Sigma$ -7S/ $\Sigma$ -7W/ $\Sigma$ -7C SERVOPACK Safety Precautions (Manual No.:TOMP C710828 00)

4.3.5 Wiring Regenerative Resistors

## 4.3.5 Wiring Regenerative Resistors

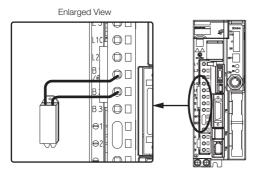
This section describes how to connect External Regenerative Resistors.

Refer to the following manual to select the capacity of a Regenerative Resistor.  $\square \Sigma$ -7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)



### **Connecting Regenerative Resistors**

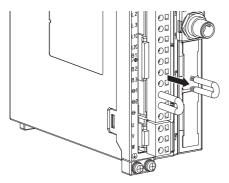
- SERVOPACK Models SGD7S-R70A, -R90A, -1R6A, -2R8A, -R70F, -R90F, -2R1F, and -2R8F
- 1. Connect the External Regenerative Resistor between the B1/⊕ and B2 terminals on the SERVOPACK.



2. Set Pn600 (Regenerative Resistor Capacity) and Pn603 (Regenerative Resistor Resistance).

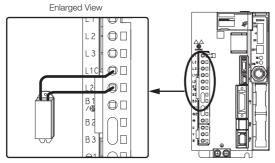
Refer to the following section for details on the settings. 5.17 Setting the Regenerative Resistor Capacity on page 5-53

- SERVOPACK Models SGD7S-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, and -330A
- 1. Remove the lead from between the B2 and B3 terminals on the SERVOPACK.

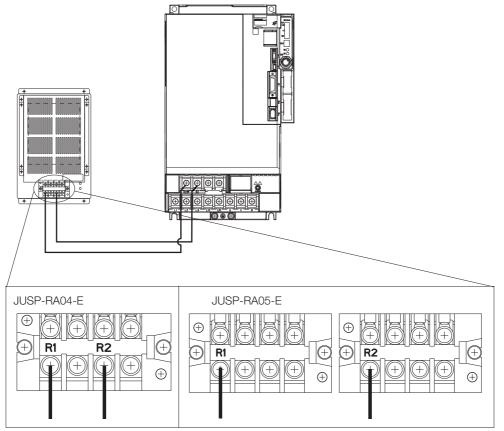


#### 4.3.5 Wiring Regenerative Resistors

2. Connect the External Regenerative Resistor between the B1/ $\oplus$  and B2 terminals.



- Set Pn600 (Regenerative Resistor Capacity) and Pn603 (Regenerative Resistor Resistance). Refer to the following section for details on the settings.
   5.17 Setting the Regenerative Resistor Capacity on page 5-53
- ◆ SERVOPACK Models SGD7S-470A, -550A, -590A, and -780A
- 1. Connect the R1 and R2 terminals on the Regenerative Resistor Unit to the B1/⊕ and B2 terminals on the SERVOPACK.



## 2. Set Pn600 (Regenerative Resistor Capacity) and Pn603 (Regenerative Resistor Resistance) as required.

- When using the Yaskawa-recommended Regenerative Resistor Unit, use the default settings for Pn600 and Pn603.
- If you use any other external regenerative resistor, set Pn600 and Pn603 according to the specifications of the regenerative resistor.

Refer to the following section for details on the settings.

5.17 Setting the Regenerative Resistor Capacity on page 5-53

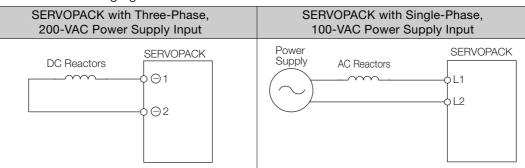
4.3.6 Wiring Reactors for Harmonic Suppression

### 4.3.6 Wiring Reactors for Harmonic Suppression

You can connect a reactor for harmonic suppression to the SERVOPACK when power supply harmonic suppression is required. Refer to the following manual for details on reactors for harmonic suppression.

Ω Σ-7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)

Refer to the following figures to connect reactors.



Note: 1. Connection terminals  $\ominus$  1 and  $\ominus$  2 for a DC Reactor are connected when the SERVOPACK is shipped. Remove the lead wire and connect a DC Reactor.

- 2. Reactors are optional products. (Purchase them separately.)
- 3. You cannot connect a DC Reactor to a SERVOPACK with a single-phase, 100-VAC power supply input.

4.4.1 Terminal Symbols and Terminal Names

## 4.4 Wiring Servomotors

## 4.4.1 Terminal Symbols and Terminal Names

The SERVOPACK terminals or connectors that are required to connect the SERVOPACK to a Servomotor are given below.

| Terminal/Connector<br>Symbols | Terminal/Connector Name | Remarks                                                                                                                           |
|-------------------------------|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| U, V, and W                   | Servomotor terminals    | Refer to the following section for the wiring procedure.<br><i>4.3.2 Wiring Procedure for Main Circuit Connector</i> on page 4-14 |
|                               | Ground terminal         | -                                                                                                                                 |
| CN2                           | Encoder connector       | -                                                                                                                                 |

### 4.4.2 Pin Arrangement of Encoder Connector (CN2)

| Pin No. | Signal   | Function                         |
|---------|----------|----------------------------------|
| 1       | PG5V     | Encoder power supply +5 V        |
| 2       | PG0V     | Encoder power supply 0 V         |
| 3       | BAT (+)* | Battery for absolute encoder (+) |
| 4       | BAT (-)* | Battery for absolute encoder (-) |
| 5       | PS       | Serial data (+)                  |
| 6       | /PS      | Serial data (-)                  |
| Shell   | Shield   | -                                |

• When Using a Rotary Servomotor

\* No wiring is required for an incremental encoder or a batteryless absolute encoder.

#### · When Using a Direct Drive Servomotor

| Pin No. | Signal | Function                  |
|---------|--------|---------------------------|
| 1       | PG5V   | Encoder power supply +5 V |
| 2       | PG0V   | Encoder power supply 0 V  |
| 3       | -      | – (Do not use.)           |
| 4       | -      | – (Do not use.)           |
| 5       | PS     | Serial data (+)           |
| 6       | /PS    | Serial data (-)           |
| Shell   | Shield | -                         |

· When Using a Linear Servomotor

| Pin No. | Signal | Function                         |
|---------|--------|----------------------------------|
| 1       | PG5V   | Linear encoder power supply +5 V |
| 2       | PG0V   | Linear encoder power supply 0 V  |
| 3       | -      | – (Do not use.)                  |
| 4       | -      | – (Do not use.)                  |
| 5       | PS     | Serial data (+)                  |
| 6       | /PS    | Serial data (-)                  |
| Shell   | Shield | -                                |

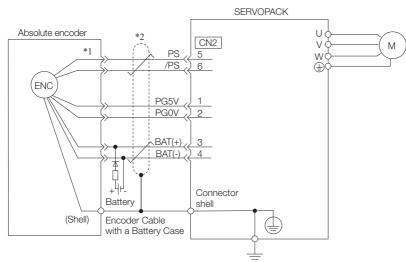
## 4.4.3 Wiring the SERVOPACK to the Encoder

#### When Using an Absolute Encoder

If you use an absolute encoder, use an Encoder Cable with a JUSP-BA01-E Battery Case or install a battery on the host controller.

Refer to the following section for the battery replacement procedure. *14.1.3 Replacing the Battery* on page 14-3

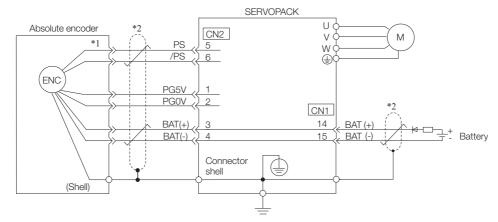
#### • Wiring Example When Using an Encoder Cable with a Battery Case



\*1. The absolute encoder pin numbers for wiring the connector depend on the Servomotor that you use.

· Wiring Example When Installing a Battery on the Host Controller

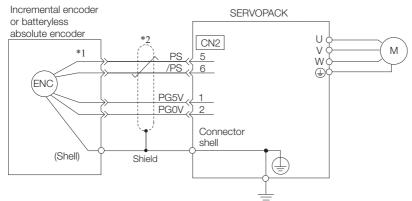
\*2. represents a shielded twisted-pair cable.



- \*1. The absolute encoder pin numbers for wiring the connector depend on the Servomotor that you use.
- \*2. represents a shielded twisted-pair cable.

| Important ( | When Installing a Battery on the Encoder Cable<br>Use the Encoder Cable with a Battery Case that is specified by Yaskawa.<br>Refer to the following manual for details.<br>$\square \Sigma$ -7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)<br>When Installing a Battery on the Host Controller<br>Insert a diode near the battery to prevent reverse current flow. |                                                                                                                                                                                                                 |                                                                                                |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
|             |                                                                                                                                                                                                                                                                                                                                                                                                | Required Component Specifications<br>• Schottky Diode<br>Reverse Voltage: $Vr \ge 40 V$<br>Forward Voltage: $Vf \le 0.37 V$<br>Reverse current: $Ir \le 5 \mu A$<br>Junction temperature: $Tj \ge 125^{\circ}C$ | • Resistor<br>Resistance: 22 $\Omega$<br>Tolerance: $\pm 5\%$ max.<br>Rated power: 0.25 W min. |

# When Using an Incremental Encoder or Batteryless Absolute Encoder



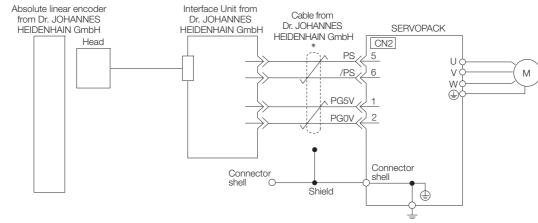
- \*1. The encoder pin numbers for wiring the connector depend on the Servomotor that you use.
- \*2. \_\_\_\_\_ represents a shielded twisted-pair cable.

#### When Using an Absolute Linear Encoder

The wiring depends on the manufacturer of the linear encoder.

#### Connections to Linear Encoder from Dr. JOHANNES HEIDENHAIN GmbH

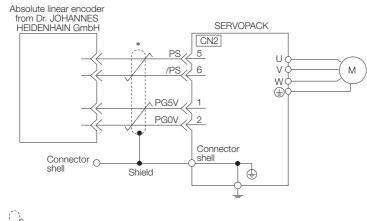
■ LIC4100 Series, LIC2100 Series, LC115, and LC415



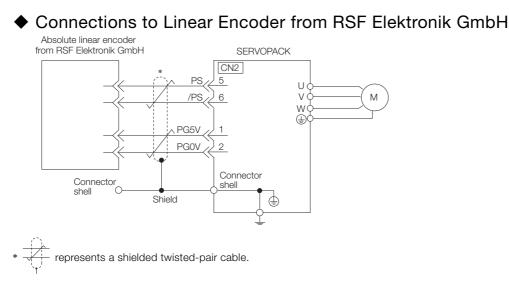
represents a shielded twisted-pair cable.

Information Sales of the interface unit EIB3391Y with the LIC4100 and LIC2100 series have ended due to the release of the LIC4190, LIC3190, and LIC2190 series.

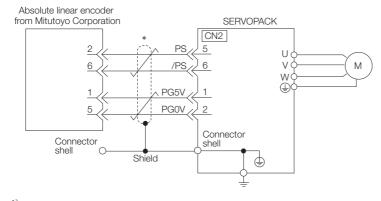
#### ■ LIC4190, LIC3190, and LIC2190 Series



represents a shielded twisted-pair cable.

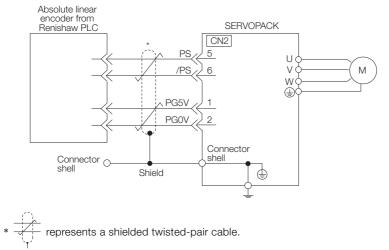


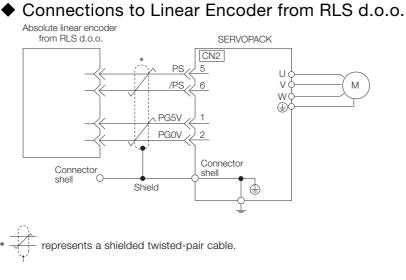
#### Connections to Linear Encoder from Mitutoyo Corporation



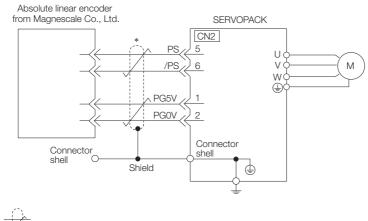
\*  $\overrightarrow{|}_{r}$  represents a shielded twisted-pair cable.

#### Connections to Absolute Linear Encoder from Renishaw PLC



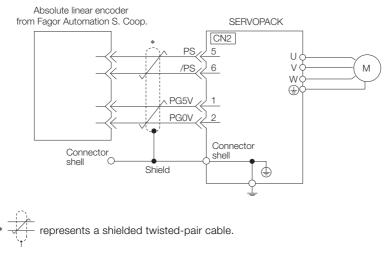


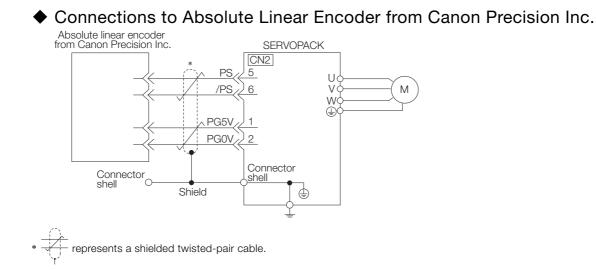
#### Connections to Absolute Linear Encoder from Magnescale Co., Ltd.



represents a shielded twisted-pair cable.

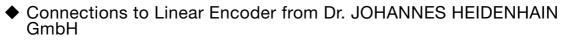
#### Connections to Absolute Linear Encoder from Fagor Automation S. Coop.

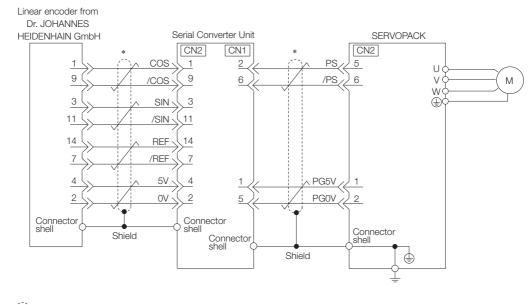




#### When Using an Incremental Linear Encoder

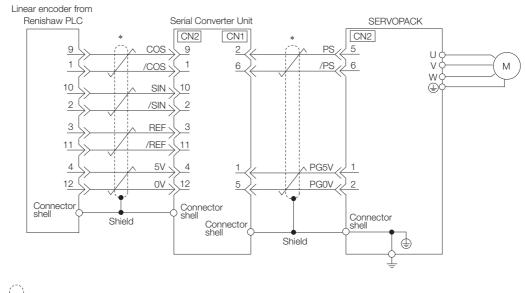
The wiring depends on the manufacturer of the linear encoder.





represents a shielded twisted-pair cable.

#### Connections to Linear Encoder from Renishaw PLC

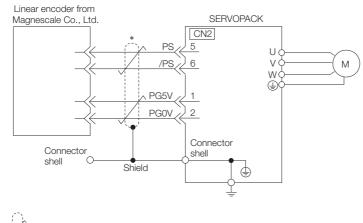


\* represents a shielded twisted-pair cable.

#### ◆ Connections to Linear Encoder from Magnescale Co., Ltd.

If you use a linear encoder from Magnescale Co., Ltd., the wiring will depend on the model of the linear encoder.

#### ■ SR75 and SR85

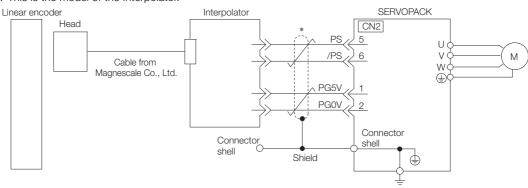


\* represents a shielded twisted-pair cable.

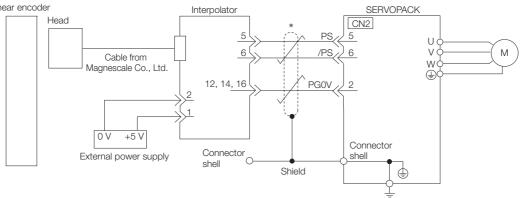
- SL700, SL710, SL720, SL730, and SQ10
- PL101-RY, MQ10-FLA, or MQ10-GLA Interpolator The following table gives the Linear Encoder and Interpolator combinations.

| Linear Encoder Model           | Interpolator Model |
|--------------------------------|--------------------|
| SL700, SL710, SL720, and SL730 | PL101-RY*1         |
| SQ10                           | MQ10-FLA*2         |
|                                | MQ10-GLA*2         |

- \*1. This is the model of the Head with Interpolator.
- \*2. This is the model of the Interpolator.

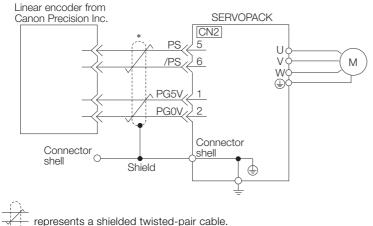


- \* represents a shielded twisted-pair cable.
- SL700, SL710, SL720, and SL730
- MJ620-T13 Interpolator
   Linear encoder



represents a shielded twisted-pair cable.

Connections to Linear Encoder from Canon Precision Inc.

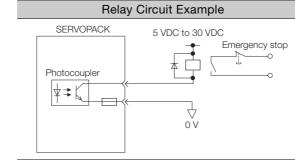


4.4.4 Wiring the SERVOPACK to the Holding Brake

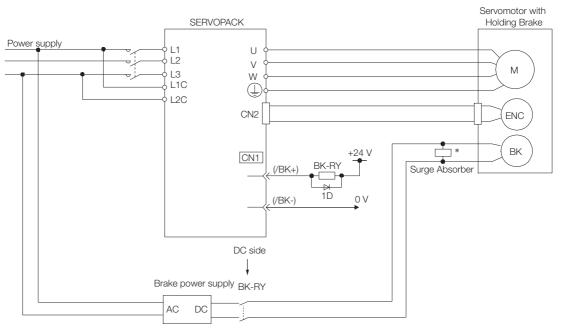
## 4.4.4 Wiring the SERVOPACK to the Holding Brake

 If you use a Rotary Servomotor, select a Surge Absorber according to the brake current and brake power supply. Refer to the following manual for details.
 Σ-7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)

 After the Surge Absorber is connected, check the brake operation delay time in your application. The Surge Absorber may affect the brake operation delay time. Configure the relay circuit to activate the holding brake for an emergency stop.



 If you use a 24-V brake, install a separate power supply for the 24-VDC power supply from other power supplies, such as the one for the I/O signals of the CN1 connector. If the power supply is shared, the I/O signals may malfunction.



BK-RY: Brake control relay 1D: Flywheel diode

\* Install the surge absorber near the brake terminals on the Servomotor.

4.5.1 I/O Signal Connector (CN1) Names and Functions

## 4.5 I/O Signal Connections

## 4.5.1 I/O Signal Connector (CN1) Names and Functions

The following table gives the pin numbers, names, and functions of the I/O signal pins.



You cannot change the pin allocations for the I/O signals on CN1.

| Signal | Pin No. | Name                                        | Function                                                                                                                                       | Reference |
|--------|---------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CCW-OT | 8       | CCW Drive Prohibit<br>Input                 | Stops Servomotor drive (to prevent overtravel) when the movable part of the machine exceeds                                                    | page 5-28 |
| CW-OT  | 9       | CW Drive Prohibit Input                     | the range of movement.                                                                                                                         |           |
| /HOME  | 11      | Origin Signal Input                         | Connects the deceleration limit switch for origin return.                                                                                      | page 12-3 |
| EXSTOP | 12      | External Stop Input                         | Stops Servomotor drive immediately and turns OFF the servo in the SERVOPACK.                                                                   | page 6-34 |
| +24VIN | 6       | Sequence Input Signal<br>Power Supply Input | Inputs the sequence input signal power supply.<br>Allowable voltage range: 24 VDC ±20% The 24-<br>VDC power supply is not provided by Yaskawa. | _         |
| BAT+   | 14      | Battery for Absolute<br>Encoder (+)         | These are the pins to connect the absolute encoder backup battery.                                                                             |           |
| BAT-   | 15      | Battery for Absolute<br>Encoder (-)         | Do not connect these pins if you use the Encoder Cable with a Battery Case.                                                                    |           |
| ТН     | 5       | Overheat Protection<br>Input                | Inputs the overheat protection signal from a Lin-<br>ear Servomotor or from a sensor attached to<br>the machine.                               | page 6-35 |

#### **Input Signals**

Note: If forward drive prohibition or reverse drive prohibition is used, the SERVOPACK is stopped by software controls. If the application does not satisfy the safety requirements, add external safety circuits as required.

## **Output Signals**

| Signal  | Pin No. | Name                  | Function                                                                                                 | Reference              |
|---------|---------|-----------------------|----------------------------------------------------------------------------------------------------------|------------------------|
| ALM+    | 3       | Servo Alarm Output    | Turns OFF (opens) when an error is detected.                                                             | page 6-3               |
| ALM-    | 4       |                       | Turns Off (opens) when an error is detected.                                                             |                        |
| /BK+    | 1       | Brake Output          | Controls the brake. The brake is opened when                                                             | page 5-31              |
| /BK-    | 2       | Diake Output          | the signal turns ON (closes).                                                                            |                        |
| /WARN+  | 23      | Warning Output        | It remains ON continuously while a warning is                                                            | page 6-3               |
| /WARN-  | 24      | Warning Output        | being detected.                                                                                          | page 6-3               |
| /S-RDY+ | 25      | Servo Ready Output    | This output is ON (closed) when the control power supply and main circuit power supply are               | page 6-4               |
| /S-RDY- | 26      | Servo heady Output    | ON and a servo alarm has not occurred.                                                                   |                        |
| PAO     | 17      | Encoder Divided Pulse |                                                                                                          | page 6-18<br>page 6-23 |
| /PAO    | 18      | Output, Phase A       | Output the encoder divided pulse output signals with a 90° phase differential.                           |                        |
| PBO     | 19      | Encoder Divided Pulse |                                                                                                          |                        |
| /PBO    | 20      | Output, Phase B       |                                                                                                          |                        |
| PCO     | 21      | Encoder Divided Pulse | Outputs the origin signal once every encoder                                                             |                        |
| /PCO    | 22      | Output, Phase C       | rotation.                                                                                                |                        |
| SG      | 16      | Signal ground         | This is the 0-V signal for the control circuits.                                                         | -                      |
| FG      | Shell   | Frame ground          | Connected to the frame ground if the shield of the I/O Signal Cable is connected to the connector shell. | -                      |

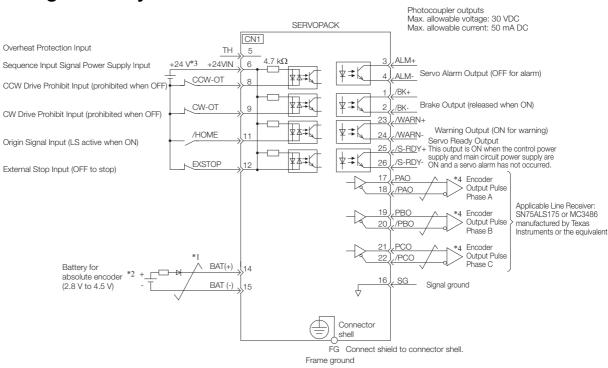
4.5.2 I/O Signal Connector (CN1) Pin Arrangement

### 4.5.2 I/O Signal Connector (CN1) Pin Arrangement

Battery for Brake /BK+ BAT+ Absolute Output Battery for Encoder (+) Brake Pin 2 /BK-15 BAT-Absolute Output Servo Encoder (-) Signal Pin 14 3 ALM+ Alarm 16 SG Ground Pin 2 Encoder Output Servo Output PAO Pin 15 4 ALM-Alarm 17 Encoder Pulse Overheat Output Output Phase A 5 TH Protection 18 /PAO Pulse Pin 12 Sequence Input Phase A Encoder Input Sig-Pin 25 ā Output Pulse 6 +24VIN nal Power 19 PBO Encoder Pin Supply Pin 26 Not Phase B Output 7 20 /PBO Input Pulse used The above view is Phase B CCW Encoder from the direction Drive Output 8 CCW-OT 21 PCO CW Encoder of the following Prohibit Pulse Drive Output Phase C arrow without the Input CW-OT 22 /PCO 9 Prohibit Pulse connector shell Phase C Input Not Waring 10 23 /WARN+ attached. used Output Origin Waring /WARN-/HOMF 24 11 Signal External Stop Output Servo Input 12 EXSTOP 25 /S-RDY+ Ready Servo Output Input Not 13 26 /S-RDY-Ready used Output

The following figure gives the pin arrangement of the I/O signal connector (CN1).

## 4.5.3 I/O Signal Wiring Examples

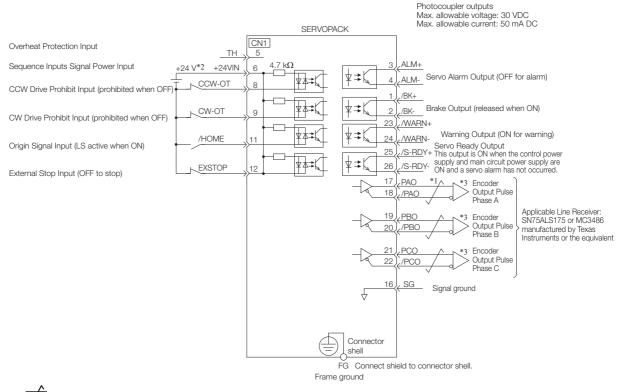


Using a Rotary Servomotor

- \*1.  $\checkmark$  represents twisted-pair wires.
- \*2. Connect these when using an absolute encoder. If the Encoder Cable with a Battery Case is connected, do not connect a backup battery.
- \*3. The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.
- \*4. Always use line receivers to receive the output signals.
- Note: If you use a 24-V brake, install a separate power supply for the 24-VDC power supply from other power supplies, such as the one for the I/O signals of the CN1 connector.
  - If the power supply is shared, the I/O signals may malfunction.

4.5.3 I/O Signal Wiring Examples

### Using a Linear Servomotor



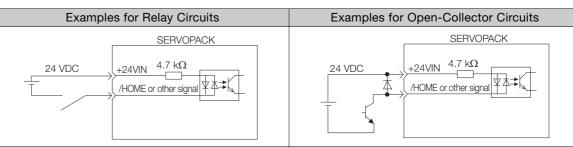
- \*1. represents twisted-pair wires.
- \*2. The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.
- \*3. Always use line receivers to receive the output signals.
- Note: If you use a 24-V brake, install a separate power supply for the 24-VDC power supply from other power supplies, such as the one for the I/O signals of the CN1 connector. If the power supply is shared, the I/O signals may malfunction.

## 4.5.4 I/O Circuits

#### **Sequence Input Circuits**

#### Photocoupler Input Circuits

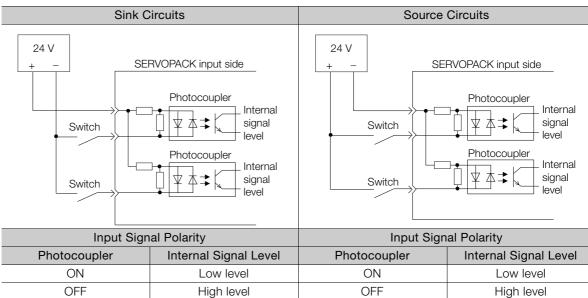
This section describes CN1 connector terminals 6 to 13.



Note: The 24-VDC external power supply capacity must be 50 mA minimum.

The SERVOPACK input circuits use bidirectional photocouplers. Select either a sink circuit or source circuit according to the specifications required by the machine.

Note: The connection examples in 4.5.3 I/O Signal Wiring Examples on page 4-37 are for sink circuit connections.



 $\odot$ 

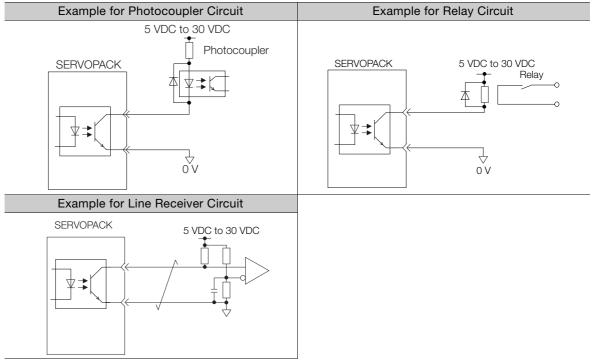
### **Sequence Output Circuits**

Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures.

If a short-circuit failure occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident that may result in death or injury.

#### Photocoupler Output Circuits

Photocoupler output circuits are used for the ALM (Servo Alarm), /S-RDY (Servo Ready), and other sequence output signals. Connect an open-collector output circuit to a photocoupler, relay, or line-receiver circuit.



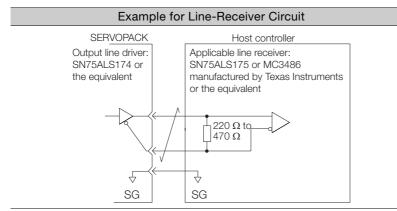
Note: The maximum allowable voltage and current range for photocoupler output circuits are as follows:

Maximum allowable voltage: 30 VDC
Current range: 5 mA to 50 mA DC

#### Line-Driver Output Circuits

This section describes CN1 connector terminals 17-18 (Phase-A Signal), 19-20 (Phase-B Signal), and 21-22 (Phase-C Signal).

The serial data from the encoder is converted to two-phase (phases A and B) pulses. The resulting output signals (PAO, /PAO and PBO, /PBO), origin pulse signal (PCO and /PCO), and the absolute encoder position output signals (PSO and /PSO) are output with line-driver output circuits. Connect the line-driver output circuits to line-receiver circuits at the host controller.



4.6.1 Pin Arrangement of Safety Function Signals (CN8)

## 4.6 Connecting Safety Function Signals

This section describes the wiring required to use a safety function. Refer to the following chapter for details on the safety function. *Chapter 11 Safety Functions* 

## 4.6.1 Pin Arrangement of Safety Function Signals (CN8)

| Pin No. | Signal  | Name                                    | Function                                                                    |  |
|---------|---------|-----------------------------------------|-----------------------------------------------------------------------------|--|
| 1       | -       | (Do not use these pips because they     | are connected to internal circuits.)                                        |  |
| 2       | -       | - (Do not use these pins because they a |                                                                             |  |
| 3       | /HWBB1- | Hard Wire Base Block Input 1            |                                                                             |  |
| 4       | /HWBB1+ | Tard Wire base block input T            | For a hard wire base block input. The                                       |  |
| 5       | /HWBB2- | Hard Wire Base Block Input 2            | base block (motor power turned OFF)<br>is in effect when the signal is OFF. |  |
| 6       | /HWBB2+ | Tard Wire base block input 2            | 5                                                                           |  |
| 7       | EDM1-   | External Device Monitor Output          | Turns ON when the /HWBB1 and the HWBB2 signals are input and the SEF        |  |
| 8       | EDM1+   |                                         | VOPACK enters a base block state.                                           |  |

### 4.6.2 I/O Circuits

Important

For safety function signal connections, the input signal is the 0-V common and the output signal is a source output. This is opposite to other signals described in this manual.

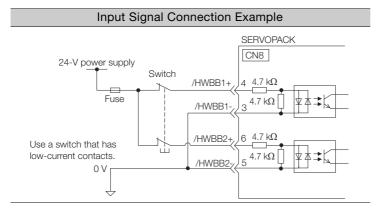
To avoid confusion, the ON and OFF status of signals for the safety function are defined as follows:

ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.

OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.

### Safety Input Circuits

Use a 0-V common to connect the safety function signals. You must connect redundant input signals.



#### 4.6.2 I/O Circuits

#### Input (HWBB) Signal Specifications

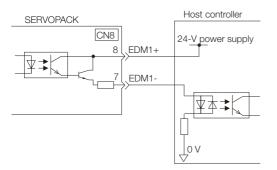
| Туре   | Signal | Connector<br>Pin No. | Status      | Meaning                                              |
|--------|--------|----------------------|-------------|------------------------------------------------------|
|        | /HWBB1 | CN8-4<br>CN8-3       | ON (closed) | Does not activate the HWBB (normal operation).       |
| Inputs |        |                      | OFF (open)  | Activates the HWBB (motor current shut-OFF request). |
| inputs | /HWBB2 | CN8-6<br>CN8-5       | ON (closed) | Does not activate the HWBB (normal operation).       |
|        |        |                      | OFF (open)  | Activates the HWBB (motor current shut-OFF request). |

The input (HWBB) signals have the following electrical characteristics.

| Item                    | Characteristics | Remarks                                                                 |
|-------------------------|-----------------|-------------------------------------------------------------------------|
| Internal Impedance      | 4.7 kΩ          | -                                                                       |
| Operating Voltage Range | +24 V ±20%      | -                                                                       |
| Maximum Delay Time      | 8 ms            | Time from /HWBB1 and /HWBB2 signals turning OFF until HWBB is activated |

#### **Diagnostic Output Circuits**

The EDM1 output signal uses a source circuit. The following figure shows a connection example.



## EDM1 Output Signal Specifications

| Туре   | Signal | Pin No.        | Output<br>Status | Meaning                                                          |
|--------|--------|----------------|------------------|------------------------------------------------------------------|
| Output | EDM1   | CN8-8<br>CN8-7 | ON               | Both the /HWBB1 and /HWBB2 signals are operat-<br>ing normally.  |
|        |        |                | OFF              | The /HWBB1 signal, the /HWBB2 signal, or both are not operating. |

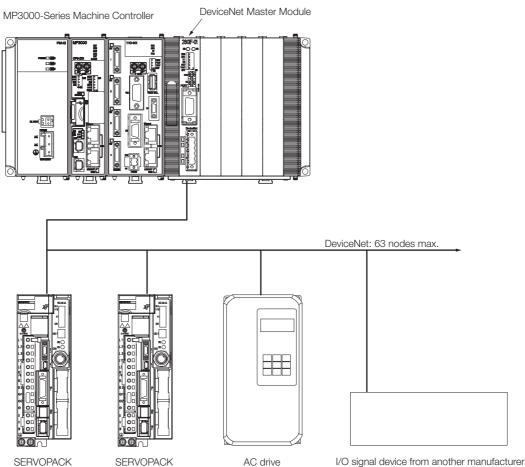
The electrical characteristics of the EDM1 signal are as follows:

| Item                      | Characteristics | Remarks                                                       |
|---------------------------|-----------------|---------------------------------------------------------------|
| Maximum Allowable Voltage | 30 VDC          | -                                                             |
| Maximum Allowable Current | 50 mA DC        | -                                                             |
| Maximum ON Voltage Drop   | 1.0 V           | Voltage between EDM1+ and EDM1- when current is 50 mA         |
| Maximum Delay Time        | 8 ms            | Time from a change in /HWBB1 or /HWBB2 until a change in EDM1 |

## 4.7 DeviceNet System Configuration

# 4.7.1 System Configuration Example for DeviceNet Communications

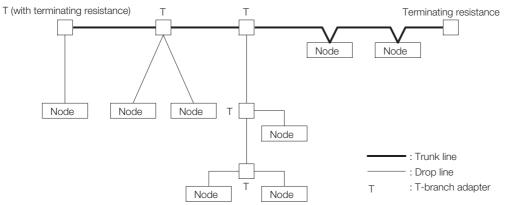
A system configuration example for DeviceNet communications is provided below. A maximum of 63 slave devices, such as SERVOPACKs, can be connected to one host controller (DeviceNet master).



4.7.2 Connection Examples for DeviceNet Communications Cable

#### 4.7.2 Connection Examples for DeviceNet Communications Cable

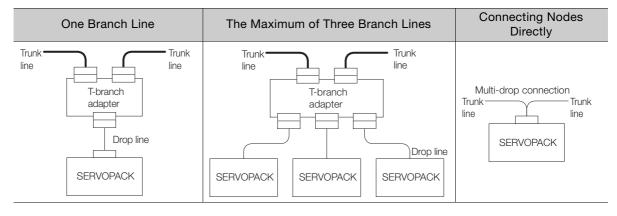
The following diagram shows an example of the connections between the host controller and the DeviceNet communications connector (CN6) on the SERVOPACK.



| Nodes                       | A node is either a slave that connects to a SERVOPACK, a similar device, or the mas-<br>ter that manages the slaves. No restrictions are placed on the locations of the master<br>or slaves. Any node can be the master or a slave.                                                                                                                           |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Trunk line and drop lines   | The cable with terminating resistance on each end is the trunk line. Any cable that branches from the trunk line is a drop line.                                                                                                                                                                                                                              |
| Connection<br>methods       | A node is connected with one of two methods: a T-branch connection or a multi-drop connection. With a T-branch connection, a T-branch adapter is used to connect the node. With a multi-drop connection, a node is connected directly to the trunk line or a drop line.<br>Both T-branch and multi-drop connections can be used together in the same network. |
| Terminating resistance      | You must connect both ends of the trunk line to terminating resistance to decrease signal reflection and ensure stable network communications.                                                                                                                                                                                                                |
| Communications power supply | You must provide power to the communications connector at each node from the communications power supply with a communications cable for DeviceNet communications.                                                                                                                                                                                            |

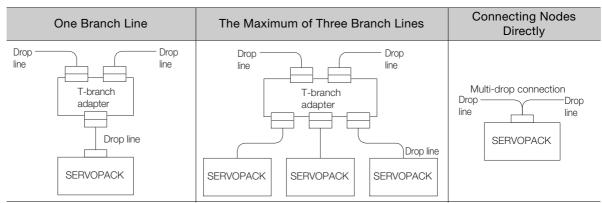
### Branching from the Trunk Line

There are three methods that you can use to branch from the trunk line.



## Branching from a Drop Line

There are three methods that you can use to branch from a drop line.

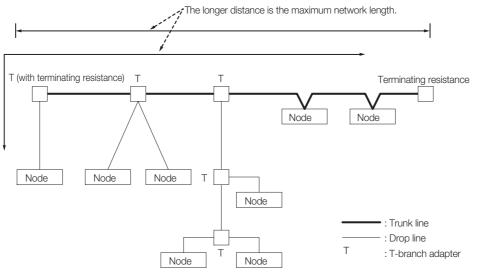


#### 4.7.3 Precautions for Connecting DeviceNet Communications Cables

Observe the following precautions when you connect the DeviceNet communications cables.

### Maximum Network Length

The maximum network length is either the length of the line between the two nodes located the farthest from each other or the length of the line between the terminating resistance on the ends of the trunk line, whichever is longer.



DeviceNet communications cables are available as either thick cables or thin cables. The following table lists the characteristics of each type of cable.

| Item                    | Cable Type                |                        |  |
|-------------------------|---------------------------|------------------------|--|
| item                    | Thick Cable               | Thin Cable             |  |
| Signal decay            | Small                     | Large                  |  |
| Communications distance | Long                      | Short                  |  |
| Flexibility             | Rigid (difficult to bend) | Pliable (bends easily) |  |

#### 4.7.3 Precautions for Connecting DeviceNet Communications Cables

The maximum network length is determined by the type of cable, as shown in the following table.

| Poud Poto (Khpo) | Maximum Network Length (Unit: m) |            |  |
|------------------|----------------------------------|------------|--|
| Baud Rate (Kbps) | Thick Cable                      | Thin Cable |  |
| 500              | 100                              | 100        |  |
| 250              | 250                              | 100        |  |
| 125              | 500                              | 100        |  |

Information You can use both thick cables and thin cables to connect different nodes in the same network. The maximum network length will be shorter than when only thick cables are used. The cable lengths must meet the following restrictions.

| Baud Rate (Kbps) | Maximum Network Length                              |
|------------------|-----------------------------------------------------|
| 500              | $L_{THICK} + L_{THIN} \le 100 \text{ m}$            |
| 250              | $L_{THICK}$ + 2.5 × $L_{THIN} \le 250$ m            |
| 125              | $L_{THICK} + 5.0 \times L_{THIN} \le 500 \text{ m}$ |
| Noteril          | ongth of thick cable                                |

Note:  $L_{THICK}$ : Length of thick cable  $L_{THIN}$ : Length of thin cable

#### **Drop Line Lengths**

The drop line length is the length of the line from the branch point from the trunk line to the farthest node on the drop line.

The maximum drop line length is 6 m. A drop line can be branched out into other drop lines.

#### **Total Drop Line Length**

The total drop line length is the total length of all of the drop lines.

#### Length Limit

The total drop line length must be within the allowable range, and each drop line must be 6 m or less.

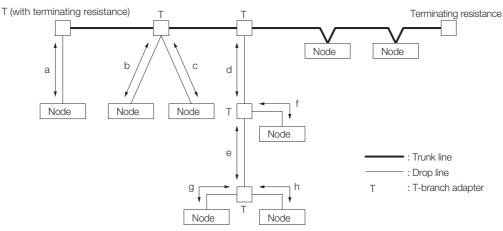
The following table shows the total drop line length, which depends on the baud rate.

| Baud Rate<br>(kbps) | Total Drop Line Length |
|---------------------|------------------------|
| 500                 | 39 m max.              |
| 250                 | 78 m max.              |
| 125                 | 156 m max.             |

#### 4.7.3 Precautions for Connecting DeviceNet Communications Cables

### ◆ Configuration Example

The following diagram shows the suggested configuration if the baud rate is 500 Kbps.



The above example must satisfy the following conditions.

- a ≤ 6 m
- b ≤ 6 m
- c ≤ 6 m
- d ≤ 6 m
- d + f ≤ 6 m
- d + e + g ≤ 6 m
- d + e + h ≤ 6 m

The total drop line length must satisfy the following condition.

• Total drop line length=  $\pm a + b + c + d + e + f + g + h \le 39 \text{ m}$ 

### **Basic Precautions**

Observe the following basic precautions.

- The communications power supply for the DeviceNet network must be 24 VDC.
- The communications power supply must have sufficient capacity to handle the device load.
- The communications power supply must be connected to the trunk line.
- If many nodes are provided with power from a single power supply, the power supply must be placed as close as possible to the middle of the trunk line.
- The allowable current flow in a thick cable is 8 A. The allowable current flow in a thin cable is 3 A.
- The power supply capacity for a drop line depends on the length of the drop line.
- The maximum current capacity of the drop line will become lower as the drop line becomes longer regardless of the thickness of the drop line. To calculate the current (I) that flows to the drop line (i.e., the total current consumption on the drop line), use the following equation: I = 4.57 / L
  - I: Allowable current in amperes, L: Drop length in meters
- If only the communications power supply is turned OFF while the network is operating, errors may occur at the nodes that are communicating at that time.

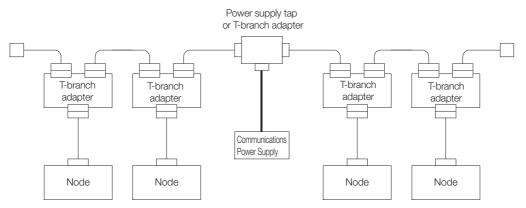
4.7.4 Signal Names and Functions of the DeviceNet Communications Connector (CN6)

### Location of Power Supply

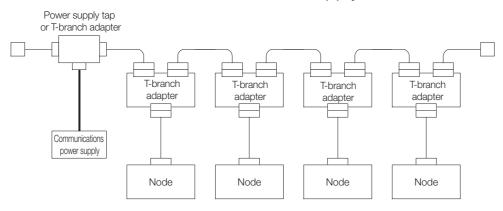
The following two types of configuration are possible for the location of the power supply.

Information We recommend that you place nodes on both sides of the power supply if a single power supply is connected to many nodes.

### Nodes on Both Sides of the Power Supply



### Nodes on One Side of the Power Supply



### 4.7.4 Signal Names and Functions of the DeviceNet Communications Connector (CN6)

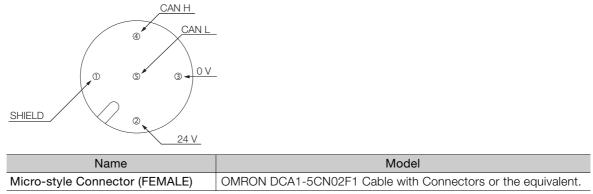
This section gives the signal names, functions, pin arrangement, and connector specifications of the DeviceNet communications connector (CN6).

### I/O Signals

| Signal<br>Name | Pin No. | Name                                   | Function                                                                                                               |
|----------------|---------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------|
| SHIELD         | 1       | Cable shield                           | -                                                                                                                      |
| 24 V           | 2       | Communications power sup-<br>ply +24 V | This pin is used to input the control power supply<br>for DeviceNet communications.<br>Operating range: +11 V to +25 V |
| 0 V            | 3       | Communications power supply 0 V        | _                                                                                                                      |
| CAN H          | 4       | CAN bus line dominant H                | -                                                                                                                      |
| CAN L          | 5       | CAN bus line dominant L                | -                                                                                                                      |

4.7.5 Network Connection Methods

### **Pin Arrangement and Connector**

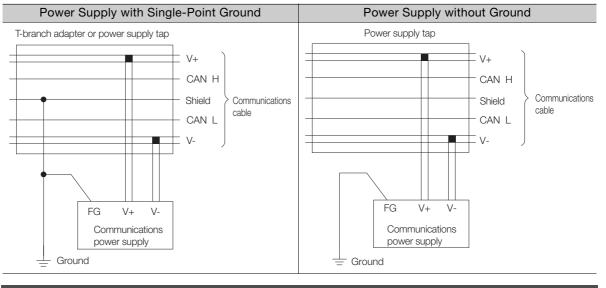


## 4.7.5 Network Connection Methods

Connect the shield wire of the cable to the FG terminal of the communications power supply and ground the shield wire.

If more than one power supply is used for communications, ground only the power supply that is located closest to the middle of the network through the shield wire. Do not ground the power supply through the shield wire at any other point.

If more than one power supply is connected to the network, connect each of them using a power supply tap.



Power supplies are not counted as nodes.
Ground the network to a resistance of 100 Ω or less.
Do not ground the network together with servo drives or AC drives.
Do not ground the network through the shield wire at more than one point. Ground it at a single point only.

4.8.1 Serial Communications Connector (CN3)

## 4.8 Connecting the Other Connectors

### 4.8.1 Serial Communications Connector (CN3)

To use a Digital Operator, connect it to CN3 on the SERVOPACK.

Refer to the following manual for the operating procedures for the Digital Operator.  $\square \Sigma$ -7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)

## 4.8.2 Computer Connector (CN7)

To use the SigmaWin+ Engineering Tool, connect the computer on which the SigmaWin+ is installed to CN7 on the SERVOPACK.

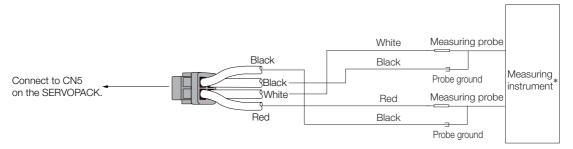


Use the Yaskawa-specified cables. Operation will not be dependable due to low noise resistance with any other cable.

## 4.8.3 Analog Monitor Connector (CN5)

To use an analog monitor, connect CN5 on the SERVOPACK.

• Wiring Example



\* The measuring instrument is not provided by Yaskawa.

Refer to the following section for information on the monitoring methods for an analog monitor. **9.3** Monitoring Machine Operation Status and Signal Waveforms on page 9-7

# Basic Functions That Require Setting before Operation

5

This chapter describes the basic functions that must be set before you start servo system operation. It also describes the setting methods.

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|      | 5.13.1                               | Detection Timing for Overload Warnings (A.910)                                                                                           | .5-38          |
|      | 5.13.2                               | Detection Timing for Overload Alarms (A.720) .                                                                                           |                |
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|      | 5.14.1<br>5.14.2                     | Electronic Gear Ratio Settings<br>Electronic Gear Ratio Setting Examples                                                                 |                |
| 5.15 | Reset                                | ting the Absolute Encoder                                                                                                                | 5-47           |
|      | 5.15.1<br>5.15.2<br>5.15.3<br>5.15.4 | Precautions on Resetting<br>Preparations<br>Applicable Tools<br>Operating Procedure                                                      | .5-47<br>.5-48 |
| 5.16 | Setting                              | g the Origin of the Absolute Encoder                                                                                                     | 5-50           |
|      | 5.16.1<br>5.16.2                     | Absolute Encoder Origin Offset<br>Setting the Origin of the Absolute<br>Linear Encoder                                                   |                |
| 5.17 | Setting                              | g the Regenerative Resistor Capacity                                                                                                     | 5-53           |

5.1.1 Parameter Classification

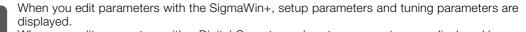
## 5.1 Manipulating Parameters (PnDDD)

This section describes the classifications, notation, and setting methods for the parameters given in this manual.

## 5.1.1 Parameter Classification

There are the following two types of SERVOPACK parameters.

| Classification    | Meaning                                                            |
|-------------------|--------------------------------------------------------------------|
| Setup Parameters  | Parameters for the basic settings that are required for operation. |
| Tuning Parameters | Parameters that are used to adjust servo performance.              |



When you edit parameters with a Digital Operator, only setup parameters are displayed by default. To edit tuning parameters, set Pn00B to n. DDD1 (Display all parameters).

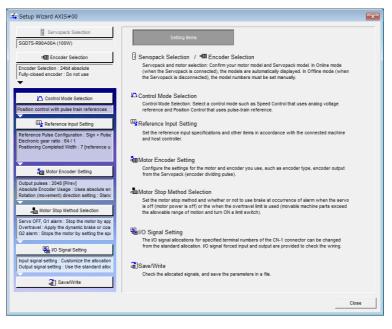
| F     | Parameter                   | Meaning                        | When Enabled  | Classification |  |
|-------|-----------------------------|--------------------------------|---------------|----------------|--|
| Pn00B | n.□□□0<br>(default setting) | Display only setup parameters. | After restart | Setup          |  |
| THEED | n.0001                      | Display all parameters.        |               |                |  |

The setting method for each type of parameter is described below.

### **Setup Parameters**

You can use the Digital Operator, or SigmaWin+ to set the setup parameters individually.

Information We recommend that you use the Setup Wizard of the SigmaWin+ to easily set the required setup parameters by setting the operating methods, machine specifications, and I/O signals according to on-screen Wizard instructions.



5.1.2 Notation for Parameters

### **Tuning Parameters**

Normally the user does not need to set the tuning parameters individually.

Use the various SigmaWin+ tuning functions to set the related tuning parameters to increase the response even further for the conditions of your machine. Refer to the following sections for details.

3.6 Autotuning without Host Reference on page 8-23

8.7 Autotuning with a Host Reference on page 8-34

🕼 8.8 Custom Tuning on page 8-42

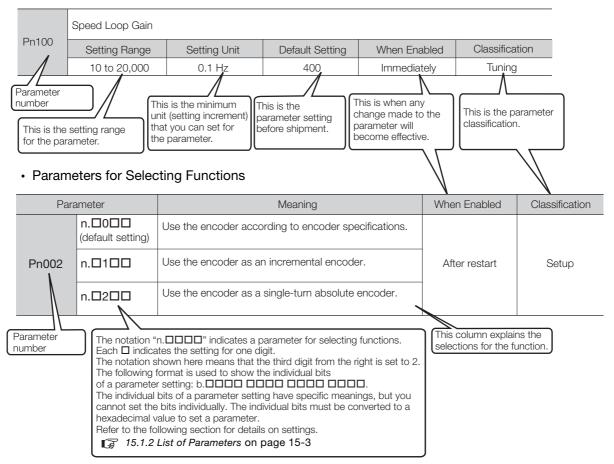
You can also set the tuning parameters individually to make adjustments. Refer to the following section for details.

3.13 Manual Tuning on page 8-79

### 5.1.2 Notation for Parameters

There are two types of notation used for parameters that depend on whether the parameter requires a numeric setting (parameter for numeric setting) or requires the selection of a function (parameter for selecting a function).

#### · Parameters for Numeric Settings



## 5.1.3 Parameter Setting Methods

You can use the SigmaWin+ or a Digital Operator to set parameters. Use the following procedure to set the parameters.

### Setting Parameters with the SigmaWin+



- 1. Click the 🧾 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Edit Parameters in the Menu Dialog Box. The Parameter Editing Dialog Box will be displayed.
- 3. Click the cell of the parameter to edit.

If the parameter to edit is not displayed in the Parameter Editing Dialog Box, click the 🔺 or 💌 Button to display the parameter to edit.

| *                                                    |                                                                                                        |                      | YASKAWA SigmaWin+ Ver                   | .7       |                             |                      |                  |         | - 0        |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------------|----------------------|-----------------------------------------|----------|-----------------------------|----------------------|------------------|---------|------------|
|                                                      | Edit Parameters                                                                                        | _                    |                                         |          |                             |                      |                  |         | <b>-</b> 9 |
|                                                      | Category                                                                                               | SERVOPACK            |                                         |          |                             |                      |                  |         |            |
| 001-5GD75<br>-RSGA0DA<br>H66 P-OT<br>POWER ESTP N-OT | All constant number<br>Function Selection(Pn0xx-)<br>Gain(Pn1xx-)<br>Position(Pn2xx-)<br>Speed(Pn3xx-) | Edited<br>Parameters | All Edited All<br>Parameters Parameters | Import E | <ul> <li>Project</li> </ul> | Read from<br>Project | nitialize Compar | List    |            |
| ESTP HOT                                             | Torque(Pn4xx-)                                                                                         | Read from            | Servo Write to Servo                    | File     | Projec                      | at                   | Function         | Display |            |
|                                                      | Sequence(Pn5ixx-)<br>I/O Sign                                                                          | No.                  | Name                                    | Unit     | 001-SGD7S-R90<br>Axis A     |                      |                  |         |            |
|                                                      | Display Settings                                                                                       | Pn000.0              | Direction Selection                     | -        | 0 : Use CCW as t…           |                      |                  |         |            |
|                                                      | Hierarchy:                                                                                             | Pn000.1              | Control Method Selection                | -        | 1 : Position contr···       |                      |                  |         |            |
|                                                      | Descriptions:                                                                                          | Pn000.2              | Reserved parameter (Do not chang        | -        | 0 : Reserved para…          |                      |                  |         |            |
|                                                      |                                                                                                        | Pn000.3              | Rotary/Linear Startup Selection Wh      | -        | 0 : Start as a rota…        |                      |                  |         |            |
|                                                      |                                                                                                        | Pn001.0              | Servo OFF or Alarm Group 1 Stoppi       | -        | 0 : Stop the moto           |                      |                  |         |            |
|                                                      |                                                                                                        | Pn001.1              | Overtravel Stopping Method              | -        | 0 : Apply the dyn…          |                      |                  |         |            |
|                                                      |                                                                                                        | Pn001.2              | Main Circuit Power Supply AC/DC In      | -        | 0 : Input AC pow…           |                      |                  |         |            |
|                                                      |                                                                                                        | Pn001.3              | Warning Code Output Selection           | -        | 0 : Output only al          |                      |                  |         |            |
|                                                      |                                                                                                        | Pn002.0              | Speed/Position Control Option (T-R      | -        | 0 : Do not use T-···        |                      |                  |         |            |
|                                                      |                                                                                                        | Pn002.1              | Torque Control Option (V-REF Input      | -        | 0 : Do not use V-···        |                      |                  |         |            |
|                                                      |                                                                                                        | Pn002.2              | Absolute Encoder Usage                  | -        | 2 : Uses absolute…          |                      |                  |         |            |
|                                                      |                                                                                                        | Pn002.3              | External Encoder Usage                  | -        | 0 : Do not use an…          |                      |                  |         |            |
|                                                      |                                                                                                        | Pn006.0-1            | Analog Monitor 1 Signal Selection       | -        | 02 : Torque refer…          |                      |                  |         |            |
|                                                      |                                                                                                        | Pn006.2              | Reserved parameter (Do not chang        | -        | 0 : Reserved para           |                      |                  |         |            |
|                                                      |                                                                                                        | Pn006.3              | Reserved parameter (Do not chang        | -        | 0 : Reserved para…          |                      |                  |         |            |
|                                                      |                                                                                                        | Pn007.0-1            | Analog Monitor 2 Signal Selection       | -        | 00 : Motor speed…           |                      |                  |         |            |
|                                                      |                                                                                                        | Pn007.2              | Reserved parameter (Do not chang        | -        | 0 : Reserved para           |                      |                  |         |            |
|                                                      |                                                                                                        | Pn007.3              | Reserved parameter (Do not chang        | -        | 0 : Reserved para…          |                      |                  |         |            |
|                                                      |                                                                                                        | Pn008.0              | Low Battery Voltage Alarm/Warning       | -        | 0 : Output alarm…           |                      |                  |         |            |
|                                                      |                                                                                                        | Pn008.1              | Function Selection for Undervoltage     | -        | 0 : Do not detect…          |                      |                  |         |            |
|                                                      |                                                                                                        | Pn008.2              | Warning Detection Selection             | -        | 0 : Detect warnin…          |                      |                  |         |            |
|                                                      |                                                                                                        | Pn008.3              | Reserved parameter (Do not chang        | -        | 0 : Reserved para…          |                      |                  |         |            |
| - <mark>12</mark>                                    |                                                                                                        | Pn009.0              | Reserved parameter (Do not chang        | -        | 0 : Reserved para…          |                      |                  |         |            |

### 4. Change the setting of the parameter.

Information 1. For a parameter for a numeric setting, input the numeric setting.

If the parameter requires selection of a function, select the function from the list of selections.

### 5. Press the Enter Key.

The background of the edited parameter cell will change to green.

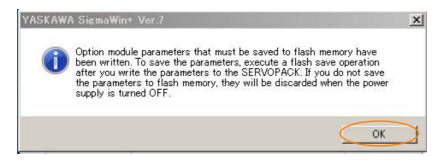
#### 5.1.3 Parameter Setting Methods

|                                                      | Edit Parameters                                                                                                        |                                   |                                      |                |                        |                    |                                         | <b>-</b> 0 |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------------------------------------|----------------|------------------------|--------------------|-----------------------------------------|------------|
| 1 🚟 🐃                                                | Category                                                                                                               | SERVOPAC                          | < _                                  |                |                        |                    |                                         |            |
| 001-50075<br>-R90A00A<br>HBB P-0T<br>POWEX ESTP N-0T | All constant number<br>Function Selection(Pn0xx-)<br>Gain(Pn1xx-)<br>Position(Pn2xx-)<br>Speed(Pn3xx-)<br>Termo(Pn2xi) | Edited<br>Parameters<br>Read from | All Edited All Parameters Parameters | import<br>File | Export Project         | Initialize Compare | Remove<br>Servo from<br>List<br>Display |            |
|                                                      | Torque(Pn4xx-)<br>Sequence(Pn5xx-)<br>I/O Sign                                                                         | No.                               | Name                                 | Unit           | Milect                 | Parcaon            | Uispiay                                 |            |
|                                                      | Display Settings                                                                                                       | Pn000.0                           | Direction Selection                  | -              | 0 : Use CCW as t…      |                    |                                         |            |
|                                                      | Hierarchy: 01                                                                                                          | Pn000.1                           | Control Method Selection             | -              | 1 : Position contr···  |                    |                                         |            |
|                                                      | Descriptions: •                                                                                                        | Pn000.2                           | Reserved parameter (Do not chang     | -              | 0 : Reserved para…     |                    |                                         |            |
|                                                      |                                                                                                                        | Pn000.3                           | Rotary/Linear Startup Selection Wh   | -              | 0 : Start as a rota··· |                    |                                         |            |
|                                                      |                                                                                                                        | Pn001.0                           | Servo OFF or Alarm Group 1 Stoppi    | -              | 0 : Stop the moto···   |                    |                                         |            |
|                                                      |                                                                                                                        | Pn001.1                           | Overtravel Stopping Method           | -              | 0 : Apply the dyn…     |                    |                                         |            |
|                                                      |                                                                                                                        | Pn001.2                           | Main Circuit Power Supply AC/DC II   | -              | 0 : Input AC pow…      |                    |                                         |            |
|                                                      |                                                                                                                        | Pn001.3                           | Warning Code Output Selection        | -              | 0 : Output only al…    |                    |                                         |            |
|                                                      |                                                                                                                        | Pn002.0                           | Speed/Position Control Option (T-R   | -              | 0 : Do not use T-····  |                    |                                         |            |
|                                                      |                                                                                                                        | Pn002.1                           | Torque Control Option (V-REF Input   | -              | 0 : Do not use V····   |                    |                                         |            |
|                                                      |                                                                                                                        | Pn002.2                           | Absolute Encoder Usage               | -              | 2 : Uses absolute…     |                    |                                         |            |
|                                                      |                                                                                                                        | Pn002.3                           | External Encoder Usage               | -              | 0 : Do not use an…     |                    |                                         |            |
|                                                      |                                                                                                                        | Pn006.0-1                         | Analog Monitor 1 Signal Selection    | -              | 02 : Torque refer…     |                    |                                         |            |
|                                                      |                                                                                                                        | Pn006.2                           | Reserved parameter (Do not chang     | -              | 0 : Reserved para…     |                    |                                         |            |
|                                                      |                                                                                                                        | Pn006.3                           | Reserved parameter (Do not chang     | -              | 0 : Reserved para…     |                    |                                         |            |
|                                                      |                                                                                                                        | Pn007.0-1                         | Analog Monitor 2 Signal Selection    | -              | 00 : Motor speed…      |                    |                                         |            |
|                                                      |                                                                                                                        | Pn007.2                           | Reserved parameter (Do not chang     | -              | 0 : Reserved para…     |                    |                                         |            |
|                                                      |                                                                                                                        | Pn007.3                           | Reserved parameter (Do not chang     | -              | 0 : Reserved para…     |                    |                                         |            |
|                                                      |                                                                                                                        | Pn008.0                           | Low Battery Voltage Alarm/Warning    | -              | 0 : Output alarm…      |                    |                                         |            |
|                                                      |                                                                                                                        | Pn008.1                           | Function Selection for Undervoltage  | -              | 0 : Do not detect…     |                    |                                         |            |
|                                                      |                                                                                                                        | Pn008.2                           | Warning Detection Selection          | -              | 0 : Detect warnin…     |                    |                                         |            |
|                                                      | -                                                                                                                      | Pn008.3                           | Reserved parameter (Do not chang     | -              | 0 : Reserved para…     |                    |                                         |            |
| - 🔀                                                  |                                                                                                                        | Pn009.0                           | Reserved parameter (Do not chang     | -              | 0 : Reserved para…     |                    |                                         |            |

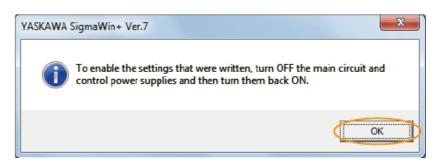
6. Select Edited Parameters in the Write to Servo Group.

The edited parameters are written to the SERVOPACK and the backgrounds of the cells change to white.

#### 7. Click the OK Button.



8. Click the OK Button.



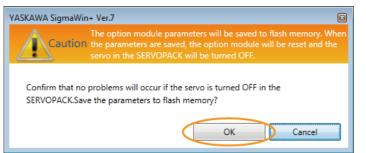
5.1.3 Parameter Setting Methods

| ategory                                                                                                 | SERVOPACK                 |                                     |              |                         |                             |                    |                              |
|---------------------------------------------------------------------------------------------------------|---------------------------|-------------------------------------|--------------|-------------------------|-----------------------------|--------------------|------------------------------|
| All constant number<br>Function Selection(Pn0xx-)<br>Position(Pn2xx-)<br>Torque(Pn4xx-)<br>Gain(Pn1xx-) | Edited<br>Parameters Para | Memor                               | Import       | Export Proje            | to Read from<br>ect Project | Initialize Compare | Remove<br>Servo from<br>List |
| Speed(Pn3xx-)                                                                                           | Read from Se              | rvo Write to Servo                  |              | File                    | Project                     | Function           | Display                      |
| Sequence(Pn5xx-)<br>I/O Sign<br>Mechatrolink(Pn8xx-)                                                    | No.                       | Name                                | Unit         | 0001-SGD7S-1R<br>Axis A |                             |                    |                              |
| Option(PnBxx-)                                                                                          | PnB01                     | Homing Direction                    | -            | 0001 H : Reverse        |                             |                    |                              |
| splay Settings                                                                                          | PnB03                     | Homing Approach Speed               | reference ur | 20000                   |                             |                    |                              |
| Hierarchy: ot                                                                                           | PnB04                     | Homing Creep Speed                  | reference ur | 10000                   |                             |                    |                              |
| Descriptions:                                                                                           | PnB05                     | Final Travel Distance for Homing    | reference ur | 0                       |                             |                    |                              |
|                                                                                                         | PnB09                     | Home Position Offset                | reference ur | 0                       |                             |                    |                              |
|                                                                                                         | PnB12                     | Coordinate Type Selection           | -            | 0000 H : Linear         | -                           |                    |                              |
|                                                                                                         | PnB13                     | Reference Units per Machine Revolu  | reference ur | 360000                  |                             |                    |                              |
|                                                                                                         | < PnB16                   | Positive Software Limit             | reference ur | 2147483647              |                             |                    |                              |
|                                                                                                         | PnB17                     | Negative Software Limit             | reference ur | 2147483647              |                             |                    |                              |
|                                                                                                         | PnB18.0                   | Software Limit Validity             | -            | 0 : Disabled            |                             |                    |                              |
|                                                                                                         | PnB18.1                   | Reserved (Do not change.)           | -            | 0 : Reserved (Do···     |                             |                    |                              |
|                                                                                                         | PnB18.2                   | Software Limit Action               | -            | 0 : Hard stop           |                             |                    |                              |
|                                                                                                         | PnB18.3-7                 | Reserved (Do not change.)           | -            | 00000 : Reserved…       |                             |                    |                              |
|                                                                                                         | PnB18.8-15                | Reserved (Do not change.)           | -            | 00000000 : Reser…       |                             |                    |                              |
|                                                                                                         | PnB1A                     | Hardware Limit Action Selection     | -            | 0000 H : Servo OFF      |                             |                    |                              |
|                                                                                                         | PnB1C                     | External Stop Action                | -            | 0                       |                             |                    |                              |
|                                                                                                         | PnB21                     | Feed Speed                          | reference ur | 400000                  |                             |                    |                              |
|                                                                                                         | PnB26                     | Acceleration/Deceleration Type      | -            | 0003 H : Asymm…         |                             |                    |                              |
|                                                                                                         | PnB29                     | Filter Selection                    | -            | 0000 H : No filter      |                             |                    |                              |
|                                                                                                         | PnB2A                     | Acceleration                        | reference ur | 4000000                 |                             |                    |                              |
|                                                                                                         | PnB2B                     | Deceleration                        | reference ur | 4000000                 |                             |                    |                              |
|                                                                                                         | PnB40                     | Time Constant for Exponential Acce  | ms           | 4                       |                             |                    |                              |
|                                                                                                         | PnB41                     | Exponential Acceleration/Decelerati |              | 0                       |                             |                    |                              |

9. Select Edited Parameters in the Save to Flash Group.

The parameters that were written to the SERVOPACK will be saved to flash memory and the cells will change to white.

- **Information** The parameters that are written are the parameters for the currently selected parameter axis (i.e., the one with the column title displayed in orange).
- **10.** Click the **OK** Button.



11. Click the OK Button.

| YASKAWA SigmaWin+ Ver.7                                                                                                         | ×    |
|---------------------------------------------------------------------------------------------------------------------------------|------|
| The parameter list was temporarily saved in the project file. To complete sa<br>them, click the Save Button in the main window. | ving |
|                                                                                                                                 | ок   |

**12.** To enable changes to the settings, turn the power supply to the SERVOPACK OFF and ON again.

This concludes the procedure to set the parameters.

### Setting Parameters with a Digital Operator

Refer to the following manual for information on setting the parameters with a Digital Operator.  $\square \Sigma$ -7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)

5.1.4 Write Prohibition Setting for Parameters

## 5.1.4 Write Prohibition Setting for Parameters

You can prohibit writing parameters from the Digital Operator. Even if you do, you will still be able to change parameter settings from the SigmaWin+.

### Preparations

No preparations are required.

### **Applicable Tools**

The following table lists the tools that you can use to change the Write Prohibition Setting.

| Tool             | Fn No./Function Name              | Reference                                                                     |
|------------------|-----------------------------------|-------------------------------------------------------------------------------|
| Digital Operator | Fn010                             | Σ-7-Series Digital Operator Operating<br>Manual (Manual No.: SIEP S800001 33) |
| SigmaWin+        | Others – Write Prohibited Setting | Gerating Procedure on page 5-8                                                |

### **Operating Procedure**

Use the following procedure to prohibit or permit writing parameter settings.

- 1. Click the 💻 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Write Prohibition Setting in the Menu Dialog Box. The Write Prohibition Setting Dialog Box will be displayed.
- **3.** Press the **v** or **i** for the rightmost digit and set one of the following. 0000: Writing is permitted (default setting). 0001: Writing is prohibited.

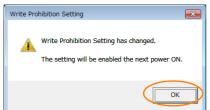


4. Click the Setting Button.



### 5. Click the OK Button.

The setting will be written to the SERVOPACK.



5.1.4 Write Prohibition Setting for Parameters

6. To enable the new setting, turn the power supply to the SERVOPACK OFF and ON again.

This concludes the procedure to prohibit or permit writing parameter settings.

### Restrictions

If you prohibit writing parameter settings, you will no longer be able to execute some functions. Refer to the following table.

| SigmaWin+                   |                                                                                                                                                                                                                                                  | Digital Operator                                                                                                                                                                                                                                                                                                     | Mhon Mrit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| SigmaWin+ Function<br>Name  | Fn No.                                                                                                                                                                                                                                           | Utility Function Name                                                                                                                                                                                                                                                                                                | ing Is Pro-<br>hibited                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Initialize *1               | Fn005                                                                                                                                                                                                                                            | Initializing Parameters                                                                                                                                                                                                                                                                                              | Cannot be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | page 5-10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Software Reset              | Fn030                                                                                                                                                                                                                                            | Software Reset                                                                                                                                                                                                                                                                                                       | Can be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | page 6-24                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
|                             | Fn011                                                                                                                                                                                                                                            | Display Servomotor Model                                                                                                                                                                                                                                                                                             | Can be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| Draduat Information         | Fn012                                                                                                                                                                                                                                            | Display Software Version                                                                                                                                                                                                                                                                                             | Can be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2222 0 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
| Product mormation           | Fn01E                                                                                                                                                                                                                                            | Display SERVOPACK and Servomotor IDs                                                                                                                                                                                                                                                                                 | Can be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | page 9-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
|                             | Fn01F                                                                                                                                                                                                                                            | Display Servomotor ID from<br>Feedback Option Module                                                                                                                                                                                                                                                                 | Can be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| Absolute Encoder Reset      | Fn008                                                                                                                                                                                                                                            | Reset Absolute Encoder                                                                                                                                                                                                                                                                                               | Cannot be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | page 5-47                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Multi-turn Limit Setup      | Fn013                                                                                                                                                                                                                                            | Multiturn Limit Setting after<br>Multiturn Limit Disagreement<br>Alarm                                                                                                                                                                                                                                               | Cannot be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | page 6-20                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Search Origin <sup>*2</sup> | Fn003                                                                                                                                                                                                                                            | Origin Search                                                                                                                                                                                                                                                                                                        | Cannot be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | page 7-18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Zero Point Position Setting | Fn020                                                                                                                                                                                                                                            | Set Absolute Linear Encoder<br>Origin                                                                                                                                                                                                                                                                                | Cannot be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | page 5-50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| Polarity Detection          | Fn080                                                                                                                                                                                                                                            | Polarity Detection                                                                                                                                                                                                                                                                                                   | Cannot be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | page 5-27                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
|                             | Fn000                                                                                                                                                                                                                                            | Display Alarm History                                                                                                                                                                                                                                                                                                | Can be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | page 14-44                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
| Display Alarm               | Fn006                                                                                                                                                                                                                                            | Clear Alarm History                                                                                                                                                                                                                                                                                                  | Cannot be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | page 14-45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
|                             | Fn014                                                                                                                                                                                                                                            | Reset Option Module Config-<br>uration Error                                                                                                                                                                                                                                                                         | Cannot be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | page 14-46                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
| Reset Motor Type Alarm      | Fn021                                                                                                                                                                                                                                            | Reset Motor Type Alarm                                                                                                                                                                                                                                                                                               | Cannot be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | page 14-48                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
| Jog                         | Fn002                                                                                                                                                                                                                                            | Jog                                                                                                                                                                                                                                                                                                                  | Cannot be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | page 7-6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
| Program JOG Operation       | Fn004                                                                                                                                                                                                                                            | Jog Program                                                                                                                                                                                                                                                                                                          | Cannot be executed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | page 7-12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
|                             | SigmaWin+ Function<br>Name Initialize *1 Software Reset Software Reset Product Information Absolute Encoder Reset Multi-turn Limit Setup Search Origin*2 Zero Point Position Setting Polarity Detection Display Alarm Beset Motor Type Alarm Jog | SigmaWin+ Function<br>NameFn No.Initialize *1Fn005Software ResetFn030Software ResetFn011Fn012Fn012Fn012Fn016Fn015Fn017Absolute InformationFn018Multi-turn Limit SetupFn003Search Origin*2Fn003Zero Point Position SettingFn020Polarity DetectionFn080Display AlarmFn006Fn014Fn014Reset Motor Type AlarmFn021JogFn002 | SigmaWin+ Function<br>NameFn No.Utility Function NameInitialize *1Fn005Initializing ParametersSoftware ResetFn030Software ResetProduct InformationFn011Display Servomotor ModelFn012Display SetWork VersionFn014Display SetWOPACK and<br>Servomotor IDsFn015Display SERVOPACK and<br>Servomotor IDsAbsolute Encoder ResetFn018Multi-turn Limit SetupFn013Multiturn Limit SetupFn013Search Origin*2Fn030Zero Point Position SettingFn020Polarity DetectionFn080Polarity DetectionFn096Display AlarmFn096Reset Motor Type AlarmFn021JogFn022JogFn024 | SigmaWin+Function<br>NameFn No.Utility Function NameWhen Writ-<br>ing Is Pro-<br>hibitedInitialize *1Fn005Initializing ParametersCannot be<br>executed.Software ResetFn030Software ResetCan be<br>executed.Product InformationFn011Display Servomotor ModelCan be<br>executed.Fn012Display Software VersionCan be<br>executed.Fn011Display Servomotor IDsCan be<br>executed.Fn011Display Servomotor ID from<br>Feedback Option ModuleCan be<br>executed.Absolute Encoder ResetFn018Reset Absolute EncoderCannot be<br>executed.Multi-turn Limit SetupFn013Multiturn Limit Setting after<br>Multiturn Limit DisagreementCannot be<br> |  |

Continued on next page.

#### 5.1.5 Initializing Parameter Settings

|                                 | Continued from previous page.                                |        |                                                            |                        |           |  |  |  |
|---------------------------------|--------------------------------------------------------------|--------|------------------------------------------------------------|------------------------|-----------|--|--|--|
|                                 | SigmaWin+                                                    |        | Digital Operator                                           | When Writ-             |           |  |  |  |
| Button in<br>Menu<br>Dialog Box | SigmaWin+ Function<br>Name                                   | Fn No. | Utility Function Name                                      | ing Is Pro-<br>hibited | Reference |  |  |  |
|                                 | Tuning -<br>Autotuning without Host<br>Reference             | Fn201  | Advanced Autotuning with-<br>out Reference                 | Cannot be executed.    | page 8-23 |  |  |  |
|                                 | Tuning -<br>Autotuning with Host Ref-<br>erence              | Fn202  | Advanced Autotuning with<br>Reference                      | Cannot be executed.    | page 8-34 |  |  |  |
| Tuning                          | Tuning -<br>Custom Tuning                                    | Fn203  | One-Parameter Tuning                                       | Cannot be executed.    | page 8-42 |  |  |  |
|                                 | Tuning - Custom Tuning -<br>Adjust Anti-resonance<br>Control | Fn204  | Adjust Anti-resonance Con-<br>trol                         | Cannot be executed.    | page 8-42 |  |  |  |
|                                 | Tuning - Custom Tuning -<br>Vibration Suppression            | Fn205  | Vibration Suppression                                      | Cannot be executed.    | page 8-56 |  |  |  |
|                                 | Response Level Setting                                       | Fn200  | Tuning-less Level Setting                                  | Cannot be executed.    | page 8-11 |  |  |  |
| Diagnostic                      | Easy FFT                                                     | Fn206  | Easy FFT                                                   | Cannot be executed.    | page 8-95 |  |  |  |
|                                 | Adjust the Analog Monitor                                    | Fn00C  | Adjust Analog Monitor Output<br>Offset                     | Cannot be executed.    | page 9-10 |  |  |  |
|                                 | Output                                                       | Fn00D  | Adjust Analog Monitor Output<br>Gain                       | Cannot be executed.    | page 9-10 |  |  |  |
| Othoro                          | Adjust the Motor Current                                     | Fn00E  | Autotune Motor Current<br>Detection Signal Offset          | Cannot be executed.    | page 6-20 |  |  |  |
| Others                          | Detection Offsets                                            | Fn00F  | Manually Adjust Motor Cur-<br>rent Detection Signal Offset | Cannot be executed.    | page 6-30 |  |  |  |
|                                 | Initialize Vibration Detection<br>Level                      | Fn01B  | Initialize Vibration Detection<br>Level                    | Cannot be executed.    | page 6-26 |  |  |  |
|                                 | Write Prohibited Setting                                     | Fn010  | Write Prohibition Setting                                  | Can be executed.       | page 5-8  |  |  |  |

\*1. An Initialize Button will be displayed when you select Parameters - Edit Parameters from the menu bar.

\*2. Cannot be used when connecting a Linear Servomotor.

## 5.1.5 Initializing Parameter Settings

You can return the parameters to their default settings.

This function will initialize the following parameters:  $Pn0\square\square$  to  $Pn6\square\square$ . This function will not initialize the settings of the parameters that are adjusted for the Fn00C, Fn00D, Fn00E, and Fn00F utility functions and the PnB $\square\square$  parameters.



To enable the new settings, turn the power supply to the SERVOPACK OFF and ON again after you complete the operation.

### Preparations

Always check the following before you initialize the parameter settings.

- The parameters must not be write prohibited.
- The servo must be OFF.
- Initializing the parameter settings must not be in progress for any other tool.

5.1.5 Initializing Parameter Settings

## **Applicable Tools**

The following table lists the tools that you can use to initialize the parameter settings.

| Tool                     | Fn No./Function Name                   | Reference                                                                       |
|--------------------------|----------------------------------------|---------------------------------------------------------------------------------|
| Digital Operator         | Fn005                                  | Ω Σ-7-Series Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+                | Basic Functions – Edit Parame-<br>ters | Operating Procedure on page 5-11                                                |
| DeviceNet communications | PnBA7                                  | Parameter Initialization on page 12-17                                          |

## **Operating Procedure**

Use the following procedure to initialize the parameter settings.

- 1. Click the <u>I</u> Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Edit Parameters in the Menu Dialog Box. The Parameter Editing Dialog Box will be displayed.
- 3. Select any parameter of the axis to initialize.
- 4. Click the Initialize Button in the Function Group.

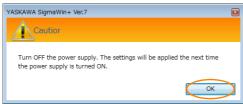
| <b>f</b>                                |                                                                                                                                  | YASKAWA SigmaWin+ Ver.7            |            |                                     | - 5 ×   |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------|-------------------------------------|---------|
| Edit Pa                                 | arameters                                                                                                                        |                                    |            |                                     | ▼ A ×   |
| Catego                                  | SERVOPACK                                                                                                                        |                                    |            |                                     | ۵       |
| ODD1-SV2<br>-OZOL2<br>HBB P-OT<br>Speet | onstant number<br>stion Selection(Pn0xx-)<br>(Pn1xx-)<br>tion(Pn2xc-)<br>d(Pn3xc-)<br>Read from<br>Nechol Selection<br>Read from | anameters parameters parameters    | Import Exp | Save to<br>Project Project Function | Display |
| Sequ<br>[/O S                           | Jence(Pn5xx-)                                                                                                                    | Name                               | Unit       |                                     | â       |
|                                         | imon Parameters(PnAxx-) Pn000.0                                                                                                  | Direction Selection                | -          | 0 : Use CCW as t…                   |         |
| Disola                                  | Pn000.1                                                                                                                          | Reserved parameter (Do not chang   | -          | 0 : Reserved para…                  |         |
|                                         | Hierarchy: or Pn000.2                                                                                                            | Reserved parameter (Do not chang   | -          | 0 : Reserved para…                  |         |
| De                                      | scriptions: Pn000.3                                                                                                              | Rotary/Linear Startup Selection Wh | -          | 0 : Start as a rota···              |         |
|                                         | Pn001.0                                                                                                                          | Servo OFF or Alarm Group 1 Stoppi  | -          | 0 : Stop the moto                   |         |
|                                         | < Pn001.1                                                                                                                        | Overtravel Stopping Method         | -          | 1 : Decelerate the…                 |         |
|                                         | Pn001.2                                                                                                                          | Main Circuit Power Supply AC/DC It | -          | 0 : Input AC pow…                   |         |
|                                         | Pn001.3                                                                                                                          | Reserved parameter (Do not chang   | -          | 0 : Reserved para…                  |         |
|                                         | Pn002.0                                                                                                                          | MECHATROLINK Command Position      | -          | 1 : Use TLIM as t…                  |         |
|                                         | Pn002.1                                                                                                                          | Torque Control Option              | -          | 1 : Use the speed…                  |         |
|                                         | Pn002.2                                                                                                                          | Absolute Encoder Usage             | -          | 1 : Use the absol···                |         |
|                                         | Pn002.3                                                                                                                          | External Encoder Usage             | -          | 0 : Do not use an…                  |         |
|                                         | Pn006.0-1                                                                                                                        | Analog Monitor 1 Signal Selection  | -          | 02 : Torque refer…                  |         |
|                                         | Pn006.2                                                                                                                          | Reserved parameter (Do not chang   | -          | 0 : Reserved para…                  |         |
|                                         | Pn006.3                                                                                                                          | Reserved parameter (Do not chang   | -          | 0 : Reserved para…                  |         |
|                                         | Pn007.0-1                                                                                                                        | Analog Monitor 2 Signal Selection  | -          | 00 : Motor speed…                   |         |
|                                         | Pn007.2                                                                                                                          | Reserved parameter (Do not chang   | -          | 0 : Reserved para…                  |         |
| • · ·                                   | Pn007.3                                                                                                                          | Reserved parameter (Do not chang   | -          | 0 : Reserved para…                  | -       |

5. Click the OK Button.

| YASKAWA SigmaWin+ Ver.7                                                                                          |
|------------------------------------------------------------------------------------------------------------------|
| Caution If you restore the default settings, the settings may no longer agree with the current machine settings. |
| The SERVOPACK parameters will be returned to the default settings.OK?                                            |
| OK Cancel                                                                                                        |

Click the Cancel Button to cancel initialization. The Parameter Editing Dialog Box will return.

6. Click the OK Button.



5.1.6 Managing Parameters (PnDDD)

7. Turn the power supply to the SERVOPACK OFF and ON again after the parameter settings have been initialized.

This concludes the procedure to initialize the parameter settings.

#### Managing Parameters (PnDDD) 5.1.6

### **Timing of Saving Parameters**

When the parameters are saved depends on the parameter numbers, as described in the following table.

| Parameters     | When Saved                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Pn000 to Pn600 | These parameters are saved immediately in nonvolatile memory in the SERVOPACK as soon as they are written.<br>The settings of some parameters, however, require that you turn the power supply OFF and ON again or reset the Module to enable changes to the parameter settings.                                                                                                                              |
| PnBロロ          | <ul> <li>These parameters are saved in nonvolatile memory in the SERVOPACK at the following times.</li> <li>When the Module is reset</li> <li>When the parameters are saved in flash memory from the SigmaWin+</li> <li>When positioning operations are preformed by changing the Start Trajectory bit to 1 after changing the parameters. (About 10 seconds is required to write the parameters.)</li> </ul> |
| Command Blocks | When the parameters are saved in flash memory from the SigmaWin+, they are saved in nonvolatile memory in the SERVOPACK.                                                                                                                                                                                                                                                                                      |



Parameters that are not saved immediately in nonvolatile memory are stored in RAM in the SERVOPACK. To save all parameters in nonvolatile memory after completing parameter adjustments, reset the Module. If the power supply is turned OFF before the Module is reset, any changes that Important have been made to the parameters that are not saved automatically will be lost.

### **Resetting the Module**

The following operations will be performed when the Module is reset.

- All parameters are saved in non-volatile memory.
- The parameters that require turning the power supply OFF and ON again are enabled.

Refer to the following section for a detailed operating procedure. 13.5.3 Executing a Module Reset on page 13-33

5.2.1 AC Power Supply Input/DC Power Supply Input Setting

## 5.2 Power Supply Type Settings for the Main Circuit and Control Circuit

A SERVOPACK with a 200-VAC power supply input can be operated on either an AC power supply input or DC power supply input to the main and control circuits. If you select an AC power supply input, you can operate the SERVOPACK on either a single-phase power supply input or a three-phase power supply input. This section describes the settings related to the power supplies.

You cannot input DC power to a SERVOPACK with a single-phase, 100-VAC power supply input.

## 5.2.1 AC Power Supply Input/DC Power Supply Input Setting

Set Pn001 =  $n.\Box X \Box \Box$  (Main Circuit Power Supply AC/DC Input Selection) to specify whether to use an AC or DC power supply input for the main circuit power supply to the SERVOPACK. If the setting of Pn001 =  $n.\Box X \Box \Box$  does not agree with the actual power supply input, an A.330

alarm (Main Circuit Power Supply Wiring Error) will occur.

Example

- Examples of When an A.330 Alarm (Main Circuit Power Supply Wiring Error) Occurs
- A DC power supply is connected between the B1/⊕ and ⊝2 terminals, but an AC power supply input is specified (Pn001 = n.□0□□).
- An AC power supply is input to the L1, L2, and L3 terminals, but a DC power supply is specified (Pn001 = n.□1□□).

| Parameter |                         | Meaning                       | When Enabled  | Classification |
|-----------|-------------------------|-------------------------------|---------------|----------------|
|           | □0□□<br>efault setting) | Use an AC power supply input. | After restart | Setup          |
| n.C       | n.□1□□                  | Use a DC power supply input.  | -             |                |

Refer to the following section for information on wiring the SERVOPACK. *4.3.4 Power Supply Wiring Diagrams* on page 4-16 5.2.2 Single-phase AC Power Supply Input/Three-phase AC Power Supply Input Setting

# 5.2.2 Single-phase AC Power Supply Input/Three-phase AC Power Supply Input Setting

Some models of Three-phase 200-VAC SERVOPACKs can also operate on a single-phase 200-VAC power supply.

You can use a single-phase, 200-V power supply input with the following models.

• SGD7S-R70A, -R90A, -1R6A, -2R8A, and -5R5A

If you use a single-phase, 200-VAC power supply input for the SERVOPACK's main circuit power supply, set parameter Pn00B to n.  $\Box 1 \Box \Box$  (Use a three-phase power supply input as a single-phase power supply input).

**Information** You do not need to change the setting of Pn00B to n.  $\Box 1 \Box \Box$  (Use a three-phase power supply input input) for a SERVOPACK with a single-phase 200-VAC power supply input (model numbers: SGD7S-120AE0A008) or for a SERVOPACK with a single-phase 100-VAC power supply input.

| Parameter |                             | Meaning                                                                        | When Enabled  | Classification |
|-----------|-----------------------------|--------------------------------------------------------------------------------|---------------|----------------|
| Pn00B     | n.□0□□<br>(default setting) | Use a three-phase power supply input.                                          | After restart | Setup          |
|           | n.0100                      | Use a three-phase power supply input and as a single-phase power supply input. | Aller restart | Setup          |
|           | ·                           |                                                                                |               |                |

|            | 1. If you use a single-phase power supply input without specifying a single-phase AC power su | Jp- |
|------------|-----------------------------------------------------------------------------------------------|-----|
| $\bigcirc$ | ply (Pn00B = n.□1□□), an A.F10 alarm (Power Supply Line Open Phase) will occur.               |     |

2. Not all SERVOPACKs can be run on a single-phase AC power supply input. If you connect a single-phase AC power supply input to a SERVOPACK that does not support single-phase power, an A.F10 alarm (Power Supply Line Open Phase) will occur.

3. If you use a single-phase 200-VAC power supply input, the torque-motor speed characteristic of the Servomotor will not be the same as for a three-phase AC power supply input. Decide whether to use a single-phase or three-phase AC power supply input after checking the characteristics given in the Servomotor manual or catalog.

Refer to the following section for information on wiring a single-phase AC power supply input to the SERVOPACK.

🕼 • Wiring Example for Single-Phase, 200-VAC Power Supply Input on page 4-18

## 5.3 Automatic Detection of Connected Motor

You can use a SERVOPACK to operate either a Rotary Servomotor or a Linear Servomotor. If you connect the Servomotor encoder to the CN2 connector on the SERVOPACK, the SER-VOPACK will automatically determine which type of Servomotor is connected. Therefore, you normally do not need to specify the Servomotor type.

**Information** If an encoder is not connected, e.g., for a test without a motor, you can specify a Rotary Servomotor or a Linear Servomotor in  $Pn000 = n.X \square \square \square$  (Rotary/Linear Startup Selection When Encoder Is Not Connected). If you specify either a Rotary or Linear Servomotor, only the parameters, monitors, alarms, and functions for the specified motor type will be enabled.

| Parameter |                             | Meaning                                                                          | When Enabled  | Classification |
|-----------|-----------------------------|----------------------------------------------------------------------------------|---------------|----------------|
| Pn000     | n.0□□□<br>(default setting) | When an encoder is not connected, start as SERVOPACK for Rotary Servo-<br>motor. | After restart | Setup          |
| FILOU     | n.1000                      | When an encoder is not connected, start as SERVOPACK for Linear Servo-<br>motor. | Aller Testart | Setup          |

## 5.4 Motor Direction Setting

You can reverse the direction of Servomotor rotation by changing the setting of  $Pn000 = n.\square\square\squareX$  (Rotation Direction Selection) without changing the polarity of the speed or position reference. This causes the rotation direction of the Servomotor to change, but the polarity of the signals, such as encoder output pulses, output from the SERVOPACK do not change. Set the appropriate direction for your system.

Refer to the following section for details on the encoder divided pulse output. 6.5 Encoder Divided Pulse Output on page 6-9

#### Rotary Servomotors

The default setting for forward rotation is counterclockwise (CCW) as viewed from the load end of the Servomotor. However, for overtravel, the rotation direction is the direction as viewed from the encoder.

| Parameter |                                                                                    | Forward/Reverse<br>Reference | Motor Direction and Encoder Divided Pulse Outputs                                     | Applicable<br>Overtravel Signal (OT)              |
|-----------|------------------------------------------------------------------------------------|------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------|
|           | n.□□□0<br>Use CCW as<br>the forward<br>direction.<br>(default setting)             | Forward<br>reference         | CCW Hotor speed Final Page And                    | CW-OT (CW<br>Drive Prohibit<br>Input) signal      |
| Pn000     |                                                                                    | Reverse<br>reference         | + Torque reference Encoder Divided Pulse Outputs                                      | CCW-OT<br>(CCW Drive<br>Prohibit Input)<br>signal |
| FILOO     | n.□□□1<br>Use CW as the<br>forward direc-<br>tion.<br>(Reverse Rota-<br>tion Mode) | Forward<br>reference         | + Torque reference Encoder Divided Pulse Outputs                                      | CW-OT (CW<br>Drive Prohibit<br>Input) signal      |
|           |                                                                                    | Reverse<br>reference         | Torque reference Encoder Divided Pulse Outputs<br>PAO Phase-A lead<br>Motor speed PBO | CCW-OT<br>(CCW Drive<br>Prohibit Input)<br>signal |

Note: The trace waveforms of the SigmaWin+ are shown in the above table for the torque reference and motor speed diagrams. If you measure them on a measuring instrument, e.g., with an analog monitor, the polarity will be reversed.

### Linear Servomotors

Before you set this parameter, make sure that Pn080 = n.  $\Box \Box X \Box$  (Motor Phase Sequence Selection) is set correctly.

| Parameter |       | Forward/Reverse<br>Reference                                                                                                        | Motor Moving Direction and Encoder Divided Pulse<br>Outputs | Applicable<br>Overtravel Signal (OT)                                                                                                                                |                                                   |
|-----------|-------|-------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
|           |       | n.□□□0<br>Use the direc-<br>tion in which<br>the linear<br>encoder counts<br>up as the for-<br>ward direction.<br>(default setting) | Forward<br>reference                                        | Moves in the count-up direction.                                                                                                                                    | CW-OT (CW<br>Drive Prohibit<br>Input) signal      |
|           |       |                                                                                                                                     | Reverse<br>reference                                        | Moves in the count-down direction.       Force reference       Encoder Divided Pulse Outputs         Moves in the count-down direction.       Motor speed       PAO | CCW-OT<br>(CCW Drive<br>Prohibit Input)<br>signal |
| Pn000     | Pn000 | n. DDD1<br>Use the direc-<br>tion in which<br>the linear<br>encoder counts<br>down as the<br>forward direc-<br>tion.                | Forward<br>reference                                        | Hore reference<br>Moves in the<br>count-down<br>direction.                                                                                                          | CW-OT (CW<br>Drive Prohibit<br>Input) signal      |
|           |       |                                                                                                                                     | Reverse<br>reference                                        | Force reference       Encoder Divided Pulse Outputs         Moves in the count-up direction.       Motor speed                                                      | CCW-OT<br>(CCW Drive<br>Prohibit Input)<br>signal |

Note: The trace waveforms of the SigmaWin+ are shown in the above table for the force reference and motor speed diagrams. If you measure them on a measuring instrument, e.g., with an analog monitor, the polarity will be reversed.

## 5.5 Setting the Linear Encoder Pitch

If you connect a linear encoder to the SERVOPACK through a Serial Converter Unit, you must set the scale pitch of the linear encoder in Pn282.

If a Serial Converter Unit is not connected, the setting of the Pn282 is disabled.

#### Serial Converter Unit

The Serial Converter Unit converts the signal from the linear encoder into a form that can be read by the SERVOPACK.

#### Scale Pitch

Term

A linear encoder has a scale for measuring lengths (positions). The length of one division on this scale is the scale pitch.

|       | Linear Encoder Pitch |              |                 |               |                |  |  |
|-------|----------------------|--------------|-----------------|---------------|----------------|--|--|
| Pn282 | Setting Range        | Setting Unit | Default Setting | When Enabled  | Classification |  |  |
|       | 0 to 6,553,600       | 0.01 µm      | 0               | After restart | Setup          |  |  |

You will not be able to control the Linear Servomotor if Pn282 is not set correctly. Check the above table and always set the correct value before you operate the Linear Servomotor.

| Type of Linear<br>Encoder | Manufacturer                    | Model                             | Serial Converter Unit Model | Linear Encoder<br>Pitch<br>[µm] |
|---------------------------|---------------------------------|-----------------------------------|-----------------------------|---------------------------------|
|                           |                                 | LIDA480                           | JZDP-H003-DDD-E             | 20                              |
|                           | Dr. JOHANNES<br>HEIDENHAIN GmbH |                                   | JZDP-J003-DD-E              |                                 |
|                           |                                 | LIF480                            | JZDP-H003-DDD-E             | 4                               |
| Incremental               |                                 |                                   | JZDP-J003-DD-E              |                                 |
| Incremental               | Renishaw PLC                    | RGH22B                            | JZDP-H005-DDD-E             | 20                              |
|                           |                                 |                                   | JZDP-J005-DDD-E             | 20                              |
|                           |                                 | TONIC series<br>(Ti0000A00V only) | JZDP-H005-DDD-E             | 20                              |
|                           |                                 |                                   | JZDP-J005-DDD-E             | 20                              |

The first time you supply power to the SERVOPACK, the panel display on the front of the Servomotor will display an A.080 alarm (Linear Encoder Pitch Setting Error). The A.080 alarm is displayed because the setting of Pn282 has not been changed. The A.080 alarm will be cleared when you change the setting of Pn282 and then turn the power supply OFF and ON again.

Information

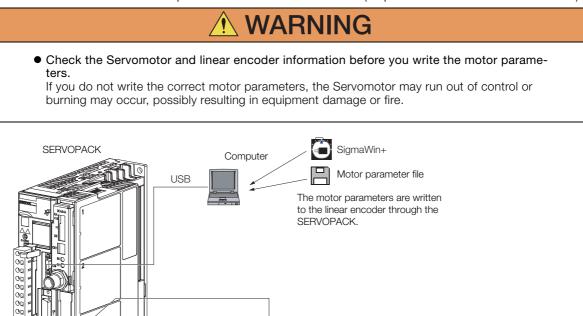
Linear Encoder Pitch

If you do not use a Serial Converter Unit, the linear encoder pitch is automatically set and the setting of the Pn282 is disabled. Refer to the following section for details.

## 5.6 Writing Linear Servomotor Parameters

If you connect a linear encoder to the SERVOPACK without going through a Serial Converter Unit, you must use the SigmaWin+ to write the motor parameters to the linear encoder. The motor parameters contain the information that is required by the SERVOPACK to operate the Linear Servomotor.

You can download the motor parameters from our web site (http://www.e-mechatronics.com/).





Serial number information is not included in the motor parameters. You cannot use the monitor functions of the SERVOPACK to monitor the serial number. If you attempt to monitor the serial number, \*\*\*\*\*\*\*\*\* will be displayed.

### Precautions

- If the encoder parameters are not written to the linear encoder, an A.CA0 alarm (Encoder Parameter Error) will occur. Consult the manufacturer of the linear encoder.
- If the motor parameters are not written to the linear encoder, an A.CAO alarm (Encoder Parameter Error) will not occur, but the following alarms will occur.

A.040 (Parameter Setting Error), A.041 (Encoder Output Pulse Setting Error),

A.050 (Combination Error), A.051 (Unsupported Device Alarm),

Linear encoder

A.550 (Maximum Speed Setting Error), A.710 (Instantaneous Överload),

A.720 (Continuous Overload), and A.C90 (Encoder Communications Error)

### Applicable Tools

The following table lists the tools that you can use to write the parameters to the Linear Servomotor.

| Tool             | Fn No./Function Name                                                     | Reference                          |  |
|------------------|--------------------------------------------------------------------------|------------------------------------|--|
| Digital Operator | You cannot write Linear Servomotor parameters from the Digital Operator. |                                    |  |
| SigmaWin+        | Encoder Setting – Motor Parameter<br>Scale Write                         | G Operating Procedure on page 5-19 |  |

### **Operating Procedure**

Use the following procedure to write the motor parameters to the Linear Encoder.

- **1.** Prepare the motor parameter file to write to the linear encoder.
- 2. Click the *P* Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **3.** Select Motor Parameter Scale Write in the Menu Dialog Box. The Motor Parameter Scale Write Dialog Box will be displayed.
- 4. Click the OK Button.

| Motor parameter scale write                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                            |
| This function rewrites data in the scale.<br>If the data which does not suit the connected motor is rewritten, the motor<br>may not work normally, resulting in motor overrun, etc., and it is very<br>dangerous.<br>Be sure that the data written in the scale suits the connected motor. |
| OK                                                                                                                                                                                                                                                                                         |

Click the **Cancel** Button to cancel writing the motor parameters to the linear encoder. The Main Window will return.

If the write is completed normally, the Motor Parameter Scale Write - File Select Dialog Box will be displayed.

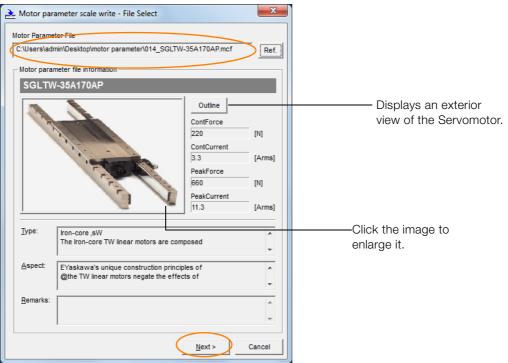
5. Click the Ref. Button.

| 🚵 Motor parameter scale write - File Select | ×    |
|---------------------------------------------|------|
| Motor Parameter File                        |      |
|                                             | Ref. |
| Motor parameter file information            |      |
| ****                                        |      |
| Outline                                     |      |

6. Select the motor parameter file that you prepared and click the Open Button.

| Dpen                                                                                               |                   |                                  | x    |
|----------------------------------------------------------------------------------------------------|-------------------|----------------------------------|------|
| O ♥ → motor parameter                                                                              | - 4+ Search       | motor parameter                  | ρ    |
| Organize   New folder                                                                              |                   | ## • 🗊                           | 0    |
| * Favorites                                                                                        | Date modified     | Туре                             | Size |
| E Desktop 014_SGLTW-35A170AP.mcf                                                                   | 5/13/2015 7:39 PM | MCF File                         |      |
| Recent Places     Libraries     Documents     Muic     Placues     Videos     Videos      Computer |                   |                                  |      |
| Win7 ENG (C:)     Win7 JPN (D:)     *     *                                                        |                   |                                  |      |
| File game: 014_S0LTW-35A170AP.met                                                                  |                   | nameter file(*.mcf)<br>In Cancel | 3    |

7. Confirm that the motor parameter file information that is displayed is suitable for your Servomotor, and then click the Next Button.

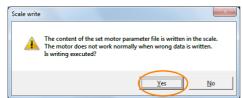


Click the **Cancel** Button to cancel writing the motor parameters to the linear encoder. The Main Window will return.

### 8. Click the Write Button.

| Motor parameter scale write - Scale write                                                                                                 |                                                                                                     |                             |        |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------------|--------|--|--|
| The motor parameter is written in the scale.<br>Please confirm the motor which connects is corresponding to<br>the following information. |                                                                                                     |                             |        |  |  |
| - Motor para                                                                                                                              | meter file information                                                                              |                             |        |  |  |
| SGLTW                                                                                                                                     | /-35A170AP                                                                                          |                             |        |  |  |
| CARACTER C                                                                                                                                |                                                                                                     | Outline<br>ContForce<br>220 |        |  |  |
|                                                                                                                                           | No.                                                                                                 | ContCurrent<br>3.3          | [Arms] |  |  |
|                                                                                                                                           | See .                                                                                               | PeakForce                   | _      |  |  |
|                                                                                                                                           | 12 11                                                                                               | 660                         | [N]    |  |  |
|                                                                                                                                           |                                                                                                     | PeakCurrent<br>11.3         | [Arms] |  |  |
|                                                                                                                                           |                                                                                                     |                             |        |  |  |
| <u>T</u> ype:                                                                                                                             | Iron-core ,sW<br>The Iron-core TW linear motors are com                                             | posed                       | *<br>• |  |  |
| <u>A</u> spect:                                                                                                                           | Aspect: EYaskawa's unique construction principles of<br>@the TW linear motors negate the effects of |                             |        |  |  |
| <u>R</u> emarks:                                                                                                                          |                                                                                                     |                             | *      |  |  |
|                                                                                                                                           |                                                                                                     |                             |        |  |  |
|                                                                                                                                           | < Back Complete Cancel                                                                              |                             |        |  |  |

9. Click the Yes Button.



Click the No Button to cancel writing the motor parameters to the linear encoder.

If you click the Yes Button, writing the motor parameter scale will start.

#### 10. Click the Complete Button.

| Motor parameter scale write - Scale write                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                    |                                                                                              |                                |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------------------------|--|
| The motor parameter is written in the scale.<br>Please confirm the motor which connects is corresponding to<br>the following information.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                    |                                                                                              |                                |  |
| - Motor parar                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | neter file information                                                             |                                                                                              |                                |  |
| SGLTW                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | /-35A170AP                                                                         |                                                                                              |                                |  |
| and the second s |                                                                                    | Outline<br>ContForce<br>220<br>ContCurrent<br>3.3<br>PeakForce<br>660<br>PeakCurrent<br>11.3 | [N]<br>[Arms]<br>[N]<br>[Arms] |  |
| <u>T</u> ype:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Iron-core ,sW<br>The Iron-core TW linear motors are comp                           | posed                                                                                        | *                              |  |
| <u>A</u> spect:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | EYaskawa's unique construction principl<br>@the TW linear motors negate the effect |                                                                                              | *                              |  |
| <u>R</u> emarks:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                    |                                                                                              | *                              |  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | < <u>B</u> ack                                                                     | Complete                                                                                     | Cancel                         |  |

#### 11. Click the OK Button.

| Motor parameter scale write AXIS#00                                                                                                                                  | 3 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|                                                                                                                                                                      |   |
| The scale writing of the motor parameter was completed.<br>Please execute the power supply re-turning ON.<br>The setting value will be enabled the next power ON.    |   |
| *After the next power ON, when "A CA0:Encoder parameter error"<br>occur, the writing of data is required separately.<br>Please ask for the data file to our company. |   |
| ОК                                                                                                                                                                   |   |

12. Turn the power supply to the SERVOPACK OFF and ON again.

This concludes the procedure to write the motor parameters.

### Confirming If the Motor Parameters Have Been Written

After you write the motor parameters, you can use a monitor function to confirm that the motor parameters are in the encoder.

If the motor parameters have not been written, no information on the Servomotor will be displayed. *9.1 Monitoring Product Information* on page 9-2

## 5.7 Selecting the Phase Sequence for a Linear Servomotor

You must select the phase sequence of the Linear Servomotor so that the forward direction of the Linear Servomotor is the same as the encoder's count-up direction.

Before you set the Linear Servomotor phase sequence (Pn080 =  $n.\Box\Box X\Box$ ), check the following items.

- Confirm that the signal from the linear encoder is being received normally.
- Make sure that the forward direction of the Linear Servomotor and the count-up direction of the linear encoder are in the same direction.



If you do not confirm the above items before you attempt to operate the Servomotor, the Servomotor may not operate or it may run out of control. Always confirm these items before you operate the Servomotor.

### **Related Parameters**

| Parameter |                             | Meaning                                                | When Enabled  | Classification |
|-----------|-----------------------------|--------------------------------------------------------|---------------|----------------|
| Pn080     | n.□□0□<br>(default setting) | Set a phase-A lead as a phase sequence of U, V, and W. | After restart | Setup          |
|           | n.0010                      | Set a phase-B lead as a phase sequence of U, V, and W. |               |                |

### **Operating Procedure**

Use the following procedure to select the phase sequence for a Linear Servomotor.

- 1. Set Pn000 to n. DDD (Set a phase-A lead as a phase sequence of U, V, and W). This setting is to make following confirmation work easier to understand.
- 2. Select *Monitor Monitor Motion Monitor* from the menu bar of the Main Window of the SigmaWin+.

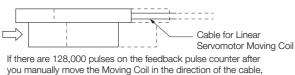
A dialog box will be displayed so that you can check the feedback pulse counter. To check the feedback pulse counter with the Digital Operator, use Un00D (Feedback Pulse Counter).

**3.** Manually move the Moving Coil from one end to the other of the stroke and confirm that only the correct number of feedback pulses is returned.

If the correct number and only the correct number of pulses is returned, the signal is being received correctly from the linear encoder.

Example

In this example, assume that a linear encoder with a scale pitch of 20  $\mu$ m and a resolution of 256 is used. If you manually move the Moving Coil 1 cm in the count-up direction of the linear encoder, the number of feedback pulses would be as follows: 1 cm/(20  $\mu$ m/256) = 128,000 pulses



you have completed the confirmation.

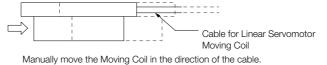
Note: The actual monitor display will be offset by the error in the travel distance. There is no problem as long as the above value is close to the calculated value.

**Information** If the correct value is not displayed for the feedback pulse counter, the following conditions may exist. Check the situation and correct any problems.

- The linear encoder pitch is not correct. If the scale pitch that is set in Pn282 does not agree with the actual scale pitch, the expected number of feedback pulses will not be returned. Check the specifications of the linear encoder.
- The linear encoder is not adjusted properly.
- If the linear encoder is not adjusted properly, the output signal level from the linear encoder will drop and the correct number of pulses will not be counted. Check the adjustment of the linear encoder. Contact the manufacturer of the linear encoder for details.
- There is a mistake in the wiring between the linear encoder and the Serial Converter Unit.

If the wiring is not correct, the correct number of pulses will not be counted. Correct the wiring.

4. Manually move the Moving Coil in the direction of the cable and check the value of the feedback pulse counter on the SigmaWin+ to confirm that it is counting up.



- 5. If the feedback pulse counter counts up, set a phase-A lead as a phase sequence of U, V, and W (Pn080 = n.□□0□). If the feedback pulse counter counts down, set a phase-B lead as a phase sequence of U, V, and W (Pn080 = n.□□1□).
- 6. Turn the power supply to the SERVOPACK OFF and ON again.
- 7. If necessary, return  $Pn000 = n.\Box\Box\BoxX$  (Direction Selection) to its original setting.

This concludes the procedure to set the phase sequence of the Linear Servomotor.

## 5.8 Polarity Sensor Setting

The polarity sensor detects the polarity of the Servomotor. You must set a parameter to specify whether the Linear Servomotor that is connected to the SERVOPACK has a polarity sensor. Specify whether there is a polarity sensor in Pn080 =  $n.\square\square\squareX$  (Polarity Sensor Selection).

If the Linear Servomotor has a polarity sensor, set Pn080 to n.  $\Box\Box\Box$  (Use polarity sensor) (default setting).

If the Linear Servomotor does not have a polarity sensor, set Pn080 to n. DDD1 (Do not use polarity sensor). Turn the power supply OFF and ON again to enable the new setting.

| Parameter |                             | Meaning                     | When Enabled  | Classification |
|-----------|-----------------------------|-----------------------------|---------------|----------------|
| Pn080     | n.□□□0<br>(default setting) | Use polarity sensor.        | After restart | Setup          |
|           | n.0001                      | Do not use polarity sensor. |               |                |

5.9.1 Restrictions

## 5.9 Polarity Detection

If you use a Linear Servomotor that does not have a polarity sensor, then you must detect the polarity.

Detecting the polarity means that the position of the electrical angle phase on the electrical angle coordinates of the Servomotor is detected. The SERVOPACK cannot control the Servomotor correctly unless it accurately knows the position of the electrical angle coordinate of the Servomotor.

The execution timing and execution method for polarity detection depend on the encoder specification as described in the following table.

| Encoder Specification | Polarity Detection Execution Timing                                                                                                                                         | Polarity Detection Execution Method                                                                                                                                                 |  |
|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|                       | Each time the control power supply to the SERVOPACK is turned ON                                                                                                            | <ul> <li>Use the Servo ON command (Enable<br/>= 1).</li> </ul>                                                                                                                      |  |
| Incremental encoder   | (Even after you execute polarity detec-<br>tion, the position of the polarity will be<br>lost the next time the control power<br>supply to the SERVOPACK is turned<br>OFF.) | <ul> <li>Use the polarity detection function of<br/>the SigmaWin+.</li> <li>Execute the Fn080 (Polarity Detection)<br/>utility function from the Digital Opera-<br/>tor.</li> </ul> |  |
|                       | Only for initial setup, or after the SERVOPACK, linear encoder, or Servomotor has been replaced                                                                             | Use the polarity detection function of the SigmaWin+.                                                                                                                               |  |
| Absolute encoder      | (The results of polarity detection is<br>stored in the absolute encoder, so the<br>polarity position is not lost when the<br>control power supply is turned OFF.)           | • Execute the Fn080 (Polarity Detection) utility function from the Digital Operator.                                                                                                |  |

Information If you use a Linear Servomotor that does not have a polarity sensor, you will not be able to turn ON the servo until polarity detection has been completed.

### 5.9.1 Restrictions

### **Assumed Conditions**

The Servomotor will move when you execute polarity detection. The following conditions must be met before you start.

- It must be OK to move the Moving Coil about 10 mm. (If polarity detection fails, the Moving Coil may move approximately 5 cm. The amount of movement depends on conditions.)
- The linear encoder pitch must be 100  $\mu m$  or less. (We recommend a pitch of 40  $\mu m$  or less for an incremental encoder.)
- As much as possible, the motor must not be subjected to an imbalanced external force. (We recommend 5% or less of the rated force.)
- The mass ratio must be 50x or less.
- The axis must be horizontal.
- There must be friction equivalent to a few percent of the rated force applied to the guides. (Air sliders cannot be used.)

### Preparations

Always check the following before you execute polarity detection.

- Not using a polarity sensor must be specified (Pn080 =  $n.\square\square\square1$ ).
- The servo must be OFF.
- The main circuit power supply must be ON.
- There must be no hard wire base block (HWBB).
- There must be no alarms except for an A.C22 alarm (Phase Information Disagreement).

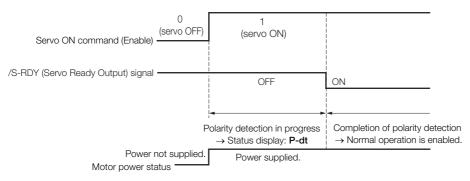
#### 5.9.2 Using the Servo ON Command to Perform Polarity Detection

- The parameters must not be write prohibited. (This item applies only when using the SigmaWin+ or Digital Operator.)
- The test without a motor function must be disabled (Pn00C =  $n.\Box\Box\Box$ ).
- There must be no overtravel.
- If the motor parameters have been written or the origin of the absolute linear encoder has been set, the power supply to the SERVOPACK must be turned OFF and ON again after completion of the writing or setting operation.
  - 1. Power is supplied to the Servomotor during polarity detection. Be careful not to get an electric shock. Also, the Moving Coil of the Linear Servomotor may greatly move during detection. Do not approach the moving parts of the Servomotor.
  - Important
    - 2. Polarity detection is affected by many factors. For example, polarity detection may fail if the mass ratio or friction is too large or the cable tension is too strong.

#### Using the Servo ON Command to Perform Polarity 5.9.2 Detection

You can use the Servo ON command to perform polarity detection only with an incremental linear encoder.

Polarity detection will start simultaneously with execution of the Servo ON command. As soon as polarity detection is completed, the /S-RDY (Servo Ready Output) signal will turn ON and the servo will remain ON.



## 5.9.3 Using a Tool Function to Perform Polarity Detection

### **Applicable Tools**

The following table lists the tools that you can use to perform polarity detection.

| Tool             | Fn No./Function Name                 | Reference                                                                     |
|------------------|--------------------------------------|-------------------------------------------------------------------------------|
| Digital Operator | Fn080                                | Σ-7-Series Digital Operator Operating<br>Manual (Manual No.: SIEP S800001 33) |
| SigmaWin+        | Encoder Setting – Polarity Detection | G Operating Procedure on page 5-27                                            |

### **Operating Procedure**

Use the following procedure to perform polarity detection.

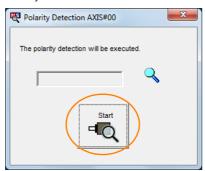
- 1. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Polarity Detection in the Menu Dialog Box. The Polarity Detection Dialog Box will be displayed.
- 3. Click the Continue Button.

| Polarity Detection                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                         |
| During execution of this function, power will be supplied to the motor.<br>Take care to avoid electric shock.<br>The motor may move widely.<br>Do not approach the motor movable parts. |
| Do you want to continue the polarity detection?                                                                                                                                         |
| Continue                                                                                                                                                                                |

Click the Cancel Button to cancel polarity detection. The Main Window will return.

#### 4. Click the Start Button.

Polarity detection will be executed.



This concludes the polarity detection procedure.

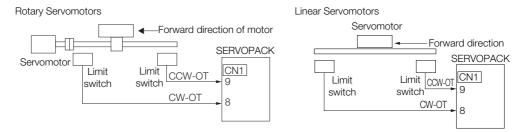
5.10.1 Overtravel Signals

## 5.10 Overtravel and Related Settings

Overtravel is a function of the SERVOPACK that forces the Servomotor to stop in response to a signal input from a limit switch that is activated when a moving part of the machine exceeds the safe range of movement.

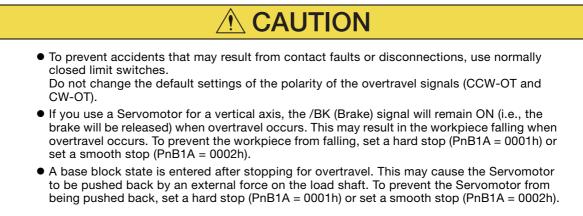
The overtravel signals include the CCW-OT (CCW Drive Prohibit) and the CW-OT (CW Drive Prohibit) signals. You use the CCW-OT and CW-OT signals to stop the machine by installing limit switches at the positions where you want to stop the machine that is operated by the Servomotor.

A SERVOPACK wiring example is provided below.



Using the overtravel function is not necessary for rotating applications such as rotary tables and conveyors. No wiring for overtravel input signals is required.

This section describes the parameters settings related to overtravel.



### 5.10.1 Overtravel Signals

The overtravel signals include the CCW-OT (CCW Drive Prohibit) and the CW-OT (CW Drive Prohibit) signals.

| Туре  | Signal | Connector Pin No. | Meaning                                                            |
|-------|--------|-------------------|--------------------------------------------------------------------|
| Input | CCW-OT | CN1-8             | Prohibits CCW drive (counterclockwise as viewed from the encoder). |
|       | CW-OT  | CN1-9             | Prohibits CW drive (clockwise as viewed from the encoder).         |

Even during overtravel, you can input a reference to drive the motor in the opposite direction.

#### 5.10.2 Setting to Enable/Disable Overtravel

## 5.10.2 Setting to Enable/Disable Overtravel

Use PnBA4 (Input Signal Settings) to enable/disable the overtravel function.

You do not need to wire the overtravel input signals if you are not going to use the overtravel function.

|        | Parameter             | Meaning                                                                                |  |
|--------|-----------------------|----------------------------------------------------------------------------------------|--|
|        | b.0000 0000 0000 0000 | The CCW-OT (CCW Drive Prohibit Input) signal is disabled.                              |  |
| PnBA4  | b.0000 0000 0000 0001 | The CCW-OT (CCW Drive Prohibit Input) signal is input from CN1-8.<br>(Default setting) |  |
| FIIDA4 | b.0000 0000 0000 0000 | The CW-OT (CW Drive Prohibit Input) signal is disabled.                                |  |
|        | b.0000 0000 0000 0010 | The CW-OT (CW Drive Prohibit Input) signal is input from CN1-9.<br>(Default setting)   |  |

Note: Overtravel does not depend on the setting of  $Pn000 = n.\Box\Box\BoxX$ .

## 5.10.3 Setting Overtravel Signal Polarity

Use PnBA3 (Input Signal Logic Settings) to set the polarity of the signals that will be active.

|        | Parameter             | Meaning                                                                                                           |  |
|--------|-----------------------|-------------------------------------------------------------------------------------------------------------------|--|
|        | b.0000 0000 0000 0000 | The CCW-OT (CCW Drive Prohibit Input) signal is active while<br>the external switch is open.<br>(Default setting) |  |
| PnBA3  | b.0000 0000 0000 0001 | The CCW-OT (CCW Drive Prohibit Input) signal is active whi the external switch is closed.                         |  |
| FIIDAJ | b.0000 0000 0000 0000 | The CW-OT (CW Drive Prohibit Input) signal is active while the external switch is open. (Default setting)         |  |
|        | b.0000 0000 0000 0010 | The CW-OT (CW Drive Prohibit Input) signal is active while the external switch is closed.                         |  |

## 5.10.4 Motor Stopping Method for Overtravel

Use PnB1A (Hardware Limit Action Selection) to set the Servomotor stopping method when overtravel occurs.

| Parameter |                            | Meaning                 | Reference                                  |
|-----------|----------------------------|-------------------------|--------------------------------------------|
|           | 0000h<br>(default setting) | Servo OFF*1             | -                                          |
| PnB1A     | 0001h                      | Hard stop <sup>*2</sup> | 13.3.5 Hard Stop Operation on page 13-20   |
|           | 0002h                      | Smooth stop*2           | 13.3.6 Smooth Stop Operation on page 13-21 |

\*1. If overtravel occurs, the servo will be turned OFF regardless of the rotation direction.

\*2. The motor will stop if overtravel occurs, but you can input a reference to drive the motor in the opposite direction.

Refer to the following section for information on stopping methods other than those for overtravel.

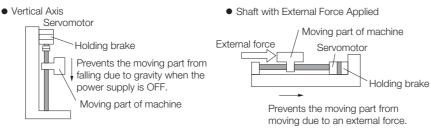
5.12.1 Stopping Method for Servo OFF on page 5-35

5.11.1 Brake Operating Sequence

## 5.11 Holding Brake

A holding brake is used to hold the position of the moving part of the machine when the SER-VOPACK is turned OFF so that moving part does not move due to gravity or an external force. You can use the brake that is built into a Servomotor with a Brake, or you can provide one on the machine.

The holding brake is used in the following cases.



• The brake built into a Servomotor with a Brake is a de-energization brake. It is used only to hold the Servomotor and cannot be used for braking. Use the holding brake only to hold a Servomotor that is already stopped.

• The /BK signal will remain ON during overtravel. The brake will not be applied.

## 5.11.1 Brake Operating Sequence

You must consider the brake release delay time and the brake operation delay time to determine the brake operation timing, as described below.



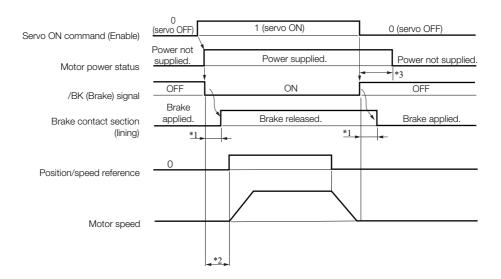
Important

#### Brake Release Delay Time

The time from when the /BK (Brake) signal is turned ON until the brake is actually released.

#### Brake Operation Delay Time

The time from when the /BK (Brake) signal is turned OFF until the brake actually operates.



#### 5.11.2 /BK (Brake) Signal

\*1. Rotary Servomotors: The brake delay times for Servomotors with Holding Brakes are given in the following table. The operation delay times in the following table are examples for when the power supply is switched on the DC side. You must evaluate the actual brake delay times on the actual equipment before using the application.

| Model            | Voltage | Brake Release<br>Delay Time [ms] | Brake Operation<br>Delay Time [ms] |
|------------------|---------|----------------------------------|------------------------------------|
| SGM7M-A1 to -A3  |         | 60                               |                                    |
| SGM7J-A5 to -04  |         | 00                               |                                    |
| SGM7J-06 and -08 |         | 80                               | 100                                |
| SGM7A-A5 to -04  |         | 60                               |                                    |
| SGM7A-06 to -10  |         | 80                               |                                    |
| SGM7A-15 to -25  |         | 170                              | 80                                 |
| SGM7A-30 to -50  | 24 VDC  | 100                              | 80                                 |
| SGM7P-01         | 24 VDC  | 20                               |                                    |
| SGM7P-02 and -04 |         | 40                               | 100                                |
| SGM7P-08 and -15 |         | 20                               |                                    |
| SGM7G-03 to -20  |         | 100                              | 80                                 |
| SGM7G-30 to -44  |         | 170                              | 100                                |
| SGM7G-55 to -1A  |         | 170                              | 90                                 |
| SGM7G-1E         | GM7G-1E |                                  | 80                                 |

Linear Servomotors: The brake delay times depend on the brake that you use. Set the parameters related to /BK signal output timing according to the delay times for the brake that you will actually use.

- \*2. Before you output a reference from the host controller to the SERVOPACK, wait for at least 50 ms plus the brake release delay time after you send the Servo ON command.
- \*3. Use the following parameters to set the timing of when the brake will operate and when the servo will be turned OFF.
  - Rotary Servomotors: Pn506 (Brake Reference-Servo OFF Delay Time), Pn507 (Brake Reference Output Speed Level), and Pn508 (Servo OFF-Brake Reference Waiting Time)
  - Linear Servomotors: Pn506 (Brake Reference-Servo OFF Delay Time), Pn508 (Servo OFF-Brake Reference Waiting Time), and Pn583 (Brake Reference Output Speed Level)

### **Connection Examples**

Refer to the following section for information on brake wiring. *4.4.4 Wiring the SERVOPACK to the Holding Brake* on page 4-35

## 5.11.2 /BK (Brake) Signal

The following settings are for the output signal that controls the brake. The /BK signal is turned OFF (to operate the brake) when the servo is turned OFF or when an alarm is detected. You can adjust the timing of brake operation (i.e., the timing of turning OFF the /BK signal) with the servo OFF delay time (Pn506).

| Туре   | Signal                 | Connector Pin No. | Signal Status        | Meaning             |
|--------|------------------------|-------------------|----------------------|---------------------|
| Output | /BK                    | CN1-1. CN1-2      | ON (closed)          | Releases the brake. |
| Output | DUT /BK CINI-1, CINI-2 | OFF (open)        | Activates the brake. |                     |

Information The /BK signal will remain ON during overtravel. The brake will not be applied.

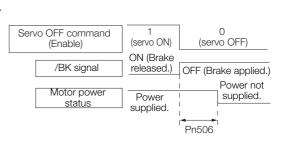
5.11.3 Output Timing of /BK (Brake) Signal When the Servomotor Is Stopped

### 5.11.3 Output Timing of /BK (Brake) Signal When the Servomotor Is Stopped

When the Servomotor is stopped, the /BK signal turns OFF as soon as the Servo OFF command (Enable = 0) is received. Use the servo OFF delay time (Pn506) to change the timing to turn OFF power supply to the motor after the Servo OFF command is input.

| Brake Reference-Servo OFF Delay Time |       |                                                                     |       |   |             |       |  |
|--------------------------------------|-------|---------------------------------------------------------------------|-------|---|-------------|-------|--|
|                                      | Pn506 | Setting Range Setting Unit Default Setting When Enabled Classificat |       |   |             |       |  |
|                                      |       | 0 to 50                                                             | 10 ms | 0 | Immediately | Setup |  |

When the Servomotor is used to control a vertical axis, the machine moving part may move slightly due to gravity or an external force. You can eliminate this slight motion by setting the servo OFF delay time (Pn506) so that power supply to the motor is stopped after the brake is applied.



• This parameter sets the timing of stopping power supply to the Servomotor while the Servomotor is stopped.

Power supply to the Servomotor will be stopped immediately when an alarm occurs, regardless of the setting of this parameter. The machine moving part may move due to gravity or an external force before the brake is applied.

# 5.11.4 Output Timing of /BK (Brake) Signal When the Servomotor Is Operating

If an alarm occurs while the Servomotor is operating, the Servomotor will start stopping and the /BK signal will be turned OFF. You can adjust the timing of /BK signal output by setting the brake reference output speed level (Rotary Servomotors: Pn507, Linear Servomotors: Pn583) and the servo OFF-brake reference waiting time (Pn508).

Note: If zero-speed stopping is set as the stopping method for alarms, the setting of Pn506 (Brake Reference-Servo OFF Delay Time) is used after the motor stops.

|       | Brake Reference Output Speed Level     |                     |                 |              |                |  |
|-------|----------------------------------------|---------------------|-----------------|--------------|----------------|--|
| Pn507 | Setting Range                          | Setting Unit        | Default Setting | When Enabled | Classification |  |
|       | 0 to 10,000                            | 1 min <sup>-1</sup> | 100             | Immediately  | Setup          |  |
|       | Servo OFF-Brake Reference Waiting Time |                     |                 |              |                |  |
| Pn508 | Setting Range                          | Setting Unit        | Default Setting | When Enabled | Classification |  |
|       | 10 to 100                              | 10 ms               | 50              | Immediately  | Setup          |  |

#### Rotary Servomotors

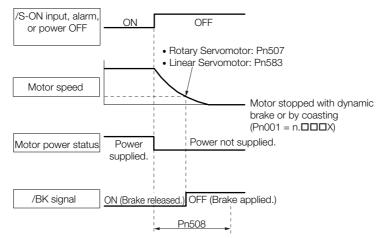
#### Linear Servomotors

|       | Brake Reference Output Speed Level |                      |                 |              |                |
|-------|------------------------------------|----------------------|-----------------|--------------|----------------|
| Pn583 | Setting Range                      | Setting Unit         | Default Setting | When Enabled | Classification |
|       | 0 to 10,000                        | 1 mm/s               | 10              | Immediately  | Setup          |
|       | Servo OFF-Brake R                  | eference Waiting Tir | ne              |              |                |
| Pn508 | Setting Range                      | Setting Unit         | Default Setting | When Enabled | Classification |
|       | 10 to 100                          | 10 ms                | 50              | Immediately  | Setup          |

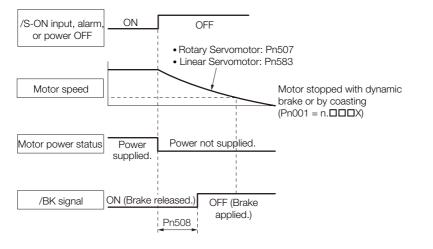
#### 5.11.4 Output Timing of /BK (Brake) Signal When the Servomotor Is Operating

The brake operates when either of the following conditions is satisfied:

• When the Motor Speed Goes below the Level Set in Pn507 for a Rotary Servomotor or in Pn583 for a Linear Servomotor after the Power Supply to the Motor Is Stopped



• When the Time Set In Pn508 Elapses after the Power Supply to the Motor Is Stopped





The Servomotor will be limited to its maximum speed even if the brake reference output speed level (Rotary Servomotor: Pn507, Linear Servomotor: Pn583) is higher than the maximum speed.

# 5.12 Motor Stopping Method for Servo OFF and Alarms

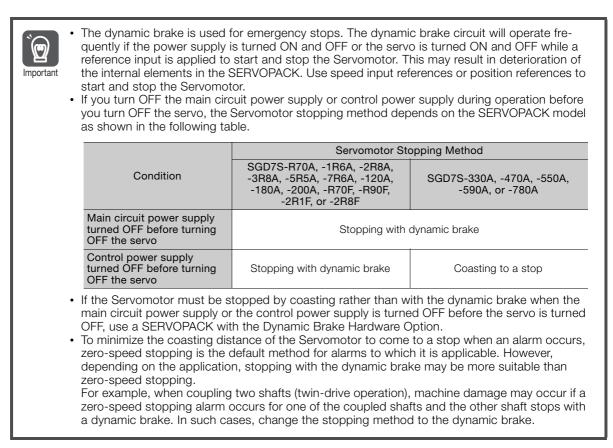
You can use the following methods to stop the Servomotor when the servo is turned OFF or an alarm occurs.

There are the following four stopping methods.

| Motor Stopping Method                  | Meaning                                                                        |
|----------------------------------------|--------------------------------------------------------------------------------|
| Stopping by Applying the Dynamic Brake | The electric circuits are internally connected to stop the Servomotor quickly. |
| Coasting to a Stop                     | The motor stops naturally due to friction during operation.                    |
| Zero-speed Stopping                    | The speed reference is set to 0 to stop the Servomotor quickly.                |
| Decelerating to a Stop                 | Emergency stop torque is used to decelerate the motor to a stop.               |

There are the following three conditions after stopping.

| Status after Stopping | Meaning                                                                                                                          |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Dynamic Brake Applied | The electric circuits are internally connected to hold the Servomotor.                                                           |
| Coasting              | The SERVOPACK does not control the Servomotor. (The machine will move in response to a force from the load.)                     |
| Zero Clamping         | A position loop is created and the Servomotor remains stopped at a position reference of 0. (The current stop position is held.) |



5.12.1 Stopping Method for Servo OFF

## 5.12.1 Stopping Method for Servo OFF

Set the stopping method for when the servo is turned OFF in Pn001 =  $n.\Box\Box\BoxX$  (Servo OFF or Alarm Group 1 Stopping Method).

| Parameter |                             | Servomotor Stop-<br>ping Method | Status after Servo-<br>motor Stops | When Enabled  | Classifi-<br>cation |
|-----------|-----------------------------|---------------------------------|------------------------------------|---------------|---------------------|
| D=001     | n.□□□0<br>(default setting) | Dynamic brake*                  | Dynamic brake*                     | After restart | Setup               |
| Pn001     | n.0001                      |                                 | Coasting                           | After restart |                     |
|           | n.0002                      | Coasting                        | Coasting                           |               |                     |

\* The Servomotor will coast to a stop when the SERVOPACK is not equipped with a built-in Dynamic Brake Resistor or an External Dynamic Brake Resistor is not connected.

Note: If Pn001 is set to n. DDD (Stop the motor by applying the dynamic brake) and the Servomotor is stopped or operates at a low speed, braking force may not be generated, just like it is not generated for coasting to a stop.

## 5.12.2 Servomotor Stopping Method for Alarms

There are two types of alarms, group 1 (Gr. 1) alarms and group 2 (Gr. 2) alarms. A different parameter is used to set the stopping method for alarms for each alarm type.

Refer to the following section to see which alarms are in group 1 and which are in group 2. *14.2.1 List of Alarms* on page 14-5

#### Motor Stopping Method for Group 1 Alarms

When a group 1 alarm occurs, the Servomotor will stop according to the setting of  $Pn001 = n.\Box\Box\BoxX$ . The default setting is to stop by applying the dynamic brake.

Refer to the following section for details.

5.12.1 Stopping Method for Servo OFF on page 5-35

#### Motor Stopping Method for Group 2 Alarms

When a group 2 alarm occurs, the Servomotor will stop according to the settings of the following three parameters. The default setting is for zero clamping.

- Pn001 = n. DDX (Servo OFF or Alarm Group 1 Stopping Method)
- Pn00A =  $n.\Box\Box\BoxX$  (Motor Stopping Method for Group 2 Alarms)
- Pn00B =  $n.\Box\Box X\Box$  (Motor Stopping Method for Group 2 Alarms)

If you set Pn00B to n.  $\Box\Box$   $\Box$  (Apply dynamic brake or coast Servomotor to a stop), you can use the same stopping method as group 1. If you are coordinating a number of Servomotors, you can use this stopping method to prevent machine damage that may result because of differences in the stopping method.

The following table shows the combinations of the parameter settings and the resulting stopping methods.

5.12.2 Servomotor Stopping Method for Alarms

|                      | Parameter                      |                             | Servomotor                                           | Status after        | When            |                |
|----------------------|--------------------------------|-----------------------------|------------------------------------------------------|---------------------|-----------------|----------------|
| Pn00B                | Pn00A                          | Pn001                       | Stopping Method                                      | Servomotor<br>Stops | Enabled         | Classification |
| n.□□0□               |                                | n.□□□0<br>(default setting) | Zero-speed stop-                                     | Dynamic<br>brake    |                 |                |
| (default<br>setting) | -                              | n.0001                      | ping                                                 | Coasting            |                 |                |
| Jotting              |                                | n.□□□2                      |                                                      | Coasting            |                 |                |
|                      |                                | n.□□□0<br>(default setting) | Dynamic brake                                        | Dynamic<br>brake    |                 |                |
| n.□□1□               | -                              | n.0001                      |                                                      | Coasting            |                 |                |
|                      |                                | n.□□□2                      | Coasting                                             | Coasting            |                 |                |
|                      |                                | n.□□□0<br>(default setting) | Dynamic brake                                        | Dynamic<br>brake    | _               |                |
|                      | n.□□□0                         | n.0001                      |                                                      | Coopting            |                 |                |
|                      |                                | n.□□□2                      | Coasting                                             | Coasting            |                 |                |
|                      | n.□□□1<br>(default<br>setting) | n.□□□0<br>(default setting) |                                                      | Dynamic<br>brake    | - After restart | Setup          |
|                      |                                | n.0001                      | Motor is deceler-<br>ated using the<br>torque set in | Coasting            |                 |                |
|                      | oottiing,                      | n.DDD2                      |                                                      |                     |                 |                |
| n.0020               | n.0002                         | n.□□□0<br>(default setting) | Pn406 as the maximum torque.                         | Coasting            |                 |                |
|                      |                                | n.0001                      |                                                      | Coasting            |                 |                |
|                      |                                | n.0002                      |                                                      |                     |                 |                |
|                      |                                | n.□□□0<br>(default setting) |                                                      | Dynamic<br>brake    |                 |                |
|                      | n.□□□3                         | n.□□□1                      |                                                      | Coasting            |                 |                |
|                      |                                | n.□□□2                      | Motor is deceler-<br>ated according to               | Obasting            |                 |                |
|                      |                                | n.□□□0<br>(default setting) | setting of Pn30A.                                    |                     |                 |                |
|                      | n.□□□4                         | n.0001                      |                                                      | Coasting            |                 |                |
|                      |                                | n.🗆 🗆 🗠 2                   |                                                      |                     |                 |                |

Note: 1. The setting of Pn00A is ignored if Pn00B is set to n. DDD or n. DD1D.

2. Refer to the following section for details on Pn406 (Emergency Stop Torque).

Stopping the Servomotor by Setting Emergency Stop Torque on page 5-36

3. Refer to the following section for details on Pn30A (Deceleration Time for Servo OFF and Forced Stops). Stopping the Servomotor by Setting the Deceleration Time on page 5-37

#### Stopping the Servomotor by Setting Emergency Stop Torque

To stop the Servomotor by setting emergency stop torque, set Pn406 (Emergency Stop Torque).

If Pn00A =  $n.\Box\Box\BoxX$  is set to 1 or 2, the Servomotor will be decelerated to a stop using the torque set in Pn406 as the maximum torque.

The default setting is 800%. This setting is large enough to allow you to operate the Servomotor at the maximum torque. However, the maximum emergency stop torque that you can actually use is the maximum torque of the Servomotor.

| Emergency Stop Torque |               |              |                 |              |                |  |
|-----------------------|---------------|--------------|-----------------|--------------|----------------|--|
| Pn406                 | Setting Range | Setting Unit | Default Setting | When Enabled | Classification |  |
|                       | 0 to 800      | 1%*          | 800             | Immediately  | Setup          |  |

\* Set a percentage of the motor rated torque.

5.12.2 Servomotor Stopping Method for Alarms

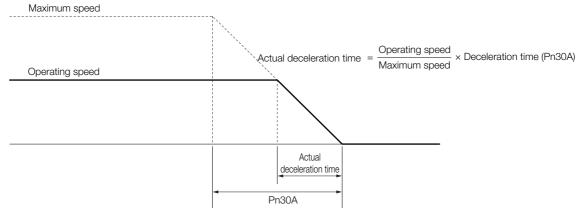
#### Stopping the Servomotor by Setting the Deceleration Time

To specify the Servomotor deceleration time and use it to stop the Servomotor, set Pn30A (Deceleration Time for Servo OFF and Forced Stops).

|       | Deceleration Time for Servo OFF and Forced Stops |              |                 |              |                |  |  |
|-------|--------------------------------------------------|--------------|-----------------|--------------|----------------|--|--|
| Pn30A | Setting Range                                    | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 10,000                                      | 1 ms         | 0               | Immediately  | Setup          |  |  |

If you set Pn30A to 0, the Servomotor will be stopped with a zero speed.

The deceleration time that you set in Pn30A is the time to decelerate the Servomotor from the maximum motor speed.



5.13.1 Detection Timing for Overload Warnings (A.910)

# 5.13 Motor Overload Detection Level

The motor overload detection level is the threshold used to detect overload alarms and overload warnings when the Servomotor is subjected to a continuous load that exceeds the Servomotor ratings.

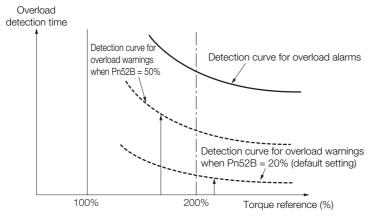
It is designed to prevent Servomotor overheating.

You can change the detection timing for A.910 warnings (Overload) and A.720 alarms (Continuous Overload). You cannot change the detection level for A.710 alarms (Instantaneous Overload).

## 5.13.1 Detection Timing for Overload Warnings (A.910)

With the default setting for overload warnings, an overload warning is detected in 20% of the time required to detect an overload alarm. You can change the time required to detect an overload warning by changing the setting of the overload warning level (Pn52B). You can increase safety by using overload warning detection as an overload protection function matched to the system.

The following graph shows an example of the detection of overload warnings when the overload warning level (Pn52B) is changed from 20% to 50%. An overload warning is detected in half of the time required to detect an overload alarm.



|       | Overload Warning L | Overload Warning Level |                 |              |                |  |  |  |  |
|-------|--------------------|------------------------|-----------------|--------------|----------------|--|--|--|--|
| Pn52B | Setting Range      | Setting Unit           | Default Setting | When Enabled | Classification |  |  |  |  |
|       | 1 to 100           | 1%                     | 20              | Immediately  | Setup          |  |  |  |  |

5.13.2 Detection Timing for Overload Alarms (A.720)

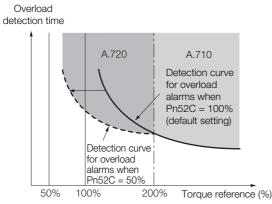
## 5.13.2 Detection Timing for Overload Alarms (A.720)

If Servomotor heat dissipation is insufficient (e.g., if the heat sink is too small), you can lower the overload alarm detection level to help prevent overheating.

To reduce the overload alarm detection level, change the setting of Pn52C (Base Current Derating at Motor Overload Detection).

|       | Base Current Derating at Motor Overload Detection |              |                 |               |                |  |  |
|-------|---------------------------------------------------|--------------|-----------------|---------------|----------------|--|--|
| Pn52C | Setting Range                                     | Setting Unit | Default Setting | When Enabled  | Classification |  |  |
|       | 10 to 100                                         | 1%           | 100             | After restart | Setup          |  |  |

An A.720 alarm (Continuous Overload) can be detected earlier to protect the Servomotor from overloading.



Note: The gray areas in the above graph show where A.710 and A.720 alarms occur.

Refer to the relevant manual given below for a diagram that shows the relationships between the Servomotor heat dissipation conditions (heat sink size, surrounding air temperature, and derating). You can protect the Servomotor from overloads more effectively by setting this derating value in Pn52C.

Ω Σ-7-Series Rotary Servomotor Product Manual (Manual No.: SIEP S800001 36)

Ω Σ-7-Series Linear Servomotor Product Manual (Manual No.: SIEP S800001 37)

 $\square$   $\Sigma$ -7-Series Direct Drive Servomotor Product Manual (Manual No.: SIEP S800001 38)

# 5.14 Electronic Gear Settings

The minimum unit of the position data that is used to move a load is called the reference unit. The reference unit is used to give travel amounts, not in pulses, but rather in distances or other physical units (such as  $\mu m$  or °) that are easier to understand.

The electronic gear is used to convert the travel distances that are specified in reference units to pulses, which are required for actual movements.

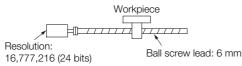
With the electronic gear, one reference unit is equal to the workpiece travel distance per reference pulse input to the SERVOPACK. In other words, if you use the SERVOPACK's electronic gear, pulses can be read as reference units.

Note: If you set an electronic gear in the host controller, normally set the electronic gear ratio in the SERVOPACK to 1:1.

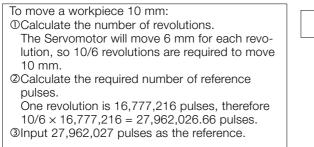
The difference between using and not using the electronic gear is shown below.

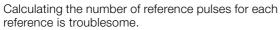
#### Rotary Servomotors

In this example, the following machine configuration is used to move the workpiece 10 mm.



When the Electronic Gear Is Not Used





When the Electronic Gear Is Used

If you use reference units to move the workpiece when one reference unit is set to 1  $\mu$ m, the travel distance is 1  $\mu$ m per pulse. To move the workpiece 10 mm (10,000  $\mu$ m), 10,000 ÷ 1 = 10,000 pulses, so 10,000 pulses would be input.

Calculating the number of reference pulses for each reference is not necessary.

#### Linear Servomotors

In this example, the following machine configuration is used to move the load 10 mm. We'll assume that the resolution of the Serial Converter Unit is 256 and that the linear encoder pitch is 20  $\mu$ m.

Linear encoder

When the Electronic Gear Is Not Used

To move the load 10 mm:  $10 \times 1000 \div 20 \times 256 = 128,000$ pulses, so 128,000 pulses are input as the reference.

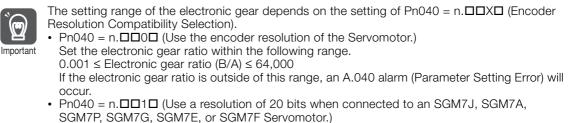
Calculating the number of reference pulses for each reference is troublesome. When the Electronic Gear Is Used

To use reference units to move the load 10 mm: If we set the reference unit to 1  $\mu$ m, the travel distance is 1  $\mu$ m per pulse. To move the load 10 mm (10,000  $\mu$ m), 10,000/1 = 10,000 pulses, so 10,000 pulses would be input as the reference.

Calculating the number of reference pulses for each reference is not necessary.

## 5.14.1 Electronic Gear Ratio Settings

Set the electronic gear ratio using Pn20E and Pn210.



Set the electronic gear ratio within the following range.

 $0.001 \le$  Electronic gear ratio (B/A)  $\le$  4,000

If the electronic gear ratio is outside of this range, an A.040 alarm (Parameter Setting Error) will occur.

The motor may not operate at the maximum speed depending on the encoder resolution and electronic gear ratio setting. Refer to the following table for details.

| Important | Encoder<br>Resolution | Electronic<br>Gear Ratio | Motor Speed Limit*      |
|-----------|-----------------------|--------------------------|-------------------------|
|           | 1,048,576             | 1                        | 6,600 min <sup>-1</sup> |
|           | 4,194,304             | 1                        | 1,650 min <sup>-1</sup> |
|           | 4,194,304             | 4                        | 6,600 min <sup>-1</sup> |
|           | 16,777,216            | 1                        | 413 min <sup>-1</sup>   |
|           | 10,777,210            | 16                       | 6,600 min <sup>-1</sup> |
|           |                       |                          |                         |

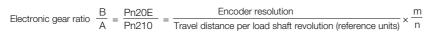
<sup>\*</sup> This is the speed when 115,343,500 reference units/s is set for a parameter or command.

|       | Electronic Gear Ratio (Numerator)   |              |                 |               |                |  |  |  |  |
|-------|-------------------------------------|--------------|-----------------|---------------|----------------|--|--|--|--|
| Pn20E | Setting Range                       | Setting Unit | Default Setting | When Enabled  | Classification |  |  |  |  |
|       | 1 to 1,073,741,824                  | 1            | 64              | After restart | Setup          |  |  |  |  |
|       | Electronic Gear Ratio (Denominator) |              |                 |               |                |  |  |  |  |
| Pn210 | Setting Range                       | Setting Unit | Default Setting | When Enabled  | Classification |  |  |  |  |
|       | 1 to 1,073,741,824                  | 1            | 1               | After restart | Setup          |  |  |  |  |

## Calculating the Settings for the Electronic Gear Ratio

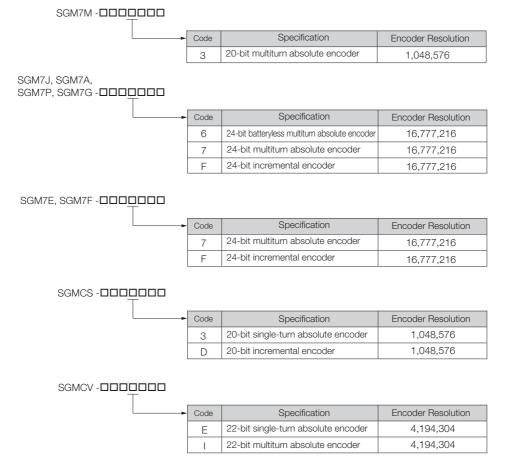
#### Rotary Servomotors

If the gear ratio between the Servomotor shaft and the load is given as n/m, where n is the number of load rotations for m Servomotor shaft rotations, the settings for the electronic gear ratio can be calculated as follows:



#### Encoder Resolution

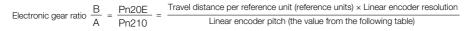
You can check the encoder resolution in the Servomotor model number.



#### Linear Servomotors

You can calculate the settings for the electronic gear ratio with the following equation: When Not Using a Serial Converter Unit

Use the following formula if the linear encoder and SERVOPACK are connected directly or if a linear encoder that does not require a Serial Converter Unit is used.



When Using a Serial Converter Unit

```
Electronic gear ratio \frac{B}{A} = \frac{Pn20E}{Pn210} = \frac{Travel distance per reference unit (reference units) \times Resolution of the Serial Converter Unit Linear encoder pitch (setting of Pn282)
```

#### Feedback Resolution of Linear Encoder

The linear encoder pitches and resolutions are given in the following table. Calculate the electronic gear ratio using the values in the following table.

| Type of<br>Linear<br>Encoder | Manufacturer               | Linear Encoder Model                        | Linear<br>Encoder<br>Pitch<br>[µm] <sup>*1</sup> | Relay Device Model<br>between SERVOPACK<br>and Linear Encoder | Resolution | Resolution |
|------------------------------|----------------------------|---------------------------------------------|--------------------------------------------------|---------------------------------------------------------------|------------|------------|
|                              |                            | LIDA480                                     | 20                                               | JZDP-H003- <b>DD</b> -E <sup>*2</sup>                         | 256        | 0.078 μm   |
|                              | Dr. JOHANNES<br>HEIDENHAIN |                                             | 20                                               | JZDP-J003- <b>DDD</b> -E <sup>*2</sup>                        | 4,096      | 0.0049 μm  |
|                              | GmbH                       | LIF480                                      | 4                                                | JZDP-H003- <b>DDD</b> -E <sup>*2</sup>                        | 256        | 0.016 µm   |
|                              |                            |                                             | 4                                                | JZDP-J003- <b>DD</b> -E <sup>*2</sup>                         | 4,096      | 0.00098 μm |
| Renis                        |                            | RGH22B                                      | 20                                               | JZDP-H005- <b>DDD</b> -E <sup>*2</sup>                        | 256        | 0.078 μm   |
|                              | Renishaw<br>PLC            | KGHZZD                                      | 20                                               | JZDP-J005- <b>DDD</b> -E <sup>*2</sup>                        | 4,096      | 0.0049 μm  |
|                              |                            | TONIC series<br>(Ti0000A00V only)           | 20                                               | JZDP-H005- <b>DDD</b> -E <sup>*2</sup>                        | 256        | 0.078 μm   |
|                              |                            |                                             |                                                  | JZDP-J005- <b>DDD</b> -E <sup>*2</sup>                        | 4,096      | 0.0049 μm  |
| Incre-                       |                            | SR75-0000LF*6                               | 80                                               | -                                                             | 8,192      | 0.0098 µm  |
| mental                       |                            | SR75-DDDDDMF                                | 80                                               | -                                                             | 1,024      | 0.078 μm   |
|                              |                            | $SR85-\Box\Box\Box\Box\BoxLF^{*6}$          | 80                                               | _                                                             | 8,192      | 0.0098 µm  |
|                              | Magnescale                 | SR85-DDDDDMF                                | 80                                               | _                                                             | 1,024      | 0.078 μm   |
|                              | Co., Ltd.                  | SL700 <sup>*6</sup> , SL710 <sup>*6</sup> , | 800                                              | PL101-RY*3                                                    | 8,192      | 0.0977 μm  |
|                              |                            | SL720 <sup>*6</sup> , SL730 <sup>*6</sup>   | 000                                              | MJ620-T13 <sup>*4</sup>                                       | 0,192      | 0.0977 μπ  |
|                              |                            | SQ10                                        | 400                                              | MQ10-FLA <sup>*4</sup>                                        | 8,192      | 0.0488 µm  |
|                              |                            | 3010                                        | 400                                              | MQ10-GLA <sup>*4</sup>                                        | 0,192      | 0.0400 µm  |
|                              | Canon                      | PH03-36110                                  | 128                                              | _                                                             | 2,048      | 0.0625 μm  |
|                              | Precision Inc.             | PH03-36120                                  | 128                                              | _                                                             | 2,048      | 0.0625 μm  |

Continued on next page.

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Continued from previous page.

| Type of<br>Linear<br>Encoder | Manufacturer            | Linear Encoder Model                                 | Linear<br>Encoder<br>Pitch<br>[µm] <sup>*1</sup> | Relay Device Model<br>between SERVOPACK<br>and Linear Encoder | Resolution | Resolution |
|------------------------------|-------------------------|------------------------------------------------------|--------------------------------------------------|---------------------------------------------------------------|------------|------------|
|                              |                         | LIC4100 Series <sup>*7</sup>                         | 20.48                                            | EIB3391Y*5                                                    | 4,096      | 0.005 μm   |
|                              |                         | *7                                                   | 204.8                                            | EIB3391Y*5                                                    | 4,096      | 0.05 µm    |
|                              |                         | LIC2100 Series <sup>*7</sup>                         | 409.6                                            | EIB3391Y*5                                                    | 4,096      | 0.1 µm     |
|                              |                         |                                                      | 40.96                                            | _                                                             | 4,096      | 0.01 µm    |
|                              | Dr.                     | LIC4190 Series                                       | 20.48                                            | _                                                             | 4,096      | 0.005 μm   |
|                              | JOHANNES<br>HEIDENHAIN  |                                                      | 4.096                                            | _                                                             | 4,096      | 0.001 µm   |
|                              | GmbH                    | LIC3190 Series                                       | 40.96                                            | -                                                             | 4,096      | 0.01 µm    |
|                              |                         | LIC2190 Series                                       | 409.6                                            | -                                                             | 4,096      | 0.1 μm     |
|                              |                         | LICZ 190 Series                                      | 204.8                                            | -                                                             | 4,096      | 0.05 µm    |
|                              |                         | LC115                                                | 40.96                                            | EIB3391Y*5                                                    | 4,096      | 0.01 µm    |
|                              |                         | LC415                                                | 40.96                                            | EIB3391Y*5                                                    | 4,096      | 0.01 µm    |
|                              | RSF Elektronik          |                                                      | 409.6                                            | _                                                             | 4,096      | 0.1 μm     |
|                              | GmbH                    | MC15Y Series                                         | 204.8                                            | _                                                             | 4,096      | 0.05 µm    |
|                              |                         | ST781A/ST781AL                                       | 256                                              | _                                                             | 512        | 0.5 µm     |
|                              |                         | ST782A/ST782AL                                       | 256                                              | _                                                             | 512        | 0.5 μm     |
|                              | Mitutoyo<br>Corporation | ST783/ST783AL                                        | 51.2                                             | -                                                             | 512        | 0.1 μm     |
|                              |                         | ST784/ST784AL                                        | 51.2                                             | -                                                             | 512        | 0.1 μm     |
|                              |                         | ST788A/ST788AL                                       | 51.2                                             | -                                                             | 512        | 0.1 μm     |
|                              |                         | ST789A/ST789AL                                       | 25.6                                             | _                                                             | 512        | 0.05 µm    |
| Absolute                     |                         | ST1381                                               | 5.12                                             | _                                                             | 512        | 0.01 µm    |
|                              |                         | ST1382                                               | 0.512                                            | -                                                             | 512        | 0.001 µm   |
|                              |                         |                                                      | 12.8                                             | -                                                             | 256        | 0.05 µm    |
|                              |                         | EL36Y00100F000                                       | 25.6                                             | -                                                             | 256        | 0.1 μm     |
|                              | Renishaw<br>PLC         | EL36Y00500F000                                       | 128                                              | _                                                             | 256        | 0.5 μm     |
|                              | T EO                    | RL36Y00000000                                        | 12.8                                             | _                                                             | 256        | 0.05 µm    |
|                              |                         | RL36Y0001000                                         | 0.256                                            | _                                                             | 256        | 0.001 µm   |
|                              |                         |                                                      | 2,000                                            | _                                                             | 2,048      | 0.9765 µm  |
|                              | RLS d.o.o.              | LA11YA Series                                        | 2,000                                            | -                                                             | 4,096      | 0.4882 µm  |
|                              |                         |                                                      | 2,000                                            | -                                                             | 8,192      | 0.2441 µm  |
|                              |                         | SR77-DDDDDLF*6                                       | 80                                               | -                                                             | 8,192      | 0.0098 µm  |
|                              |                         | SR77-DDDDDMF                                         | 80                                               | _                                                             | 1,024      | 0.078 μm   |
|                              |                         | SR87-DDDDDLF <sup>*6</sup>                           | 80                                               | _                                                             | 8,192      | 0.0098 µm  |
|                              |                         | SR87-DDDDDMF                                         | 80                                               | _                                                             | 1,024      | 0.078 µm   |
|                              | Magnescale<br>Co., Ltd. | SQ47/SQ57-<br>DDDDDSFDDD<br>SQ47/SQ57-<br>DDDDTFDDD  | 20.48                                            | _                                                             | 4,096      | 0.005 μm   |
|                              |                         | SQ47/SQ57-<br>DDDDDAFDDD<br>SQ47/SQ57-<br>DDDDDFFDDD | 40.96                                            | _                                                             | 4,096      | 0.01 µm    |

Continued on next page.

Continued from previous page.

| Type of<br>Linear<br>Encoder | Manufacturer                    | Linear Encoder Model | Linear<br>Encoder<br>Pitch<br>[µm] <sup>*1</sup> | Relay Device Model<br>between SERVOPACK<br>and Linear Encoder | Resolution | Resolution |
|------------------------------|---------------------------------|----------------------|--------------------------------------------------|---------------------------------------------------------------|------------|------------|
|                              |                                 | L2AK208              | 20                                               | _                                                             | 256        | 0.078 μm   |
|                              |                                 | L2AK211              | 20                                               | _                                                             | 2,048      | 0.0098 µm  |
|                              | Fagor<br>Automation S.<br>Coop. | LAK209               | 40                                               | -                                                             | 512        | 0.078 μm   |
|                              |                                 | LAK212               | 40                                               | -                                                             | 4,096      | 0.0098 µm  |
|                              |                                 | S2AK208              | 20                                               | -                                                             | 256        | 0.078 µm   |
| Absolute                     |                                 | SV2AK208             | 20                                               | -                                                             | 256        | 0.078 µm   |
| Absolute                     | 0000                            | G2AK208              | 20                                               | -                                                             | 256        | 0.078 μm   |
|                              |                                 | S2AK211              | 20                                               | _                                                             | 2,048      | 0.0098 µm  |
|                              |                                 | SV2AK211             | 20                                               | -                                                             | 2,048      | 0.0098 µm  |
|                              |                                 | G2AK211              | 20                                               | -                                                             | 2,048      | 0.0098 µm  |
|                              | Canon<br>Precision Inc.         | PH03-36E00           | 128                                              | -                                                             | 2,048      | 0.0625 μm  |

\*1. These are reference values for setting SERVOPACK parameters. Contact the manufacturer for actual linear encoder scale pitches.

\*2. This is the model of the Serial Converter Unit.

\*3. This is the model of the Head with Interpolator.

\*4. This is the model of the Interpolator.

\*5. This is the model of the Interface Unit.

\*6. If you use an encoder pulse output with this linear encoder, the setting range of the encoder output resolution (Pn281) is restricted. Refer to the following section for details on the encoder output resolution (Pn281). 6.5.2 Setting for the Encoder Divided Pulse Output on page 6-14

\*7. Sales of the interface unit EIB3391Y with the LIC4100 and LIC2100 series have ended due to the release of the LIC4190, LIC3190, and LIC2190 series.

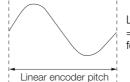
#### Resolution Information

You can calculate the resolution that is used inside the SERVOPACK (i.e., the travel distance per feedback pulse) with the following formula.

Linear encoder pitch

Resolution (travel distance per feedback pulse) = Resolution of Serial Converter Unit or linear encoder

The SERVOPACK uses feedback pulses as the unit to control a Servomotor.



Linear encoder pitch =Distance for one cycle of the analog voltage feedback signal from the linear encoder

5.14.2 Electronic Gear Ratio Setting Examples

## 5.14.2 Electronic Gear Ratio Setting Examples

Setting examples are provided in this section.

• Rotary Servomotors

|      |                                                                   | Machine Configuration                                                                                                 |                                                                                    |                                                                                                          |  |  |
|------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|--|--|
|      |                                                                   | Ball Screw                                                                                                            | Rotary Table                                                                       | Belt and Pulley                                                                                          |  |  |
| Step | Description                                                       | Reference unit: 0.001 mm<br>Load shaft<br>Dentrice for the second second<br>Encoder: Ball screw lead:<br>24 bits 6 mm | Reference unit: 0.01°<br>Gear ratio:<br>1/100<br>Load shaft<br>Encoder: 24 bits    | Reference unit: 0.005 mm<br>Load shaft<br>Gear ratio: Pulley dia.:<br>1/50 Encoder: 24 bits              |  |  |
| 1    | Machine<br>Specifications                                         | <ul><li>Ball screw lead: 6 mm</li><li>Gear ratio: 1/1</li></ul>                                                       | <ul> <li>Rotation angle per revolution: 360°</li> <li>Gear ratio: 1/100</li> </ul> | <ul> <li>Pulley dia.: 100 mm<br/>(Pulley circumference:<br/>314 mm)</li> <li>Gear ratio: 1/50</li> </ul> |  |  |
| 2    | Encoder Resolution                                                | 16,777,216 (24 bits)                                                                                                  | 16,777,216 (24 bits)                                                               | 16,777,216 (24 bits)                                                                                     |  |  |
| 3    | Reference Unit                                                    | 0.001 mm (1 μm)                                                                                                       | 0.01°                                                                              | 0.005 mm (5 μm)                                                                                          |  |  |
| 4    | Travel Distance per<br>Load Shaft Revolution<br>(Reference Units) | 6 mm/0.001 mm =<br>6,000                                                                                              | 360°/0.01° = 36,000                                                                | 314 mm/0.005 mm =<br>62,800                                                                              |  |  |
| 5    | Electronic Gear Ratio                                             | $\frac{B}{A} = \frac{16,777,216}{6,000} \times \frac{1}{1}$                                                           | $\frac{B}{A} = \frac{16,777,216}{36,000} \times \frac{100}{1}$                     | $\frac{B}{A} = \frac{16,777,216}{62,800} \times \frac{50}{1}$                                            |  |  |
| 6    | Parameters                                                        | Pn20E: 16,777,216                                                                                                     | Pn20E: 167,772,160                                                                 | Pn20E: 838,860,800                                                                                       |  |  |
| U    |                                                                   | Pn210: 6,000                                                                                                          | Pn210: 3,600                                                                       | Pn210: 62,800                                                                                            |  |  |

#### Linear Servomotors

A setting example for a Serial Converter Unit resolution of 256 is given below.

|      |                       | Machine Configuration                                   |  |  |
|------|-----------------------|---------------------------------------------------------|--|--|
| Step | Description           | Reference unit:<br>0.02 mm (20 µm)<br>Forward direction |  |  |
| 1    | Linear encoder pitch  | 0.02 mm (20 μm)                                         |  |  |
| 2    | Reference Unit        | 0.001 mm (1 μm)                                         |  |  |
| 3    | Electronic Gear Ratio | $\frac{B}{A} = \frac{1 (\mu m)}{20 (\mu m)} \times 256$ |  |  |
| 4    | Setting Parameters    | Pn20E: 256<br>Pn210: 20                                 |  |  |

5.15.1 Precautions on Resetting

# 5.15 Resetting the Absolute Encoder

In a system that uses an absolute encoder, the multiturn data must be reset at startup. An alarm related to the absolute encoder (A.810 or A.820) will occur when the absolute encoder must be reset, such as when the power supply is turned ON.

When you reset the absolute encoder, the multiturn data is reset and any alarms related to the absolute encoder are cleared.

Reset the absolute encoder in the following cases.

- When an A.810 alarm (Encoder Backup Alarm) occurs
- When an A.820 alarm (Encoder Checksum Alarm) occurs
- · When starting the system for the first time
- When you want to reset the multiturn data in the absolute encoder
- When the Servomotor has been replaced

# 

• The multiturn data will be reset to a value between -2 and +2 rotations when the absolute encoder is reset. The reference position of the machine system will change. Adjust the reference position in the host controller to the position that results from resetting the absolute encoder.

If the machine is started without adjusting the position in the host controller, unexpected operation may cause personal injury or damage to the machine.

- Information 1. The multiturn data will always be zero in the following cases. It is never necessary to reset the absolute encoder in these cases. An alarm related to the absolute encoder (A.810 or A.820) will not occur.
  - When you use a single-turn absolute encoder
  - When the encoder is set to be used as a single-turn absolute encoder (Pn002 = n.□2□□)
  - 2. If a batteryless absolute encoder is used, an A.810 alarm (Encoder Backup Alarm) will occur the first time the power is turned ON. After you reset the absolute encoder, the A.810 alarm will no longer occur.

## 5.15.1 Precautions on Resetting

- You cannot use the Alarm Clear command from the SERVOPACK to clear the A.810 alarm (Encoder Backup Alarm) or the A.820 alarm (Encoder Checksum Alarm). Always use the operation to reset the absolute encoder to clear these alarms.
- If an A.8□□ alarm (Internal Encoder Monitoring Alarm) occurs, turn OFF the power supply to reset the alarm.
- Confirm that setup (initialization) is not in progress from any other tool.

#### 5.15.2 Preparations

Always check the following before you reset an absolute encoder.

- The parameters must not be write prohibited.
- The servo must be OFF.

5.15.3 Applicable Tools

## 5.15.3 Applicable Tools

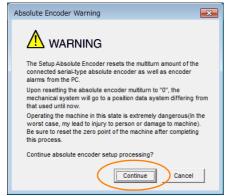
The following table lists the tools that you can use to reset the absolute encoder.

| Tool                     | Fn No./Function Name                             | Reference                                                                       |  |
|--------------------------|--------------------------------------------------|---------------------------------------------------------------------------------|--|
| Digital Operator         | Fn008                                            | Ω Σ-7-Series Digital Operator Operating<br>Manual (Manual No.: SIEP S800001 33) |  |
| SigmaWin+                | Encoder Setting – Reset Absolute<br>Encoder      | 5.15.4 Operating Procedure on page 5-48                                         |  |
| DeviceNet communications | PnBA7 (object number 0x64, attribute number 253) | Resetting the Absolute Encoder on page 12-17                                    |  |

## 5.15.4 Operating Procedure

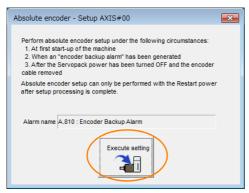
Use the following procedure to reset the absolute encoder.

- 1. Confirm that the servo is OFF.
- 2. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **3.** Select Reset Absolute Encoder in the Menu Dialog Box. The Absolute Encoder Reset Dialog Box will be displayed.
- 4. Click the Continue Button.



Click the Cancel Button to cancel resetting the absolute encoder. The Main Window will return.

#### 5. Click the Execute setting Button.



The current alarm code and name will be displayed in the Alarm name Box.

5.15.4 Operating Procedure

6. Click the Continue Button.



Click the **Cancel** Button to cancel resetting the absolute encoder. The previous dialog box will return.

#### 7. Click the OK Button.

The absolute encoder will be reset.

#### When Resetting Fails

If you attempted to reset the absolute encoder when the servo was ON in the SERVOPACK, the following dialog box will be displayed and processing will be canceled.

| Absolute encod | ler reset conditions error                                         |
|----------------|--------------------------------------------------------------------|
|                | ro ON now.<br>I the Servo UFF when resetting the absolute encoder. |
|                | ОК                                                                 |

Click the **OK** Button. The Main Window will return. Turn OFF the servo and repeat the procedure from step 1.

#### When Resetting Is Successful

The following dialog box will be displayed when the absolute encoder has been reset.

| Completion Warning Message                                                                                                                                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                   |
| Absolute Encoder reset processing has been performed. The<br>Multitum amount in the absolute encoder has been to "0".<br>Be sure to reset the mechanical system to "0" after restarting<br>power. |
| ОК                                                                                                                                                                                                |

The Main Window will return.

**8.** To enable the change to the settings, turn the power supply to the SERVOPACK OFF and ON again.

This concludes the procedure to reset the absolute encoder.

5.16.1 Absolute Encoder Origin Offset

# 5.16 Setting the Origin of the Absolute Encoder

## 5.16.1 Absolute Encoder Origin Offset

Refer to the following section for details. *Origin Offset* on page 12-4

## 5.16.2 Setting the Origin of the Absolute Linear Encoder

You can set any position as the origin in the following Linear Encoders.

- Dr. JOHANNES HEIDENHAIN GmbH LIC4190, LIC3190, or LIC2190 Series
- RSF Elektronik GmbH MC15Y Series
- Mitutoyo Corporation ABS ST780A Series or ST1300 Series Models: ABS ST78□A/ST78□AL/ST13□□
- Renishaw PLC EVOLUTE Series Models: EL36Y
- Renishaw PLC RESOLUTE Series Models: RL36Y
- Canon Precision Inc. Model: PH03-36E00



- After you set the origin, the /S-RDY (Servo Ready) signal will become inactive because the system position data was changed. Always turn the SERVOPACK power supply OFF and ON again.
- 2. After you set the origin, the Servomotor phase data in the SERVOPACK will be discarded. If you are using a Linear Servomotor without a Polarity Sensor, execute polarity detection again to save the Servomotor phase data in the SERVOPACK.

#### Preparations

Always check the following before you set the origin of an absolute encoder.

- The parameters must not be write prohibited.
- The servo must be OFF.

#### Applicable Tools

The following table lists the tools that you can use to set the origin of the absolute linear encoder.

| Tool             | Fn No./Function Name                          | Reference                                                                     |  |
|------------------|-----------------------------------------------|-------------------------------------------------------------------------------|--|
| Digital Operator | Fn020                                         | Σ-7-Series Digital Operator Operating<br>Manual (Manual No.: SIEP S800001 33) |  |
| SigmaWin+        | Encoder Setting – Zero Point Position Setting | Operating Procedure on page 5-51                                              |  |

#### 5.16.2 Setting the Origin of the Absolute Linear Encoder

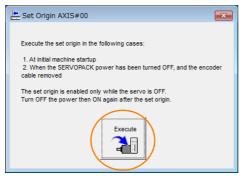
#### **Operating Procedure**

Use the following procedure to set the origin of an absolute linear encoder.

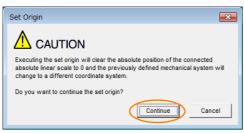
- 1. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Zero Point Position Setting in the Menu Dialog Box. The Set Origin Dialog Box will be displayed.
- 3. Click the Continue Button.

| Set Origin                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WARNING<br>The set origin sets the current position to the connected absolute linear scale<br>as the zero-point position.<br>Always refer to the user's manual before executing this function.<br>Note the following points:                                                                                                                                                                                                                                                                                 |
| 1.Always make the settings for the mechanical system again after the set origin.<br>The absolute position of the connected absolute linear scale is cleared to 0 and the previously defined mechanical system will change to a different coordinate system.<br>Operating the machine in this state is extremely dangerous.<br>Failure to observe this warning may result in personal injury and/or damage to the machine.<br>Be sure to reset the zero point for the mechanical system after the set origin. |
| 2.Satisfy the following conditions before executing this function:     The following conditions must be satisfied to execute the set origin:     a. Servo OFF     b. The polarity detection has been completed.     Check the SERVOPACK status.     3.Always turn the SERVOPACK power OFF then ON again after the set origin.     The set zero point position will be valid after turning OFF the power then ON again.     Always turn OFF the SERVOPACK power of N again after the set origin.              |
| Do you want to continue the set origin?                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

4. Click the Execute Button.



5. Click the Continue Button.



Click the **Cancel** Button to cancel setting the origin of the absolute linear encoder. The previous dialog box will return.

5.16.2 Setting the Origin of the Absolute Linear Encoder

6. Click the OK Button.



- 7. Turn the power supply to the SERVOPACK OFF and ON again.
- 8. If you use a Linear Servomotor that does not have a polarity sensor, perform polarity detection.

Refer to the following section for details on the polarity detection.

This concludes the procedure to set the origin of the absolute linear encoder.

# 5.17 Setting the Regenerative Resistor Capacity

The regenerative resistor consumes regenerative energy that is generated by the Servomotor, e.g., when the Servomotor decelerates.

If an External Regenerative Resistor is connected, you must set Pn600 (Regenerative Resistor Capacity) and Pn603 (Regenerative Resistor Resistance).

Refer to the following manual to select the capacity of a Regenerative Resistor.  $\square$   $\Sigma$ -7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)

## 

- If you connect an External Regenerative Resistor, set Pn600 and Pn603 to suitable values. If a suitable value is not set, A.320 alarms (Regenerative Overload) will not be detected correctly, and the External Regenerative Resistor may be damaged or personal injury or fire may result.
- When you select an External Regenerative Resistor, make sure that it has a suitable capacity.

There is a risk of personal injury or fire.

|       | Regenerative Resistor Capacity                             |                              |                 |              |                |  |  |
|-------|------------------------------------------------------------|------------------------------|-----------------|--------------|----------------|--|--|
|       | Setting Range                                              | Setting Unit                 | Default Setting | When Enabled | Classification |  |  |
| Pn600 | 0 to SERVOPACK's<br>maximum applica-<br>ble motor capacity | 10 W                         | 0               | Immediately  | Setup          |  |  |
|       | Regenerative Resiste                                       | nerative Resistor Resistance |                 |              |                |  |  |
| Pn603 | Setting Range                                              | Setting Unit                 | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 65,535                                                | 10 mΩ                        | 0               | Immediately  | Setup          |  |  |

Set the regenerative resistor capacity to a value that is consistent with the allowable capacity of the External Regenerative Resistor. The setting depends on the cooling conditions of the External Regenerative Resistor.

- For self-cooling (natural convection cooling): Set the parameter to a maximum 20% of the capacity (W) of the actually installed regenerative resistor.
- For forced-air cooling: Set the parameter to a maximum 50% of the capacity (W) of the actually installed regenerative resistor.

**Example** For a self-cooling 100-W External Regenerative Resistor, set Pn600 to 2 (×10 W) (100 W × 20% = 20 W).

Note: 1. An A.320 alarm will be displayed if the setting is not suitable.

2. The default setting of 0 specifies that the SERVOPACK's built-in regenerative resistor or Yaskawa's Regenerative Resistor Unit is being used.



1. When an External Regenerative Resistor is used at the normal rated load ratio, the resistor temperature increases to between 200°C and 300°C. Always apply derating. Consult the manufacturer for the resistor's load characteristics.

2. For safety, use an External Regenerative Resistor with a thermoswitch.

# Application Functions

This chapter describes the application functions that you can set before you start servo system operation. It also describes the setting methods.

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6.1.1 Input Signals

# 6.1 I/O Signal Descriptions

This section describes the I/O signals.

You can confirm the status of I/O signals on the I/O signal monitor. Refer to the following section for information on the I/O signal monitor. *9.2.2 Monitoring Operation, Status, and I/O* on page 9-3

## 6.1.1 Input Signals

# CCW-OT (CCW Drive Prohibit Input) Signal and CW-OT (CW Drive Prohibit) Signal

Refer to the following section for details. 5.10.1 Overtravel Signals on page 5-28

## /HOME (Origin Signal Input) Signal

Refer to the following section for details. *12.2.2 Parameter Settings* on page 12-3

## **EXSTOP** (External Stop Input) Signal

Refer to the following section for details. *6.13 External Stop Function* on page 6-34

## 6.1.2 Output Signals

#### ALM (Servo Alarm) Signal

This signal is output when the SERVOPACK detects an error.



Configure an external circuit so that this alarm output turns OFF the main circuit power supply to the SERVOPACK whenever an error occurs.

| Туре       | Signal | Connector Pin No. | Signal Status | Meaning                 |
|------------|--------|-------------------|---------------|-------------------------|
| Output ALM | ALM    | CN1-3 and CN1-4   | ON (closed)   | Normal SERVOPACK status |
| Output     | ALIVI  |                   | OFF (open)    | SERVOPACK alarm         |

#### ♦ Alarm Reset Methods

Refer to the following section for information on the alarm reset methods. *14.2.3 Resetting Alarms* on page 14-43

#### /WARN (Warning) Signal

Both alarms and warnings are generated by the SERVOPACK. Alarms indicate errors in the SERVOPACK for which operation must be stopped immediately. Warnings indicate situations that may results in alarms but for which stopping operation is not yet necessary.

| Туре   | Signal | Connector Pin No. | Signal Status | Meaning       |
|--------|--------|-------------------|---------------|---------------|
| Output | /WARN  | CN1-23 and        | ON (closed)   | Warning       |
| Output |        | CN1-24            | OFF (open)    | Normal status |

6.1.2 Output Signals

## /BK (Brake) Signal

Refer to the following section for details. *5.11.2 /BK (Brake) Signal* on page 5-31

## /S-RDY (Servo Ready) Signal

The /S-RDY (Servo Ready) signal turns ON when the SERVOPACK is ready to accept the Servo ON (Enable = 1) command.

The /S-RDY signal is turned ON under the following conditions.

- Main circuit power supply is ON.
- There is no hard wire base block state.
- There are no alarms.
- There is no forced stop state (FSTP).
- If a Servomotor without a polarity sensor is used, polarity detection has been completed.

| Туре          | Signal     | Connector Pin No. | Signal Status                        | Meaning                           |
|---------------|------------|-------------------|--------------------------------------|-----------------------------------|
| Output        | CN1-25 and | CN1-25 and        | ON (closed)                          | Servo ON command can be accepted. |
| Output /S-RDY | CN1-26     | OFF (open)        | Servo ON command cannot be accepted. |                                   |

Note: 1. Refer to the following section for information on the hard wire base block and the /S-RDY signal.

2. Refer to the following section for information on polarity detection.

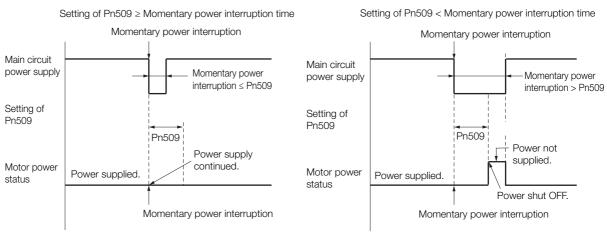
5.9 Polarity Detection on page 5-25

# 6.2 Operation for Momentary Power Interruptions

Even if the main power supply to the SERVOPACK is interrupted momentarily, power supply to the motor (servo ON status) will be maintained for the time set in Pn509 (Momentary Power Interruption Hold Time).

|       | Momentary Power Interruption Hold Time |              |                 |              |                |  |  |
|-------|----------------------------------------|--------------|-----------------|--------------|----------------|--|--|
| Pn509 | Setting Range                          | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 20 to 50,000                           | 1 ms         | 20              | Immediately  | Setup          |  |  |

If the momentary power interruption time is equal to or less than the setting of Pn509, power supply to the motor will be continued. If it is longer than the setting, power supply to the motor will be stopped. Power will be supplied to the motor again when the main circuit power supply recovers.



- **Information** 1. If the momentary power interruption time exceeds the setting of Pn509, the Servo Ready bit will change to 0 and the servo will be turned OFF.
  - 2. If uninterruptible power supplies are used for the control power supply and main circuit power supply, the SERVOPACK can withstand a power interruption that lasts longer than 50,000 ms.
  - 3. The holding time of the SERVOPACK control power supply is approximately 100 ms. If control operations become impossible during a momentary power interruption of the control power supply, the setting of Pn509 will be ignored and the same operation will be performed as for when the power supply is turned OFF normally.



The holding time of the main circuit power supply depends on the output from the SERVOPACK. If the load on the Servomotor is large and an A.410 alarm (Undervoltage) occurs, the setting of Pn509 will be ignored.

# 6.3 SEMI F47 Function

The SEMI F47 function detects an A.971 warning (Undervoltage) and limits the output current if the DC main circuit power supply voltage to the SERVOPACK drops to a specified value or lower because the power was momentarily interrupted or the main circuit power supply voltage was temporarily reduced.

This function complies with the SEMI F47 standards for semiconductor manufacturing equipment.

You can combine this function with the momentary power interruption hold time (Pn509) to allow the Servomotor to continue operating without stopping for an alarm or without recovery work even if the power supply voltage drops.

#### **Execution Sequence**

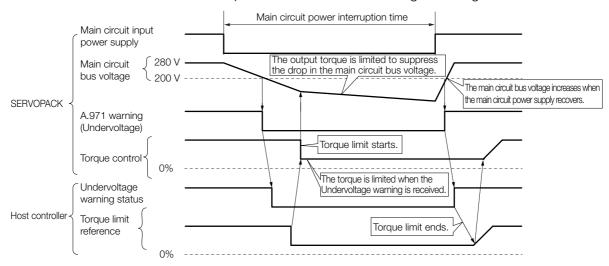
This function can be executed either with the host controller or with the SERVOPACK. Use  $Pn008 = n.\square\squareX\square$  (Function Selection for Undervoltage) to specify whether the function is executed by the host controller or by the SERVOPACK.

The default setting (Pn008 =  $n.\Box\Box0\Box$ ) disables detection of an A.971 warning (Undervoltage).

| Parameter |                                                                                                        | Description                                                      | When Enabled | Classification |
|-----------|--------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|--------------|----------------|
| Pn008     | n.□□0□<br>(default set-<br>ting)                                                                       | Do not detect undervoltage.                                      |              |                |
|           | n.0010                                                                                                 | Detect undervoltage warning and limit torque at host controller. |              | Setup          |
|           | <b>n.Detect</b> undervoltage warning and limit torque with Pn424 and Pn425 (i.e., only in SERVO-PACK). |                                                                  |              |                |

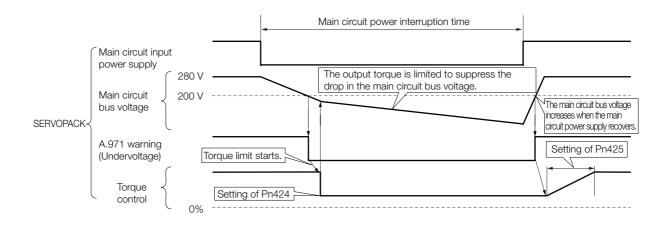
#### • Execution with the Host Controller (Pn008 = $n.\Box\Box1\Box$ )

The host controller limits the torque in response to an A.971 warning (Undervoltage). The host controller removes the torque limit after the Undervoltage warning is cleared.



#### • Execution with the SERVOPACK (Pn008 = $n.\Box\Box2\Box$ )

The torque is limited in the SERVOPACK in response to an Undervoltage warning. The SERVOPACK controls the torque limit for the set time after the Undervoltage warning is cleared.



#### **Related Parameters**

The following parameters are related to the SEMI F47 function.

|       | Torque Limit at Main Circuit Voltage Drop |                                                            |                 |              |                |  |  |
|-------|-------------------------------------------|------------------------------------------------------------|-----------------|--------------|----------------|--|--|
| Pn424 | Setting Range                             | Setting Unit                                               | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 100                                  | 1%*                                                        | 50              | Immediately  | Setup          |  |  |
|       | Release Time for To                       | Release Time for Torque Limit at Main Circuit Voltage Drop |                 |              |                |  |  |
| Pn425 | Setting Range                             | Setting Unit                                               | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 1,000                                | 1 ms                                                       | 100             | Immediately  | Setup          |  |  |
|       | Momentary Power In                        | nterruption Hold Tim                                       | e               |              |                |  |  |
| Pn509 | Setting Range                             | Setting Unit                                               | Default Setting | When Enabled | Classification |  |  |
|       | 20 to 50,000                              | 1 ms                                                       | 20              | Immediately  | Setup          |  |  |

\* Set a percentage of the motor rated torque.

Important

Note: If you will use the SEMI F47 function, set the time to 1,000 ms.

• This function handles momentary power interruptions for the voltage and time ranges stipulated in SEMI F47. An uninterruptible power supply (UPS) is required as a backup for momentary power interruptions that exceed these voltage and time ranges.

• Set the host controller or SERVOPACK torque limit so that a torque reference that exceeds the specified acceleration torque will not be output when the power supply for the main circuit is restored.

• For a vertical axis, do not limit the torque to a value that is lower than the holding torque.

• This function limits torque within the range of the SERVOPACK's capability for power interruptions. It is not intended for use under all load and operating conditions. Set the parameters while monitoring operation on the actual machine.

• You can set the momentary power interruption hold time to increase the amount of time from when the power supply is turned OFF until power supply to the motor is stopped. To stop the power supply to the motor immediately, execute the Servo OFF (Enable = 0) command.

# 6.4 Setting the Motor Maximum Speed

You can set the maximum speed of the Servomotor with the following parameter.

Rotary Servomotors

|       | Maximum Motor Speed |                     |                 |               |                |  |  |
|-------|---------------------|---------------------|-----------------|---------------|----------------|--|--|
| Pn316 | Setting Range       | Setting Unit        | Default Setting | When Enabled  | Classification |  |  |
|       | 0 to 65,535         | 1 min <sup>-1</sup> | 10,000          | After restart | Setup          |  |  |
|       |                     |                     |                 |               | -              |  |  |

Linear Servomotors

|       | Maximum Motor Speed |              |                 |               |                |  |  |
|-------|---------------------|--------------|-----------------|---------------|----------------|--|--|
| Pn385 | Setting Range       | Setting Unit | Default Setting | When Enabled  | Classification |  |  |
|       | 1 to 100            | 100 mm/s     | 50              | After restart | Setup          |  |  |

You can achieve the following by lowering the maximum speed of the Servomotor.

• If the Servomotor speed exceeds the setting, an A.510 alarm (Overspeed) will occur.

With a Linear Servomotor, you can increase the upper limit for the setting of Pn281 (Encoder Output Resolution). Refer to the following section for details.
 6.5 Encoder Divided Pulse Output on page 6-9

Changing the setting of the parameter is effective in the following cases.

- To protect the machine by stopping machine operation with an alarm when the set speed is reached or exceeded
- To limit the speed so that the load is driven beyond the allowable moment of inertia Refer to relevant manual from the following list for the relationship between the speed and the allowable moment of inertia.

Ω Σ-7-Series Rotary Servomotor Product Manual (Manual No.: SIEP S800001 36)

Ω Σ-7-Series Direct Drive Servomotor Product Manual (Manual No.: SIEP S800001 38)

 $\bigcap ~\Sigma$ -7-Series Linear Servomotor Product Manual (Manual No.: SIEP S800001 37)

• To increase the encoder output resolution and increase the position resolution managed by the host controller (for a Linear Servomotor)

# 6.5 Encoder Divided Pulse Output

The encoder divided pulse output is a signal that is output from the encoder and processed inside the SERVOPACK. It is then output externally in the form of two phase pulse signals (phases A and B) with a 90° phase differential. At the host controller, it can be used as the position feedback.

The following table describes the signals and output phase forms.

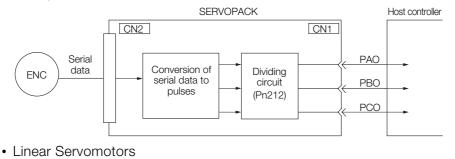
## 6.5.1 Encoder Divided Pulse Output Signals

| Туре        | Signal | Connector Pin No. | Name                                     | Remarks                                                                                                                                                                                                                                                                                                                                 |  |  |
|-------------|--------|-------------------|------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
|             | PAO    | CN1-17            | Encoder Divided Pulse Output,            | Rotary Servomotors     These encoder divided pulse     output pins output the number                                                                                                                                                                                                                                                    |  |  |
| Output<br>F | /PAO   | CN1-18            | Phase A                                  | of pulses per Servomotor reso-<br>lution that is set in Pn212<br>(Number of Encoder Output                                                                                                                                                                                                                                              |  |  |
|             | PBO    | CN1-19            | _                                        | Pulses). The phase difference<br>between phase A and phase B<br>is an electric angle of 90°.                                                                                                                                                                                                                                            |  |  |
|             | /PBO   | CN1-20            | Encoder Divided Pulse Output,<br>Phase B | <ul> <li>Linear Servomotors         These encoder divided pulse             output pins output pulses at the             resolution that is set in Pn281             (Encoder Output Resolution).             The phase difference between             phase A and phase B is an             electric angle of 90°.         </li> </ul> |  |  |
|             | PCO    | CN1-21            | Encoder Divided Pulse Output,            | These pins output one pulse                                                                                                                                                                                                                                                                                                             |  |  |
|             | /PCO   | CN1-22            | Phase C*                                 | every Servomotor rotation.                                                                                                                                                                                                                                                                                                              |  |  |

\* Refer to the following section for information on the origin within one encoder rotation.

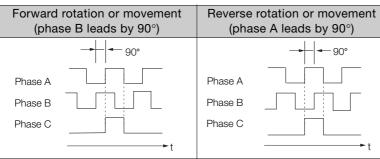
Relation between Renishaw PLC Incremental Linear Encoders and Encoder Output Pulse Signal from the SER-VOPACK When Using an RGS20 Scale and RGH22B Sensor Head, or a TONIC Series Encoder on page 6-10

Rotary Servomotor



SERVOPACK Host controller CN2 CN1 Linea encoder Serial data PAO Conversion of Dividing Serial ENC serial data to circuit PBO Converter Unit pulses (Pn281) PCO

#### **Output Phase Forms**



Note: The pulse width of the origin within one encoder rotation depends on the setting of number of encoder output pulses (Pn212) or the encoder output resolution (Pn281). It is the same as the width of phase A. Even for reverse operation (Pn000 = n.  $\Box \Box \Box \Box$ ), the output phase form is the same as shown above.



If you use the SERVOPACK's phase-C pulse output for an origin return, rotate the Servomotor two or more rotations before you start an origin return. If the Servomotor cannot be rotated two or more times, perform an origin return operation at a motor speed of 600 min<sup>-1</sup> or lower. If the motor speed is higher than 600 min<sup>-1</sup>, the phase-C pulse may not be output correctly.

## **Linear Encoder Application Precautions**

The following precautions apply to the encoder output pulses when an external linear encoder is used.

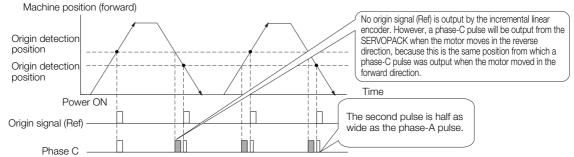
 Relation between Renishaw PLC Incremental Linear Encoders and Encoder Output Pulse Signal from the SERVOPACK When Using an RGS20 Scale and RGH22B Sensor Head, or a TONIC Series Encoder

The output position of the origin signal (Ref) will depend on the direction of movement for some models of incremental linear encoders from Renishaw PLC.

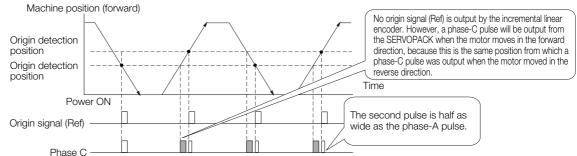
In that case, the phase-C pulse of the SERVOPACK is output at two positions.

For detailed specifications on the origin signal, refer to the manual for the Renishaw PLC incremental linear encoder.

When Passing the First Origin Signal (Ref) in the Forward Direction and Returning after Turning ON the Power Supply



When Passing the First Origin Signal (Ref) in the Reverse Direction and Returning after Turning ON the Power Supply

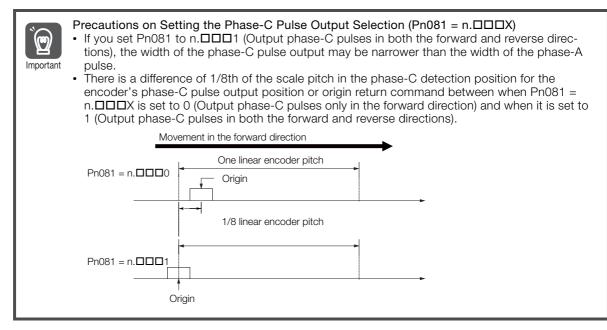


#### Precautions When Using a Linear Incremental Encoder from Magnescale Co., Ltd.

#### ■ Encoder Divided Phase-C Pulse Output Selection

You can also output the encoder's phase-C pulse for reverse movement. To do so, set Pn081 to n. DDD1.

| Parameter |                             | Meaning                                                           | When Enabled  | Classification |
|-----------|-----------------------------|-------------------------------------------------------------------|---------------|----------------|
| Pn081     | n.□□□0<br>(default setting) | Output phase-C pulses only in the forward direction.              | After restart | Setup          |
| 111001    | n.0001                      | Output phase-C pulses in both the forward and reverse directions. | Aller Testart | Setup          |



Observe the following precaution if you set Pn081 to n.  $\Box\Box\Box$  (Output phase-C pulses only in the forward direction).

When a linear incremental encoder from Magnescale Co., Ltd. is used, the count direction of the encoder determines how the phase-C pulse (CN1-21 and CN1-22) is output.

Note: The count direction (up or down) of the linear encoder determines whether a phase-C pulse is output. The output of the pulse does not depend on the setting of the movement direction ( $Pn000 = n.\square\square\square1$ ).

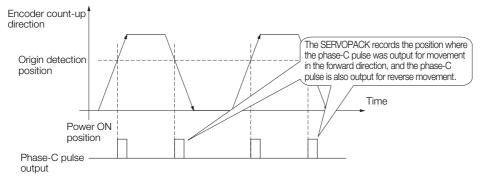
| Encoder Model | Interpolator          | Linear Encoder Pitch [µm] |
|---------------|-----------------------|---------------------------|
| SL710         |                       | 800                       |
| SL720         | PL101-RY<br>MJ620-T13 | 800                       |
| SL730         |                       | 800                       |
| SR75          |                       | 80                        |
|               | SR85                  | 80                        |

| Encoder Model | Interpolator | Linear Encoder Pitch [µm] |
|---------------|--------------|---------------------------|
| SQ10          | MQ10-FLA     | 400                       |
|               | MQ10-GLA     | - 400                     |

#### When First Passing the Origin Signal in the Forward Direction and Returning after Turning ON the Power Supply

The encoder's phase-C pulse (CN1-21 and CN1-22) is output when the origin detection position is passed for the first time in the forward direction after the power supply is turned ON.

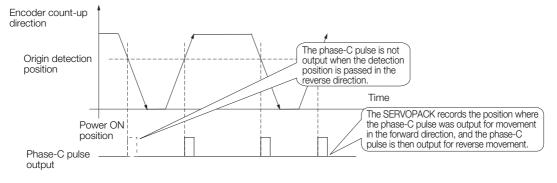
After that, the phase-C pulse is output whenever the origin detection position is passed in the forward or reverse direction.



#### When First Passing the Origin Signal in the Reverse Direction and Returning after Turning ON the Power Supply

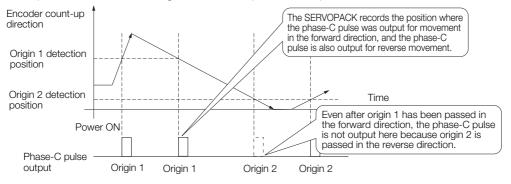
The encoder's phase-C pulse (CN1-19 and CN1-20) is not output when the origin detection position is passed for the first time in the reverse direction after the power supply is turned ON.

However, after the origin detection position is passed in the forward direction and the encoder's phase-C pulse is output, it will then also be output when the origin detection point is passed in the reverse direction.



# When Using a Linear Encoder with Multiple Origins and First Passing the Origin Position in the Forward Direction and Returning after Turning ON the Power Supply

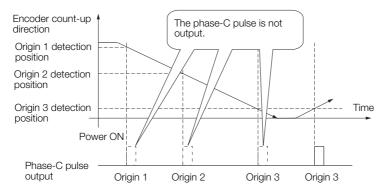
The encoder's phase-C pulse is output when the origin detection position is passed for the first time in the forward direction after the power supply is turned ON. After that, the phase-C pulse is output whenever the origin detection position is passed in the forward or reverse direction.



When Using a Linear Encoder with Multiple Origins and First Passing the Origin Position in the Reverse Direction after Turning ON the Power Supply

The encoder's phase-C pulse is not output when the origin detection position is passed for the first time in the reverse direction after the power supply is turned ON.

However, after the origin detection position is passed in the forward direction and the encoder's phase-C pulse it output, it will then also be output when the origin detection point is passed in the reverse direction.



6.5.2 Setting for the Encoder Divided Pulse Output

#### 6.5.2 Setting for the Encoder Divided Pulse Output

This section describes the setting for the encoder divided pulse output for a Rotary Servomotor or Linear Servomotor.

# Encoder Divided Pulse Output When Using a Rotary Servomotor

If you will use a Rotary Servomotor, set the number of encoder output pulses (Pn212).

|       | Number of Encoder Output Pulses |              |                 |               |                |  |  |
|-------|---------------------------------|--------------|-----------------|---------------|----------------|--|--|
| Pn212 | Setting Range                   | Setting Unit | Default Setting | When Enabled  | Classification |  |  |
|       | 16 to 1,073,741,824             | 1 P/Rev      | 2,048           | After restart | Setup          |  |  |

The number of pulses from the encoder per rotation are processed inside the SERVOPACK, divided by the setting of Pn212, and then output.

Set the number of encoder divided output pulses according to the system specifications of the machine or host controller.

The setting of the number of encoder output pulses is limited by the resolution of the encoder.

| Setting of the Number<br>of Encoder Output<br>Pulses [P/Rev] | Setting<br>Increment | Encoder Resolution               |                                  |                                   | Upper Limit of Servo-                                                          |
|--------------------------------------------------------------|----------------------|----------------------------------|----------------------------------|-----------------------------------|--------------------------------------------------------------------------------|
|                                                              |                      | 20 bits<br>(1,048,576<br>pulses) | 22 bits<br>(4,194,304<br>pulses) | 24 bits<br>(16,777,216<br>pulses) | motor Speed for Set<br>Number of Encoder<br>Output Pulses [min <sup>-1</sup> ] |
| 16 to 16,384                                                 | 1                    | 0                                | 0                                | 0                                 | 6,000                                                                          |
| 16,386 to 32,768                                             | 2                    | 0                                | 0                                | 0                                 | 3,000                                                                          |
| 32,772 to 65,536                                             | 4                    | 0                                | 0                                | 0                                 | 1,500                                                                          |
| 65,544 to 131,072                                            | 8                    | 0                                | 0                                | 0                                 | 750                                                                            |
| 131,088 to 262,144                                           | 16                   | 0                                | 0                                | 0                                 | 375                                                                            |
| 262,176 to 524,288                                           | 32                   | -                                | 0                                | 0                                 | 187                                                                            |
| 524,352 to 1,048,576                                         | 64                   | -                                | 0                                | 0                                 | 93                                                                             |
| 1,048,704 to 2,097,152                                       | 128                  | -                                | -                                | 0*                                | 46                                                                             |
| 2,097,408 to 4,194,304                                       | 256                  | _                                | _                                | 0*                                | 23                                                                             |

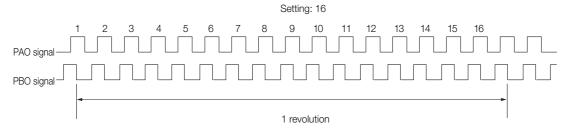
\* Available only for incremental encoder

Note: 1. The setting range of the number of encoder output pulses (Pn212) depends on the resolution of the Servomotor encoder. An A.041 alarm (Encoder Output Pulse Setting Error) will occur if the above setting conditions are not met.

Correct setting example: Pn212 can be set to 25,000 [P/Rev]. Incorrect setting example: Pn212 cannot be set to 25,001 (P/Rev) because the setting increment in the above table is not used.

 The upper limit of the pulse frequency is approximately 1.6 Mpps. The Servomotor speed will be limited if the setting of the number of encoder output pulses is too high. An A.511 alarm (Encoder Output Pulse Overspeed) will occur if the upper limit of the motor speed is exceeded.

Output example: An output example is given below for the PAO (Encoder Pulse Output Phase A) signal and the PBO (Encoder Pulse Output Phase B) signal when Pn212 is set to 16 (16 pulses output per revolution).



6.5.2 Setting for the Encoder Divided Pulse Output

# Encoder Divided Pulse Output When Using a Linear Servomotor

If you will use a Linear Servomotor, set the encoder output resolution (Pn281).

|       | Encoder Output Re |              |                 |               |                |
|-------|-------------------|--------------|-----------------|---------------|----------------|
| Pn281 | Setting Range     | Setting Unit | Default Setting | When Enabled  | Classification |
|       | 1 to 4,096        | 1 edge/pitch | 20              | After restart | Setup          |

Note: 1. The maximum setting for the encoder output resolution is 4,096.

If the resolution of the external encoder exceeds 4,096, pulse output will no longer be possible at the resolution given in ■ Feedback Resolution of Linear Encoder on page 5-43.

2. If the setting of Pn281 exceeds the resolution of the external encoder, the A.041 alarm (Encoder Output Pulse Setting Error) will be output.

Set the encoder output resolution for the encoder pulse output signals (PAO, /PAO, PBO, and /PBO) from the SERVOPACK to the host controller.

The number of feedback pulses per linear encoder pitch is divided by the setting of Pn281 (after multiplication by 4) inside the SERVOPACK and then the resulting number of pulses is output. Set the parameter according to the system specifications of the machine or host controller.

The setting range depends on the Servomotor's maximum speed (Pn385) and the linear scale pitch (Pn282).<sup>\*</sup> You can calculate the upper limit of the setting of Pn281 with the following formula.

Upper limit of Pn281 =  $\frac{\text{Linear Encoder Pitch*/100}}{\text{Pn385}} \times 72$ 

\* The value depends on whether a Serial Converter Unit is used.

| Using a Serial Converter Unit       Setting of Pn282         Not Using a Serial Converter Unit (when the linear encoder and SERVOPACK are connected directly or when a linear encoder that does not require a Serial Converter Unit is used)       The linear encoder pitch is automatically detected by the SERVO-PACK, so the setting of Pn282 is disabled.         Information       When the linear encoder pitch is 4 µm, the maximum motor speed is limited to 1 m/s because of the maximum response frequency of the Serial Converter Unit. If the setting is out of range or does not satisfy the setting conditions, an A.041 alarm (Encoder Output Pulse Setting Error) will be output. If the motor speed exceeds the upper limit for the set encoder output resolution, an A.511 alarm (Encoder Output Pulse Overspeed) will be output. The upper limit of the encoder output resolution is restricted by the dividing specifications of the Serial Converter Unit.         Example       Setting Example Correct setting for a linear encoder pitch of 20 µm and a maximum motor speed of 5 m/s (Pn385 = 50): Pn281 = 28 (edges/pitch) (An A.041 alarm would be output.)         Example       Pulse Output Example When Pn281 = 20 (20-edge output (5-pulse output) per linear encoder pitch)         Phase B       Image output (5-pulse output) per linear encoder pitch)         Phase B       Image output (5-pulse output) per linear encoder pitch output) |                                                                                         |                                                                                                                                                                                            |                                                                                                                                                                                                                                              |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul> <li>ear encoder and SERVOPACK are connected directly or when a linear encoder that does not require a Serial Converter Unit is used)</li> <li>Information</li> <li>When the linear encoder pitch is 4 μm, the maximum motor speed is limited to 1 m/s because of the maximum response frequency of the Serial Converter Unit. If the setting is out of range or does not satisfy the setting conditions, an A.041 alarm (Encoder Output Pulse Setting Error) will be output. If the motor speed exceeds the upper limit for the set encoder output resolution, an A.511 alarm (Encoder Output Pulse Overspeed) will be output. The upper limit of the encoder output resolution is restricted by the dividing specifications of the Serial Converter Unit.</li> <li>Example</li> <li>Setting Example Correct setting for a linear encoder pitch of 20 μm and a maximum motor speed of 5 m/s (Pn385 = 50): Pn281 = 28 (edges/pitch) (An A.041 alarm would be output.)</li> <li>Example</li> <li>Pulse Output Example When Pn281 = 20 (20-edge output (5-pulse output) per linear encoder pitch)</li> <li>Phase A I I I I I I I I I I I I I I I I I I</li></ul>                                                                                                                                                                                                                                                                                                             | Using a Seria                                                                           | al Converter Unit                                                                                                                                                                          | Setting of Pn282                                                                                                                                                                                                                             |
| <ul> <li>because of the maximum response frequency of the Serial Converter Unit.<br/>If the setting is out of range or does not satisfy the setting conditions, an A.041 alarm<br/>(Encoder Output Pulse Setting Error) will be output. If the motor speed exceeds the upper<br/>limit for the set encoder output resolution, an A.511 alarm (Encoder Output Pulse Overspeed)<br/>will be output.<br/>The upper limit of the encoder output resolution is restricted by the dividing specifications of<br/>the Serial Converter Unit.</li> <li>Example</li> <li>Setting Example<br/>Correct setting for a linear encoder pitch of 20 μm and a maximum motor speed of 5 m/s<br/>(Pn385 = 50): Pn281 = 28 (edges/pitch)<br/>Incorrect setting: Pn281 = 29 (edges/pitch) (An A.041 alarm would be output.)</li> <li>Example</li> <li>Pulse Output Example<br/>When Pn281 = 20 (20-edge output (5-pulse output) per linear encoder pitch)<br/>Phase A          <ul> <li>Phase B</li> <li>Phase B</li> <li>Phase B</li> <li>Phase B</li> <li>Phase B</li> <li>Phase B</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                        | ear encoder and SERVOPACK are connected directly or when a linear encoder that does not |                                                                                                                                                                                            |                                                                                                                                                                                                                                              |
| Example       Correct setting for a linear encoder pitch of 20 μm and a maximum motor speed of 5 m/s (Pn385 = 50): Pn281 = 28 (edges/pitch) Incorrect setting: Pn281 = 29 (edges/pitch) (An A.041 alarm would be output.)         Example       Pulse Output Example When Pn281 = 20 (20-edge output (5-pulse output) per linear encoder pitch)         Phase A       Image: A model         Phase B       Image: A model         Image: A       Image: A model         Image: B       Image: A         Image: B       Image: B         Image: B       Image: B     <                                                                                                                                                                                                                                                                                                          | Information                                                                             | because of the maximum resp<br>If the setting is out of range or<br>(Encoder Output Pulse Setting<br>limit for the set encoder output<br>will be output.<br>The upper limit of the encoder | nonse frequency of the Serial Converter Unit.<br>t does not satisfy the setting conditions, an A.041 alarm<br>g Error) will be output. If the motor speed exceeds the upper<br>t resolution, an A.511 alarm (Encoder Output Pulse Overspeed) |
| When Pn281 = 20 (20-edge output (5-pulse output) per linear encoder pitch) Phase A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Example                                                                                 | Correct setting for a linear end<br>(Pn385 = 50): Pn281 = 28 (ed                                                                                                                           | ges/pitch)                                                                                                                                                                                                                                   |
| Linear encoder pitch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Example                                                                                 | When Pn281 = 20 (20-edge of Phase A                                                                                                                                                        | utput (5-pulse output) per linear encoder pitch)                                                                                                                                                                                             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                         | Linear en                                                                                                                                                                                  | coder pitch                                                                                                                                                                                                                                  |

6.6.1 Setting to Enable/Disable Software Limits

# 6.6 Software Limits

You can set limits in the software for machine movement that do not use the overtravel signals (CCW-OT and CW-OT). If a software limit is exceeded, an emergency stop will be executed in the same way as it is for overtravel.

You must make the following settings to use the software limits.

- You must enable the software limit function.
- You must set the software limits.

## 6.6.1 Setting to Enable/Disable Software Limits

You can use PnB18 (Software Limit Action Selection) to enable and disable the software limit function.

The software limits are enabled at the following times:

- When an absolute encoder is used
- · After completing an origin return when an incremental encoder is used

In all other cases, the software limit function will not operate even if a software limit is exceeded.

|        | Parameter             | Meaning                                             |  |
|--------|-----------------------|-----------------------------------------------------|--|
| PnB18  | b.0000 0000 0000 0000 | The software limits are disabled. (Default setting) |  |
| FIIDTO | b.0000 0000 0000 0001 | The software limits are enabled.                    |  |

#### 6.6.2 Setting the Software Limit Action

You can use PnB18 (Software Limit Action Selection) to set the stopping method when a software limit is exceeded.

When a software limit is reached, the target position is automatically replaced with the current position.

|       | Parameter             | Meaning                       |
|-------|-----------------------|-------------------------------|
| PnB18 | b.0000 0000 0000 0000 | Smooth stop (default setting) |
|       | b.0000 0000 0000 0100 | Hard stop                     |

## 6.6.3 Setting the Software Limits

Software limits are set in both the forward and reverse directions.

The reverse software limit must be less than the forward software limit to set a limit in each direction.

|       | Forward Software Limit          |                  |                 |              |  |  |
|-------|---------------------------------|------------------|-----------------|--------------|--|--|
| PnB16 | Setting Range                   | Setting Unit     | Default Setting | When Enabled |  |  |
| THETO | -2,147,483,647 to 2,147,483,647 | 1 reference unit | 2,147,483,647   | Immediately  |  |  |
|       | Reverse Software Limit          |                  |                 |              |  |  |
| PnB17 | Setting Range                   | Setting Unit     | Default Setting | When Enabled |  |  |
|       | -2,147,483,647 to 2,147,483,647 | 1 reference unit | -2,147,483,647  | Immediately  |  |  |

# 6.7 Internal Torque Limits

You can limit the torque that is output by the Servomotor.

If you use internal torque limits, the maximum output torque will always be limited to the specified forward torque limit (Pn402) and reverse torque limit (Pn403).

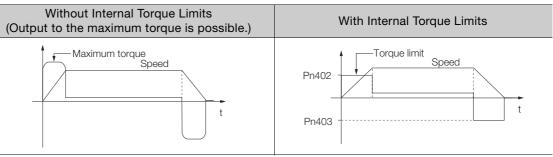
Note: If you set a value that exceeds the maximum torque of the Servomotor, the torque will be limited to the maximum torque of the Servomotor.

#### • Rotary Servomotors

|       | Forward Torque Limit |              |                 |              |                |  |
|-------|----------------------|--------------|-----------------|--------------|----------------|--|
| Pn402 | Setting Range        | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | 0 to 800             | 1%*          | 800             | Immediately  | Setup          |  |
|       | Reverse Torque Limit |              |                 |              |                |  |
| Pn403 | Setting Range        | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | 0 to 800             | 1%*          | 800             | Immediately  | Setup          |  |

\* Set a percentage of the rated motor torque.

Note: If the setting of Pn402 or Pn403 is too low, the torque may be insufficient for acceleration or deceleration of the Servomotor.

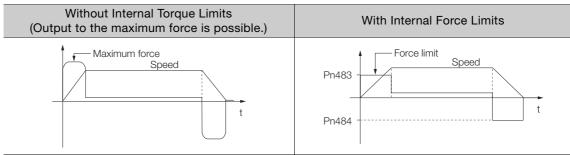


Linear Servomotors

|       | Forward Force Limit |              |                 |              |                |  |  |
|-------|---------------------|--------------|-----------------|--------------|----------------|--|--|
| Pn483 | Setting Range       | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 800            | 1%*          | 30              | Immediately  | Setup          |  |  |
|       | Reverse Force Limit |              |                 |              |                |  |  |
| Pn484 | Setting Range       | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 800            | 1%*          | 30              | Immediately  | Setup          |  |  |

\* Set a percentage of the rated motor force.

Note: If the setting of Pn483 or Pn484 is too low, the force may be insufficient for acceleration or deceleration of the Servomotor.



# 6.8 Absolute Encoders

The absolute encoder records the current position of the stop position even when the power supply is OFF.

With a system that uses an absolute encoder, the host controller can monitor the current position. Therefore, it is not necessary to perform an origin return operation when the power supply to the system is turned ON.

There are four types of encoders for Rotary Servomotors. The usage of the encoder is specified in  $Pn002 = \Box X \Box \Box$ .

SERVOPACKs with software version 0023 or higher support batteryless absolute encoders.

Refer to the following section for encoder models.

■ Encoder Resolution on page 5-42

#### · Parameter Settings When Using an Incremental Encoder

| Parameter |                             | Meaning                                                                          | When Enabled  | Classification |
|-----------|-----------------------------|----------------------------------------------------------------------------------|---------------|----------------|
|           | n.□0□□<br>(default setting) |                                                                                  |               |                |
| Pn002     | n.0100                      | Use the encoder as an incremental encoder.<br>A battery is not required.         | After restart | Setup          |
|           | n.0200                      | Use the encoder as a single-turn absolute encoder.<br>A battery is not required. |               |                |

#### · Parameter Settings When Using a Single-Turn Absolute Encoder

| F     | Parameter                   | Meaning                                                                          | When Enabled  | Classification |
|-------|-----------------------------|----------------------------------------------------------------------------------|---------------|----------------|
|       | n.□0□□<br>(default setting) | Use the encoder as a single-turn absolute encoder.<br>A battery is not required. |               |                |
| Pn002 | n.0100                      | Use the encoder as an incremental encoder.<br>A battery is not required.         | After restart | Setup          |
|       | n.0200                      | Use the encoder as a single-turn absolute encoder.<br>A battery is not required. | *             |                |

#### · Parameter Settings When Using a Multiturn Absolute Encoder

| F     | Parameter                   | Meaning                                                                          | When Enabled  | Classification |
|-------|-----------------------------|----------------------------------------------------------------------------------|---------------|----------------|
|       | n.□0□□<br>(default setting) | Use the encoder as a multiturn absolute encoder.<br>A battery is required.       |               |                |
| Pn002 | n.0100                      | Use the encoder as an incremental encoder.<br>A battery is not required.         | After restart | Setup          |
|       | n.¤2¤¤                      | Use the encoder as a single-turn absolute encoder.<br>A battery is not required. | *             |                |

#### • Parameter Settings When Using a Batteryless Multiturn Absolute Encoder

| F     | Parameter                   | Meaning                                                                                       | When Enabled  | Classification |
|-------|-----------------------------|-----------------------------------------------------------------------------------------------|---------------|----------------|
|       | n.□0□□<br>(default setting) | Use the encoder as a batteryless multiturn absolute<br>encoder.<br>A battery is not required. |               |                |
| Pn002 | n.0100                      | Use the encoder as an incremental encoder.<br>A battery is not required.                      | After restart | Setup          |
|       | n.¤2¤¤                      | Use the encoder as a single-turn absolute encoder.<br>A battery is not required.              |               |                |

## NOTICE

• Install a battery at either the host controller or on the Encoder Cable. If you install batteries both at the host controller and on the Encoder Cable at the same time, you will create a loop circuit between the batteries, resulting in a risk of damage or burning.

#### 6.8.1 Connecting an Absolute Encoder

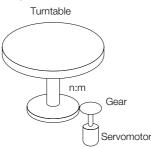
If you use an absolute encoder, the encoder divided pulse output signals (PAO, PBO, and PCO) are output only once when the power supply turns ON. Normally, do not use these signals. Therefore, it is not necessary to wire the PAO, PBO, and PCO (Encoder Divided Pulse Output) signals. If they need to be wired, refer to the following section.

[ ₹ 4.4.3 Wiring the SERVOPACK to the Encoder on page 4-27

37 4.5.3 I/O Signal Wiring Examples on page 4-37

#### 6.8.2 Multiturn Limit Setting

The multiturn limit is used in position control for a turntable or other rotating body. For example, consider a machine that moves the turntable shown in the following diagram in only one direction.



Because the turntable moves in only one direction, the upper limit to the number of rotations that can be counted by an absolute encoder will eventually be exceeded. The multiturn limit is used in cases like this to prevent fractions from being produced by the

integer ratio of the number of Servomotor rotations and the number of turntable rotations.

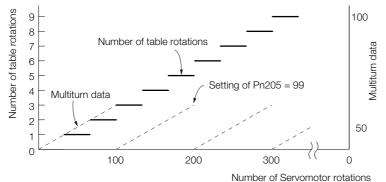
For a machine with a ratio of n:m between the number of Servomotor rotations and the number of turntable rotations, as shown above, the value of m minus 1 will be the setting for the multi-turn limit setting (Pn205).

Multiturn limit (Pn205) = m - 1

If m = 100 and n = 3 (i.e., the turntable rotates three times for each 100 Servomotor rotations), the relationship between the number of Servomotor rotations and the number of turntable rotations would be as shown below.

#### Set Pn205 to 99.

Pn205 = 100 - 1 = 99



|       | Multiturn Limit |              |                 |               |                |
|-------|-----------------|--------------|-----------------|---------------|----------------|
| Pn205 | Setting Range   | Setting Unit | Default Setting | When Enabled  | Classification |
|       | 0 to 65,535     | 1 Rev        | 65,535          | After restart | Setup          |

Note: This parameter is enabled when you use an absolute encoder.

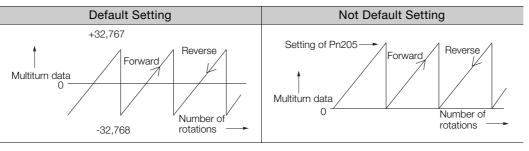
6.8.3 Multiturn Limit Disagreement Alarm (A.CC0)

The data will change as shown below when this parameter is set to anything other than the default setting.

- If the Servomotor operates in the reverse direction when the multiturn data is 0, the multiturn data will change to the value set in Pn205.
- If the motor operates in the forward direction when the multiturn data is at the value set in Pn205, the multiturn data will change to 0.

Set Pn205 to one less than the desired multiturn data.

If you change the multiturn limit in Pn205, an A.CCO alarm (Multiturn Limit Disagreement) will be displayed because the setting disagrees with the value in the encoder. Refer to the following section for the procedure to change the multiturn limit settings in the encoder.



Information The multiturn data will always be 0 in the following cases. It is not necessary to reset the absolute encoder in these cases.

- When you use a single-turn absolute encoder
- When the encoder is set to be used as a single-turn absolute encoder (Pn002 =  $n.\Box 2\Box \Box$ ) Absolute encoder-related alarms (A.810 and A.820) will not occur.

## 6.8.3 Multiturn Limit Disagreement Alarm (A.CC0)

If you change the multiturn limit in Pn205 (Multiturn Limit), an A.CCO alarm (Multiturn Limit Disagreement) will be displayed because the setting disagrees with the value in the encoder.

| Display | Name                         | Meaning                                                               |
|---------|------------------------------|-----------------------------------------------------------------------|
| A.CC0   | Multiturn Limit Disagreement | Different multiturn limits are set in the encoder and SERVO-<br>PACK. |

If this alarm is displayed, use the following procedure to change the multiturn limit in the encoder to the same value as the setting of Pn205.

#### **Applicable Tools**

The following table lists the tools that you can use to set the multiturn limit.

| Tool             | Fn No./Function Name                        | Operating Procedure Reference                                                 |
|------------------|---------------------------------------------|-------------------------------------------------------------------------------|
| Digital Operator | Fn013                                       | Ω-7-Series Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+        | Encoder Setting – Multi-turn Limit<br>Setup | Operating Procedure on page 6-21                                              |

#### 6.8.3 Multiturn Limit Disagreement Alarm (A.CC0)

## **Operating Procedure**

Use the following procedure to adjust the multiturn limit setting.

- 1. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Multi-turn Limit Setting in the Menu Dialog Box. The Multiturn Limit Setting Dialog Box will be displayed.
- 3. Click the Continue Button.

| Multiturn Limit Setting                                                                                                                                                                                   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                           |
| The position data is cleared when this function is used.<br>Since the Multiturn (multiple rotations) limit is changed,<br>the position data of the machine system is changed and<br>it is very dangerous. |
| Do you want to continue the process?                                                                                                                                                                      |
|                                                                                                                                                                                                           |

Click the **Cancel** Button to cancel setting the multiturn limit. The Main Window will return.

4. Change the setting.

| 🐻 Multiturn     | Limit Setting AXIS#00         | ×    |
|-----------------|-------------------------------|------|
| Multiturn Limit | Setting Change                |      |
| Pn205:Multitu   | rn Limit                      |      |
| 65535           | [Rev] 🕨 65535 [               | Rev] |
|                 | (0-65535)                     |      |
|                 | Writing into<br>the Servopack |      |

- 5. Click the Writing into the Servopack Button.
- 6. Click the OK Button.

| Multiturn Limit Setting                                                                                                     |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------|--|--|--|
| ⚠                                                                                                                           |  |  |  |
| Multiturn limit value was changed.<br>The following procedure is needed to operate with changing<br>the Multiturn limit.    |  |  |  |
| 1. Close this function program.                                                                                             |  |  |  |
| <ol><li>"A.CC0.Multiturn Limit Disagreement" is occurred<br/>when the power of the Servopack (control) is cycled.</li></ol> |  |  |  |
| 3. Select "Multiturn Limit Setting function" again.                                                                         |  |  |  |
| <ol> <li>Set the Multiturn limit setting value to the servomotor<br/>according to the instruction of the screen.</li> </ol> |  |  |  |
| <ol> <li>Cycle power again Multiturn limit change is completed,<br/>through these procedures.</li> </ol>                    |  |  |  |
| OK                                                                                                                          |  |  |  |

6.8.3 Multiturn Limit Disagreement Alarm (A.CC0)

7. Turn the power supply to the SERVOPACK OFF and ON again.

An A.CC0 alarm (Multiturn Limit Disagreement) will occur because setting the multiturn limit in the Servomotor is not yet completed even though the setting has been changed in the SERVOPACK.

- 8. Display the Multiturn Limit Setting in the Menu Dialog Box.
- 9. Click the Continue Button.

| Multiturn Limit Setting                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                   |
| The position data is cleared when this function is used.<br>Since the Multiturn (multiple rotations) limit is changed,<br>the position data of the machine system is changed and<br>it is very dangerous.<br>Do you want to continue the process? |
| Continue                                                                                                                                                                                                                                          |

10. Click the Writing into the servomotor Button.



Click the **Re-change** Button to change the setting.

11. Click the OK Button.

| Multiturn Limit Setting                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                 |
| Multiturn Limit Setting has been completed. Cycle (control) power.<br>The operation can be done with the set multiturn limit from the next<br>time when the power is turned on. |
| It is very dangerous to operate the machine in this state. Be sure to<br>perform the original point re-setup of a machine system after<br>power is turned on again.             |
| ОК                                                                                                                                                                              |

This concludes the procedure to set the multiturn limit.

6.9.1 Connecting an Absolute Linear Encoder

# 6.9 Absolute Linear Encoders

The absolute linear encoder records the current position of the stop position even when the power supply is OFF.

With a system that uses an absolute linear encoder, the host controller can monitor the current position. Therefore, it is not necessary to perform an origin return operation when the power supply to the system is turned ON.

There are three types of linear encoders for Linear Servomotors. The usage of the linear encoder is specified in Pn002 =  $n.\Box X \Box \Box$ .

Refer to the following section for linear encoder models.

■ Feedback Resolution of Linear Encoder on page 5-43

#### · Parameter Settings When Using an Incremental Linear Encoder

| Parameter |                             | Meaning                                           | When Enabled  | Classification |
|-----------|-----------------------------|---------------------------------------------------|---------------|----------------|
| Pn002     | n.□0□□<br>(default setting) | Use the encoder as an incremental linear encoder. | After restart | Setup          |
|           | n.□1□□                      | Use the encoder as an incremental linear encoder. |               |                |

#### Parameter Settings When Using an Absolute Linear Encoder

| Parameter |                             | Meaning                                           | When Enabled  | Classification |
|-----------|-----------------------------|---------------------------------------------------|---------------|----------------|
| Pn002     | n.□0□□<br>(default setting) | Use the encoder as an absolute linear encoder.    | After restart | Setup          |
|           | n.0100                      | Use the encoder as an incremental linear encoder. |               |                |

## 6.9.1 Connecting an Absolute Linear Encoder

If you use an absolute linear encoder, the encoder divided pulse output signals (PAO, PBO, and PCO) are output only once when the power supply turns ON. Normally, do not use these signals. Therefore, it is not necessary to wire the PAO, PBO, and PCO (Encoder Divided Pulse Output) signals. If they need to be wired, refer to the following section.

4.4.3 Wiring the SERVOPACK to the Encoder on page 4-27

37 4.5.3 I/O Signal Wiring Examples on page 4-37

6.10.1 Preparations

# Software Reset

You can reset the SERVOPACK internally with the software. A software reset is used when resetting alarms and changing the settings of parameters that normally require turning the power supply to the SERVOPACK OFF and ON again. This can be used to change those parameters without turning the power supply to the SERVOPACK OFF and ON again.

Information

- 1. Always confirm that the servo is OFF and that the Servomotor is stopped before you start a software reset.
  - 2. This function resets the SERVOPACK independently of the host controller. The SERVO-PACK carries out the same processing as when the power supply is turned ON and outputs the ALM (Servo Alarm) signal. The status of other output signals may be forcibly changed.
  - 3. When you execute a software reset, the SERVOPACK will not respond for approximately five seconds.

Before you execute a software reset, check the status of the SERVOPACK and Servomotor and make sure that no problems will occur.

#### 6.10.1 Preparations

Always check the following before you perform a software reset.

- The servo must be OFF.
- The motor must be stopped.

#### 6.10.2 Applicable Tools

The following table lists the tools that you can use to perform a software reset.

| Tool             | Fn No./Function Name             | Operating Procedure Reference                                                   |
|------------------|----------------------------------|---------------------------------------------------------------------------------|
| Digital Operator | Fn030                            | Ω Σ-7-Series Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+        | Basic Functions – Software Reset | 6.10.3 Operating Procedure on page 6-24                                         |

#### 6.10.3 **Operating Procedure**

Use the following procedure to perform a software reset.

- 1. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- Select Software Reset in the Menu Dialog Box. The Software Reset Dialog Box will be displayed.
- 3. Click the Execute Button.

| Software Reset                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                         |
| The software reset function resets the Servopack by using software<br>and re-calculates all settings including parameters.<br>Be sure to carefully read the SigmaWin+ Operation Manual before<br>executing this function. Special care must be taken for the following. |
| The Servopack will stop responding for approximately 5 seconds<br>after the execution begins.<br>Before executing this function, always check the Servopack and<br>motor status to ensure safety.                                                                       |
| Cancel                                                                                                                                                                                                                                                                  |

Click the Cancel Button to cancel the software reset. The Main Window will return.

6.10.3 Operating Procedure

4. Click the Execute Button.

| ${igodold O}$ Software Reset Common for the Unit                                                                                             | × |
|----------------------------------------------------------------------------------------------------------------------------------------------|---|
| The software reset function will be executed.<br>The Servopack will stop responding for approximately 5<br>seconds after the fuction begins. |   |
| Execute<br>0%                                                                                                                                |   |
| ,                                                                                                                                            |   |

#### 5. Click the OK Button to end the software reset operation.

All settings including parameters will have been re-calculated. When you finish this operation, disconnect the SigmaWin+ from the SERVOPACK, and then connect it again.

| Software Reset                                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                  |
| The software reset function has been completed.<br>All settings including parameters were re-calculated. Always<br>reconnect the SigmaWin+ to the Servopack after execution of this<br>function. |
| ОК                                                                                                                                                                                               |

This concludes the procedure to reset the software.

#### 6.11.1 Preparations

# 6.11 Initializing the Vibration Detection Level

You can detect machine vibration during operation to automatically adjust the settings of Pn312 or Pn384 (Vibration Detection Level) to detect A.520 alarms (Vibration Alarm) and A.911 warnings (Vibration Warning) more precisely.

This function detects specific vibration components in the Servomotor speed.

| Parameter |                             | Meaning                                            | When<br>Enabled | Classification |
|-----------|-----------------------------|----------------------------------------------------|-----------------|----------------|
|           | n.□□□0<br>(default setting) | Do not detect vibration.                           |                 | Ostur          |
| Pn310     | n.0001                      | Output a warning (A.911) if vibration is detected. | Immediately     | Setup          |
|           | n.□□□2                      | Output an alarm (A.520) if vibration is detected.  |                 |                |

If the vibration exceeds the detection level calculated with the following formula, an alarm or warning occurs according to Pn310 (Vibration Detection Selection).

Rotary Servomotors

Detection level = Vibration detection level (Pn312 [min-1]) × Vibration detection sensitivity (Pn311 [%])

100

• Linear Servomotors

Detection level = <u>
Vibration detection level (Pn384 [mm/s]) × Vibration detection sensitivity (Pn311 [%])</u> 100

Use this function only if A.520 or A.911 alarms are not output at the correct times when vibration is detected with the default vibration detection level (Pn312 or Pn384).

There will be discrepancies in the detection sensitivity for vibration alarms and warnings depending on the condition of your machine. If there is a discrepancy, use the above formula to adjust Pn311 (Vibration Detection Sensitivity).

|       | Vibration Detection Sensitivity |              |                 |              |                |
|-------|---------------------------------|--------------|-----------------|--------------|----------------|
| Pn311 | Setting Range                   | Setting Unit | Default Setting | When Enabled | Classification |
|       | 50 to 500                       | 1%           | 100             | Immediately  | Tuning         |

Information 1. Vibration may not be detected because of unsuitable servo gains. Also, not all kinds of vibrations can be detected.

2. Set a suitable moment of inertia ratio (Pn103). An unsuitable setting may result in falsely detecting or not detecting vibration alarms or vibration warnings.

- 3. To use this function, you must input the actual references that will be used to operate your system.
- 4. Execute this function under the operating conditions for which you want to set the vibration detection level.
- 5. Execute this function while the Servomotor is operating at 10% of its maximum speed or faster.

#### 6.11.1 Preparations

Always check the following before you initialize the vibration detection level.

- The parameters must not be write prohibited.
- The test without a motor function must be disabled (Pn00C =  $n.\Box\Box\Box$ ).

## 6.11.2 Applicable Tools

The following table lists the tools that you can use to initialize the vibration detection level.

| Tool             | Fn No./Function Name                             | Operating Procedure Reference                                                   |
|------------------|--------------------------------------------------|---------------------------------------------------------------------------------|
| Digital Operator | Fn01B                                            | Ω Σ-7-Series Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+        | Others – Initialize Vibration<br>Detection Level | F 6.11.3 Operating Procedure on page 6-27                                       |

## 6.11.3 Operating Procedure

Use the following procedure to initialize the vibration detection level.

- 1. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Initialize Vibration Detection Level in the Menu Dialog Box. The Initialize Vibration Detection Level Dialog Box will be displayed.
- Select Pn311: Vibration Detection Sensitivity and Pn310: Vibration Detection Selections and then click the Detection Start Button. A setting execution standby mode will be entered.

| Initialize Vibration Detection Level AXIS#00                                    |  |  |  |  |
|---------------------------------------------------------------------------------|--|--|--|--|
| Setting Condition                                                               |  |  |  |  |
| Pn311 : Vibration Detection Sensitivity (50 - 500)                              |  |  |  |  |
| 100 . [%]                                                                       |  |  |  |  |
| Pn310 : Vibration Detection Selections<br>digit 0 Vibration Detection Selection |  |  |  |  |
| 2 : Output an alarm (A.520) if vibration is detected.                           |  |  |  |  |
|                                                                                 |  |  |  |  |
| Setting Result                                                                  |  |  |  |  |
| Pn312 : Vibration Detection Level                                               |  |  |  |  |
| 50 [min-1]                                                                      |  |  |  |  |
|                                                                                 |  |  |  |  |

#### 6.11.3 Operating Procedure

4. Click the Execute Button.

| Initialize Vibration Detection Level AXIS#00                                    |  |  |  |  |  |
|---------------------------------------------------------------------------------|--|--|--|--|--|
| Setting Condition                                                               |  |  |  |  |  |
| Pn311 : Vibration Detection Sensitivity (50 - 500)                              |  |  |  |  |  |
| 100 [%]                                                                         |  |  |  |  |  |
| Pn310 : Vibration Detection Selections<br>digit 0 Vibration Detection Selection |  |  |  |  |  |
| 2 : Output an alarm (A.520) if vibration is detected.                           |  |  |  |  |  |
| Execute                                                                         |  |  |  |  |  |
| Setting Result                                                                  |  |  |  |  |  |
| Pn312 : Vibration Detection Level                                               |  |  |  |  |  |
| 50 [min-1]                                                                      |  |  |  |  |  |
|                                                                                 |  |  |  |  |  |

The newly set vibration detection level will be displayed and the value will be saved in the SERVO-PACK.

| 🗣 Initialize Vibration Detection Level AXIS#00 🛛 💽                                |  |  |  |  |
|-----------------------------------------------------------------------------------|--|--|--|--|
| - Setting Condition                                                               |  |  |  |  |
| Pn311 : Vibration Detection Sensitivity (50 - 500)                                |  |  |  |  |
| 100 . [%]                                                                         |  |  |  |  |
| Pn310 : Vibration Detection Selections<br>digit 0 Vibration Detection Selection   |  |  |  |  |
| 2 : Output an alarm (A.520) if vibration is detected.                             |  |  |  |  |
| Detection Start                                                                   |  |  |  |  |
| Setting Result                                                                    |  |  |  |  |
| Pn312 : Vibration Detection Level                                                 |  |  |  |  |
| 50 [min-1] <b>b</b> 50 [min-1]                                                    |  |  |  |  |
| When vibration exceeds a detection level 50 [min-1],<br>Alarm(A.520) is detected. |  |  |  |  |
|                                                                                   |  |  |  |  |

This concludes the procedure to initialize the vibration detection level.

6.11.4 Related Parameters

## 6.11.4 Related Parameters

The following three items are given in the following table.

- Parameters Related to this Function
  - These are the parameters that are used or referenced when this function is executed.
- Changes during Function Execution Not allowed: The parameter cannot be changed using the SigmaWin+ or other tool while this function is being executed.

Allowed: The parameter can be changed using the SigmaWin+ or other tool while this function is being executed.

Automatic Changes after Function Execution
 Yes: The parameter is automatically set or adjusted after execution of this function.
 No: The parameter is not automatically set or adjusted after execution of this function.

| Parameter | Name                            | Setting Changes | Automatic<br>Changes |
|-----------|---------------------------------|-----------------|----------------------|
| Pn311     | Vibration Detection Sensitivity | Allowed         | No                   |
| Pn312     | Vibration Detection Level       | Not allowed     | Yes                  |
| Pn384     | Vibration Detection Level       | Not allowed     | Yes                  |

6.12.1 Automatic Adjustment

# 6.12 Adjusting the Motor Current Detection Signal Offset

The motor current detection signal offset is used to reduce ripple in the torque. You can adjust the motor current detection signal offset either automatically or manually.

## 6.12.1 Automatic Adjustment

Perform this adjustment only if highly accurate adjustment is required to reduce torque ripple. It is normally not necessary to adjust this offset.



Execute the automatic offset adjustment if the torque ripple is too large when compared with other SERVOPACKs.

Information The offset does not use a parameter, so it will not change even if the parameter settings are initialized.

#### Preparations

Always check the following before you automatically adjust the motor current detection signal offset.

- The parameters must not be write prohibited.
- The servo must be in ready status.
- The servo must be OFF.

#### **Applicable Tools**

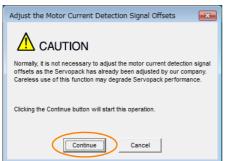
The following table lists the tools that you can use to automatically adjust the offset.

| Tool                                                            | Fn No./Function Name | Operating Procedure Reference                                                   |
|-----------------------------------------------------------------|----------------------|---------------------------------------------------------------------------------|
| Digital Operator                                                | Fn00E                | Ω Σ-7-Series Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+ Others – Adjust the Motor<br>Current Detection Offset |                      | C Operating Procedure on page 6-30                                              |

#### **Operating Procedure**

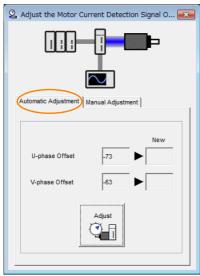
Use the following procedure to automatically adjust the motor current detection signal offset.

- 1. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Adjust the Motor Current Detection Offset in the Menu Dialog Box. The Adjust the Motor Current Detection Signal Offsets Dialog Box will be displayed.
- 3. Click the Continue Button.



6.12.1 Automatic Adjustment

4. Click the Automatic Adjustment Tab in the Adjust the Motor Current Detection Signal Offsets Dialog Box.



#### 5. Click the Adjust Button.

The values that result from automatic adjustment will be displayed in the New Boxes.

| Adjust the Motor Current Detection Signal O |                   |  |  |  |
|---------------------------------------------|-------------------|--|--|--|
|                                             |                   |  |  |  |
| Automatic Adjustment                        | Ianual Adjustment |  |  |  |
| U-phase Offset<br>V-phase Offset            | -73 ► -74         |  |  |  |
| Adjust                                      |                   |  |  |  |

This concludes the procedure to automatically adjust the motor current detection signal offset.

6.12.2 Manual Adjustment

## 6.12.2 Manual Adjustment

You can use this function if you automatically adjust the motor current detection signal offset and the torque ripple is still too large.

If the offset is incorrectly adjusted with this function, the Servomotor characteristics may be adversely affected.

- Observe the following precautions when you manually adjust the offset.
- Important Operate the Servomotor at a speed of approximately 100 min<sup>-1</sup>.
  - Adjust the offset while monitoring the torque reference with the analog monitor until the ripple is minimized.
  - Adjust the offsets for the phase-U current and phase-V current of the Servomotor so that they
    are balanced. Alternately adjust both offsets several times.

Information

on The offset does not use a parameter, so it will not change even if the parameter settings are initialized.

## Preparations

Always check the following before you manually adjust the motor current detection signal offset.

• The parameters must not be write prohibited.

## **Applicable Tools**

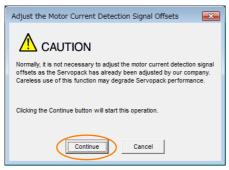
The following table lists the tools that you can use to manually adjust the offset.

| Tool             | Fn No./Function Name                                  | Operating Procedure Reference         |
|------------------|-------------------------------------------------------|---------------------------------------|
| Digital Operator | Fn00F                                                 | Channel (Manual No.: SIEP S800001 33) |
| SigmaWin+        | Others – Adjust the Motor Current<br>Detection Offset | G Operating Procedure on page 6-32    |

#### **Operating Procedure**

Use the following procedure to manually adjust the motor current detection signal offset.

- 1. Operate the Servomotor at approximately 100 min<sup>-1</sup>.
- 2. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **3.** Select Adjust the Motor Current Detection Offset in the Menu Dialog Box. The Adjust the Motor Current Detection Signal Offsets Dialog Box will be displayed.
- 4. Click the Continue Button.



6.12.2 Manual Adjustment

5. Click the Manual Adjustment Tab in the Adjust the Motor Current Detection Signal Offsets Dialog Box.

| Search Adjust the Motor Current Detection Signal O |   |  |  |  |
|----------------------------------------------------|---|--|--|--|
|                                                    |   |  |  |  |
| Automatic Adjustment Manual Adjustment             |   |  |  |  |
| Motor Current Detection Offset                     |   |  |  |  |
| Channel U-phase                                    | • |  |  |  |
| Offset +1 0                                        |   |  |  |  |
|                                                    |   |  |  |  |

- 6. Set the Channel Box in the Motor Current Detection Offset Area to U-phase.
- **7.** Use the +1 and -1 Buttons to adjust the offset for phase U. Change the offset by about 10 in the direction that reduces the torque ripple. Adjustment range: -512 to +511
- 8. Set the Channel Box in the Motor Current Detection Offset Area to V-phase.
- 9. Use the +1 and -1 Buttons to adjust the offset for phase V. Change the offset by about 10 in the direction that reduces the torque ripple.
- **10.** Repeat steps 6 to 9 until the torque ripple cannot be decreased any further regardless of whether you increase or decrease the offsets.
- **11.** Reduce the amount by which you change the offsets each time and repeat steps 6 to 9.

This concludes the procedure to manually adjust the motor current detection signal offset.

6.13.1 EXSTOP (External Stop Input) Signal

# 6.13 External Stop Function

The external stop function forces the Servomotor to stop when an external switch that is connected to the SERVOPACK operates. The EXSTOP (External Stop Input) signal is used for the external stop function. If the switch operates, a hard stop is performed for the motor and the servo is turned OFF.

Note: The external stop function is not designed to comply with any safety standard. In this respect, it is different from the hard wire base block (HWBB).



 To prevent accidents that may result from contact faults or disconnections, use a normally closed switch for the External Stop Input switch.

## 6.13.1 EXSTOP (External Stop Input) Signal

| Type Signal Co |        | Connector Pin No. | Meaning                    |  |
|----------------|--------|-------------------|----------------------------|--|
| Input          | EXSTOP | CN1-12            | External Stop Input signal |  |

#### 6.13.2 Enabling/Disabling the External Stop Input Signal

You can disable the External Stop Input signal by changing the settings of a parameter in the SERVOPACK. If the signal is disabled, wiring the External Stop Input signal is not required.

|       | Parameter             | Meaning                                                                         |
|-------|-----------------------|---------------------------------------------------------------------------------|
|       | b.0000 0000 0000 0000 | The External Stop Input signal is disabled.                                     |
| PnBA4 | b.0000 0000 0010 0000 | The EXSTOP (External Stop Input) signal is input from CN1-12. (Default setting) |

## 6.13.3 Setting the Polarity of the External Stop Input Signal

This parameter sets the polarity of the External Stop Input signal that will be active.

| Parameter       |                       | Meaning                                                                                       |
|-----------------|-----------------------|-----------------------------------------------------------------------------------------------|
| b.0000000000000 | b.0000 0000 0000 0000 | The External Stop Input signal is active while the external switch is open. (Default setting) |
| FIDAS           | b.0000 0000 0010 0000 | The External Stop Input signal is active while the external switch is closed.                 |

#### 6.14.1 Connecting the Overheat Protection Input (TH) Signal

# 6.14 Overheat Protection

Overheat protection detects an A.93B warning (Overheat Warning) and an A.862 alarm (Overheat Alarm) by monitoring the overheat protection input signal from a Yaskawa SGLFW2 Linear Servomotor or from a sensor attached to the machine.

SERVOPACKs with software version 0023 or higher support overheat protection.

When you use overheat protection, you must wire the overheat protection input (TH) signal and select overheat protection (Pn61A =  $n.\Box\Box\BoxX$ ).

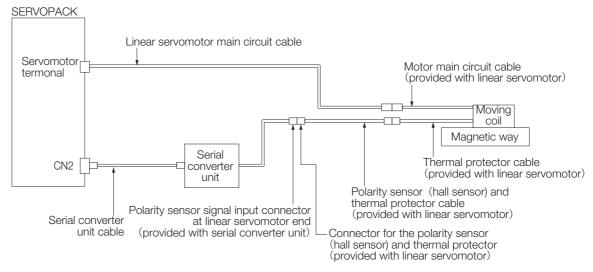
## 6.14.1 Connecting the Overheat Protection Input (TH) Signal

To use overheat protection, you must connect an overheat protection input (TH) signal to the SERVOPACK. This section describes the connection methods for the overheat protection input (TH) signal.

#### Using Overheat Protection in the Linear Servomotor

#### When Using a Serial Converter Unit

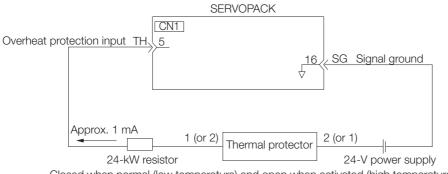
Connect the connector for the polarity sensor (hall sensor) and thermal protector of the linear servomotor to the serial converter unit.



6.14.2 Overheat Protection Selection

## Using Overheat Protection for the Machine

To use overheat protection for the machine, connect the overheat protection input (an analog voltage input) from the sensor mounted to the machine to the CN1-5 on the SERVOPACK.



Closed when normal (low temperature) and open when activated (high temperature)

• The recommended length of the thermal protector cable is 15 m maximum.

- The 24-V power supply and 24-k $\Omega$  resistor are not provided by Yaskawa.
- Use a 0.3 W or greater 24-V power supply, and use a 0.2 W or greater 24-k $\Omega$  resistor. Important

• Be sure to connect the positive and negative sides of the power supply correctly. Otherwise there is a risk of SERVOPACK failure.

#### **Overheat Protection Selection** 6.14.2

The overheat protection function is selected with  $Pn61A = n.\Box\Box\BoxX$  (Overheat Protection Selections).

| Parameter |                             | Meaning                                                                                                     | When Enabled  | Classification |
|-----------|-----------------------------|-------------------------------------------------------------------------------------------------------------|---------------|----------------|
| Pn61A     | n.□□□0<br>(default setting) | Disable overheat protection.                                                                                |               |                |
|           | n.0001                      | Use overheat protection in the Yaskawa Linear Servomotor.*                                                  |               |                |
|           | n.□□□2                      | Monitor a negative voltage input from a sensor attached to the machine and use overheat pro-tection.        | After restart | Setup          |
|           | n.0003                      | Monitor a positive voltage input from a sensor<br>attached to the machine and use overheat pro-<br>tection. |               |                |

\* The SGLFW2 is the only Yaskawa Linear Servomotor that supports this function.

6.14.2 Overheat Protection Selection

#### Using Overheat Protection in the Yaskawa Linear Servomotor

To use the overheat protection in the Yaskawa Linear Servomotor (SGLFW2), set Pn61A to n.DDD1.

An A.93B warning (Overheat Warning) will be detected if the overheat protection input (TH) signal from the Yaskawa SGLFW2 Linear Servomotor exceeds the warning temperature.

An A.862 alarm (Overheat Alarm) will be detected if the overheat protection input (TH) signal from the Yaskawa SGLFW2 Linear Servomotor exceeds the alarm temperature.

• If the overheat protection input signal line is disconnected or short-circuited, an A.862 alarm will occur.



• If you set Pn61A to n. DDD1 (Use overheat protection in the Yaskawa Linear Servomotor), the parameters in the Servomotor are enabled and the following parameters are disabled.

- Overheat Alarm Level (Pn61B)
- Overheat Warning Level (Pn61C)
   Overheat Alarma Filter Times (Pn61D)
- Overheat Alarm Filter Time (Pn61D)

# Monitoring the Machine's Temperature and Using Overheat Protection

Set Pn61A =  $n.\Box\Box\BoxX$  to 2 or 3 to use overheat protection for the machine.

Set the following parameters as required.

|       | Overheat Alarm Level |              |                 |              |                |  |  |
|-------|----------------------|--------------|-----------------|--------------|----------------|--|--|
| Pn61B | Setting Range        | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 500             | 0.01 V       | 250             | Immediately  | Setup          |  |  |
|       | Overheat Warning Le  | evel         |                 | L            |                |  |  |
| Pn61C | Setting Range        | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 100             | 1%           | 100             | Immediately  | Setup          |  |  |
|       | Overheat Alarm Filte | r Time       | •               |              |                |  |  |
| Pn61D | Setting Range        | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 65,535          | 1 s          | 0               | Immediately  | Setup          |  |  |

 When Pn61A is set to n.□□□2, an A.862 alarm will occur if the overheat protection input signal line is disconnected or short-circuited.

• When Pn61A is set to n. DDD3, an A862 alarm will not occur if the overheat protection input signal line is disconnected or short-circuited. To ensure safety, we recommend that you connect the external circuits so that you can use a negative voltage input for the overheat protection input (an analog voltage input).

6.14.2 Overheat Protection Selection

# Trial Operation and Actual Operation

7

This chapter provides information on the flow and procedures for trial operation and convenient functions to use during trial operation.

| 7.1 | Flow                    | of Trial Operation7-2                                                                                    |
|-----|-------------------------|----------------------------------------------------------------------------------------------------------|
|     | 7.1.1<br>7.1.2          | Flow of Trial Operation for Rotary Servomotors 7-2<br>Flow of Trial Operation for Linear Servomotors 7-3 |
| 7.2 | Inspec                  | tions and Confirmations before Trial Operation 7-5                                                       |
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7.1.1 Flow of Trial Operation for Rotary Servomotors

# 7.1 Flow of Trial Operation

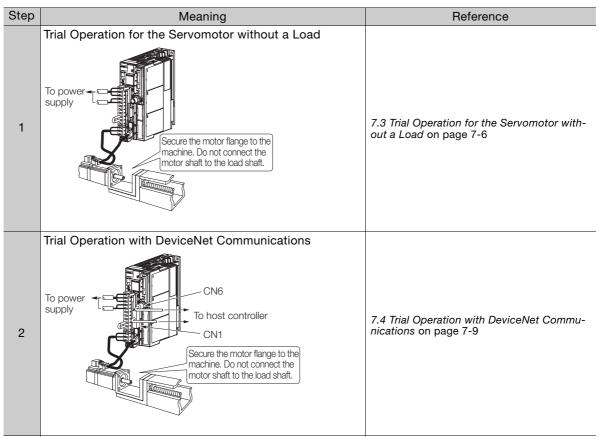
## 7.1.1 Flow of Trial Operation for Rotary Servomotors

The procedure for trial operation is given below.

#### • Preparations for Trial Operation

| Step | Meaning                                                                                                                                                                                         | Reference                                                            |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| 1    | Installation<br>Install the Servomotor and SERVOPACK<br>according to the installation conditions. First,<br>operation is checked with no load. Do not<br>connect the Servomotor to the machine. | Chapter 3 Installation                                               |
| 2    | Wiring and Connections<br>Wire and connect the SERVOPACK. First,<br>Servomotor operation is checked without a<br>load. Do not connect the CN1 connector on<br>the SERVOPACK.                    | Chapter 4 Wiring and Connections                                     |
| 3    | Confirmations before Trial Operation                                                                                                                                                            | 7.2 Inspections and Confirmations before Trial Operation on page 7-5 |
| 4    | Power ON                                                                                                                                                                                        | -                                                                    |
| 5    | Resetting the Absolute Encoder<br>This step is necessary only for a Servomotor<br>with an Absolute Encoder.                                                                                     | 5.15 Resetting the Absolute Encoder on page 5-47                     |

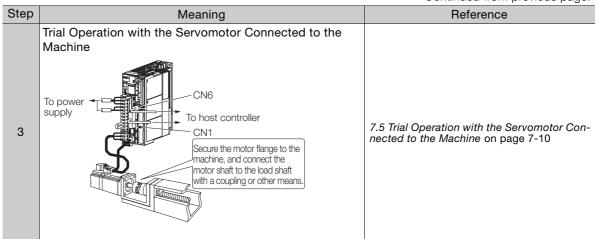
#### Trial Operation



Continued on next page.

#### 7.1.2 Flow of Trial Operation for Linear Servomotors

Continued from previous page.



## 7.1.2 Flow of Trial Operation for Linear Servomotors

The procedure for trial operation is given below.

#### • Preparations for Trial Operation

| Step |                                                                                                                                                                                                          | Meanir                                              | g                                                   |                                                                                   | Referen                                                          | се                  |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------|---------------------|
| 1    | Installation<br>Install the Servomotor and SERVOPACK according to the<br>installation conditions. First, operation is checked with no<br>load. Do not connect the Servomotor to the machine.             |                                                     |                                                     |                                                                                   | Chapter 3 Installation                                           |                     |
| 2    | Wiring and Connections<br>Wire and connect the SERVOPACK. First, Servomotor<br>operation is checked without a load. Do not connect the<br>CN1 connector on the SERVOPACK.                                |                                                     |                                                     |                                                                                   | Chapter 4 Wiring and Con                                         | nections            |
| 3    | Confirm                                                                                                                                                                                                  | nations before Trial Ope                            | ration                                              |                                                                                   | 7.2 Inspections and Confir<br>Operation on page 7-5              | mations before Tria |
| 4    | Power                                                                                                                                                                                                    | ON                                                  |                                                     |                                                                                   | -                                                                |                     |
|      | Setting                                                                                                                                                                                                  | Parameters in the SER<br>No. of Parameter to<br>Set | Description                                         |                                                                                   | Remarks                                                          | Reference           |
|      | 5-1                                                                                                                                                                                                      | Pn282                                               | Linear Encoder<br>Pitch                             | Set this parameter only if you are using a Serial Converter Unit.                 |                                                                  | page 5-17           |
| 5    | 5-2                                                                                                                                                                                                      | -                                                   | Writing Parameters<br>to the Linear Servo-<br>motor | you                                                                               | this parameter only if<br>are not using a Serial<br>verter Unit. | page 5-18           |
| 0    | 5-3                                                                                                                                                                                                      | Pn080 = n.□□X□                                      | Motor Phase<br>Sequence Selec-<br>tion              | _                                                                                 |                                                                  | page 5-22           |
|      | 5-4                                                                                                                                                                                                      | Pn080 = n.□□□X                                      | Polarity Sensor<br>Selection                        | -                                                                                 |                                                                  | page 5-24           |
|      | 5-5                                                                                                                                                                                                      | _                                                   | Polarity Detection                                  | This step is necessary only<br>for a Linear Servomotor with<br>a Polarity Sensor. |                                                                  | page 5-25           |
|      | 5-6                                                                                                                                                                                                      | Pn483, Pn484                                        | Force Control                                       |                                                                                   |                                                                  | page 6-17           |
| 6    | 3-0       F1483, F1404       F0100 Control       -       page 6-17         Setting the Origin of the Absolute Linear Encoder       5.16.2 Setting the Origin of the Absolute Linear Encoder on page 5-50 |                                                     |                                                     |                                                                                   |                                                                  |                     |

#### 7.1.2 Flow of Trial Operation for Linear Servomotors

#### • Trial Operation

| Step | Meaning                                                           | Reference                                                                        |
|------|-------------------------------------------------------------------|----------------------------------------------------------------------------------|
| 1    | Trial Operation for the Servomotor without a Load                 | 7.3 Trial Operation for the Servomotor without a Load on page 7-6                |
| 2    | Trial Operation with DeviceNet Communica-<br>tions                | 7.4 Trial Operation with DeviceNet Communications on page 7-9                    |
| 3    | Trial Operation with the Servomotor Con-<br>nected to the Machine | 7.5 Trial Operation with the Servomotor Connected to the<br>Machine on page 7-10 |

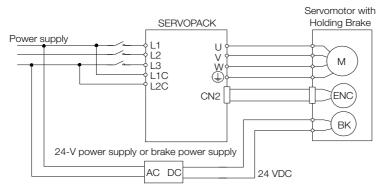
# 7.2 Inspections and Confirmations before Trial Operation

To ensure safe and correct trial operation, check the following items before you start trial operation.

- Make sure that the SERVOPACK and Servomotor are installed, wired, and connected correctly.
- Make sure that the correct power supply voltage is supplied to the SERVOPACK.
- Make sure that there are no loose parts in the Servomotor mounting.
- If you are using a Servomotor with an Oil Seal, make sure that the oil seal is not damaged. Also make sure that oil has been applied.
- If you are performing trial operation on a Servomotor that has been stored for a long period of time, make sure that all Servomotor inspection and maintenance procedures have been completed.

Refer to the manual for your Servomotor for Servomotor maintenance and inspection information.

• If you are using a Servomotor with a Holding Brake, make sure that the brake is released in advance. To release the brake, you must apply the specified voltage of 24 VDC to the brake. A circuit example for trial operation is provided below.



7.3.1 Preparations



# Trial Operation for the Servomotor without a Load

You use jogging for trial operation of the Servomotor without a load.

Jogging is used to check the operation of the Servomotor without connecting the SERVOPACK to the host controller. The Servomotor is moved at the preset jogging speed.



• During jogging, the overtravel function is disabled. Consider the range of motion of your machine when you jog the Servomotor.



The tuning-less function is enabled as the default setting. When the tuning-less function is enabled, gain will increase and vibration may occur if the Servomotor is operated with no load. If vibration occurs, disable the tuning-less function ( $Pn170 = n.\square\square\square$ ).

#### 7.3.1 Preparations

Always check the following before you execute jogging.

- The parameters must not be write prohibited.
- The main circuit power supply must be ON.
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- The servo must be OFF.
- The jogging speed must be set considering the operating range of the machine. The jogging speed is set with the following parameters.
  - Rotary Servomotors

|       | Jogging Speed      |              |                 |              |                |  |  |
|-------|--------------------|--------------|-----------------|--------------|----------------|--|--|
| Pn304 | Setting Range      | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 10,000        | 1 min⁻¹      | 500             | Immediately  | Setup          |  |  |
|       | Soft Start Acceler | ation Time   |                 |              |                |  |  |
| Pn305 | Setting Range      | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 10,000        | 1 ms         | 0               | Immediately  | Setup          |  |  |
|       | Soft Start Deceler | ration Time  |                 |              |                |  |  |
| Pn306 | Setting Range      | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 10,000        | 1 ms         | 0               | Immediately  | Setup          |  |  |

#### Direct Drive Servomotors

|       | Jogging Speed                |                       |                 |              |                |
|-------|------------------------------|-----------------------|-----------------|--------------|----------------|
| Pn304 | Setting Range                | Setting Unit          | Default Setting | When Enabled | Classification |
|       | 0 to 10,000                  | 0.1 min <sup>-1</sup> | 500             | Immediately  | Setup          |
|       | Soft Start Acceler           | ation Time            |                 |              |                |
| Pn305 | Setting Range                | Setting Unit          | Default Setting | When Enabled | Classification |
|       | 0 to 10,000                  | 1 ms                  | 0               | Immediately  | Setup          |
|       | Soft Start Deceleration Time |                       |                 |              |                |
| Pn306 | Setting Range                | Setting Unit          | Default Setting | When Enabled | Classification |
|       | 0 to 10,000                  | 1 ms                  | 0               | Immediately  | Setup          |

7.3.2 Applicable Tools

Linear Servomotors

|       | Jogging Speed                |              |                 |              |                |  |
|-------|------------------------------|--------------|-----------------|--------------|----------------|--|
| Pn383 | Setting Range                | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | 0 to 10,000                  | 1 mm/s       | 50              | Immediately  | Setup          |  |
|       | Soft Start Acceler           | ration Time  |                 |              |                |  |
| Pn305 | Setting Range                | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | 0 to 10,000                  | 1 ms         | 0               | Immediately  | Setup          |  |
|       | Soft Start Deceleration Time |              |                 |              |                |  |
| Pn306 | Setting Range                | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | 0 to 10,000                  | 1 ms         | 0               | Immediately  | Setup          |  |

## 7.3.2 Applicable Tools

The following table lists the tools that you can use to perform jogging.

| Tool             | Fn No./Function Name | Operating Procedure Reference                                                 |
|------------------|----------------------|-------------------------------------------------------------------------------|
| Digital Operator | Fn002                | Chanal Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33) |
| SigmaWin+        | Operation – Jog      | Derating Procedure on page 7-7                                                |

## 7.3.3 Operating Procedure

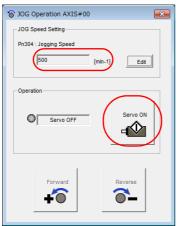
Use the following procedure to jog the motor.

- 1. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select JOG Operation in the Menu Dialog Box. The Jog Operation Dialog Box will be displayed.
- 3. Read the warnings and then click the OK Button.



7.3.3 Operating Procedure

4. Check the jogging speed and then click the Servo ON Button.

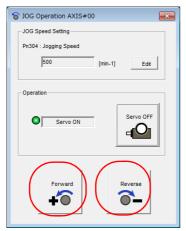




Information To change the speed, click the Edit Button and enter the new speed.

5. Click the Forward Button or the Reverse Button.

Jogging will be performed only while you hold down the mouse button.



6. After you finish jogging, turn the power supply to the SERVOPACK OFF and ON again.

This concludes the jogging procedure.

# 7.4 Trial Operation with DeviceNet Communications

A trial operation example for DeviceNet communications is given below. Refer to the following chapter for details on commands.

G Chapter 12 DeviceNet Functions

- 1. Connect the DeviceNet communications connector (CN6 connector).
- 2. Confirm that the wiring is correct, and then connect the I/O signal connector (CN1 connector).

Refer to the following chapter for details on wiring. Chapter 4 Wiring and Connections

- **3.** Turn ON the power supplies to the SERVOPACK. If power is being supplied correctly, the CHARGE indicator on the SERVOPACK will light.
- 4. Set the following items, which are necessary for trial operation.

| Setting                                                | Parameters to Set                | Reference                                                        |
|--------------------------------------------------------|----------------------------------|------------------------------------------------------------------|
| Motor Direction                                        | Pn000                            | 5.4 Motor Direction Setting on page 5-16                         |
| Feed Speed                                             | PnB21<br>PnB26<br>PnB29          | ਡੂੰ 12.3 Positioning on page 12-6                                |
| Acceleration Rate                                      | PnB2A                            |                                                                  |
| Deceleration Rate                                      | PnB2B                            |                                                                  |
| Holding Brake                                          | Pn506<br>Pn507 (Pn583)*<br>Pn508 |                                                                  |
| Motor Stopping<br>Method after Servo<br>OFF and Alarms | Pn001<br>Pn00B                   | 5.12 Motor Stopping Method for Servo OFF and Alarms on page 5-34 |

\* Set Pn507 for a Rotary Servomotor and Pn583 for a Linear Servomotor.

5. Use DeviceNet I/O communications to perform positioning. Refer to the following section for details on operation.

(a) 12.3 Positioning on page 12-6

6. While operation is in progress for step 5, confirm the following items.

| Confirmation Item                                                                                                                                                                             | Reference                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Confirm that the rotational direction of the<br>Servomotor agrees with the forward or<br>reverse reference. If they do not agree, cor-<br>rect the rotation direction of the Servomo-<br>tor. |                                                                                                 |
| Confirm that no abnormal vibration, noise,<br>or temperature rise occurs. If any abnor-<br>malities are found, implement corrections.                                                         | 14.4 Troubleshooting Based on the Operation and Condi-<br>tions of the Servomotor on page 14-57 |

Note: If the load machine is not sufficiently broken in before trial operation, the Servomotor may become overloaded. 7.5.1 Precautions

## 7.5 Trial Operation with the Servomotor Connected to the Machine

This section provides the procedure for trial operation with both the machine and Servomotor.

## 7.5.1 Precautions

# \land WARNING

• Operating mistakes that occur after the Servomotor is connected to the machine may not only damage the machine, but they may also cause accidents resulting in personal injury.



If you disabled the overtravel function for trial operation of the Servomotor without a load, enable the overtravel function (CCW-OT and CW-OT signal) before you preform trial operation with the Servomotor connected to the machine in order to provide protection.

If you will use a holding brake, observe the following precautions during trial operation.

- Before you check the operation of the brake, implement measures to prevent the machine from falling due to gravity and to prevent vibration from being caused by an external force.
- First check the Servomotor operation and brake operation with the Servomotor uncoupled from the machine. If no problems are found, connect the Servomotor to the machine and perform trial operation again.

Control the operation of the brake with the /BK (Brake) signal output from the SERVOPACK. Refer to the following sections for information on wiring and the related parameter settings. *C* 4.4.4 Wiring the SERVOPACK to the Holding Brake on page 4-35

5.11 Holding Brake on page 5-30



Failures caused by incorrect wiring or incorrect voltage application in the brake circuit may cause the SERVOPACK to fail, damage the SERVOPACK, damage the equipment, or cause an accident resulting in death or injury.

t Observe the precautions and instructions for wiring and trial operation precisely as described in this manual.

## 7.5.2 Preparations

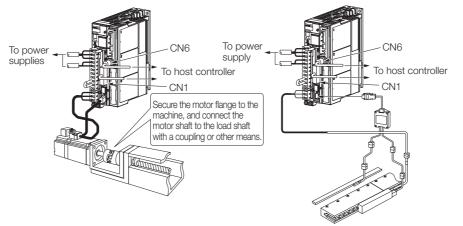
Always confirm the following before you perform the trial operation procedure for both the machine and Servomotor.

- Make sure that the procedure described in 7.4 Trial Operation with DeviceNet Communications on page 7-9 has been completed.
- Make sure that the SERVOPACK is connected correctly to both the host controller and the peripheral devices.
  - Safety Function Wiring
    - If you are not using the safety function, leave the Safety Jumper Connector (provided as an accessory with the SERVOPACK) connected to CN8.
    - If you are using the safety function, remove the Safety Jumper Connector from CN8 and connect the safety function device.
  - Overtravel wiring
  - Brake wiring
  - Emergency stop circuit wiring
  - Host controller wiring

7.5.3 Operating Procedure

## 7.5.3 Operating Procedure

- 1. Enable the overtravel signals.
- 2. Make the settings for the protective functions, such as the safety function, overtravel, and the brake.
  - 3.6 Connecting Safety Function Signals on page 4-41
  - 5.10 Overtravel and Related Settings on page 5-28
  - 3.11 Holding Brake on page 5-30
- **3.** Turn OFF the power supplies to the SERVOPACK. The control power supply and main circuit power supply will turn OFF.
- 4. Couple the Servomotor to the machine.



- 5. Turn ON the power supplies to the machine and host controller and turn ON the control power supply and main circuit power supply to the SERVOPACK.
- 6. Check the protective functions, such as overtravel and the brake, to confirm that they operate correctly.

Note: Enable activating an emergency stop so that the Servomotor can be stopped safely should an error occur during the remainder of the procedure.

- 7. Perform trial operation according to 7.4 Trial Operation with DeviceNet Communications on page 7-9 and confirm that the same results are obtained as when trial operation was performed on the Servomotor without a load.
- 8. If necessary, adjust the servo gain to improve the Servomotor response characteristics. The Servomotor and machine may not be broken in completely for the trial operation. Therefore, let the system run for a sufficient amount of time to ensure that it is properly broken in.
- 9. For future maintenance, save the parameter settings with one of the following methods.
  - Use the SigmaWin+ to save the parameters as a file.
  - Use the Parameter Copy Mode of the Digital Operator.
  - Record the settings manually.

This concludes the procedure for trial operation with both the machine and Servomotor.

7.6.1 Program Jogging

# 7.6 Convenient Function to Use during Trial Operation

This section describes some convenient operations that you can use during trial operation. Use them as required.

#### 7.6.1 Program Jogging

You can use program jogging to perform continuous operation with a preset operation pattern, travel distance, movement speed, acceleration/deceleration time, waiting time, and number of movements.

You can use this operation when you set up the system in the same way as for normal jogging to move the Servomotor without connecting it to the host controller in order to check Servomotor operation and execute simple positioning operations.

#### Preparations

Always check the following before you execute program jogging.

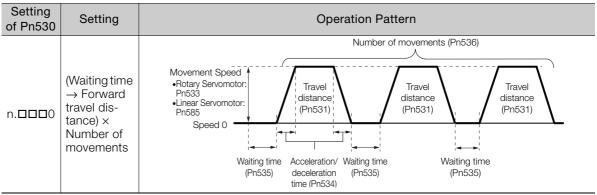
- The parameters must not be write prohibited.
- The main circuit power supply must be ON.
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- The servo must be OFF.
- The range of machine motion and the safe movement speed of your machine must be considered when you set the travel distance and movement speed.
- There must be no overtravel.

## Additional Information

- You can use the functions that are applicable to position control. However, parameters related to Command Option Modules in PnB00 and higher are disabled.
- The overtravel function is enabled.
- For overtravel, the rotation direction is the direction as viewed from the load end of the Servomotor.
- The software limits are disabled.

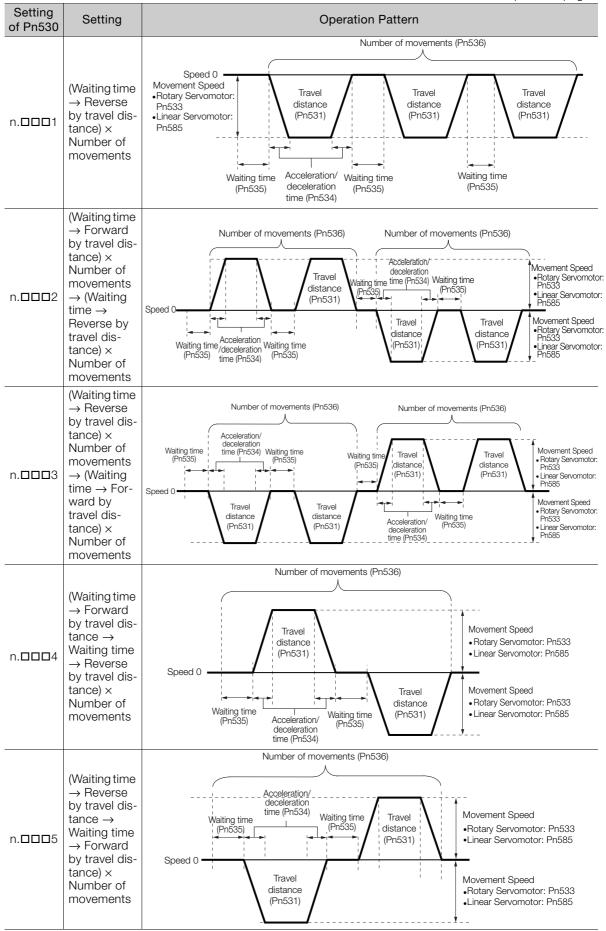
#### **Program Jogging Operation Pattern**

An example of a program jogging operation pattern is given below. In this example, the Servomotor direction is set to  $Pn000 = n.\Box\Box\Box\Box$  (Use CCW as the forward direction).



Continued on next page.

Continued from previous page.



Information If Pn530 is set to n.  $\Box$   $\Box$   $\Box$ , n.  $\Box$   $\Box$   $\Box$ , n.  $\Box$   $\Box$   $\Box$ , or n.  $\Box$   $\Box$   $\Box$ , you can set Pn536 (Program Jogging Number of Movements) to 0 to perform infinite time operation. You cannot use infinite time operation if Pn530 is set to n.  $\Box$   $\Box$   $\Box$   $\Box$   $\Box$ . If you perform infinite time operation from the Digital Operator, press the **JOG/SVON** Key to turn OFF the servo to end infinite time operation.

### **Related Parameters**

Use the following parameters to set the program jogging operation pattern. Do not change the settings while the program jogging operation is being executed.

Rotary Servomotors

|       | Program Jogging-Related Selections             |                  |                 |              |                |
|-------|------------------------------------------------|------------------|-----------------|--------------|----------------|
| Pn530 | Setting Range                                  | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 0000 to 0005                                   | _                | 0000            | Immediately  | Setup          |
|       | Program Jogging Tr                             | avel Distance    |                 |              |                |
| Pn531 | Setting Range                                  | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 1 to 1,073,741,824                             | 1 reference unit | 32,768          | Immediately  | Setup          |
|       | Program Jogging M                              | ovement Speed    |                 |              |                |
| Pn533 | Setting Range                                  | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 1 to 10,000                                    | 1 min⁻¹          | 500             | Immediately  | Setup          |
|       | Program Jogging Acceleration/Deceleration Time |                  |                 |              |                |
| Pn534 | Setting Range                                  | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 2 to 10,000                                    | 1 ms             | 100             | Immediately  | Setup          |
|       | Program Jogging Waiting Time                   |                  |                 |              |                |
| Pn535 | Setting Range                                  | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 0 to 10,000                                    | 1 ms             | 100             | Immediately  | Setup          |
|       | Program Jogging Number of Movements            |                  |                 |              |                |
| Pn536 | Setting Range                                  | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 0 to 1,000                                     | 1                | 1               | Immediately  | Setup          |

#### • Direct Drive Servomotors

| Program Jogging-Related Selections |                                                |                       |                 |              |                |
|------------------------------------|------------------------------------------------|-----------------------|-----------------|--------------|----------------|
| Pn530                              | Setting Range                                  | Setting Unit          | Default Setting | When Enabled | Classification |
|                                    | 0000 to 0005                                   | -                     | 0000            | Immediately  | Setup          |
|                                    | Program Jogging Tra                            | avel Distance         |                 |              |                |
| Pn531                              | Setting Range                                  | Setting Unit          | Default Setting | When Enabled | Classification |
|                                    | 1 to 1,073,741,824                             | 1 reference unit      | 32,768          | Immediately  | Setup          |
|                                    | Program Jogging M                              | ovement Speed         |                 |              |                |
| Pn533                              | Setting Range                                  | Setting Unit          | Default Setting | When Enabled | Classification |
|                                    | 1 to 10,000                                    | 0.1 min <sup>-1</sup> | 500             | Immediately  | Setup          |
|                                    | Program Jogging Acceleration/Deceleration Time |                       |                 |              |                |
| Pn534                              | Setting Range                                  | Setting Unit          | Default Setting | When Enabled | Classification |
|                                    | 2 to 10,000                                    | 1 ms                  | 100             | Immediately  | Setup          |
|                                    | Program Jogging W                              | aiting Time           |                 |              |                |
| Pn535                              | Setting Range                                  | Setting Unit          | Default Setting | When Enabled | Classification |
|                                    | 0 to 10,000                                    | 1 ms                  | 100             | Immediately  | Setup          |
|                                    | Program Jogging Nu                             | umber of Movemen      | its             |              |                |
| Pn536                              | Setting Range                                  | Setting Unit          | Default Setting | When Enabled | Classification |
|                                    | 0 to 1,000                                     | 1                     | 1               | Immediately  | Setup          |

• Linear Servomotors

|       | Program Jogging-Related Selections             |                  |                 |              |                |
|-------|------------------------------------------------|------------------|-----------------|--------------|----------------|
| Pn530 | Setting Range                                  | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 0000 to 0005                                   | -                | 0000            | Immediately  | Setup          |
|       | Program Jogging Tr                             | avel Distance    |                 |              |                |
| Pn531 | Setting Range                                  | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 1 to 1,073,741,824                             | 1 reference unit | 32,768          | Immediately  | Setup          |
|       | Program Jogging M                              | ovement Speed    |                 |              |                |
| Pn585 | Setting Range                                  | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 1 to 10,000                                    | 1 mm/s           | 50              | Immediately  | Setup          |
|       | Program Jogging Acceleration/Deceleration Time |                  |                 |              |                |
| Pn534 | Setting Range                                  | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 2 to 10,000                                    | 1 ms             | 100             | Immediately  | Setup          |
|       | Program Jogging Waiting Time                   |                  |                 |              |                |
| Pn535 | Setting Range                                  | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 0 to 10,000                                    | 1 ms             | 100             | Immediately  | Setup          |
|       | Program Jogging N                              | umber of Movemer | nts             |              |                |
| Pn536 | Setting Range                                  | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 0 to 1,000                                     | 1                | 1               | Immediately  | Setup          |

### **Applicable Tools**

The following table lists the tools that you can use to perform program jogging.

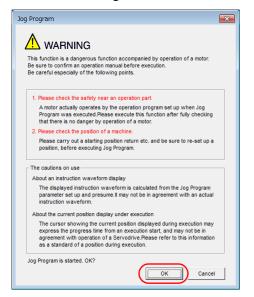
| Tool             | Fn No./Function Name                     | Reference                                                                     |  |
|------------------|------------------------------------------|-------------------------------------------------------------------------------|--|
| Digital Operator | Fn004                                    | Chanal Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33) |  |
| SigmaWin+        | <b>Operation – Program JOG Operation</b> | Ge Operating Procedure on page 7-15                                           |  |

# **Operating Procedure**

Use the following procedure for a program jog operation.

- 1. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select JOG Program in the Menu Dialog Box. The Jog Program Dialog Box will be displayed.

3. Read the warnings and then click the OK Button.



**4.** Set the operating conditions, click the **Apply** Button, and then click the **Run** Button. A graph of the operation pattern will be displayed.

| 된 Jog Program AXIS#00                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AUTO (min-1/div)                                                                                                                    | Pns31:Program Jogging Travel Distance           Pns31:Program Jogging Travel Distance           3276800 [reference units] (1-1073741824)           Pns33:Program Jogging Movement Speed           500 [min-1] (1-10000)           Pns34:Program Jogging Acceleration/Deceleration           26 [ms] (2-10000)           Pns53:Program Jogging Waiting Time           100 [ms] (0-10000)           Pns58:Program Jogging Number of Movements           3 [times] (0-1000) (0: Infinite) |
| -200<br>-300<br>0 976 1952 2928 3904 4880<br>                                                                                       | Ph530.0: Program Jogging Operation Pattern<br>0: (Waiting time in Ph535 -> Forward by travel d                                                                                                                                                                                                                                                                                                                                                                                         |
| Running Information           Total Time         4880(ms]           The total amount of movements         +9830400(reference units) | Run                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

5. Click the Servo ON Button and then the Execute Button. The program jogging operation will be executed.

| AUTO ▼ [min-1/div]<br>1 700 T                                                                         | Servo OFF                       |
|-------------------------------------------------------------------------------------------------------|---------------------------------|
| 600                                                                                                   | 4                               |
| 500                                                                                                   |                                 |
| 400                                                                                                   |                                 |
| 200                                                                                                   | Run                             |
| 100                                                                                                   | Execute                         |
| o <mark></mark>                                                                                       | Stopping                        |
| -100                                                                                                  |                                 |
| -200                                                                                                  |                                 |
| 0 976 1952 2928 3904 4880                                                                             | Progress time                   |
|                                                                                                       | -[sec]                          |
| ·                                                                                                     | The number of forward movements |
| FULL T [ms/div]                                                                                       |                                 |
|                                                                                                       | The number of reverse movements |
| Running Information                                                                                   | 0/0[times]                      |
| Total Time         4880[ms]           The total amount of movements         +9830400[reference units] |                                 |
| +3630400[released units]                                                                              | Running condition re-setting    |
|                                                                                                       |                                 |

- Be aware of the following points if you cancel the program jogging operation while the Servomotor is operating.
  - If you cancel operation with the Servo OFF Button, the Servomotor will stop according to setting of the Servo OFF stopping method (Pn001 = n.DDX).
  - If you cancel operation with the **Cancel** Button, the Servomotor will decelerate to a stop and then enter a zero-clamped state.

This concludes the program jogging procedure.

7.6.2 Origin Search

# 7.6.2 Origin Search

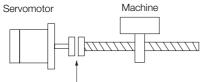
The origin search operation positions the motor to the origin within one rotation and then clamps it there.



• Make sure that the load is not coupled when you execute an origin search. The CCW Drive Prohibit (CCW-OT) signal and CW Drive Prohibit (CW-OT) signal are disabled during an origin search.

Use an origin search when it is necessary to align the origin within one rotation with the machine origin. The following speeds are used for origin searches.

- Rotary Servomotors: 60 min<sup>-1</sup>
- Direct Drive Servomotors: 6 min<sup>-1</sup>
- Linear Servomotors: 15 mm/s



To align the origin within one rotation with the machine origin

# Preparations

Always check the following before you execute an origin search.

- The parameters must not be write prohibited.
- The main circuit power supply must be ON.
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- The servo must be OFF.

# **Applicable Tools**

The following table lists the tools that you can use to perform an origin search.

| Tool Fn No./Function Name |                                 | Reference                                                                       |  |
|---------------------------|---------------------------------|---------------------------------------------------------------------------------|--|
| Digital Operator Fn003    |                                 | Ω Σ-7-Series Digital Operator Operating<br>Manual (Manual No.: SIEP S800001 33) |  |
| SigmaWin+*                | Encoder Setting – Search Origin | Gerating Procedure on page 7-19                                                 |  |

\* Cannot be used when connecting a Linear Servomotor.

7.6.2 Origin Search

# **Operating Procedure**

Use the following procedure to perform an origin search.

- 1. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Search Origin in the Menu Dialog Box. The Origin Search Dialog Box will be displayed.
- 3. Read the warnings and then click the OK Button.

| Origin Search                                                                                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                           |
| It is dangerous to operate this function, because the servomotor will rotate.<br>Always be sure to check the user's manual before operating.                                                                                                                              |
| Pay particular attention to the following points:                                                                                                                                                                                                                         |
| 1. Perform safety checks around moving parts.                                                                                                                                                                                                                             |
| The servomotor will actually turn at approximately 60min-1 (6min-1 with DD<br>motor) while clicking the FORWARD/REVERSE button. Perform this after<br>thoroughly checking that there is no danger from servomotor operation.                                              |
| 2. [Forward Run Prohibit (P-OT)]/[Reverse Run Prohibit (N-OT)] is disabled.                                                                                                                                                                                               |
| The Forward Run Prohibit (P-OT)/Reverse Run Prohibit (N-OT) signals are<br>disabled during origin search (the servomotor will not stop even if the<br>P-OTN-D signals are passed). When operating, carefully verify the action<br>and position of the servomotor/machine. |
| Clicking the OK button to start the Origin Search.                                                                                                                                                                                                                        |
| Cancel                                                                                                                                                                                                                                                                    |

4. Click the Servo ON Button.

| 🎳 Origin Search AXIS#00           |
|-----------------------------------|
| Status Origin Search Not Executed |
| Operation<br>Servo OFF            |
| Forward                           |

#### 5. Click the Forward Button or the Reverse Button.

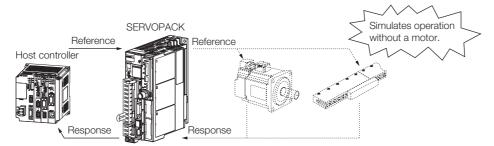
An origin search will be performed only while you hold down the mouse button. The motor will stop when the origin search has been completed.

| 🎳 Origin Search AXIS#00              |
|--------------------------------------|
| Status<br>Origin Search Not Executed |
| Operation<br>Servo OFF               |
| Forward                              |

This concludes the origin search procedure.

# 7.6.3 Test without a Motor

A test without a motor is used to check the operation of the host controller and peripheral devices by simulating the operation of the Servomotor in the SERVOPACK, i.e., without actually operating a Servomotor. This test allows you to check wiring, debug the system, and verify parameters to shorten the time required for setup work and to prevent damage to the machine that may result from possible malfunctions. The operation of the Servomotor can be checked with this test regardless of whether the Servomotor is actually connected or not.



Use  $Pn00C = n.\square\square\squareX$  to enable or disable the test without a motor.

| Parameter |                             | Meaning                        | When Enabled  | Classification |
|-----------|-----------------------------|--------------------------------|---------------|----------------|
| Pn00C     | n.□□□0<br>(default setting) | Disable tests without a motor. | After restart | Setup          |
|           | n.□□□1                      | Enable tests without a motor.  |               |                |

Information An asterisk is displayed on the status display of the Digital Operator while a test without a motor is being executed.

# Motor Information and Encoder Information

The motor and encoder information is used during tests without a motor. The source of the information depends on the device connection status.

Rotary Servomotor

| Motor Connection<br>Status | Information That Is Used                                                             | Source of Information                                                                                                                                                                                                                                                                                                                                                                   |  |
|----------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Connected                  | Motor information <ul> <li>Rated motor speed</li> <li>Maximum motor speed</li> </ul> | Information in the Servomotor that is connected                                                                                                                                                                                                                                                                                                                                         |  |
| Connected                  | Encoder information <ul> <li>Encoder resolution</li> <li>Encoder type</li> </ul>     |                                                                                                                                                                                                                                                                                                                                                                                         |  |
| Not connected              | Motor information<br>• Rated motor speed<br>• Maximum motor speed                    | <ul> <li>Setting of Pn000 = n.X□□□ (Rotary/Linear Startup Selection When Encoder Is Not Connected)</li> <li>Rated motor speed and maximum motor speed The values previously saved in the SERVOPACK will be used for the rated motor speed and maximum motor speed.<br/>Use the motor displays (Un020: Rated Motor Speed and Un021: Maximum Motor Speed) to check the values.</li> </ul> |  |
|                            | Encoder information <ul> <li>Encoder resolution</li> <li>Encoder type</li> </ul>     | <ul> <li>Encoder resolution: Setting of Pn00C = n.□□X□<br/>(Encoder Resolution for Tests without a Motor)</li> <li>Encoder type: Setting of Pn00C = n.□X□□ (Encoder<br/>Type Selection for Tests without a Motor)</li> </ul>                                                                                                                                                            |  |

If you use fully-closed loop control, the external encoder information is also used.

| External Encoder Connection<br>Status | Information That Is<br>Used                       | Source of Information                                                       |
|---------------------------------------|---------------------------------------------------|-----------------------------------------------------------------------------|
| Connected                             | External encoder infor-<br>mation                 | Information in the external encoder that is con-<br>nected                  |
| Not connected                         | <ul><li>Resolution</li><li>Encoder type</li></ul> | <ul><li>Resolution: 256</li><li>Encoder type: Incremental encoder</li></ul> |

#### · Linear Servomotors

| Motor Connection<br>Status | Information That Is Used                                                             | Source of Information                                                                                                                                                                                    |
|----------------------------|--------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            | Motor information                                                                    | Information in the motor that is connected                                                                                                                                                               |
| Connected                  | Linear encoder informa-<br>tion<br>• Resolution<br>• Encoder pitch<br>• Encoder type | Information in the linear encoder that is connected                                                                                                                                                      |
|                            | Motor information                                                                    | Setting of Pn000 = n.X□□□ (Rotary/Linear Startup Selection When Encoder Is Not Connected)                                                                                                                |
| Not connected              | Linear encoder informa-<br>tion<br>• Resolution<br>• Encoder pitch<br>• Encoder type | <ul> <li>Resolution: 256</li> <li>Encoder pitch: Setting of Pn282 (Linear Encoder Pitch)</li> <li>Encoder type: Setting of Pn00C = n. □X□□ (Encoder Type Selection for Tests without a Motor)</li> </ul> |

#### Related Parameters

| F     | Parameter                   | Meaning                                                                     | When Enabled  | Classification |
|-------|-----------------------------|-----------------------------------------------------------------------------|---------------|----------------|
| Pn000 | n.0□□□<br>(default setting) | When an encoder is not connected, start as SERVOPACK for Rotary Servomotor. | After restart | Setup          |
|       | n.1000                      | When an encoder is not connected, start as SERVOPACK for Linear Servomotor. | Aller lestart | Getup          |

|                 | Linear Encoder P            | itch                                                         |                                 |               |                |       |                |  |
|-----------------|-----------------------------|--------------------------------------------------------------|---------------------------------|---------------|----------------|-------|----------------|--|
| Pn282           | Setting Range               | Setting Unit                                                 | Setting Unit Default Setting Wh |               |                |       | Classification |  |
|                 | 0 to 6,553,600              | 0.01 µm                                                      | 0                               | Aft           | ter restart    |       | Setup          |  |
| P               | Parameter Meaning           |                                                              | When Enabled                    |               | Classification |       |                |  |
|                 | n.□□0□<br>(default setting) | Use 13 bits as enco without a motor.                         | der resolution for te           | sts           |                |       |                |  |
|                 | n.0010                      | Use 20 bits as encoder resolution for tests without a motor. |                                 |               |                |       |                |  |
| n.□□2□<br>Pn00C |                             | Use 22 bits as encoder resolution for tests without a motor. |                                 |               | After restart  |       | Satup          |  |
| 111000          | n.□□3□                      | Use 24 bits as encoder resolution for tests without a motor. |                                 |               |                | Setup |                |  |
|                 | n.□0□□<br>(default setting) | Use an incremental encoder for tests without a motor.        |                                 |               |                |       |                |  |
|                 | n.0100                      | Use an absolute end<br>motor.                                | coder for tests with            | sts without a |                |       |                |  |

## Motor Position and Speed Responses

For a test without a motor, the following responses are simulated for references from the host controller according to the gain settings for position or speed control.

- Servomotor position
- Motor speed
- External encoder position

The load model will be for a rigid system with the moment of inertia ratio that is set in Pn103.

## Restrictions

The following functions cannot be used during the test without a motor.

- Regeneration and dynamic brake operation
- Brake output signal
- Items marked with "x" in the following utility function table

| Menu     Comparison       Dialog Box     Initializ       Softward     Softward       Basic     Produ       Functions     Produ       Encoder     Multi-fill       Setting     Search       Zero F     Setting | are Reset                                         | Fn No.<br>Fn005<br>Fn030<br>Fn011 | Utility Function Name<br>Initializing Parameters<br>Software Reset     | Motor Not<br>Connected | Motor<br>Connected | Reference  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-----------------------------------|------------------------------------------------------------------------|------------------------|--------------------|------------|
| Basic<br>FunctionsSoftwaProductProductEncoder<br>SettingReset<br>Encoder<br>Search<br>Zero F<br>Setting                                                                                                       | are Reset                                         | Fn030                             |                                                                        | 0                      | _                  |            |
| Basic<br>FunctionsProduProduProduEncoder<br>SettingReset<br>Encoder<br>                                                                                                                                       |                                                   |                                   | Software Reset                                                         |                        | 0                  | page 5-10  |
| Functions       Product         Encoder       Resett         Setting       Search         Zero F       Setting                                                                                                |                                                   | Fn011                             |                                                                        | 0                      | 0                  | page 6-24  |
| Functions       Product         Encoder       Resett         Setting       Search         Zero F       Setting                                                                                                |                                                   |                                   | Display Servomotor<br>Model                                            | 0                      | 0                  |            |
| Encoder<br>Setting<br>Setting<br>Encoder<br>Search<br>Zero F<br>Setting                                                                                                                                       |                                                   | Fn012                             | Display Software Ver-<br>sion                                          | 0                      | 0                  |            |
| Encoder<br>Setting<br>Zero F<br>Setting                                                                                                                                                                       | ict Information                                   | Fn01E                             | Display SERVOPACK<br>and Servomotor IDs                                | 0                      | 0                  | page 9-2   |
| Encoder<br>Setting<br>Zero F<br>Setting                                                                                                                                                                       |                                                   | Fn01F                             | Display Servomotor ID<br>from Feedback Option<br>Module                | 0                      | 0                  |            |
| Encoder<br>Setting<br>Zero F<br>Setting                                                                                                                                                                       | Absolute<br>der                                   | Fn008                             | Reset Absolute<br>Encoder                                              | ×                      | 0                  | page 5-47  |
| Zero F<br>Setting                                                                                                                                                                                             | turn Limit Setup                                  | Fn013                             | Multiturn Limit Setting<br>after Multiturn Limit<br>Disagreement Alarm | ×                      | 0                  | page 6-20  |
| Setting                                                                                                                                                                                                       | h Origin <sup>*2</sup>                            | Fn003                             | Origin Search                                                          | 0                      | 0                  | page 7-18  |
| Polarit                                                                                                                                                                                                       | Zero Point Position<br>Setting                    |                                   | Set Absolute Linear<br>Encoder Origin                                  | ×                      | 0                  | page 5-50  |
|                                                                                                                                                                                                               | ty Detection                                      | Fn080                             | Polarity Detection                                                     | ×                      | ×                  | page 5-27  |
|                                                                                                                                                                                                               |                                                   | Fn000                             | Display Alarm History                                                  | 0                      | 0                  | page 14-44 |
| Displa                                                                                                                                                                                                        | ay Alarm                                          | Fn006                             | Clear Alarm History                                                    | 0                      | 0                  | page 14-45 |
| Trouble-<br>shooting                                                                                                                                                                                          |                                                   | Fn014                             | Reset Option Module<br>Configuration Error                             | 0                      | 0                  | page 14-46 |
| Reset<br>Alarm                                                                                                                                                                                                | Motor Type                                        | Fn021                             | Reset Motor Type<br>Alarm                                              | 0                      | 0                  | page 14-48 |
| Jog                                                                                                                                                                                                           |                                                   | Fn002                             | Jog                                                                    | 0                      | 0                  | page 7-6   |
| Operation Progration                                                                                                                                                                                          | am JOG Opera-                                     | Fn004                             | Jog Program                                                            | 0                      | 0                  | page 7-12  |
|                                                                                                                                                                                                               | g -<br>uning without<br>Reference                 | Fn201                             | Advanced Autotuning without Reference                                  | ×                      | ×                  | page 8-23  |
| Tuning<br>Autotu<br>Refere                                                                                                                                                                                    | uning with Host                                   | Fn202                             | Advanced Autotuning with Reference                                     | ×                      | ×                  | page 8-34  |
| Tuning<br>Custo                                                                                                                                                                                               | g -<br>m Tuning                                   | Fn203                             | One-Parameter Tuning                                                   | ×                      | ×                  | page 8-42  |
| ing - A<br>onanc                                                                                                                                                                                              | g - Custom Tun-<br>Adjust Anti-res-<br>ce Control | Fn204                             | Adjust Anti-resonance<br>Control                                       | ×                      | ×                  | page 8-42  |
| ing - V<br>pressi                                                                                                                                                                                             |                                                   | Fn205                             | Vibration Suppression                                                  | ×                      | ×                  | page 8-56  |
| ting                                                                                                                                                                                                          | Response Level Set-                               |                                   | Tuning less Louis! Oct                                                 |                        |                    |            |
| Diagnostic Easy F                                                                                                                                                                                             |                                                   | Fn200                             | Tuning-less Level Set-<br>ting                                         | ×                      | ×                  | page 8-11  |

Continued on next page.

Continued from previous page.

|                                 | Disitel Oceanter Evenuteble?            |        |                                                               |                        |                    |            |  |
|---------------------------------|-----------------------------------------|--------|---------------------------------------------------------------|------------------------|--------------------|------------|--|
|                                 | SigmaWin+                               |        | Digital Operator                                              |                        | Executable?        |            |  |
| Button in<br>Menu<br>Dialog Box | SigmaWin+ Function<br>Name              | Fn No. | Utility Function Name                                         | Motor Not<br>Connected | Motor<br>Connected | Reference  |  |
|                                 | Adjust the Analog                       | Fn00C  | Adjust Analog Monitor<br>Output Offset                        | 0                      | 0                  | page 0, 10 |  |
|                                 | Monitor Output                          | Fn00D  | Adjust Analog Monitor<br>Output Gain                          | 0                      | 0                  | page 9-10  |  |
| Others                          | Adjust the Motor Cur-                   | Fn00E  | Autotune Motor Cur-<br>rent Detection Signal<br>Offset        | ×                      | 0                  | page 6-30  |  |
| Others                          | rent Detection Offsets                  | Fn00F  | Manually Adjust Motor<br>Current Detection Sig-<br>nal Offset | ×                      | 0                  | page 0-50  |  |
|                                 | Initialize Vibration<br>Detection Level | Fn01B  | Initialize Vibration<br>Detection Level                       | ×                      | ×                  | page 6-26  |  |
|                                 | Write Prohibited Set-<br>ting           | Fn010  | Write Prohibition Set-<br>ting                                | 0                      | 0                  | page 5-8   |  |

\*1. An Initialize Button will be displayed when you select Parameters - Edit Parameters from the menu bar.

\*2. Cannot be used when connecting a Linear Servomotor.

7.6 Convenient Function to Use during Trial Operation

# Tuning

This chapter provides information on the flow of tuning, details on tuning functions, and related operating procedures.

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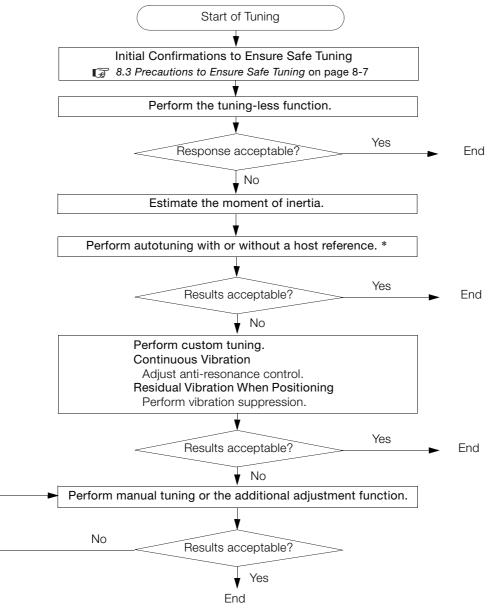
# 8.1 Overview and Flow of Tuning

Tuning is performed to optimize response by adjusting the servo gains in the SERVOPACK.

The servo gains are set using a combination of parameters, such as parameters for the speed loop gain, position loop gain, filters, friction compensation, and moment of inertia ratio. These parameters influence each other, so you must consider the balance between them.

The servo gains are set to stable settings by default. Use the various tuning functions to increase the response even further for the conditions of your machine.

The basic tuning procedure is shown in the following flowchart. Make suitable adjustments considering the conditions and operating requirements of your machine.



\* If possible, perform autotuning with a host reference.

If a host controller is not available, set an operation pattern that is as close as possible to the host reference and perform autotuning without a host reference. If an operation pattern that is close to the host reference is not possible, perform autotuning with a host reference

If an operation pattern that is close to the host reference is not possible, perform autotuning with a host reference while performing program jogging.

8.1.1 Tuning Functions

# 8.1.1 **Tuning Functions**

| Can use it with the default settings.Page 8-1Moment of Inertia<br>EstimationThe moment of inertia ratio is calculated by operating the Servomotor a<br>few times.<br>The moment of inertia ratio that is calculated here is used in other tun-<br>ing functions.page 8-1Autotuning without<br>Host ReferenceThe following parameters are automatically adjusted in the internal ref-<br>erences in the SERVOPACK during automatic operation.<br>• Gains (e.g., position loop gain and speed loop gain)<br>• Filters (torque reference filter and notch filters)<br>• Friction compensation<br>• Anti-resonance control<br>• Vibration suppressionpage 8-2Autotuning with Host<br>ReferenceThe following parameters are automatically adjusted with the position<br>reference input from the host controller while the machine is in opera-<br>tion. You can use this function for fine-tuning after you perform autotun-<br>ing without a host reference.<br>• Gains (e.g., position loop gain and speed loop gain)<br>• Filters (torque reference filter and notch filters)<br>• Firction compensation<br>• Anti-resonance control<br>• Vibration suppressionpage 8-3Custom TuningThe following parameters are adjusted with the position reference or<br>speed reference filter and notch filters)<br>• Friction compensation<br>• Anti-resonance control<br>• Vibration suppressionpage 8-4Anti-resonance<br>Control AdjustmentThis function effectively suppresses continuous vibration.page 8-5Speed Ripple Com-<br>pensationThis function effectively suppresses residual vibration if it occurs when<br>positioning.page 8-5Speed Ripple Com-<br>pensationThis function combines autotuning with custom tuning. You can use it<br>to improve adjustment results.page 8-6                                                                                                                                                                                                      | Tuning Function                      | Outline                                                                                                                                                                                                                                                                                                                                                                                                | Reference |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Moment of Inertia<br>Estimationfew times.<br>The moment of inertia ratio that is calculated here is used in other tun-<br>ing functions.page 8-1Autotuning without<br>Host ReferenceThe following parameters are automatically adjusted in the internal ref-<br>erences in the SERVOPACK during automatic operation.<br>• Gains (e.g., position loop gain and speed loop gain)<br>• Friction compensation<br>• Anti-resonance control<br>• Vibration suppressionpage 8-2Autotuning with Host<br>ReferenceThe following parameters are automatically adjusted with the position<br>reference input from the host controller while the machine is in opera-<br>tion. You can use this function for fine-tuning after you perform autotun-<br>ing without a host reference.<br>• Gains (e.g., position loop gain and speed loop gain)<br>• Friction compensation<br>• Anti-resonance control<br>• Vibration suppressionpage 8-3Custom TuningThe following parameters are adjusted with the position reference or<br>speed reference input from the host controller while the machine is in<br>operation.<br>• Anti-resonance control<br>• Vibration suppressionpage 8-3Custom TuningThe following parameters are adjusted with the position reference or<br>speed reference input from the host controller while the machine is in<br>operation.<br>• Anti-resonance control<br>• Vibration suppressionpage 8-4Anti-resonance<br>Control AdjustmentThis function effectively suppresses continuous vibration.page 8-5Speed Ripple Com-<br>pensationThis function reduces the ripple in the motor speed.<br>page 8-5page 8-6Additional<br>Additional<br>AdditonalThis function combines autotuning with custom tuning. You can use it<br>to improve adjustment results.page 8-6 <td>Tuning-less Function</td> <td>tion without servo tuning. This function can be used to obtain a stable response regardless of the type of machine or changes in the load. You</td> <td>page 8-11</td> | Tuning-less Function                 | tion without servo tuning. This function can be used to obtain a stable response regardless of the type of machine or changes in the load. You                                                                                                                                                                                                                                                         | page 8-11 |
| Autotuning without<br>Host Referenceerences in the SERVOPACK during automatic operation.<br>Gains (e.g., position loop gain and speed loop gain)<br>Filters (torque reference filter and notch filters)<br>Friction compensation<br>Anti-resonance control<br>Vibration suppressionpage 8-2Autotuning with Host<br>ReferenceThe following parameters are automatically adjusted with the position<br>reference input from the host controller while the machine is in opera-<br>tion. You can use this function for fine-tuning after you perform autotun-<br>ing without a host reference.<br>Gains (e.g., position loop gain and speed loop gain)<br>Fitters (torque reference filter and notch filters)<br>Friction compensation<br>Anti-resonance control<br>Vibration suppressionpage 8-3Custom TuningThe following parameters are adjusted with the position reference or<br>speed reference input from the host controller while the machine is in<br>operation.<br>Custom TuningPage 8-3Custom TuningThe following parameters are adjusted with the position reference or<br>speed reference input from the host controller while the machine is in<br>operation.<br>Cains (e.g., position loop gain and speed loop gain)<br>Filters (torque reference filter and notch filters)<br>Friction compensation<br>Anti-resonance control<br>Vibration suppressionpage 8-4Anti-resonance<br>Control AdjustmentThis function effectively suppresses continuous vibration.page 8-5Speed Ripple Com-<br>pensationThis function reduces the ripple in the motor speed.page 8-6Additional<br>Adjustment Function <td>Moment of Inertia<br/>Estimation</td> <td>few times.<br/>The moment of inertia ratio that is calculated here is used in other tun-</td> <td>page 8-15</td>                                                                                                                                                                                                         | Moment of Inertia<br>Estimation      | few times.<br>The moment of inertia ratio that is calculated here is used in other tun-                                                                                                                                                                                                                                                                                                                | page 8-15 |
| Autotuning with Host<br>Referencereference input from the host controller while the machine is in opera-<br>tion. You can use this function for fine-tuning after you perform autotun-<br>ing without a host reference.<br>• Gains (e.g., position loop gain and speed loop gain)<br>• Friction compensation<br>• Anti-resonance control<br>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Autotuning without<br>Host Reference | <ul> <li>erences in the SERVOPACK during automatic operation.</li> <li>Gains (e.g., position loop gain and speed loop gain)</li> <li>Filters (torque reference filter and notch filters)</li> <li>Friction compensation</li> <li>Anti-resonance control</li> </ul>                                                                                                                                     | page 8-23 |
| Custom Tuningspeed reference input from the host controller while the machine is in<br>operation.<br>• Gains (e.g., position loop gain and speed loop gain)<br>• Filters (torque reference filter and notch filters)<br>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Autotuning with Host<br>Reference    | <ul> <li>reference input from the host controller while the machine is in opera-<br/>tion. You can use this function for fine-tuning after you perform autotun-<br/>ing without a host reference.</li> <li>Gains (e.g., position loop gain and speed loop gain)</li> <li>Filters (torque reference filter and notch filters)</li> <li>Friction compensation</li> <li>Anti-resonance control</li> </ul> | page 8-34 |
| Control AdjustmentThis function effectively suppresses continuous vibration.page 8-5Vibration<br>SuppressionThis function effectively suppresses residual vibration if it occurs when<br>positioning.page 8-5Speed Ripple Com-<br>pensationThis function reduces the ripple in the motor speed.page 8-6Additional<br>Adjustment FunctionThis function combines autotuning with custom tuning. You can use it<br>to improve adjustment results.page 8-6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Custom Tuning                        | <ul> <li>speed reference input from the host controller while the machine is in operation.</li> <li>Gains (e.g., position loop gain and speed loop gain)</li> <li>Filters (torque reference filter and notch filters)</li> <li>Friction compensation</li> </ul>                                                                                                                                        | page 8-42 |
| Suppressionpositioning.page 8-5Speed Ripple CompensationThis function reduces the ripple in the motor speed.page 8-6AdditionalThis function combines autotuning with custom tuning. You can use it<br>to improve adjustment results.page 8-6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Anti-resonance<br>Control Adjustment | This function effectively suppresses continuous vibration.                                                                                                                                                                                                                                                                                                                                             | page 8-51 |
| pensationThis function reduces the ripple in the motor speed.page 8-6Additional<br>Adjustment FunctionThis function combines autotuning with custom tuning. You can use it<br>to improve adjustment results.page 8-6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Vibration<br>Suppression             |                                                                                                                                                                                                                                                                                                                                                                                                        | page 8-56 |
| Adjustment Function to improve adjustment results.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Speed Ripple Com-<br>pensation       | This function reduces the ripple in the motor speed.                                                                                                                                                                                                                                                                                                                                                   | page 8-60 |
| Manual Tuning You can manually adjust the servo gains to adjust the response. page 8-7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Additional<br>Adjustment Function    |                                                                                                                                                                                                                                                                                                                                                                                                        | page 8-66 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Manual Tuning                        | You can manually adjust the servo gains to adjust the response.                                                                                                                                                                                                                                                                                                                                        | page 8-79 |

The following table provides an overview of the tuning functions.

# 8.1.2 Diagnostic Tool

You can use the following tools to measure the frequency characteristics of the machine and set notch filters.

| Diagnostic Tool     | Outline                                                                                                                                       | Reference |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Mechanical Analysis | The machine is subjected to vibration to detect resonance frequencies.<br>The measurement results are displayed as waveforms or numeric data. | page 8-93 |
| Easy FFT            | The machine is subjected to vibration to detect resonance frequencies.<br>The measurement results are displayed only as numeric data.         | page 8-95 |

# 8.2 Monitoring Methods

You can use the data tracing function of the SigmaWin+ or the analog monitor signals of the SERVOPACK for monitoring. If you perform custom tuning or manual tuning, always use the above functions to monitor the machine operating status and SERVOPACK signal waveform while you adjust the servo gains.

Check the adjustment results with the following response waveforms.

| Item                     | Unit                   |                   |  |  |
|--------------------------|------------------------|-------------------|--|--|
| nem                      | Rotary Servomotor      | Linear Servomotor |  |  |
| Torque reference         |                        | %                 |  |  |
| Feedback speed           | min <sup>-1</sup>      | mm/s              |  |  |
| Position reference speed | min <sup>-1</sup> mm/s |                   |  |  |
| Position deviation       | Refere                 | nce units         |  |  |

8.3.1 Overtravel Settings

# 8.3 Precautions to Ensure Safe Tuning

# 

- Observe the following precautions when you perform tuning.
  - Do not touch the rotating parts of the motor when the servo is ON.
- Before starting the Servomotor, make sure that an emergency stop can be performed at any time.
- Make sure that trial operation has been successfully performed without any problems.
- Provide an appropriate stopping device on the machine to ensure safety.

Perform the following settings in a way that is suitable for tuning.

# 8.3.1 Overtravel Settings

Overtravel settings are made to force the Servomotor to stop for a signal input from a limit switch when a moving part of the machine exceeds the safe movement range.

Refer to the following section for details.

5.10 Overtravel and Related Settings on page 5-28

# 8.3.2 Torque Limit Settings

You can limit the torque that is output by the Servomotor based on calculations of the torque required for machine operation. You can use torque limits to reduce the amount of shock applied to the machine when problems occur, such as collisions or interference. If the torque limit is lower than the torque that is required for operation, overshooting or vibration may occur.

Refer to the following section for details. 6.7 Internal Torque Limits on page 6-17

# 8.3.3 Setting the Position Deviation Overflow Alarm Level

The position deviation overflow alarm is a protective function that is enabled when the SERVO-PACK is used in position control.

If the alarm level is set to a suitable value, the SERVOPACK will detect excessive position deviation and will stop the Servomotor if the Servomotor operation does not agree with the reference.

The position deviation is the difference between the position reference value and the actual position.

You can calculate the position deviation from the position loop gain (Pn102) and the motor speed with the following formula.

#### Rotary Servomotors

Position deviation [reference units] =  $\frac{\text{Motor speed [min^{-1}]}}{60} \times \frac{\text{Encoder resolution}^{*1}}{\text{Pn102 [0.1/s]/10}^{*2,*3}} \times \frac{\text{Pn210}}{\text{Pn20E}}$ 

#### Linear Servomotors

|                                      | Motor speed [mm/s]                   | Resolution                        | Pn210 |
|--------------------------------------|--------------------------------------|-----------------------------------|-------|
| Position deviation [reference units] | = Pn102 [0.1/s]/10 <sup>*2, *3</sup> | × Linear encoder pitch [μm]/1,000 | Pn20E |

#### 8.3.3 Setting the Position Deviation Overflow Alarm Level

Position Deviation Overflow Alarm Level (Pn520) [setting unit: reference units]

#### Rotary Servomotors

| Pn520 >  | $\frac{\text{Maximum motor speed [min-1]}}{60} \times$ | Encoder resolution*1<br>Pn102 [0.1/s]/10*2,*3 | × Pn210<br>Pn20E | × (1.2 to 2)*4 |  |
|----------|--------------------------------------------------------|-----------------------------------------------|------------------|----------------|--|
| • Linear | Servomotors                                            |                                               |                  |                |  |
|          | Maximum motor speed [mm/s]                             | Resolution                                    |                  | Pn210          |  |

 $Pn520 > \frac{Pn120}{Pn102} [0.1/s]/10^{*2,*3} \times \frac{Pn200}{Linear encoder pitch [µm]/1,000} \times \frac{Pn200}{Pn200} \times \frac{(1.2 \text{ to } 2)^{*4}}{(1.2 \text{ to } 2)^{*4}}$ 

\*1. Refer to the following section for details.

5.14 Electronic Gear Settings on page 5-40

- \*2. When model following control (Pn140 = n.□□□1) is enabled, use the setting of Pn141 (Model Following Control Gain) instead of the setting of Pn102 (Position Loop Gain).
- \*3. To check the setting of Pn102 on the Digital Operator, change the parameter display setting to display all parameters (Pn00B = n.□□□1).
- \*4. The underlined coefficient "× (1.2 to 2)" adds a margin to prevent an A.d00 alarm (Position Deviation Overflow) from occurring too frequently.

If you set a value that satisfies the formula, an A.d00 alarm (Position Deviation Overflow) should not occur during normal operation.

If the Servomotor operation does not agree with the reference, position deviation will occur, an error will be detected, and the Servomotor will stop.

The following calculation example uses a Rotary Servomotor with a maximum motor speed of

6,000 and an encoder resolution of 16,777,216 (24 bits). Pn102 is set to 400.  $\frac{Pn210}{Pn20E} = \frac{1}{1}$ 

 $Pn520 = \frac{6,000}{60} \times \frac{16,777,216}{400/10} \times \frac{1}{16} \times 2$  $= 2,621,440 \times 2$ 

= 5,242,880 (default setting of Pn520)

If the acceleration/deceleration rate required for the position reference exceeds the tracking capacity of the Servomotor, the tracking delay will increase and the position deviation will no longer satisfy the above formulas. If this occurs, lower the acceleration/deceleration rate so that the Servomotor can follow the position reference or increase the position deviation overflow alarm level.

### **Related Parameters**

|       | Position Deviation Overflow Alarm Level   |                  |                 |              |                |  |  |
|-------|-------------------------------------------|------------------|-----------------|--------------|----------------|--|--|
| Pn520 | Setting Range                             | Setting Unit     | Default Setting | When Enabled | Classification |  |  |
|       | 1 to 1,073,741,823                        | 1 reference unit | 5,242,880       | Immediately  | Setup          |  |  |
|       | Position Deviation Overflow Warning Level |                  |                 |              |                |  |  |
| Pn51E | Setting Range                             | Setting Unit     | Default Setting | When Enabled | Classification |  |  |
|       | 10 to 100                                 | 1%               | 100             | Immediately  | Setup          |  |  |

## **Related Alarms**

| Alarm Number | Alarm Name                     | Alarm Meaning                                                                                                       |
|--------------|--------------------------------|---------------------------------------------------------------------------------------------------------------------|
| A.d00        | Position Deviation<br>Overflow | This alarm occurs if the position deviation exceeds the setting of Pn520 (Position Deviation Overflow Alarm Level). |

## **Related Warnings**

| Warning Number | Warning Name                   | Warning Meaning                                                                                     |
|----------------|--------------------------------|-----------------------------------------------------------------------------------------------------|
| A.900          | Position Deviation<br>Overflow | This warning occurs if the position deviation exceeds the specified percentage (Pn520 × Pn51E/100). |

8.3.4 Vibration Detection Level Setting

# 8.3.4 Vibration Detection Level Setting

You can set the vibration detection level (Pn312) to more accurately detect A.520 alarms (Vibration Alarm) and A.911 warnings (Vibration Warning) when vibration is detected during machine operation.

Set the initial vibration detection level to an appropriate value. Refer to the following section for details.

6.11 Initializing the Vibration Detection Level on page 6-26

# 8.3.5 Setting the Position Deviation Overflow Alarm Level at Servo ON

If the servo is turned ON when there is a large position deviation, the Servomotor will attempt to return to the original position to bring the position deviation to 0, which may create a hazardous situation. To prevent this, you can set a position deviation overflow alarm level at servo ON to restrict operation.

The related parameters and alarms are given in the following tables.

## **Related Parameters**

|       | Position Deviation Overflow Alarm Level at Servo ON   |                  |                 |              |                |  |  |
|-------|-------------------------------------------------------|------------------|-----------------|--------------|----------------|--|--|
| Pn526 | Setting Range                                         | Setting Unit     | Default Setting | When Enabled | Classification |  |  |
|       | 1 to 1,073,741,823                                    | 1 reference unit | 5,242,880       | Immediately  | Setup          |  |  |
|       | Position Deviation Overflow Warning Level at Servo ON |                  |                 |              |                |  |  |
| Pn528 | Setting Range                                         | Setting Unit     | Default Setting | When Enabled | Classification |  |  |
|       | 10 to 100                                             | 1%               | 100             | Immediately  | Setup          |  |  |

Rotary Servomotors

|       | Speed Limit Level at Servo ON |                     |                 |              |                |  |  |
|-------|-------------------------------|---------------------|-----------------|--------------|----------------|--|--|
| Pn529 | Setting Range                 | Setting Unit        | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 10,000                   | 1 min <sup>-1</sup> | 10,000          | Immediately  | Setup          |  |  |

Linear Servomotors

|       | Speed Limit Level at Servo ON |              |                 |              |                |  |  |
|-------|-------------------------------|--------------|-----------------|--------------|----------------|--|--|
| Pn584 | Setting Range                 | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 10,000                   | 1 mm/s       | 10,000          | Immediately  | Setup          |  |  |

## **Related Alarms**

| Alarm Number | Alarm Name                                                             | Alarm Meaning                                                                                                                                                                                                                                                                                                             |
|--------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A.d01        | Position Deviation<br>Overflow Alarm at<br>Servo ON                    | This alarm occurs if the servo is turned ON after the position devia-<br>tion exceeded the setting of Pn526 (Excessive Position Deviation<br>Alarm Level at Servo ON) while the servo was OFF.                                                                                                                            |
| A.d02        | Position Deviation<br>Overflow Alarm for<br>Speed Limit at Servo<br>ON | If position deviation remains in the deviation counter, the setting of<br>Pn529 or Pn584 (Speed Limit Level at Servo ON) will limit the speed<br>when the servo is turned ON. This alarm occurs if a position refer-<br>ence is input and the setting of Pn520 (Excessive Position Deviation<br>Alarm Level) is exceeded. |

Refer to the following section for information on troubleshooting alarms. *14.2.3 Resetting Alarms* on page 14-43 8.3.5 Setting the Position Deviation Overflow Alarm Level at Servo ON

# **Related Warnings**

| Warning Number | Warning Name                                          | Warning Meaning                                                                                                                  |
|----------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| A.901          | Position Deviation<br>Overflow Warning<br>at Servo ON | This warning occurs if the servo is turned ON while the position deviation exceeds the specified percentage (Pn526 × Pn528/100). |

8.4.1 Application Restrictions

# 8.4 **Tuning-less Function**

The tuning-less function performs autotuning to obtain a stable response regardless of the type of machine or changes in the load. Autotuning is started when the servo is turned ON.



- The tuning-less function is disabled during torque control.
- The Servomotor may momentarily emit a sound or vibrate the first time the servo is turned ON after the Servomotor is connected to the machine. This sound is caused by setting the automatic notch filter. It does not indicate a problem. However, if this sound or vibration continues, manually set a function to suppress vibration (e.g., a notch filter).
- The Servomotor may vibrate if it exceeds the allowable load moment of inertia. If that occurs, set the tuning-less load level to 2 (Pn170 = n.2□□□) or reduce the Tuning-less Rigidity Level (Pn170 = n.□X□□).
- To ensure safety, make sure that you can perform an emergency stop at any time when you execute the tuning-less function.

# 8.4.1 Application Restrictions

| Function                                    | Executable? | Remarks                                                                                                                                        |
|---------------------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| Vibration Detection Level<br>Initialization | 0           | -                                                                                                                                              |
| Moment of Inertia Estimation                | ×           | Disable the tuning-less function (Pn170 = $n.\Box\Box\Box$ 0) before you execute moment of inertia estimation.                                 |
| Autotuning without Host<br>Reference        | ×           | Disable the tuning-less function (Pn170 = $n.\Box\Box\Box$ 0)<br>before you execute autotuning without a host reference.                       |
| Autotuning with Host Reference              | ×           | -                                                                                                                                              |
| Custom Tuning                               | ×           | -                                                                                                                                              |
| Anti-Resonance Control<br>Adjustment        | ×           | _                                                                                                                                              |
| Vibration Suppression                       | ×           | -                                                                                                                                              |
| Easy FFT                                    | 0           | The tuning-less function is disabled while you execute<br>Easy FFT and then it is enabled when Easy FFT has been<br>completed.                 |
| Friction Compensation                       | ×           | -                                                                                                                                              |
| Gain Selection                              | ×           | -                                                                                                                                              |
| Mechanical Analysis                         | 0           | The tuning-less function is disabled while you execute mechanical analysis and then it is enabled when mechanical analysis has been completed. |

The following application restrictions apply to the tuning-less function.

\* O: Yes ×: No

# 8.4.2 Operating Procedure

The tuning-less function is enabled in the default settings. No specific procedure is required. You can use the following parameter to enable or disable the tuning-less function.

| Parameter |                             | Meaning                                                             | When Enabled  | Classification |
|-----------|-----------------------------|---------------------------------------------------------------------|---------------|----------------|
|           | n.🗆 🗆 🗆 0                   | Disable tuning-less function.                                       |               |                |
|           | n.□□□1<br>(default setting) | Enable tuning-less function.                                        |               |                |
| Pn170     | n.□□0□<br>(default setting) | Use for speed control.                                              | After restart | Setup          |
| n.0010    |                             | Use for speed control and use host controller for position control. |               |                |

When you enable the tuning-less function, you can select the tuning-less type. Normally, set Pn14F to n.  $\Box \Box \Box \Box$  (Use tuning-less type 3) (default setting). If compatibility with previous models is required, set Pn14F to n.  $\Box \Box \Box \Box$  (Use tuning-less type 1) or n.  $\Box \Box \Box \Box$  (Use tuning-less type 2).

| Parameter |                             | Meaning                                                                                  | When Enabled  | Classification |
|-----------|-----------------------------|------------------------------------------------------------------------------------------|---------------|----------------|
|           | n.□□0□                      | Use tuning-less type 1.                                                                  | After restart | Tuning         |
| Pn14F     | n.0010                      | Use tuning-less type 2. (The noise level is improved more than with tuning-less type 1.) |               |                |
|           | n.□□2□<br>(default setting) | Use tuning-less type 3.                                                                  |               |                |

# **Tuning-less Level Settings**

If vibration or other problems occur, change the tuning-less levels. To change the tuning-less levels, use the SigmaWin+.

### Preparations

Always check the following before you set the tuning-less levels.

- The tuning-less function must be enabled (Pn170 =  $n.\Box\Box\Box$ 1).
- The test without a motor function must be disabled (Pn00C =  $n.\Box\Box\Box$ ).

#### ♦ Procedure

Use the following procedure to set the tuning-less levels.

In addition to the following procedure, you can also set the parameters directly. Refer to *Related Parameters*, below, for the parameters to set.

- 1. Click the <u>I</u> Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Response Level Setting in the Menu Dialog Box. The Tuning-less Level Setting-Adj Dialog Box will be displayed.

8.4.3 Troubleshooting Alarms

Click the ▲ or ▼ Button to adjust the tuning-less level setting. Increase the tuning-less level setting to increase the response. Decrease the tuning-less level setting to suppress vibration.

The default response level setting is 4.

| Tuning-less Level   | Description          | Remarks                                                                                                                    |
|---------------------|----------------------|----------------------------------------------------------------------------------------------------------------------------|
| 7                   | Response level: High |                                                                                                                            |
| 6                   |                      | You cannot select these levels if tuning-less type 1 or 2 (Pn14F = $n.\Box\Box\Box\Box$ or $n.\Box\Box\Box\Box$ ) is used. |
| 5                   |                      |                                                                                                                            |
| 4 (default setting) |                      |                                                                                                                            |
| 3                   |                      |                                                                                                                            |
| 2                   |                      | -                                                                                                                          |
| 1                   | 25                   |                                                                                                                            |
| 0                   | Response level: Low  |                                                                                                                            |

#### 4. Click the Completed Button.

The adjustment results will be saved in the SERVOPACK.

#### Related Parameters

#### Tuning-less Rigidity Level

If you use tuning-less type 1 or 2 (Pn14F =  $n.\square\square\square\square$  or  $n.\square\square\square\square$ ), set the tuning-less level to between 0 and 4 (Pn170 =  $n.\square\square\square\square$  to  $n.\square4\square\square$ ). Do not set the tuning-less level to between 5 and 7 (Pn170 =  $n.\square5\square\square$  to  $n.\square7\square\square$ ).

| Parameter |                             | Description                                  | When Enabled | Classification |
|-----------|-----------------------------|----------------------------------------------|--------------|----------------|
|           | n.🗆0🗆 🗆                     | Tuning-less rigidity level 0 (low rigidity)  |              |                |
|           | n.0100                      | Tuning-less rigidity level 1                 |              |                |
| Pn170     | n.🗆2🗆 🗆                     | Tuning-less rigidity level 2                 | Immediately  | Setup          |
|           | n.🗆3🗆 🗆                     | Tuning-less rigidity level 3                 |              |                |
|           | n.□4□□<br>(default setting) | Tuning-less rigidity level 4                 |              |                |
|           | n.¤5¤¤                      | Tuning-less rigidity level 5                 |              |                |
|           | n.□6□□                      | Tuning-less rigidity level 6                 |              |                |
|           | n.0700                      | Tuning-less rigidity level 7 (high rigidity) |              |                |

#### Tuning-less Load Level

| Parameter |                             | Description              | When Enabled | Classification |
|-----------|-----------------------------|--------------------------|--------------|----------------|
| Pn170     | n.0000                      | Tuning-less load level 0 | Immediately  | Setup          |
|           | n.1□□□<br>(default setting) | Tuning-less load level 1 |              |                |
|           | n.2000                      | Tuning-less load level 2 |              |                |

# 8.4.3 Troubleshooting Alarms

An A.521 alarm (Autotuning Alarm) will occur if a resonant sound occurs or if excessive vibration occurs during position control. If an alarm occurs, implement the following measures.

- Resonant Sound
- Decrease the setting of Pn170 =  $n.X\Box\Box\Box$  or the setting of Pn170 =  $n.\Box X\Box\Box$ .
- Excessive Vibration during Position Control Increase the setting of Pn170 = n.□X□□ or decrease the setting of Pn170 = n.□X□□.

8.4.4 Parameters Disabled by Tuning-less Function

# 8.4.4 Parameters Disabled by Tuning-less Function

When the tuning-less function is enabled (Pn170 =  $n.\Box\Box\Box1$ ) (default setting), the parameters in the following table are disabled.

| Item                              | Parameter Name                                                                | Parameter Number |
|-----------------------------------|-------------------------------------------------------------------------------|------------------|
|                                   | Speed Loop Gain<br>Second Speed Loop Gain                                     | Pn100<br>Pn104   |
| Gain-Related Parameters           | Speed Loop Integral Time Constant<br>Second Speed Loop Integral Time Constant | Pn101<br>Pn105   |
|                                   | Position Loop Gain<br>Second Position Loop Gain                               | Pn102<br>Pn106   |
|                                   | Moment of Inertia Ratio                                                       | Pn103            |
| Advanced Control-Related          | Friction Compensation Function Selection                                      | Pn408 = n.X□□□   |
| Parameters                        | Anti-Resonance Control Selection                                              | Pn160 = n.□□□X   |
| Gain Selection-Related Parameters | Gain Switching Selection                                                      | Pn139 = n.□□□X   |

The tuning-less function is disabled during Easy FFT and mechanical analysis for a vertical axis. The gain-related parameters in the above table are enabled for Easy FFT and mechanical analysis for a vertical axis.

# 8.4.5 Automatically Adjusted Function Setting

You can also automatically adjust notch filters.

Normally, set Pn460 to n. D1DD (Adjust automatically) (default setting). Vibration is automatically detected and a notch filter is set.

Set Pn460 to n.  $\Box 0 \Box \Box$  (Do not adjust automatically) only if you do not change the setting of the notch filter before you execute the tuning-less function.

| Parameter                                     |                             | Meaning                                                                                                                                                                                                                         | When Enabled | Classification |
|-----------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|
| n.□0□□<br>Pn460<br>n.□1□□<br>(default setting | n.□0□□                      | Do not adjust the second stage notch filter<br>automatically when the tuning-less function is<br>enabled or during execution of autotuning<br>without a host reference, autotuning with a<br>host reference, and custom tuning. | Immediately  | Tuning         |
|                                               | n.□1□□<br>(default setting) | Adjust the second stage notch filter automati-<br>cally when the tuning-less function is enabled<br>or during execution of autotuning without a<br>host reference, autotuning with a host refer-<br>ence, and custom tuning.    | inineulately | Tuning         |

### 8.4.6 Related Parameters

The following parameters are automatically adjusted when you execute the tuning-less function.

Do not manually change the settings of these parameters after you have enabled the tuningless function.

| Parameter | Name                                                    |
|-----------|---------------------------------------------------------|
| Pn401     | First Stage First Torque Reference Filter Time Constant |
| Pn40A     | First Stage Notch Filter Q Value                        |
| Pn40C     | Second Stage Notch Filter Frequency                     |
| Pn40D     | Second Stage Notch Filter Q Value                       |

8.5.1 Outline

# 8.5 Estimating the Moment of Inertia

This section describes how the moment of inertia is calculated.

The moment of inertia ratio that is calculated here is used in other tuning functions. You can also estimate the moment of inertia during autotuning without a host reference. Refer to the following section for the procedure.

3.6.4 Operating Procedure on page 8-25

# 8.5.1 Outline

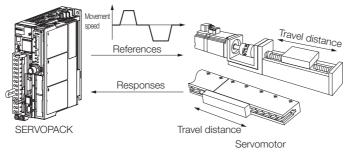
The moment of inertia during operation is automatically calculated by the SERVOPACK for round-trip (forward and reverse) operation. A reference from the host controller is not used.

The moment of inertia ratio (i.e., the ratio of the load moment of inertia to the motor moment of inertia) is a basic parameter for adjusting gains. It must be set as accurately as possible.

Although the load moment of inertia can be calculated from the weight and structure of the mechanisms, doing so is very troublesome and calculating it accurately can be very difficult with the complex mechanical structures that are used these days. With an estimate of the moment of inertia, you can obtain an accurate load moment of inertia simply by running the Servomotor in the actual system in a forward and reverse direction a few times.

The Servomotor is operated with the following specifications.

- Maximum speed: ±1,000 min<sup>-1</sup> (can be changed)
- Acceleration rate: ±20,000 min<sup>-1</sup>/s (can be changed)
- Travel distance: ±2.5 rotations max. (can be changed)



Note: Execute moment of inertia estimation after jogging to a position that ensures a suitable range of motion.

8.5.2 Restrictions

# 8.5.2 Restrictions

The following restrictions apply to estimating the moment of inertia.

### Systems for which Execution Cannot Be Performed

- When the machine system can move only in one direction
- When the range of motion is 0.5 rotations or less

# Systems for Which Adjustments Cannot Be Made Accurately

- When a suitable range of motion is not possible
- When the moment of inertia changes within the set operating range
- When the machine has high dynamic friction
- When the rigidity of the machine is low and vibration occurs when positioning is performed
- When the position integration function is used
- When mode switching is used

# Preparations

Always check the following before you execute moment of inertia estimation.

- The main circuit power supply must be ON.
- There must be no overtravel.
- The servo must be OFF.
- The gain switching selection must be set to disable automatic gain switching (Pn139 = n.□□□0).
- The first gains must be selected.
- The test without a motor function must be disabled (Pn00C =  $n.\square\square\square$ ).
- There must be no alarms or warnings.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.
- The tuning-less function must be disabled (Pn170 =  $n.\Box\Box\Box$ 0).

## 8.5.3 Applicable Tools

The following table lists the tools that you can use to estimate the moment of inertia.

| Tool             | Fn No./Function Name                                                 | Operating Procedure Reference            |
|------------------|----------------------------------------------------------------------|------------------------------------------|
| Digital Operator | You cannot estimate the moment of inertia from the Digital Operator. |                                          |
| SigmaWin+        | Tuning - Tuning                                                      | 🕼 8.5.4 Operating Procedure on page 8-17 |

Note: If you specify moment of inertia estimation, mode switching will be disabled and PI control will be used while the moment of inertia is being calculated. Mode switching will be enabled after moment of inertia estimation has been completed.

# 8.5.4 Operating Procedure

Use the following procedure to estimate the moment of inertia ratio.

# \land WARNING

• Estimating the moment of inertia requires operating the Servomotor and therefore presents hazards. Observe the following precautions.

Confirm safety around moving parts.

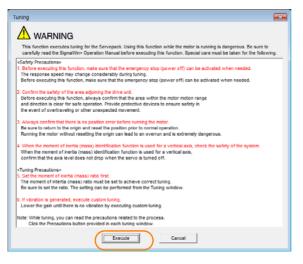
This function involves automatic operation with vibration. Make sure that you can perform an emergency stop (to turn OFF the power supply) at any time. There will be movement in both directions within the set range of movement. Check the range of movement and the directions and implement protective controls for safety, such as the overtravel functions.

# **A CAUTION**

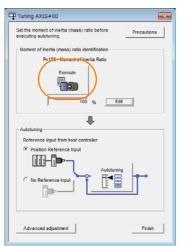
- Be aware of the following points if you cancel the moment of inertia estimation while the Servomotor is operating.
  - If you cancel operation with the **Servo OFF** Button, the Servomotor will stop according to setting of the Servo OFF stopping method (Pn001 = n.□□□X).
  - If you cancel operation with the **Cancel** Button, the Servomotor will decelerate to a stop and then enter a zero-clamped state.
- 1. Click the <u>I</u> Servo Drive Button in the workspace of the Main Window of the SigmaWin+.

#### **2.** Select Tuning in the Menu Dialog Box. The Tuning Dialog Box will be displayed. Click the **Cancel** Button to cancel tuning.

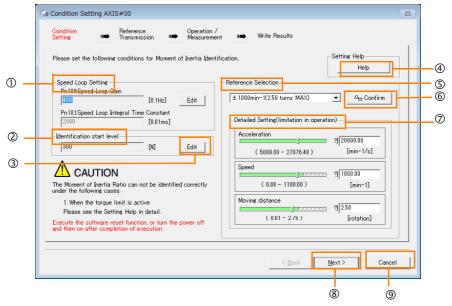
3. Click the Execute Button.



#### 4. Click the Execute Button.



5. Set the conditions as required.



#### ① Speed Loop Setting Area

Make the speed loop settings in this area.

If the speed loop response is too bad, it will not be possible to measure the moment of inertia ratio accurately.

The values for the speed loop response that are required for moment of inertia estimation are set for the default settings. It is normally not necessary to change these settings. If the default speed loop gain is too high for the machine (i.e., if vibration occurs), lower

the setting. It is not necessary to increase the setting any farther.

#### 2 Identification Start Level Group

This is the setting of the moment of inertia calculation starting level.

If the load is large or the machine has low rigidity, the torque limit may be applied, causing moment of inertia estimation to fail.

If that occurs, estimation may be possible if you double the setting of the start level. ③ Edit Buttons

#### (a) Edit Buttons

Click the button to display a dialog box to change the settings related to the speed loop or estimation start level.

#### ④ Help Button

Click this button to display guidelines for setting the reference conditions. Make the following settings as required.

• Operate the Servomotor to measure the load moment of inertia of the machine in comparison with the rotor moment of inertia.

- Set the operation mode, reference pattern (maximum acceleration rate, maximum speed, and maximum travel distance), and speed loop-related parameters.
- Correct measurement of the moment of inertia ratio may not be possible depending on the settings. Set suitable settings using the measurement results as reference.

S Reference Selection Area

Either select the reference pattern for estimation processing from the box, or set the values in the **Detailed Setting** Group. Generally speaking, the larger the maximum acceleration rate is, the more accurate the moment of inertia estimation will be.

Set the maximum acceleration range within the possible range of movement considering the gear ratio, e.g., the pulley diameters or ball screw pitch.

#### 6 Confirm Button

Click this button to display the Reference Confirmation Dialog Box.

| Reference confirmation |            | <b>E</b> |  |  |
|------------------------|------------|----------|--|--|
| Moving distance 2.50   | (rotation) |          |  |  |
| Driving pattern        |            |          |  |  |
|                        |            |          |  |  |
| V:Speed                | 1000.00    | (min-1)  |  |  |
| T1:Acceleration Time   | 50         | (ms)     |  |  |
| T2:Constant-speed time | 100        | [ms]     |  |  |
| Total operation time   | 400        | [ms]     |  |  |
| 0                      | K ]        |          |  |  |

#### ⑦ Detailed Setting Area

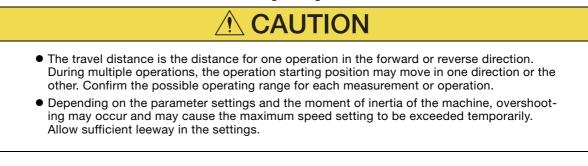
You can change the settings by moving the bars or directly inputting the settings to create the required reference pattern.

#### In the second second

Click this button to display the Reference Transmission Dialog Box.

O Cancel Button
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Click this button to return to the Tuning Dialog Box.



Information

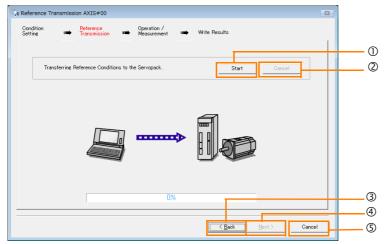
#### When Measurement Is Not Correct

Estimating the moment of inertia ratio cannot be performed correctly if the torque limit is activated. Adjust the limits or reduce the acceleration rate in the reference selection so that the torque limit is not activated.

#### 6. Click the Next Button.

The Reference Transmission Dialog Box will be displayed.

7. Click the Start Button.



#### ① Start Button

The reference conditions will be transferred to the SERVOPACK. A progress bar will show the progress of the transfer.

2 Cancel Button

The **Cancel** Button is enabled only while data is being transferred to the SERVOPACK. You cannot use it after the transfer has been completed.

3 Back Button

This button returns you to the Condition Setting Dialog Box. It is disabled while data is being transferred.

④ Next Button

This button is enabled only when the data has been transferred correctly. You cannot use it if an error occurs or if you cancel the transfer before it is completed.

Click the **Next** Button to display the Operation/Measurement Dialog Box.

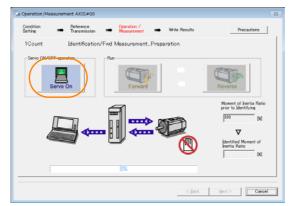
#### S Cancel Button

This button cancels processing and returns you to the Tuning Dialog Box.

8. Click the Next Button.

The Operation/Measurement Dialog Box will be displayed.

9. Click the Servo On Button.



#### 10. Click the Forward Button.

The Servomotor shaft will rotate in the forward direction and the measurement will start. After the measurement and data transfer have been completed, the **Reverse** Button will be displayed in color.

11. Click the Reverse Button.



The Servomotor shaft will rotate in the reverse direction and the measurement will start. After the measurement and data transfer have been completed, the **Forward** Button will be displayed in color.

| Operation/Measu      | urement AXIS#00           |                             |               | 1                                                                                                                                                                                                                                                                                                                                                   |
|----------------------|---------------------------|-----------------------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Condition<br>Setting | Reference<br>Transmission | Operation /     Measurement | Write Results | Precautions                                                                                                                                                                                                                                                                                                                                         |
| 2Count               | Identification            | /Fwd MeasurementPr          | rep. Complete |                                                                                                                                                                                                                                                                                                                                                     |
| Servo ON/OFF         | operation<br>rvo On       | Pun<br>Forward              |               | Reverse                                                                                                                                                                                                                                                                                                                                             |
| Į                    |                           |                             |               | Moment of Inertia Ratio<br>pror to Identifying<br>00 Pd<br>United Moment of<br>Identified Moment of |
|                      |                           | 100%                        |               | 1 14                                                                                                                                                                                                                                                                                                                                                |
|                      |                           |                             | < <u>Back</u> | Next > Cancel                                                                                                                                                                                                                                                                                                                                       |

12. Repeat steps 9 to 11 until the Next Button is enabled.

Measurements are performed from 2 to 7 times and then verified. The number of measurements is displayed in upper left corner of the dialog box. A progress bar at the bottom of the dialog box will show the progress of the transfer each time.

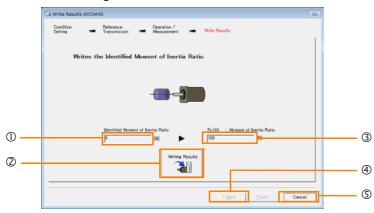
- **13.** When the measurements have been completed, click the **Servo On** Button to turn OFF the servo.
- 14. Click the Next Button.

The Write Results Dialog Box will be displayed.

Information If you click the **Next** Button before you turn OFF the servo, the following Dialog Box will be displayed. Click the **OK** Button to turn OFF the servo.

| Moment of Inertia Identification |
|----------------------------------|
| 1 turns the Servo OFF.           |
| OK Cancel                        |

15. Click the Writing Results Button.



#### ① Identified Moment of Inertia Ratio Box

The moment of inertia ratio that was found with operation and measurements is displayed here.

2 Writing Results Button

If you click this button, Pn103 (Moment of Inertia Ratio) in the SERVOPACK is set to the value that is displayed for the identified moment of inertia ratio.

#### 3 Pn103: Moment of Inertia Ratio Box

The value that is set for the parameter is displayed here.

After you click the **Writing Results** Button, the value that was found with operation and measurements will be displayed as the new setting.

④ Back Button

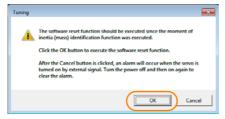
This button is disabled.

S Cancel Button

This button will return you to the Tuning Dialog Box.

16. Confirm that the Identified Moment of Inertia Ratio Box and the Pn103: Moment of Inertia Ratio Box show the same value and then click the Finish Button.

#### 17. Click the OK Button.



18. Click the Execute Button.

| ① Software Reset Common for the Unit                                                                                                         | × |  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------|---|--|--|
| The software reset function will be executed.<br>The Servopack will stop responding for approximately 5<br>seconds after the fuction begins. |   |  |  |
| Execute                                                                                                                                      |   |  |  |
| 0%                                                                                                                                           |   |  |  |
|                                                                                                                                              |   |  |  |

If the setting of the moment of inertia ratio (Pn103) was changed, the new value will be saved and the Tuning Dialog Box will be displayed again.

This concludes the procedure to estimate the moment of inertia ratio.

8.6.1 Outline

# 8.6 Autotuning without Host Reference

This section describes autotuning without a host reference.

Autotuning without a host reference performs adjustments based on the setting of the speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when ( )adjustments are started. Make adjustments after lowering the speed loop gain (Pn100) until Important vibration is eliminated. You cannot execute autotuning without a host reference if the tuning-less function is enabled  $(Pn170 = n.\Box\Box\Box1 (default setting))$ . Disable the tuning-less function  $(Pn170 = n.\Box\Box\Box0)$ before you execute autotuning without a host reference. • If you change the machine load conditions or drive system after you execute autotuning without a host reference and then you execute autotuning without a host reference with moment of inertia estimation specified, use the following parameter settings. If you execute autotuning without a host reference for any other conditions, the machine may vibrate and may be damaged.  $Pn140 = n.\Box\Box\Box$  (Do not use model following control.)  $Pn160 = n.\Box\Box\Box$  (Do not use anti-resonance control.) Pn408 = n.0000 (Disable friction compensation, first stage notch filter, and second stage notch filter.) Note: If you are using the Digital Operator and the above parameters are not displayed, change the parameter display setting to display all parameters (Pn00B =  $n.\Box\Box\Box$ 1) and then turn the power supply OFF and ON again.

# 8.6.1 Outline

For autotuning without a host reference, operation is automatically performed by the SERVO-PACK for round-trip (forward and reverse) operation to adjust for machine characteristics during operation. A reference from the host controller is not used.

The following items are adjusted automatically.

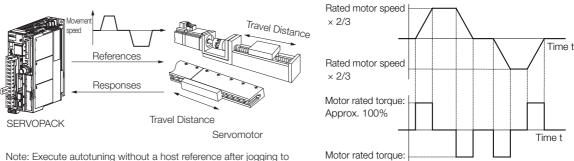
- Moment of inertia ratio
- Gains (e.g., speed loop gain and position loop gain)
- Filters (torque reference filter and notch filters)
- Friction compensation
- Anti-resonance control
- Vibration suppression (only for mode 2 or 3)

Refer to the following section for details on the parameters that are adjusted. *8.6.7 Related Parameters* on page 8-33

The Servomotor is operated with the following specifications.

| Maximum speed          | Rated motor speed × $\frac{2}{3}$                                                                                                                                                                    |                                                                                                                         |
|------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Acceleration<br>Torque | Rated motor torque: Approx. 100%<br>Note: The acceleration torque depends on the setting of the moment of inertia ratio (Pn103), and<br>the influences of machine friction and external disturbance. |                                                                                                                         |
| Travel Distance        | Rotary Servomotors                                                                                                                                                                                   | You can set the desired travel distance. The default setting is for a value equivalent to 3 Servomotor shaft rotations. |
|                        | Direct Drive Servomotors                                                                                                                                                                             | You can set the desired travel distance. The default setting is for a value equivalent to 0.3 rotations.                |
|                        | Linear Servomotors                                                                                                                                                                                   | You can set the desired travel distance in increments of 1,000 reference units. (The default setting is for 90 mm.)     |

#### 8.6.2 Restrictions



Note: Execute autotuning without a host reference after jogging to a position that ensures a suitable range of motion.

Example of Automatic Operation Pattern

# **WARNING**

Approx. 100%

- Autotuning without a host reference requires operating the Servomotor and therefore presents hazards. Observe the following precaution.
  - Confirm safety around moving parts.

This function involves automatic operation with vibration. Make sure that you can perform an emergency stop (to turn OFF the power supply) at any time. There will be movement in both directions within the set range of movement. Check the range of movement and the directions and implement protective controls for safety, such as the overtravel functions.

# 8.6.2 Restrictions

The following restrictions apply to autotuning without a host reference.

If you cannot use autotuning without a host reference because of these restrictions, use autotuning with a host reference or custom tuning. Refer to the following sections for details.  $\mathbb{R}$  8.7 Autotuning with a Host Reference on page 8-34

₹ 8.8 Custom Tuning on page 8-42

## Systems for Which Execution Cannot Be Performed

- · When the machine system can move only in one direction
- When the range of motion is 0.5 rotations or less

# Systems for Which Adjustments Cannot Be Made Accurately

- When a suitable range of motion is not possible
- · When the moment of inertia changes within the set operating range
- When the machine has high friction
- When the rigidity of the machine is low and vibration occurs when positioning is performed
- When the position integration function is used
- When mode switching is used
- Note: If you specify moment of inertia estimation, mode switching will be disabled and PI control will be used while the moment of inertia is being calculated. Mode switching will be enabled after moment of inertia estimation has been completed.
- When the positioning completed width (Pn522) is too narrow

8.6.3 Applicable Tools

### Preparations

Always check the following before you execute autotuning without a host reference.

- The main circuit power supply must be ON.
- There must be no overtravel.
- The servo must be OFF.
- The gain switching selection must be set to disable automatic gain switching (Pn139 = n.□□□0).
- The first gains must be selected.
- The test without a motor function must be disabled (Pn00C =  $n.\Box\Box\Box$ ).
- There must be no alarms or warnings.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.
- The tuning-less function must be disabled (Pn170 = n.□□□□0), or the tuning-less function must be enabled (Pn170 = n.□□□1) (default setting) and moment of inertia estimation must be specified.
- If you execute autotuning without a host reference during speed control, set the mode to 1.

Information • If you start autotuning without a host reference while the SERVOPACK is in speed control for mode 2 or 3, the SERVOPACK will change to position control automatically to perform autotuning without a host reference. The SERVOPACK will return to speed control after autotuning has been completed.

### 8.6.3 Applicable Tools

The following table lists the tools that you can use to perform autotuning without a host reference.

| Tool             | Fn No./Function Name | Operating Procedure Reference                                                   |
|------------------|----------------------|---------------------------------------------------------------------------------|
| Digital Operator | Fn201                | Ω Σ-7-Series Digital Operator Operating<br>Manual (Manual No.: SIEP S800001 33) |
| SigmaWin+        | Tuning - Tuning      | 8.6.4 Operating Procedure on page 8-25                                          |

### 8.6.4 Operating Procedure

Use the following procedure to perform autotuning without a host reference.

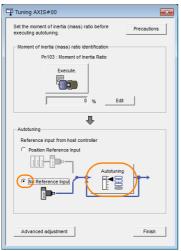


• If you specify not estimating the moment of inertia, set the moment of inertia ratio (Pn103) correctly. If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.

- 1. Confirm that the moment of inertia ratio (Pn103) is set correctly.
- 2. Click the *I* Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 3. Select Tuning in the Menu Dialog Box. The Tuning Dialog Box will be displayed. Click the Cancel Button to cancel tuning.
- 4. Click the Execute Button.

| Tuning                                                                                                                                                                                                                                                                                                                            |  |  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
|                                                                                                                                                                                                                                                                                                                                   |  |  |  |
| This function executes tuning for the Servopack. Using this function while the motor is running is dangerous. Be sure to<br>carefully read the SigmaWin+ Operation Manual before executing this function. Special care must be taken for the following.                                                                           |  |  |  |
| <safety precautions=""><br/>1. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.<br/>The response speed may change considerably during tuning.<br/>Before executing this function, make sure that the emergency stop (power off) can be activated when needed.</safety> |  |  |  |
| 2. Confirm the safety of the area adjoining the drive unit.<br>Before executing this function, always confirm that the area within the motor motion range<br>and direction is clear for safe operation. Provide protective devices to ensure safety in<br>the event of overtraveling or other unexpected movement.                |  |  |  |
| 3 Always confirm that there is no position error before running the motor.<br>Be sure to return to the origin and reset the position prior to normal operation.<br>Running the motor without resetting the origin can lead to an overum and a extremely dangerous.                                                                |  |  |  |
| 4. When the moment of inertia (mass) identification function is used for a vertical axis, check the safety of the system.<br>When the moment of inertia (mass) identification function is used for a vertical axis,<br>confirm that the axis level does not drop when the servo is turned off.                                    |  |  |  |
| <ul> <li><tuning precautions=""></tuning></li> <li>5. Set the moment of metria (mass) ratio first.</li> <li>The moment of intertia (mass) ratio first be set to achieve correct tuning.</li> <li>Be sure to set the ratio. The setting can be performed from the Tuning window.</li> </ul>                                        |  |  |  |
| <ol> <li>If vibration is generated, execute custom tuning.</li> <li>Lower the gain until there is no vibration by executing custom tuning.</li> </ol>                                                                                                                                                                             |  |  |  |
| Note: While tuning, you can read the precautions related to the process.<br>Click the Precautions button provided in each tuning window.                                                                                                                                                                                          |  |  |  |
| Cancel                                                                                                                                                                                                                                                                                                                            |  |  |  |

5. Select the No Reference Input Option in the Autotuning Area and then click the Autotuning Button.



Information

When the following dialog box is displayed, click the **OK** Button and then confirm that the correct moment of inertia ratio is set in Pn103 (Moment of Inertia Ratio).

| Tuning 🗾                                                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                            |
| The moment of inertia (mass) ratio has never been changed from the default<br>setting.<br>Set a correct moment of inertia (mass) ratio in the Moment of Inertia (Mass) Setting<br>window before starting tuning.<br>If an incorrect moment of inertia (mass) ratio is set, vibration may be generated<br>during tuning.<br>Do you want to continue tuning? |
| Cancel                                                                                                                                                                                                                                                                                                                                                     |

6. Set the conditions in the Switching the load moment of inertia (load mass) identification Box, the Mode selection Box, the Mechanism selection Box, and the Distance Box, and then click the Next Button.

| Image: Setting Conditions AXIS#00         Set conditions.         Switching the load moment of intertia (load mass) identification         1:A moment of inertia is not presumed.         Mode selection                                                                                     |   | i<br>:<br>:                                                                                                                                                                                                                                                                  | dentification Box<br>Specify whether to<br>Description: A moment of ine<br>A moment of ine | estimate the moment of inertia.<br>ertia is presumed. (default setting)<br>ertia is not presumed.                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2:For positioning<br>A gain adjustment specialized for positioning will be executed. In addition, the<br>following automatic adjustments can be executed. Model following control, notch<br>filter, anti-resonance control, and wirantion suppression.                                       |   |                                                                                                                                                                                                                                                                              | <b>Mode selection</b> B<br>Set the mode.                                                   | lox                                                                                                                                                                                                                                          |
|                                                                                                                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                              | Mode Selection                                                                             | Description                                                                                                                                                                                                                                  |
| Mechanism selection           2:Ball screw mechanism or linear motor           Executes adjustment suitable for relatively high-rigidity mechanism, such as a ball screw or linear motor. Select this type if there is no applicable mechanism.                                              |   |                                                                                                                                                                                                                                                                              | 1: Standard                                                                                | Standard gain adjustment is per-<br>formed. In addition to gain adjust-<br>ment, notch filters and anti-resonance<br>control are automatically adjusted.                                                                                     |
| Distance<br>The moving range from the current value is specified.<br>786 x 1000 = 786000 [reference units]<br>(-99990 - 99990)<br>(Setting invalid range : -131 - 131) 3.0 [Rotation]                                                                                                        |   |                                                                                                                                                                                                                                                                              | 2: For positioning                                                                         | Tuning is performed for positioning<br>applications. In addition to gain<br>adjustment, model following control,<br>notch filters, anti-resonance control,<br>and vibration suppression are auto-<br>matically adjusted.                     |
| Start tuning using the default settings.                                                                                                                                                                                                                                                     |   |                                                                                                                                                                                                                                                                              | 3: For positioning<br>especially to pre-<br>vent overshooting                              | Tuning is performed for positioning<br>applications with emphasis on elimi-<br>nating overshooting. In addition to<br>gain adjustment, notch filters, anti-<br>resonance control, and vibration sup-<br>pression are automatically adjusted. |
| Distance Box                                                                                                                                                                                                                                                                                 |   |                                                                                                                                                                                                                                                                              |                                                                                            |                                                                                                                                                                                                                                              |
| <b>Distance</b> Box<br>Set the travel distance.<br>Movement range: -99,990,000 to<br>+99,990,000 [reference units]<br>Minimum setting increment for travel dis-<br>tance: 1,000 [reference units]<br>Negative values are for reverse operation<br>and positive values are for forward opera- |   | • Mechanism selection Box<br>Select the type according to the machine element to<br>drive.<br>If there is noise or if the gain does not increase, better<br>results may be obtained by changing the rigidity type.<br>Select the type according to the following guidelines. |                                                                                            |                                                                                                                                                                                                                                              |
| tion from the current position.<br>Default settings:                                                                                                                                                                                                                                         |   |                                                                                                                                                                                                                                                                              | Mechanism<br>Selection                                                                     | Description                                                                                                                                                                                                                                  |
| Rotary Servomotors: Approx. 3 rotations<br>Direct Drive Servomotors: Approx. 0.3<br>rotations<br>Linear Servomotors: Approx 90 mm<br>Set the distance to the following values or<br>higher. To ensure tuning precision, we rec-<br>ommend that you use approximately the                     |   |                                                                                                                                                                                                                                                                              | 1: Belt mechanism                                                                          | Tuning is performed for a mecha-<br>nism with relatively low rigidity, e.g.,<br>a belt.                                                                                                                                                      |
|                                                                                                                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                              | 2: Ball screw mech-<br>anism or linear<br>motor                                            | Tuning is performed for a mecha-<br>nism with relatively high rigidity, e.g.,<br>a ball screw or Linear Servomotor.<br>Use this setting if there is no other<br>appropriate setting.                                                         |
| default distance setting.<br>Rotary Servomotors: 0.5 rotations<br>Direct Drive Servomotors: 0.05 rotations<br>Linear Servomotors: 5 mm                                                                                                                                                       |   |                                                                                                                                                                                                                                                                              | 3: Rigid model                                                                             | Tuning is performed for a mecha-<br>nism with high rigidity, e.g., a rigid<br>body system.                                                                                                                                                   |
|                                                                                                                                                                                                                                                                                              |   |                                                                                                                                                                                                                                                                              |                                                                                            |                                                                                                                                                                                                                                              |
|                                                                                                                                                                                                                                                                                              | L | ;                                                                                                                                                                                                                                                                            |                                                                                            | rs Box<br>eters to use for tuning.<br>tart tuning using the default set-                                                                                                                                                                     |

If you select the **Start tuning using the default set-tings** Check Box, the tuning parameters will be returned to the default settings before tuning is started.

7. Click the Servo ON Button.

| Autotuning - Automatic s                                                                         | setting AXIS#00   | <b>×</b>                                   |
|--------------------------------------------------------------------------------------------------|-------------------|--------------------------------------------|
| Waiting for execution<br>Oscillation level<br>measurement<br>Gain search<br>behaviour evaluation | Servo ON/OFF oper | eton<br>vo OFF<br>Servo ON<br>Start tuning |
| Tuning completed                                                                                 | Mode selection    |                                            |
|                                                                                                  | 2:For positioning | I                                          |
|                                                                                                  | Mechanism sele    | ction                                      |
|                                                                                                  | 2:Ball screw me   | chanism or linear motor                    |
|                                                                                                  | Distance          |                                            |
| Notch filter                                                                                     | 786000            | [reference units]                          |
| Vib Suppress                                                                                     | 3.0               | [Rotation]                                 |
| Wy in Subbress                                                                                   |                   |                                            |
| Precautions                                                                                      | < <u>B</u> ack    | Finish Cancel                              |

8. Click the Start tuning Button.

| Autotuning - Automatic              | setting AXIS#00                                            |
|-------------------------------------|------------------------------------------------------------|
| Waiting for execution               | Servo ON/OFF operation  Servo ON  Servo OFF                |
| Gain search<br>behaviour evaluation | Tuning<br>Start tuning                                     |
| Tuning completed                    | Mode selection<br>2:For positioning<br>Mechanism selection |
|                                     | 2:Ball screw mechanism or linear motor                     |
| Notch filter<br>Anti-res Adj        | Distance 786000 [reference units] 3.0 [Rotation]           |
| Vib Suppress                        |                                                            |
| Precautions                         | < Back Finish Cancel                                       |

#### 8.6.5 Troubleshooting Problems in Autotuning without a Host Reference

9. Confirm safety around moving parts and click the Yes Button.



The Servomotor will start operating and tuning will be executed.

Vibration that occurs during tuning will be detected automatically and suitable settings will be made for that vibration. When the settings have been completed, the indicators for the functions that were used will light at the lower left of the dialog box.

| Autotuning - Automatic setting AXIS#00                                                                 |
|--------------------------------------------------------------------------------------------------------|
| Waiting for execution Servo ON/OFF operation Servo OFF Servo ON                                        |
| Oscillation level measurement                                                                          |
| Gain search<br>behaviour evaluation                                                                    |
| Tuning completed Mode selection 2:For positioning                                                      |
| Mechanism selection<br>2.Ball screw mechanism or linear motor                                          |
| Distance           Notch filter         786000           Anti-res Adj         3.0           (Rotation) |
| Ann-res Adj         3.0         [Rotation]           Vib Suppress                                      |

**10.** When tuning has been completed, click the Finish Button.

The results of tuning will be set in the parameters and you will return to the Tuning Dialog Box.

This concludes the procedure to perform autotuning without a host reference.

# 8.6.5 Troubleshooting Problems in Autotuning without a Host Reference

The following tables give the causes of and corrections for problems that may occur in autotuning without a host reference.

#### Autotuning without a Host Reference Was Not Performed

| Possible Cause                                             | Corrective Action                                                                                                                                                          |
|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Main circuit power supply is OFF.                          | Turn ON the main circuit power supply.                                                                                                                                     |
| An alarm or warning occurred.                              | Remove the cause of the alarm or warning.                                                                                                                                  |
| Overtraveling occurred.                                    | Remove the cause of overtraveling.                                                                                                                                         |
| The second gains were selected with the gain selection.    | Disable automatic gain switching.                                                                                                                                          |
| The HWBB was activated.                                    | Release the HWBB.                                                                                                                                                          |
| The setting of the travel distance is too small.           | Set the travel distance again in step 6 of the proce-<br>dure.                                                                                                             |
| The settings for the tuning-less function are not correct. | <ul> <li>Disable the tuning-less function (Pn170 = n.□□□0).</li> <li>Enable the tuning-less function (Pn170 = n.□□□1) and specify moment of inertia estimation.</li> </ul> |

8.6.5 Troubleshooting Problems in Autotuning without a Host Reference

#### When an Error Occurs during Execution of Autotuning without a Host Reference

| Error                                                                                                                     | Possible Cause                                                                                                                                      | Corrective Action                                                                                                                                                                                                                                                          |  |  |
|---------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| The gain adjustments<br>were not successfully<br>completed.                                                               | Machine vibration occurs or the posi-<br>tioning completion signal is not stable<br>when the Servomotor stops.                                      | <ul> <li>Increase the setting of the positioning completed width (Pn522).</li> <li>Change the mode from 2 to 3.</li> <li>If machine vibration occurs, suppress the vibration with the anti-resonance control adjustment and the vibration suppression function.</li> </ul> |  |  |
| An error occurred during calculation of the moment of inertia.                                                            | Refer to the following section for troubleshooting information.<br><i>When an Error Occurs during Calculation of Moment of Inertia</i> on page 8-30 |                                                                                                                                                                                                                                                                            |  |  |
| Positioning was not<br>completed within<br>approximately 10 sec-<br>onds after position<br>adjustment was com-<br>pleted. | The positioning completed width is too narrow.                                                                                                      | Increase the setting of the positioning completed width (Pn522).                                                                                                                                                                                                           |  |  |

#### When an Error Occurs during Calculation of Moment of Inertia

| Possible Cause                                                                                 | Corrective Action                                                                                                                                                      |
|------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The SERVOPACK started calculating the moment of inertia but the calculation was not completed. | <ul><li>Increase the setting of the speed loop gain (Pn100).</li><li>Increase the stroke (travel distance).</li></ul>                                                  |
| The moment of inertia fluctuated greatly and did not converge within 10 tries.                 | Set Pn103 (Moment of Inertia Ratio) from the machine specifications and specify not estimating the moment of inertia.                                                  |
| Low-frequency vibration was detected.                                                          | Double the setting of moment of inertia calculation starting level (Pn324).                                                                                            |
| The torque limit was reached.                                                                  | <ul> <li>If you are using the torque limit, increase the torque limit.</li> <li>Double the setting of moment of inertia calculation starting level (Pn324).</li> </ul> |

#### ◆ Adjustment Results Are Not Satisfactory for Position Control

You may be able to improve the adjustment results by changing the settings of the positioning completed width (Pn522) and the electronic gear (Pn20E/Pn210).

If satisfactory results are still not possible, adjust the overshoot detection level (Pn561). That may improve the adjustment results.

- Pn561 = 100% (default setting)
- This will allow tuning with overshooting that is equivalent to the positioning completed width. • Pn561 = 0%

This will allow tuning to be performed without overshooting within the positioning completed width, but the positioning completed width may be extended.

|       | Overshoot Detection Level |              |                 |              |                |  |
|-------|---------------------------|--------------|-----------------|--------------|----------------|--|
| Pn561 | Setting Range             | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | 0 to 100                  | 1%           | 100             | Immediately  | Setup          |  |

8.6.6 Automatically Adjusted Function Settings

### 8.6.6 Automatically Adjusted Function Settings

You can specify whether to automatically adjust the following functions during autotuning.

### Automatic Notch Filters

Normally, set Pn460 to n. D1DD (Adjust automatically) (default setting).

Vibration will be detected during autotuning without a host reference and a notch filter will be adjusted.

Set Pn460 to n.  $\Box 0 \Box \Box$  (Do not adjust automatically) only if you do not change the setting of the notch filter before you execute this function.

| Parameter |                             | Function                                                                                                                                                                                                                        | When Enabled | Classification |
|-----------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|
| Pn460     | n.□□□0                      | Do not adjust the first stage notch filter auto-<br>matically during execution of autotuning with-<br>out a host reference, autotuning with a host<br>reference, and custom tuning.                                             |              | Tuning         |
|           | n.□□□1<br>(default setting) | Adjust the first stage notch filter automatically<br>during execution of autotuning without a host<br>reference, autotuning with a host reference,<br>and custom tuning.                                                        |              |                |
|           | n.□0□□                      | Do not adjust the second stage notch filter<br>automatically when the tuning-less function is<br>enabled or during execution of autotuning<br>without a host reference, autotuning with a<br>host reference, and custom tuning. | Immediately  |                |
|           | n.□1□□<br>(default setting) | Adjust the second stage notch filter automati-<br>cally when the tuning-less function is enabled<br>or during execution of autotuning without a<br>host reference, autotuning with a host refer-<br>ence, and custom tuning.    |              |                |

#### Anti-Resonance Control Adjustment

This function reduces low vibration frequencies, for which the notch filters cannot be used.

Normally, set Pn160 to n. DD1D (Adjust automatically) (default setting).

Vibration will be detected during autotuning without a host reference and anti-resonance control will be automatically adjusted.

| Parameter |                             | Function                                                                                                                                                                      | When Enabled | Classification |
|-----------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|
| Pn160     | n.□□0□                      | Do not adjust anti-resonance control automat-<br>ically during execution of autotuning without a<br>host reference, autotuning with a host refer-<br>ence, and custom tuning. |              |                |
| FIITOU    | n.□□1□<br>(default setting) | Adjust anti-resonance control automatically<br>during execution of autotuning without a host<br>reference, autotuning with a host reference,<br>and custom tuning.            | mmediately   | Turning        |

8.6.6 Automatically Adjusted Function Settings

#### Vibration Suppression

You can use vibration suppression to suppress transitional vibration at a low frequency from 1 Hz to 100 Hz, which is generated mainly when the machine vibrates during positioning.

Normally, set Pn140 to n. D1DD (Adjust automatically) (default setting).

Vibration will be detected during autotuning without a host reference and vibration suppression control will be automatically set.

Set  $Pn140 = n.\Box 0 \Box \Box$  (Do not adjust automatically) only if you do not change the settings for vibration suppression before you execute autotuning without a host reference.

Note: Autotuning without a host reference uses model following control. Therefore, it can be executed only if the mode is set to 2 or 3.

| Parameter |                             | Function                                                                                                                                                                     | When Enabled | Classification |
|-----------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|
| Pn140     | n.0000                      | Do not adjust vibration suppression automati-<br>cally during execution of autotuning without a<br>host reference, autotuning with a host refer-<br>ence, and custom tuning. | Immediately  | Tursian        |
| F11140    | n.□1□□<br>(default setting) | Adjust vibration suppression automatically<br>during execution of autotuning without a host<br>reference, autotuning with a host reference,<br>and custom tuning.            | immediately  | Tuning         |

#### Friction Compensation

Friction compensation compensates for changes in the following conditions.

- Changes in the viscous resistance of the lubricant, such as grease, on the sliding parts of the machine
- · Changes in the friction resistance resulting from variations in the machine assembly
- Changes in the friction resistance due to aging

The conditions for applying friction compensation depend on the mode selection.

| Mode Selection Settings                            | Friction Compensation                                                                 |  |
|----------------------------------------------------|---------------------------------------------------------------------------------------|--|
| 1: Standard                                        | Based on the setting of Pn408 = n.X□□□<br>(Friction Compensation Function Selection)* |  |
| 2: For position control                            | Adjusted with friction compensation.                                                  |  |
| 3: For position control (emphasis on overshooting) | Adjusted with inclion compensation.                                                   |  |

| Parameter |                             | Function                       | When Enabled | Classification |
|-----------|-----------------------------|--------------------------------|--------------|----------------|
| Pn408     | n.0□□□<br>(default setting) | Disable friction compensation. | Immediately  | Setup          |
| n.1000    |                             | Enable friction compensation.  |              |                |

\* Refer to the following section for details.

Required Parameter Settings on page 8-69

8.6.7 Related Parameters

### 8.6.7 Related Parameters

The following parameters are automatically adjusted or used as reference when you execute autotuning without a host reference.

Do not change the settings while autotuning without a host reference is being executed.

| Parameter | Name                                                    | Automatic Changes |
|-----------|---------------------------------------------------------|-------------------|
| Pn100     | Speed Loop Gain                                         | Yes               |
| Pn101     | Speed Loop Integral Time Constant                       | Yes               |
| Pn102     | Position Loop Gain                                      | Yes               |
| Pn103     | Moment of Inertia Ratio                                 | Yes               |
| Pn121     | Friction Compensation Gain                              | Yes               |
| Pn123     | Friction Compensation Coefficient                       | Yes               |
| Pn124     | Friction Compensation Frequency Correction              | No                |
| Pn125     | Friction Compensation Gain Correction                   | Yes               |
| Pn401     | First Stage First Torque Reference Filter Time Constant | Yes               |
| Pn408     | Torque-Related Function Selections                      | Yes               |
| Pn409     | First Stage Notch Filter Frequency                      | Yes               |
| Pn40A     | First Stage Notch Filter Q Value                        | Yes               |
| Pn40C     | Second Stage Notch Filter Frequency                     | Yes               |
| Pn40D     | Second Stage Notch Filter Q Value                       | Yes               |
| Pn140     | Model Following Control-Related Selections              | Yes               |
| Pn141     | Model Following Control Gain                            | Yes               |
| Pn142     | Model Following Control Gain Correction                 | Yes               |
| Pn143     | Model Following Control Bias in the Forward Direction   | Yes               |
| Pn144     | Model Following Control Bias in the Reverse Direction   | Yes               |
| Pn145     | Vibration Suppression 1 Frequency A                     | Yes               |
| Pn146     | Vibration Suppression 1 Frequency B                     | Yes               |
| Pn147     | Model Following Control Speed Feedforward Compensation  | Yes               |
| Pn160     | Anti-Resonance Control-Related Selections               | Yes               |
| Pn161     | Anti-Resonance Frequency                                | Yes               |
| Pn163     | Anti-Resonance Damping Gain                             | Yes               |
| Pn531     | Program Jogging Travel Distance                         | No                |
| Pn533     | Program Jogging Movement Speed for Rotary Servomotor    | No                |
| Pn585     | Program Jogging Movement Speed for Linear Servomotor    | No                |
| Pn534     | Program Jogging Acceleration/Deceleration Time          | No                |
| Pn535     | Program Jogging Waiting Time                            | No                |
| Pn536     | Program Jogging Number of Movements                     | No                |

Yes: The parameter is automatically set.

No: The parameter is not automatically set, but the setting is read during execution.

8.7.1 Outline

### 8.7 Autotuning with a Host Reference

This section describes autotuning with a host reference.



Autotuning with a host reference makes adjustments based on the set speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when adjustments are started. Make adjustments after lowering the speed loop gain (Pn100) until vibration is eliminated.

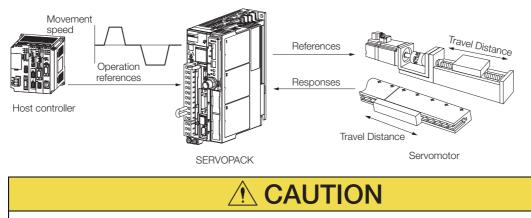
### 8.7.1 Outline

Autotuning with a host reference automatically makes optimum adjustments for operation references from the host controller.

The following items are adjusted automatically.

- Gains (e.g., speed loop gain and position loop gain)
- Filters (torque reference filter and notch filters)
- Friction compensation
- Anti-resonance control
- Vibration suppression

Refer to the following section for details on the parameters that are adjusted. **8.7.7** *Related Parameters* on page 8-41



• Because autotuning with a host reference adjusts the SERVOPACK during automatic operation, vibration or overshooting may occur. To ensure safety, make sure that you can perform an emergency stop at any time.

8.7.2 Restrictions

### 8.7.2 Restrictions

# Systems for Which Adjustments Cannot Be Made Accurately

Adjustments will not be made correctly for autotuning with a host reference in the following cases. Use custom tuning.

- When the travel distance for the reference from the host controller is equal to or lower than the setting of the positioning completed width (Pn522)
- Rotary Servomotors: When the movement speed for the reference from the host controller is equal to or lower than the setting of the rotation detection level (Pn502)
- Linear Servomotors: When the movement speed for the reference from the host controller is equal to or lower than the setting of the zero speed level (Pn581)
- When the time required to stop is 10 ms or less
- When the rigidity of the machine is low and vibration occurs when positioning is performed
- When the position integration function is used
- When mode switching is used
- When the positioning completed width (Pn522) is too narrow

Refer to the following sections for details on custom tuning.

🕼 8.8 Custom Tuning on page 8-42

### Preparations

Always check the following before you execute autotuning with a host reference.

- The servo must be in ready status.
- There must be no overtravel.
- The servo must be OFF.
- Position control must be selected if power is supplied to the motor (i.e., when the servo is ON).
- The gain switching selection must be set to disable automatic gain switching (Pn139 =  $n.\square\square\square0$ ).
- The first gains must be selected.
- The test without a motor function must be disabled (Pn00C =  $n.\square\square\square$ ).
- There must be no warnings.
- The tuning-less function must be disabled (Pn170 =  $n.\Box\Box\Box$ ).
- The parameters must not be write prohibited.

### 8.7.3 Applicable Tools

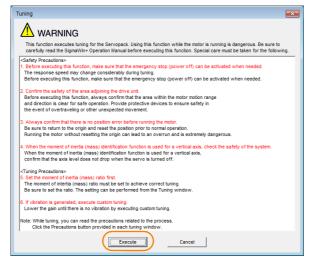
The following table lists the tools that you can use to perform autotuning with a host reference.

| Tool             | Fn No./Function Name | Operating Procedure Reference                                                   |
|------------------|----------------------|---------------------------------------------------------------------------------|
| Digital Operator | Fn202                | Ω Σ-7-Series Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+        | Tuning - Tuning      | 8.7.4 Operating Procedure on page 8-36                                          |

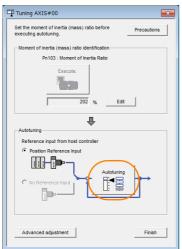
### 8.7.4 Operating Procedure

Use the following procedure to perform autotuning with a host reference.

- 1. Confirm that the moment of inertia ratio (Pn103) is set correctly.
- Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **3.** Select Tuning in the Menu Dialog Box. The Tuning Dialog Box will be displayed. Click the **Cancel** Button to cancel tuning.
- 4. Click the Execute Button.



5. Select the **Position reference input** Option in the **Autotuning** Area and then click the **Autotuning** Button.



**Information** When the following dialog box is displayed, click the **OK** Button and then confirm that the correct moment of inertia ratio is set in Pn103 (Moment of Inertia Ratio).



6. Set the conditions in the Mode selection Box and the Mechanism selection Box, and then click the Next Button.

If you select the Start tuning using the default settings Check Box in the Tuning parameters Area, the tuning parameters will be returned to the default settings before tuning is started.

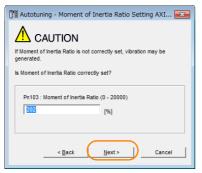
| [] Autotuning - Setting Conditions AXIS#00 ■                                                                                                                                                                                                                  | <b>·</b> | Mode selection Bo<br>Set the mode.                            | XC                                                                                                                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Set conditions.                                                                                                                                                                                                                                               |          | Mode Selection                                                | Description                                                                                                                                                                                                                                  |
| 2:For positioning     A gain adjustment specialized for positioning will be executed. In     addition, the following automatic adjustments can be executed: Model     following control, notch filter, anti-resonance control, and vibration     suppression. |          | 1: Standard                                                   | Standard gain adjustment is per-<br>formed. In addition to gain adjust-<br>ment, notch filters and anti-<br>resonance control are automatically<br>adjusted.                                                                                 |
| Mechanism selection           2:Ball screw mechanism or linear motor           Executes adjustment suitable for relatively high-rigidity mechanism, such as a ball screw or linear motor. Select this type if there is no applicable mechanism.               |          | 2: For positioning                                            | Tuning is performed for positioning<br>applications. In addition to gain<br>adjustment, model following control,<br>notch filters, anti-resonance control,<br>and vibration suppression are auto-<br>matically adjusted.                     |
| Tuning parameters                                                                                                                                                                                                                                             |          | 3: For positioning<br>especially to pre-<br>vent overshooting | Tuning is performed for positioning<br>applications with emphasis on elimi-<br>nating overshooting. In addition to<br>gain adjustment, notch filters, anti-<br>resonance control, and vibration sup-<br>pression are automatically adjusted. |
| Next > Cancel                                                                                                                                                                                                                                                 |          |                                                               |                                                                                                                                                                                                                                              |
| Funing parameters Box<br>Specify the parameters to use for tuning.<br>If you select the <b>Start tuning using the</b><br><b>default settings</b> Check Box, the tuning<br>parameters will be returned to the default<br>settings before tuning is started.    |          | drive.<br>If there is noise or it<br>results may be obta      | ion Box<br>ording to the machine element to<br>f the gain does not increase, better<br>ained by changing the rigidity type.<br>ording to the following guidelines.                                                                           |
|                                                                                                                                                                                                                                                               |          | Mechanism<br>Selection                                        | Description                                                                                                                                                                                                                                  |
|                                                                                                                                                                                                                                                               |          | 1: Belt mechanism                                             | Tuning is performed for a mecha-<br>nism with relatively low rigidity, e.g.,<br>a belt.                                                                                                                                                      |
|                                                                                                                                                                                                                                                               |          | 2: Ball screw<br>mechanism or linear<br>motor                 | Tuning is performed for a mecha-<br>nism with relatively high rigidity, e.g.,<br>a ball screw or Linear Servomotor.<br>Use this setting if there is no other<br>appropriate setting.                                                         |
|                                                                                                                                                                                                                                                               |          | 3: Rigid model                                                | Tuning is performed for a mecha-<br>nism with high rigidity, e.g., a rigid<br>body system.                                                                                                                                                   |

7. Click the Yes Button.

| Autotuning                                                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                |
| Tuning will be executed after resetting the tuning<br>parameters to their default values.<br>When tuning starts, the current tuning results will be<br>lost.<br>Do you want to execute tuning? |
| Ves No                                                                                                                                                                                         |

Tuning

8. Input the correct moment of inertia ratio and click the Next Button.



**9.** First confirm safety around moving parts. Turn ON the servo, enter a reference from the host controller, and then click the **Start tuning** Button.

| Autotuning - Automatic s                                                | setting AXIS#00                                                                                                | ×  |
|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----|
| Waiting for execution                                                   | Tuning<br>Turn the servo on, input the reference from the host<br>controller, and then click the Start button. |    |
| Oscillation level<br>measurement<br>Gain search<br>behaviour evaluation | Start tuning                                                                                                   |    |
|                                                                         | Mode selection                                                                                                 |    |
|                                                                         | 2:For positioning                                                                                              |    |
| Notch filter                                                            | Mechanism selection                                                                                            |    |
| OAnti-res Adj<br>Vib Suppress                                           | 2:Ball screw mechanism or linear motor                                                                         |    |
| Precautions                                                             | < Back Finish Cance                                                                                            | el |

#### 10. Click the Yes Button.



Tuning will be executed.

Vibration that occurs during tuning will be detected automatically and suitable settings will be made for that vibration. When the settings have been completed, the indicators for the functions that were used will light at the lower left of the dialog box.

| Waiting for execution               | Tuning Executing tuning (Input the reference.) |
|-------------------------------------|------------------------------------------------|
|                                     |                                                |
| Oscillation level<br>measurement    | Cancel                                         |
|                                     |                                                |
| Gain search<br>behaviour evaluation |                                                |
|                                     |                                                |
| Tuning completed                    |                                                |
|                                     | Mode selection                                 |
|                                     | Mode Selection                                 |
|                                     | 2:For positioning                              |
|                                     |                                                |
| Notch filter                        | 2:For positioning                              |

**11.** When tuning has been completed, click the Finish Button. The results of tuning will be set in the parameters and you will return to the Tuning Dialog Box.

This concludes the procedure to perform autotuning with a host reference.

8.7.5 Troubleshooting Problems in Autotuning with a Host Reference

# 8.7.5 Troubleshooting Problems in Autotuning with a Host Reference

The following tables give the causes of and corrections for problems that may occur in autotuning with a host reference.

#### ◆ Autotuning with a Host Reference Was Not Performed

| Possible Cause                                          | Corrective Action                         |
|---------------------------------------------------------|-------------------------------------------|
| Main circuit power supply is OFF.                       | Turn ON the main circuit power supply.    |
| An alarm or warning occurred.                           | Remove the cause of the alarm or warning. |
| Overtraveling occurred.                                 | Remove the cause of overtraveling.        |
| The second gains were selected with the gain selection. | Disable automatic gain switching.         |
| The HWBB was activated.                                 | Release the HWBB.                         |

### Troubleshooting Errors

| Error                                                                                                                   | Possible Cause                                                                                          | Corrective Action                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The gain adjustments were not successfully completed.                                                                   | Machine vibration<br>occurs or positioning<br>completion is not stable<br>when the Servomotor<br>stops. | <ul> <li>Increase the setting of the positioning completed width (Pn522).</li> <li>Change the mode from 2 to 3.</li> <li>If machine vibration occurs, suppress the vibration with the anti-resonance control adjustment and the vibration suppression function.</li> </ul> |
| Positioning was not<br>completed within<br>approximately 10<br>seconds after posi-<br>tion adjustment was<br>completed. | The positioning com-<br>pleted width is too nar-<br>row.                                                | Increase the setting of the positioning completed width (Pn522).                                                                                                                                                                                                           |

#### ◆ Adjustment Results Are Not Satisfactory for Position Control

You may be able to improve the adjustment results by changing the settings of the positioning completed width (Pn522) and the electronic gear (Pn20E/Pn210).

If satisfactory results are still not possible, adjust the overshoot detection level (Pn561). That may improve the adjustment results.

- Pn561 = 100% (default setting)
- This will allow tuning with overshooting that is equivalent to the positioning completed width. • Pn561 = 0%

This will allow tuning to be performed without overshooting within the positioning completed width, but the positioning completed width may be extended.

|       | Overshoot Detection Level |              |                 |              |                |  |
|-------|---------------------------|--------------|-----------------|--------------|----------------|--|
| Pn561 | Setting Range             | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | 0 to 100                  | 1%           | 100             | Immediately  | Setup          |  |

### 8.7.6 Automatically Adjusted Function Settings

These function settings are the same as for autotuning without a host reference. Refer to the following section.

8.6.6 Automatically Adjusted Function Settings on page 8-31

8.7.7 Related Parameters

### 8.7.7 Related Parameters

The following parameters are automatically adjusted or used as reference when you execute autotuning with a host reference.

Do not change the settings while autotuning with a host reference is being executed.

| Parameter | Name                                                    | Automatic Changes |
|-----------|---------------------------------------------------------|-------------------|
| Pn100     | Speed Loop Gain                                         | Yes               |
| Pn101     | Speed Loop Integral Time Constant                       | Yes               |
| Pn102     | Position Loop Gain                                      | Yes               |
| Pn103     | Moment of Inertia Ratio                                 | No                |
| Pn121     | Friction Compensation Gain                              | Yes               |
| Pn123     | Friction Compensation Coefficient                       | Yes               |
| Pn124     | Friction Compensation Frequency Correction              | No                |
| Pn125     | Friction Compensation Gain Correction                   | Yes               |
| Pn401     | First Stage First Torque Reference Filter Time Constant | Yes               |
| Pn408     | Torque-Related Function Selections                      | Yes               |
| Pn409     | First Stage Notch Filter Frequency                      | Yes               |
| Pn40A     | First Stage Notch Filter Q Value                        | Yes               |
| Pn40C     | Second Stage Notch Filter Frequency                     | Yes               |
| Pn40D     | Second Stage Notch Filter Q Value                       | Yes               |
| Pn140     | Model Following Control-Related Selections              | Yes               |
| Pn141     | Model Following Control Gain                            | Yes               |
| Pn142     | Model Following Control Gain Correction                 | Yes               |
| Pn143     | Model Following Control Bias in the Forward Direction   | Yes               |
| Pn144     | Model Following Control Bias in the Reverse Direction   | Yes               |
| Pn145     | Vibration Suppression 1 Frequency A                     | Yes               |
| Pn146     | Vibration Suppression 1 Frequency B                     | Yes               |
| Pn147     | Model Following Control Speed Feedforward Compensation  | Yes               |
| Pn160     | Anti-Resonance Control-Related Selections               | Yes               |
| Pn161     | Anti-Resonance Frequency                                | Yes               |
| Pn163     | Anti-Resonance Damping Gain                             | Yes               |

Yes: The parameter is automatically set.

No: The parameter is not automatically set, but the setting is read during execution.

8.8.1 Outline

### 8.8 Custom Tuning

This section describes custom tuning.

### 8.8.1 Outline

You can use custom tuning to manually adjust the servo during operation with a reference from the host controller. You can use it to fine-tune adjustments that were made with autotuning.

The following items are adjusted automatically.

- · Gains (e.g., speed loop gain and position loop gain)
- Filters (torque reference filter and notch filters)
- Friction compensation
- Anti-resonance control

Refer to the following section for details on the parameters that are adjusted.

8.8.7 Related Parameters on page 8-50

There are two adjustment methods that you can use for custom tuning.

 Tuning Mode 0 (Setting Servo Gains Giving Priority to Stability) or 1 (Setting Servo Gains Giving Priority to Good Response)

These modes allow you to set stable control conditions for multiple servo gains by manipulating only one tuning level. Automatic setting of notch filters and anti-resonance control is provided if vibration is detected. Manual anti-resonance control adjustment is also possible during custom tuning.

 Tuning Mode 2 (Setting Servo Gains Giving Priority to Position Control Applications) or 3 (Setting Servo Gains Giving Priority to Preventing Overshooting in Position Control Applications)

Two tuning levels are manipulated to reduce positioning time even further and set multiple servo gains.

Model following control is used to reduce the positioning time. If vibration is detected, notch filters and anti-resonance control are automatically adjusted, and friction compensation is automatically set. Manual anti-resonance control adjustment and vibration suppression are also possible during custom tuning.



• Vibration or overshooting may occur during custom tuning. To ensure safety, make sure that you can perform an emergency stop at any time.

### 8.8.2 Preparations

Always check the following before you execute custom tuning.

- The test without a motor function must be disabled (Pn00C =  $n.\square\square\square$ ).
- The tuning-less function must be disabled (Pn170 =  $n.\Box\Box\Box$ ).
- The parameters must not be write prohibited.

8.8.3 Applicable Tools

### 8.8.3 Applicable Tools

The following table lists the tools that you can use to perform custom tuning.

| Tool             | Fn No./Function Name | Operating Procedure Reference                                                   |
|------------------|----------------------|---------------------------------------------------------------------------------|
| Digital Operator | Fn203                | Ω Σ-7-Series Digital Operator Operating<br>Manual (Manual No.: SIEP S800001 33) |
| SigmaWin+        | Tuning - Tuning      | 8.8.4 Operating Procedure on page 8-43                                          |

### 8.8.4 Operating Procedure

te: While tuning, you can Click the Precautions recautions related to the p ided in each tuning windo

Cancel

Use the following procedure to perform custom tuning.

| RNING                                                                                                                                                                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| e information provided in the SigmaWin+ oper-<br>ncy stop at any time.<br>Imeters will be overwritten with the recommended<br>hase before and after execution. Make sure that you<br>bu execute custom tuning.<br>noment of inertia, vibration may occur.<br>a setting will not be used immediately. It will be used |
| n103) is set correctly.                                                                                                                                                                                                                                                                                              |
| rkspace of the Main Window of the Sig-                                                                                                                                                                                                                                                                               |
|                                                                                                                                                                                                                                                                                                                      |
|                                                                                                                                                                                                                                                                                                                      |
|                                                                                                                                                                                                                                                                                                                      |
|                                                                                                                                                                                                                                                                                                                      |

Tuning

5. Click the Advanced adjustment Button.

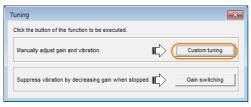
| Tuning AXIS#00                                                                  |  |  |  |  |
|---------------------------------------------------------------------------------|--|--|--|--|
| Set the moment of inertia (mass) ratio before Precautions executing autotuning. |  |  |  |  |
| Moment of inertia (mass) ratio identification                                   |  |  |  |  |
| Pn103 : Moment of Inertia Ratio                                                 |  |  |  |  |
| Execute.                                                                        |  |  |  |  |
| 100 % <u>Edit</u>                                                               |  |  |  |  |
| Autotuning                                                                      |  |  |  |  |
| Reference input from host controller                                            |  |  |  |  |
| Position Reference Input                                                        |  |  |  |  |
|                                                                                 |  |  |  |  |
| Advanced adjustment Finish                                                      |  |  |  |  |

#### Information

When the following dialog box is displayed, click the **OK** Button and then confirm that the correct moment of inertia ratio is set in Pn103 (Moment of Inertia Ratio).

| Tuning                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                           |
| The moment of inertia (mass) ratio has never been changed from the default<br>seting.<br>Set a correct moment of inertia (mass) ratio in the Moment of Inertia (Mass) Setting<br>window before starting tuning.<br>If an incorrect moment of inertia (mass) ratio is set, vibration may be generated<br>during tuning.<br>Do you want to continue tuning? |
| OK Cancel                                                                                                                                                                                                                                                                                                                                                 |

6. Click the Custom tuning Button.



7. Set the Tuning mode Box and Mechanism selection Box, and then click the Next Button.

| Custom Tuning - Mode selection AXIS#00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  | Tuning mode Box                                                                                     |                                                                                                                                                                                                                                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|-----------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tuning mode                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  | Mode Selection                                                                                      | Description                                                                                                                                                                                                                     |
| Set servo gains for positioning application. CiSet servo gains with priority given to stability. Overshoot will rarely occur since priority is given to stability. In addition to gain adjustments, the notch filter and anti-resonance control (except for torque (force) control) can be adjusted. 1:Set servo gains with priority given to response. Overshoot may occur since priority is given to responsiveness. In addition to gain adjustments, the notch filter and anti-resonance control (except for torque (force) control) can be adjusted. Mechanism selection   2:Bail screw mechanism or linear motor   2:Bail screw or linear motor. Select this type if there is no applicable   Option   Friction compensation @ Enable   Next >   Cancel |  | 0: Set servo gains<br>with priority given<br>to stability.                                          | This setting gives priority to stability<br>and preventing overshooting. In addi-<br>tion to gain adjustment, notch filters<br>and anti-resonance control (except<br>during torque control) are automatically<br>adjusted.      |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  | 1: Set servo gains<br>with priority given<br>to response.                                           | Overshooting may occur because pri-<br>ority is given to response. In addition to<br>gain adjustment, notch filters and anti-<br>resonance control (except during<br>torque control) are automatically<br>adjusted.             |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  | 2: Set servo gains for positioning application.                                                     | Tuning is performed for positioning<br>applications. In addition to gain adjust-<br>ment, notch filters, anti-resonance<br>control, and vibration suppression are<br>adjusted.                                                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  | 3: Set servo gains<br>especially to pre-<br>vent overshooting<br>during positioning<br>application. | Tuning is performed for positioning<br>applications with emphasis on elimi-<br>nating overshooting. In addition to gain<br>adjustment, notch filters, anti-reso-<br>nance control, and vibration suppres-<br>sion are adjusted. |

#### Mechanism Selection Box

Select the type according to the machine element to drive.

If there is noise or if the gain does not increase, better results may be obtained by changing the rigidity type. Select the type according to the following guidelines.

| Mechanism Selection                     | Description                                                                                                                                                            |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1: Belt mechanism                       | Tuning is performed for a mechanism with relatively low rigidity, e.g., a belt.                                                                                        |
| 2: Ball screw mechanism or Linear motor | Tuning is performed for a mechanism with relatively high rigidity, e.g., a ball screw or Linear Servomotor. Use this setting if there is no other appropriate setting. |
| 3: Rigid body system                    | Tuning is performed for a mechanism with high rigidity, e.g., a rigid body system.                                                                                     |

Information The tuning modes that you can select depend on the SERVOPACK setting.

8. If the moment of inertia ratio is not set correctly, correct the setting and then click the Next Button.

| Custom Tuning - Moment of Inertia Ratio Setti 💽                                   |  |  |  |  |
|-----------------------------------------------------------------------------------|--|--|--|--|
|                                                                                   |  |  |  |  |
| When Moment of Inertia Ratio is not correctly set, vibration may be<br>generated. |  |  |  |  |
| Is Moment of Inertia Ratio correctly set?                                         |  |  |  |  |
| Pn103 : Moment of Inertia Ratio (0 - 20000)                                       |  |  |  |  |
| < Back Next > Cancel                                                              |  |  |  |  |

**9.** Turn ON the servo, enter a reference from the host controller, and then click the **Start tuning** Button.

Tuning Mode 0 or 1

| Tuning mode                                                                                                 | 0 : Set servo gains with priority given to stability.       | Tu |
|-------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|----|
| Mechanism selection                                                                                         | 2 : Ball screw mechanism or linear motor                    | Me |
| Friction compensation                                                                                       | Enable                                                      | Fr |
| Gain status                                                                                                 | 1 gain                                                      | Gi |
| Tuning level adjustmer<br>Setting the tuning level<br>too high can aruse<br>vibration or abnormal<br>noise. | Tuning level                                                |    |
|                                                                                                             | Auto-setting<br>Noto filer<br>1 step - nactive Cancel       |    |
|                                                                                                             | Anti-res CtrlAdj Anti-res Adj inactive Cencel Anti-res Ctrl |    |

#### m Tuning - Adust AXIS#00 2 : Set servo gains for p ism sel 2 : Ball screw mechanism or linear moto Enable 1 gair Tuning level Set the tuning level and start the Feed forward level (FF) 88 Notch filte 1 step 2 step Anti-res Ctrl Ad Anti-res Ctrl Adi Anti-res Ad Vib Suppres Vib Suppress To Autotuning Cor Cancel

#### **10.** Use the $\blacktriangle$ and $\blacktriangledown$ Buttons to change the tuning level.

Click the **Back** Button during tuning to restore the setting to its original value. The tuning level will return to the value from before when custom tuning was started.

#### Tuning Mode 0 or 1

Increase the tuning level until overshooting occurs.

| Tuning mode                                                                                                 | 0 : Set servo gains with priority given to stability.         |            |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|------------|
| Mechanism selection                                                                                         | 2 : Ball screw mechanism or linear motor                      |            |
| Friction compensation                                                                                       | Enable                                                        |            |
| Gain status                                                                                                 | 1 gain                                                        |            |
| Tuning level adjustment<br>Setting the tuning level<br>to high can cause<br>vibration or abnormal<br>noise. | Tung level<br>Set the tuning level.<br>Tuning level           | Back       |
|                                                                                                             | Auto-setting<br>Notch fitter Vibration not detected<br>1 step | Vib Detect |
|                                                                                                             |                                                               |            |

Tuning Mode 2 or 3

Tuning Mode 2 or 3

Increase the feedforward level until overshooting occurs and then increase the feedback level until overshooting is eliminated. Repeat these changes to make the adjustment.

| Custom Tuning - Ac       | lust AXIS#00                                     | ×                 |  |  |  |  |
|--------------------------|--------------------------------------------------|-------------------|--|--|--|--|
| Tuning mode              | 2 : Set servo gains for positioning application. |                   |  |  |  |  |
| Mechanism selection      | 2 : Ball screw mechanism or linear motor         |                   |  |  |  |  |
| Friction compensation    | Enable                                           |                   |  |  |  |  |
| Gain status              | 1 gain                                           |                   |  |  |  |  |
|                          | Tuning level                                     |                   |  |  |  |  |
| FF level adjustment      | Set the tuning level.<br>Feed forward level (FF) | Back              |  |  |  |  |
| Increase until           |                                                  |                   |  |  |  |  |
| overshooting occurs.     | <b>T</b>                                         |                   |  |  |  |  |
| <del></del>              | Feedback level (FB)                              |                   |  |  |  |  |
| FB level adjustment      |                                                  |                   |  |  |  |  |
| Increase until           | (1 - 2000)                                       |                   |  |  |  |  |
| overshooting disappears. | Auto-setting                                     |                   |  |  |  |  |
| 1 1                      | Notch filter Vibration not detected              | Vib Detect        |  |  |  |  |
|                          | 1 step inactive                                  |                   |  |  |  |  |
| Response level OK?       | 2 step inactive Cancel                           |                   |  |  |  |  |
| No                       |                                                  |                   |  |  |  |  |
| Yes                      | Anti-res Ctrl Adj Vibration not detected         |                   |  |  |  |  |
| <b>V</b>                 | Anti-res Adj inactive Cancel                     | Anti-res Ctrl Adj |  |  |  |  |
| Finish                   | Vib Suppression                                  |                   |  |  |  |  |
|                          | Frequency 1 inactive Cancel                      | Vib Suppress      |  |  |  |  |
| Precautions              | < Back To Autotuning Completed.                  | Cancel            |  |  |  |  |

Information

The new feedforward level will not be used until the positioning completed signal is output.

- **11.** You can set the functions to suppress vibration (notch filters, automatic anti-resonance control setting, anti-resonance control adjustment, and autotuning with a host reference) as required.
  - Refer to the following section for details.
  - Vibration Suppression Functions on page 8-48

**12.** When tuning has been completed, click the Completed Button. The values that were changed will be saved in the SERVOPACK and you will return to the Tuning Dialog Box.

| Tuning mode                                                                                                 | 0 : Set servo gains with priority given t         | o stability. |            |
|-------------------------------------------------------------------------------------------------------------|---------------------------------------------------|--------------|------------|
| Mechanism selection                                                                                         | 2 : Ball screw mechanism or linear mot            | tor          |            |
| Friction compensation                                                                                       | Enable                                            |              |            |
| Gain status                                                                                                 | 1 gain                                            |              |            |
| Tuning level adjustmen<br>Setting the tuning level<br>too high can cause<br>vibration or abnormal<br>noise. |                                                   | -2000)       | Back       |
|                                                                                                             | Auto-setting<br>Notch filter Vibration not detect |              |            |
|                                                                                                             | Noteri niter                                      |              | Vib Detect |
|                                                                                                             | 1 step inactive                                   | Cancel       | -6         |
|                                                                                                             | 2 step inactive                                   |              | 4          |
|                                                                                                             | 2 0100                                            |              |            |
|                                                                                                             | Anti-res Ctrl Adj Vibration not detec             | ted          |            |

This concludes the procedure to set up custom tuning.

### **Vibration Suppression Functions**

#### Notch Filters and Automatic Anti-resonance Control Setting

If the vibration frequency that occurs when you increase the servo gains is at 1,000 Hz or higher, notch filters are effective to suppress vibration. If the vibration is between 100 Hz and 1,000 Hz, anti-resonance control is effective.

#### ♦ Automatic Setting

To set vibration suppression automatically, use the parameters to enable notch filters and automatic anti-resonance control setting.

The notch filter frequency (stage 1 or 2) or anti-resonance control frequency that is effective for the vibration that was detected during tuning will be automatically set.

| <sup>0</sup> Custom Tuning - Adust | AXIS#1                                          |
|------------------------------------|-------------------------------------------------|
|                                    |                                                 |
| Tuning mode                        | 2: Set servo gains for positioning application. |
| Mechanism selection                | 2 : Ball screw mechanism or linear motor        |
| Friction compensation              | Disable                                         |
| Gain status                        | 1 gain                                          |
|                                    |                                                 |
| •                                  | Tuning level                                    |
|                                    | Set the tuning level. Feed forward level (FF)   |
| FF level adjustment                | Back                                            |
| Increase until                     |                                                 |
| overshooting occurs.               |                                                 |
|                                    | (1 - 2000)                                      |
| <b>↓</b>                           | Feedback level (FB)                             |
|                                    |                                                 |
| FB level adjustment                |                                                 |
| Increase until                     | (1 - 2000)                                      |
| overshooting disappears.           | (1 - 2000)                                      |
| 1                                  | Auto-setting                                    |
| ±                                  | Notch filter Vibration not detected Vib Detect  |
| Response level OK?>                | 1 step inactive                                 |
| No Response level UK /             | 2 step inactive                                 |
| VO Ves                             |                                                 |
|                                    | Anti-res Ctrl Adj Vibration not detected        |
|                                    | Anti-res Adj inactive Cancel Anti-res Ctrl Adj  |
| Finish                             |                                                 |
|                                    | Vib Suppression                                 |
|                                    | Frequency 1 inactive Cancel Vib Suppress        |
|                                    |                                                 |
| Precautions                        | Back To Autotuing Completed. Cancel             |

#### Auto-setting Cancel Buttons

The automatically set notch filter frequencies or the anti-resonance control frequencies may not always suppress vibration. Click the **Cancel** Button to reset the notch filter frequencies or the anti-resonance control frequencies to the values from just before these frequencies were set automatically.

When they are reset, vibration detection will start again.

#### • Vib Detect Button

While the notch filter or automatic anti-resonance control setting function is enabled, you can click the **Vib Detect** Button to manually detect vibration. When you click the **Vib Detect** Button, the SERVOPACK will detect vibration at that time, and set the notch filter frequency (stage 1 or 2) or anti-resonance control frequency that is effective for the detected vibration. You can also perform manual vibration detection even when the SERVOPACK does not detect vibration.

#### · Anti-res Ctrl Adj Button

You can use the **Anti-res Ctrl Adj** Button to execute the anti-resonance control adjustment if fine-tuning is required. Refer to the following section.

3.9 Anti-Resonance Control Adjustment on page 8-51

#### · Vib Suppress Button

Click the **Vib Suppress** Button to suppress low and transient vibration (oscillation) of approximately 1 Hz to 100 Hz that occurs during positioning. Refer to the following section.

8.10 Vibration Suppression on page 8-56

#### ◆ Autotuning with a Host Reference

You can perform autotuning with a host reference. Refer to the following section for details. 8.7 Autotuning with a Host Reference on page 8-34

8.8.5 Automatically Adjusted Function Settings

### 8.8.5 Automatically Adjusted Function Settings

You cannot use vibration suppression functions at the same time. Other automatic function settings are the same as for autotuning without a host reference. Refer to the following section.

### 8.8.6 <u>Tuning Example for Tuning Mode 2 or 3</u>

| Step | Measurement Display Examples                                                    | Operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Position<br>deviation<br>Reference<br>speed<br>Positioning<br>completion signal | The positioning time is measured after the moment of inertia<br>ratio (Pn103) is set correctly.<br>Tuning is completed if the specifications are met.<br>The tuning results are saved in the SERVOPACK.                                                                                                                                                                                                                                                                                                                                                    |
| 2    |                                                                                 | The positioning time will be reduced if the feedforward level is<br>increased.<br>Tuning is completed if the specifications are met. The tuning<br>results are saved in the SERVOPACK.<br>If overshooting occurs before the specifications are met, pro-<br>ceed to step 3.                                                                                                                                                                                                                                                                                |
| 3    |                                                                                 | Overshooting will be reduced if the feedback level is increased.<br>If the overshooting is eliminated, proceed to step 4.                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 4    |                                                                                 | The graph shows overshooting that occurred when the feed-<br>forward level was increased even more after step 3. In this<br>state, overshooting occurs, but the positioning settling time<br>is shorter. Tuning is completed if the specifications are met.<br>The tuning results are saved in the SERVOPACK. If over-<br>shooting occurs before the specifications are met, repeat<br>steps 3 and 4.<br>If vibration occurs before the overshooting is eliminated, the<br>vibration is suppressed with the notch filters and anti-reso-<br>nance control. |
| 5    | -                                                                               | The tuning results are saved in the SERVOPACK.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

8.8.7 Related Parameters

### 8.8.7 Related Parameters

The following parameters are automatically adjusted or used as reference when you execute custom tuning.

| Parameter | Name                                                    | Automatic Changes |
|-----------|---------------------------------------------------------|-------------------|
| Pn100     | Speed Loop Gain                                         | Yes               |
| Pn101     | Speed Loop Integral Time Constant                       | Yes               |
| Pn102     | Position Loop Gain                                      | Yes               |
| Pn103     | Moment of Inertia Ratio                                 | No                |
| Pn121     | Friction Compensation Gain                              | Yes               |
| Pn123     | Friction Compensation Coefficient                       | Yes               |
| Pn124     | Friction Compensation Frequency Correction              | No                |
| Pn125     | Friction Compensation Gain Correction                   | Yes               |
| Pn401     | First Stage First Torque Reference Filter Time Constant | Yes               |
| Pn408     | Torque-Related Function Selections                      | Yes               |
| Pn409     | First Stage Notch Filter Frequency                      | Yes               |
| Pn40A     | First Stage Notch Filter Q Value                        | Yes               |
| Pn40C     | Second Stage Notch Filter Frequency                     | Yes               |
| Pn40D     | Second Stage Notch Filter Q Value                       | Yes               |
| Pn140     | Model Following Control-Related Selections              | Yes               |
| Pn141     | Model Following Control Gain                            | Yes               |
| Pn142     | Model Following Control Gain Correction                 | Yes               |
| Pn143     | Model Following Control Bias in the Forward Direction   | Yes               |
| Pn144     | Model Following Control Bias in the Reverse Direction   | Yes               |
| Pn145     | Vibration Suppression 1 Frequency A                     | No                |
| Pn146     | Vibration Suppression 1 Frequency B                     | No                |
| Pn147     | Model Following Control Speed Feedforward Compensation  | Yes               |
| Pn160     | Anti-Resonance Control-Related Selections               | Yes               |
| Pn161     | Anti-Resonance Frequency                                | Yes               |
| Pn163     | Anti-Resonance Damping Gain                             | Yes               |

Do not change the settings while custom tuning is being executed.

Yes: The parameter is automatically set.

No: The parameter is not automatically set, but the setting is read during execution.

8.9.1 Outline

### 8.9 Anti-Resonance Control Adjustment

This section describes anti-resonance control.

### 8.9.1 Outline

Anti-resonance control increases the effectiveness of vibration suppression after custom tuning.

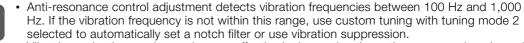
Anti-resonance control is effective for suppression of continuous vibration frequencies from 100 to 1,000 Hz that occur when the control gain is increased. Vibration can be eliminated by setting vibration frequencies through automatic detection or by manually setting them to adjust the damping gain. Input an operation reference and execute this anti-resonance control adjustment when there is vibration.

Anti-resonance control is automatically set by autotuning without a host reference or autotuning with a host reference. Use anti-resonance control adjustment only if fine-tuning is required or readjustment is required as a result of a failure to detect vibration.

Perform custom tuning if required to increase the response after performing anti-resonance control adjustment. If the control gain is increased, e.g., when custom tuning is performed, vibration may occur again. If that occurs, perform anti-resonance control adjustment again to fine-tune the parameters.

## 

- Related parameters will be set automatically when anti-resonance control adjustment is executed. This may greatly affect the response before and after execution. Make sure that you can perform an emergency stop at any time.
- Before you execute anti-resonance control adjustment, set the correct moment of inertia ratio (Pn103). If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may occur.



 Vibration reduction can be made more effective by increasing the anti-resonance damping gain (Pn163), but the vibration may become larger if the damping gain is too high. Increase the damping gain by approximately 0% to 200% in 10% increments while checking the effect on vibration. If vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain by using a different method, such as custom tuning.

### 8.9.2 Preparations

0

Always check the following before you execute anti-resonance control adjustment.

- The tuning-less function must be disabled (Pn170 =  $n.\Box\Box\Box$ 0).
- The test without a motor function must be disabled (Pn00C =  $n.\square\square\square$ ).
- The parameters must not be write prohibited.

Tuning

8.9.3 Applicable Tools

### 8.9.3 Applicable Tools

The following table lists the tools that you can use to perform anti-resonance control adjustment.

| Tool             | Fn No./Function Name | Operating Procedure Reference                                                 |
|------------------|----------------------|-------------------------------------------------------------------------------|
| Digital Operator | Fn204                | Σ-7-Series Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+        | Tuning - Tuning      | S.9.4 Operating Procedure on page 8-52                                        |

### 8.9.4 Operating Procedure

To execute anti-resonance control adjustment, an operation reference is input, and the adjustment is executed while vibration is occurring.

The following methods can be used to execute anti-resonance control adjustment.

- To automatically detect the vibration frequency
- To manually set the vibration frequency

Use the following procedure to perform anti-resonance control.

| the S<br>Obse<br>• Ma<br>Pa<br>em<br>• Se<br>If t<br>no<br>• If y<br>qu<br>wh<br>• If e<br>ad<br>cu<br>• Pe<br>na<br>If t | bre you execute anti-resonance control adjustment, check the information provided in<br>SigmaWin+ operating manual.<br>erve the following precautions.<br>ake sure that you can perform an emergency stop at any time.<br>arameters will be set automatically when anti-resonance control adjustment is executed. This<br>ay greatly affect the response before and after execution. Make sure that you can perform an<br>nergency stop (to turn OFF the power supply) at any time.<br>et the moment of inertia correctly before you execute anti-resonance control adjustment.<br>the setting greatly differs from the actual moment of inertia, effective vibration reduction may<br>to be possible.<br>you have already performed anti-resonance control adjustment and then you change the fre-<br>iency, the current anti-resonance control effect may be lost. Caution is particularly required<br>hen automatically detecting the vibration frequency.<br>effective vibration reduction is not achieved even after you execute anti-resonance control<br>ljustment, cancel the function and lower the control gain by using a different method, such as<br>storn tuning.<br>erform custom tuning separately if required to increase the response after performing anti-reso-<br>nce control adjustment.<br>the servo gain is increased, e.g., when custom tuning is performed, vibration may occur again.<br>that occurs, perform anti-resonance control adjustment again to fine-tune the parameters. |
|---------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

1. Perform steps 1 to 8 of the procedure for custom tuning. Refer to the following section for details.

8.8.4 Operating Procedure on page 8-43

2. Click the Anti-res Ctrl Adj Button.

The rest of the procedure depends on whether you know the vibration frequency.

|                                                                                                                       | dust AXIS#00 🗖 🗇                                                              |
|-----------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Tuning mode                                                                                                           | 0 : Set servo gains with priority given to stability.                         |
| Mechanism selection                                                                                                   | 2 : Ball screw mechanism or linear motor                                      |
| Friction compensation                                                                                                 | Enable                                                                        |
| Gain status                                                                                                           | 1 gain                                                                        |
| Tuning level adjustmer<br>Setting the tuning level<br>too high can cause<br>vibration or abnormal<br>noise.<br>Finish |                                                                               |
|                                                                                                                       |                                                                               |
|                                                                                                                       | Auto-setting<br>Notch filter<br>1 step Inactive<br>2 step 860Hz active Cancel |
|                                                                                                                       | Notch filter Vib Detect                                                       |

**3.** If you do not know the vibration frequency, click the **Auto Detect** Button. If you know the vibration frequency, click the **Manual Set** Button.

To Automatically Detect the Vibration Frequency

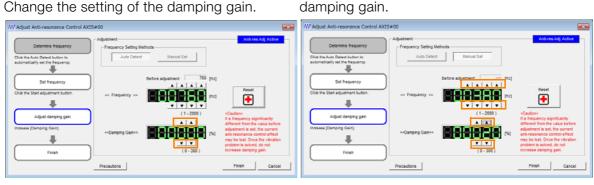
| The frequency                                                                              | will be                           | set.                       |                                                                                                                                                                                                                                                                |   |
|--------------------------------------------------------------------------------------------|-----------------------------------|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| M Adjust Anti-resonance Control AXIS                                                       | #00                               |                            | F                                                                                                                                                                                                                                                              | × |
| Determine frequency<br>Clisk the Auto Detect butten to<br>automatically set the theoremop: | Adjustment                        |                            | Anti-res Adji Inactive                                                                                                                                                                                                                                         | h |
| Sel frequency<br>Click the Start adjustment button.                                        | << Frequency >>                   | Before adjustment 700 [Hz] | Start adjustment                                                                                                                                                                                                                                               |   |
| Adjust damping gan<br>Increase (Damping Gain).                                             | < <damping gain="">&gt;</damping> | (1-2000)                   | <caution»<br>If a frequency significantly<br/>different from the value before<br/>adjustment is set, the current<br/>anti-resonance control effect<br/>may be loat. Once the vibration<br/>problem is solved, do not<br/>increase dampting gain.</caution»<br> |   |
| Finish                                                                                     | Precautions                       | (0-300)                    | Finish Cancel                                                                                                                                                                                                                                                  |   |

To Manually Set the Vibration Frequency

|                                                              | Adjustment          |                        | Anti-ret                               | Adj: Inactive   |
|--------------------------------------------------------------|---------------------|------------------------|----------------------------------------|-----------------|
| Determine frequency                                          | Frequency Setting M | ethods                 | -                                      |                 |
| k the Auto Detect button to<br>omatically set the frequency. | Auto Detect         | Manual Set             |                                        |                 |
| Set frequency                                                |                     | Before adjustment [Hz] | Start aduate                           |                 |
| k the Start adjustment button.                               | << Frequency >>     |                        | 73 6                                   | 1               |
| +                                                            |                     |                        |                                        |                 |
| Adjust damping gain                                          |                     | (1-2000)               | «Caution»                              |                 |
|                                                              |                     | A A                    | If a frequency sid                     |                 |
| ease (Damping Gain).                                         | «Damping Gain»»     |                        | adjustment is set<br>anti-resonance of |                 |
|                                                              |                     | <b>x x</b>             | may be lost. Onc                       | e the vibration |
| Finish                                                       |                     | (0-300)                | problem is solver<br>increase damping  |                 |
|                                                              | Precautions         |                        | Finish                                 | Cancel          |

- 4. Click the Start adjustment Button.
- 5. Use the ▲ and ▼ Buttons in the Adjustment Area to change the settings. Click the **Reset** Button during tuning to restore the setting to its original value. The tuning level will return to the value from before when custom tuning was started.

To Automatically Detect the Vibration Frequency To Manually Set the Vibration Frequency Change the settings of the frequency and damping gain.



#### 8.9.5 Related Parameters

#### 6. When the adjustment has been completed, click the Finish Button.

The values that were changed will be saved in the SERVOPACK and you will return to the Tuning Dialog Box.

|                                                                     | Adjustment                        |                           | Anti-res Adj: Active                                              |
|---------------------------------------------------------------------|-----------------------------------|---------------------------|-------------------------------------------------------------------|
| Determine frequency                                                 | - Frequency Setting M             | ethods                    |                                                                   |
| Click the Auto Detect button to<br>automatically set the frequency. | Auto Detect                       | Manual Set                |                                                                   |
| Set frequency                                                       | )                                 | Before adjustment 760 pig |                                                                   |
| Click the Start adjustment button.                                  | << Frequency >>                   |                           | z] Reset                                                          |
|                                                                     |                                   | <b>T T T</b>              |                                                                   |
| Adjust damping gain                                                 |                                   | (1-2000)                  | «Caution»<br>If a frequency significantly                         |
| Increase (Damping Gain).                                            |                                   |                           | different from the value before<br>adjustment is set, the current |
|                                                                     | < <damping gain="">&gt;</damping> |                           | anti-resonance control effect                                     |
| <b>+</b>                                                            |                                   | * *                       | may be lost. Once the vibration<br>problem is solved, do not      |
| Einiah                                                              | 1                                 | (9-309)                   | increase damping gain.                                            |

This concludes the procedure to set up anti-resonance control.

### 8.9.5 Related Parameters

The following parameters are automatically adjusted or used as reference when you execute anti-resonance control adjustment.

Do not change the settings while anti-resonance control adjustment is being executed.

| Parameter | Name                                             | Automatic Changes |
|-----------|--------------------------------------------------|-------------------|
| Pn160     | Anti-Resonance Control-Related Selections        | Yes               |
| Pn161     | Anti-Resonance Frequency                         | Yes               |
| Pn162     | Anti-Resonance Gain Correction                   | No                |
| Pn163     | Anti-Resonance Damping Gain                      | Yes               |
| Pn164     | Anti-Resonance Filter Time Constant 1 Correction | No                |
| Pn165     | Anti-Resonance Filter Time Constant 2 Correction | No                |

Yes: The parameter is automatically set.

No: The parameter is not automatically set, but the setting is read during execution.

# 8.9.6 Suppressing Different Vibration Frequencies with Anti-resonance Control

When you use anti-resonance control and increase the control gain, for some mechanism, vibration can occur at a higher frequency than the frequency for which vibration was suppressed. If this occurs, you can suppress vibration for more than one frequency by adjusting Pn166 (Anti-Resonance Damping Gain 2).

Information

#### tion Guidelines for Vibration That Can Be Suppressed

- Anti-resonance frequency (Pn161): fa [Hz], Another vibration frequency that occurs when the control gain is increased: fb [Hz]
- Vibration frequencies: 100 Hz to 1,000 Hz
- Range of different vibration frequencies:  $1 < (fb/fa) \le 3$  to 4

### **Required Parameter Settings**

The following parameter settings are required to use anti-resonance control for more than one vibration frequency.

|       | Parameter Descri            |                                    | Description     | cription     |              | n<br>ed        | Classifi-<br>I cation |  |
|-------|-----------------------------|------------------------------------|-----------------|--------------|--------------|----------------|-----------------------|--|
| Pn160 | n.□□□0<br>(default setting) | Do not use anti-resonance control. |                 |              |              | +              | Setup                 |  |
|       | n.0001                      | Use anti-resonance control.        |                 |              | restart      |                |                       |  |
|       | Anti-Resonance Frequency    |                                    |                 |              |              |                |                       |  |
| Pn161 | Setting Range               | Setting Unit                       | Default Setting | When Ena     | abled        | Cla            | assification          |  |
|       | 10 to 20,000                | 0.1 Hz                             | 1000            | Immedia      | ately        |                | Tuning                |  |
|       | Anti-Resonance Ga           | ain Correction                     |                 |              |              |                |                       |  |
| Pn162 | Setting Range               | Setting Unit                       | Default Setting | When Ena     | When Enabled |                | Classification        |  |
|       | 1 to 1,000                  | 1%                                 | 100             | Immediately  |              | Tuning         |                       |  |
|       | Anti-Resonance Da           | amping Gain                        |                 |              |              |                |                       |  |
| Pn163 | Setting Range               | Setting Unit                       | Default Setting | When Enabled |              | Classification |                       |  |
|       | 0 to 300                    | 1%                                 | 0               | Immedia      | ately        | Tuning         |                       |  |
|       | Anti-Resonance Fi           | lter Time Constant 1 C             | orrection       |              |              |                |                       |  |
| Pn164 | Setting Range               | Setting Unit                       | Default Setting | When Ena     | abled        | Classification |                       |  |
|       | -1,000 to 1,000             | 0.01 ms                            | 0               | Immedia      | ately        | Tuning         |                       |  |
|       | Anti-Resonance Fi           | lter Time Constant 2 C             | orrection       |              |              |                |                       |  |
| Pn165 | Setting Range               | Setting Unit                       | Default Setting | When Ena     | abled        | Cla            | assification          |  |
|       | -1,000 to 1,000             | 0.01 ms                            | 0               | Immedia      | Immediately  |                | Tuning                |  |
|       | Anti-Resonance Da           | amping Gain 2                      |                 |              |              |                |                       |  |
| Pn166 | Setting Range               | Setting Unit                       | Default Setting | When Ena     | abled        | Cla            | assification          |  |
|       | 0 to 1,000                  | 1%                                 | 0               | Immedia      | ately        |                | Tuning                |  |

### Adjustment Procedure for Suppressing Different Vibration Frequencies with Anti-resonance Control

Use the following procedure to make adjustments to suppress different vibration frequencies with anti-resonance control.

| Step | Operation                                                                                                                                                                                                                                                                                                     |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Use the gain adjustment and anti-resonance control.<br>Refer to the following section for details.<br>3.9.4 Operating Procedure on page 8-52                                                                                                                                                                  |
| 2    | If there is vibration at a higher frequency than the vibration suppressed with anti-resonance control in step 1, adjust Pn166 (Anti-Resonance Damping Gain 2).                                                                                                                                                |
| 3    | Adjust Pn166 (Anti-Resonance Damping Gain 2) while checking to see if vibration reduction is effective.<br>To adjust Pn166 (Anti-Resonance Damping Gain 2), increase the setting by 10% at a time starting from the value that resulted in Pn163 (Anti-Resonance Damping Gain) from the adjustment in step 1. |
| 4    | If the vibration disappears, the adjustment is completed.<br>However, if the vibration does not disappear even when you adjust Pn166 (Anti-Resonance<br>Damping Gain 2), reduce the tuning level or feedback level until vibration does not occur.                                                            |

8.10.1 Outline

#### **Vibration Suppression** 8.10

This section describes vibration suppression.

#### **Outline** 8.10.1

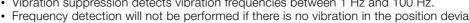
Important

You can use vibration suppression to suppress transient vibration at a low frequency from 1 Hz to 100 Hz, which is generated mainly when the machine vibrates during positioning. This is effective for vibration frequencies for which notch filters and anti-resonance control adjustment are not effective.

Vibration suppression is automatically set by autotuning without a host reference or autotuning with a host reference. Use vibration suppression only if fine-tuning is required or readjustment is required as a result of a failure to detect vibration. To execute vibration suppression, input an operation reference and execute the function when there is vibration.

Perform custom tuning if required to increase the response after performing vibration suppression.

| <ul> <li>Related parameters will be set automatically when vibration suppression is executed. This may greatly affect the response before and after execution. Make sure that you can perform an emergency stop at any time.</li> </ul>                                                                                                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul> <li>Before you execute vibration suppression, set the correct moment of inertia ratio (Pn103)<br/>with autotuning without a host reference or another method. If the setting greatly differs<br/>from the actual moment of inertia ratio, normal control of the machine may not be possible,<br/>and vibration may occur.</li> </ul> |
| Vibration suppression detects vibration frequencies between 1 Hz and 100 Hz.                                                                                                                                                                                                                                                              |
| Frequency detection will not be performed if there is no vibration in the position deviation or if                                                                                                                                                                                                                                        |



the vibration frequency is outside the range of detectable frequencies. If that is a problem, use a device such as a displacement meter or vibration sensor to measure the vibration frequency. If an automatically detected vibration frequency is not suppressed, the actual frequency and

the detected frequency may be different. Fine-tune the detected frequency if necessary.

### Items That Influence Performance

If continuous vibration occurs while the Servomotor is stopping, vibration suppression cannot be used to suppress the vibration effectively. In this case, use anti-resonance control adjustment or custom tuning.

### **Detection of Vibration Frequencies**

Frequency detection may not be possible if vibration does not appear in the position deviation or the vibration that results from the position deviation is too small. You can adjust the detection sensitivity by changing the setting of the residual vibration detection width (Pn560), which is set as a percentage of the positioning completed width (Pn522). Perform the detection of vibration frequencies again after adjusting the setting of Pn560.

|       | Residual Vibration Detection Width |              |                 |              |                |
|-------|------------------------------------|--------------|-----------------|--------------|----------------|
| Pn560 | Setting Range                      | Setting Unit | Default Setting | When Enabled | Classification |
|       | 1 to 3,000                         | 0.1%         | 400             | Immediately  | Setup          |

Note: As a guideline, change the setting 10% at a time. If the setting of this parameter is lowered, the detection sensitivity will be increased. Vibration may not be detected accurately if the setting is too small.

The vibration frequencies that are automatically detected may vary somewhat with each posi-Information tioning operation. Perform positioning several times and make adjustments while checking the effect of vibration suppression.

8.10.2 Preparations

### 8.10.2 Preparations

Always check the following before you execute vibration suppression.

- The tuning-less function must be disabled (Pn170 =  $n.\Box\Box\Box$ 0).
- The test without a motor function must be disabled (Pn00C =  $n.\square\square\square$ ).
- The parameters must not be write prohibited.

### 8.10.3 Applicable Tools

The following table lists the tools that you can use to perform vibration suppression.

| Tool             | Fn No./Function Name | Operating Procedure Reference                                                   |
|------------------|----------------------|---------------------------------------------------------------------------------|
| Digital Operator | Fn205                | Ω Σ-7-Series Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+        | Tuning - Tuning      | S.10.4 Operating Procedure on page 8-57                                         |

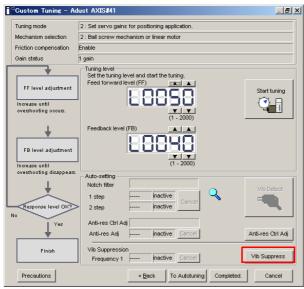
### 8.10.4 Operating Procedure

Use the following procedure to perform vibration suppression.

1. Perform steps 1 to 8 of the procedure for custom tuning. Refer to the following section for details.

8.8.4 Operating Procedure on page 8-43

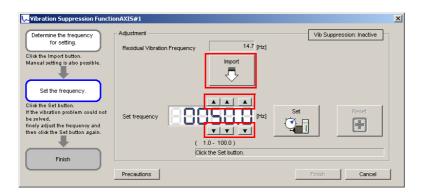
2. Click the Vib Suppress Button.



**3.** Click the Import Button or click ▲ and ▼ Button to manually adjust the set frequency. When you click the Import Button, the residual vibration frequency in the Servomotor is read as the set frequency. (The frequency can be read only when the residual vibration frequency is between 1.0 and 100.0.)



Frequency detection will not be performed if there is no vibration or if the vibration frequency is outside the range of detectable frequencies. If a vibration frequency is not detected, provide a means of measuring the vibration frequency.



#### 4. Click the Set Button.

No settings related to vibration suppression are changed during operation. If the Servomotor does not stop within approximately 10 seconds after changing the setting, an update timeout will occur. The setting will be automatically returned to the previous value.

| Vibration Suppression Functi                                                                                                                     | INAXIS#1                                                                         |
|--------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Determine the frequency<br>for setting.<br>Click the Import button.<br>Manual setting is also possible.                                          | Adjustment Vib Suppression: Active Residual Vibration Frequency 13.5 [Hz] Import |
| Click the Set button.<br>If the vibration problem could not<br>be solved,<br>finely adjust the frequency and<br>then click the Set button again. | Set frequency                                                                    |
|                                                                                                                                                  | Precautions Finish Cancel                                                        |

If the vibration is not eliminated, use the  $\blacktriangle$  and  $\blacktriangledown$  Buttons for the set frequency to fine-tune the value and click the **Set** Button again.

| 😾 Vibration Suppression Function                                                                                                                 | nAXIS#1                                    |           | ×                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-----------|-------------------------|
| Determine the frequency<br>for setting.                                                                                                          | Adjustment<br>Residual Vibration Frequency | 13.5 [Hz] | Vib Suppression: Active |
| Manual setting is also possible.                                                                                                                 |                                            |           |                         |
| Click the Set button.<br>If the vibration problem could not<br>be solved,<br>finely adjust the frequency and<br>then click the Set button again. | Set frequency                              | [Hz] Set  | Reset                   |
| Finish                                                                                                                                           | Current valu                               |           | Finish Cancel           |

Click the **Reset** Button during adjustment to restore the setting to its original value. The status from before when adjustment was started will be restored.

5. When the vibration has been eliminated, click the Finish Button. The updated value will be saved in the SERVOPACK.



Vibration suppression will be enabled in step 5. The Servomotor response, however, will change when the Servomotor comes to a stop with no reference input.

This concludes the procedure to set up vibration suppression.

8.10.5 Related Parameters

### 8.10.5 Related Parameters

The following parameters are automatically adjusted or used as reference when you execute vibration suppression.

Do not change the settings while vibration suppression is being executed.

| Parameter | Name                                                   | Automatic Changes |
|-----------|--------------------------------------------------------|-------------------|
| Pn140     | Model Following Control-Related Selections             | Yes               |
| Pn141     | Model Following Control Gain                           | Yes               |
| Pn142     | Model Following Control Correction                     | No                |
| Pn143     | Model Following Control Bias in the Forward Direction  | No                |
| Pn144     | Model Following Control Bias in the Reverse Direction  | No                |
| Pn145     | Vibration Suppression 1 Frequency A                    | Yes               |
| Pn146     | Vibration Suppression 1 Frequency B                    | Yes               |
| Pn147     | Model Following Control Speed Feedforward Compensation | No                |
| Pn14A     | Vibration Suppression 2 Frequency                      | No                |
| Pn14B     | Vibration Suppression 2 Correction                     | No                |

Yes: The parameter is automatically set.

No: The parameter is not automatically set, but the setting is read during execution.

8.11.1 Outline

### 8.11 Speed Ripple Compensation

This section describes speed ripple compensation.

### 8.11.1 Outline

Speed ripple compensation reduces the amount of ripple in the motor speed due to torque ripple or cogging torque. You can enable speed ripple compensation to achieve smoother operation. To enable it, you must set up ripple compensation on the SigmaWin+.

## 

• Speed ripple compensation requires operating the Servomotor and therefore presents hazards. Observe the following precautions.

Confirm safety around moving parts.

This function involves automatic operation. Make sure that you can perform an emergency stop (to turn OFF the power supply) at any time.



- Execute speed ripple compensation only after adjusting the gains.
- Reset speed ripple compensation after you replace the Servomotor or SERVOPACK.

• Execute speed ripple compensation after jogging to a position that ensures a suitable range of motion.

### 8.11.2 Setting Up Speed Ripple Compensation

### Restrictions

The following restrictions apply to the setup for speed ripple compensation.

#### Systems for Which Execution Cannot Be Performed

There are no restrictions.

#### Systems for Which Adjustments Cannot Be Made Accurately

Systems for which there is not a suitable range of motion

#### Preparations

Always check the following before you set up speed ripple compensation.

- The main circuit power supply must be ON.
- The servo must be OFF.
- There must be no alarms or warnings.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.

8.11.2 Setting Up Speed Ripple Compensation

### **Applicable Tools**

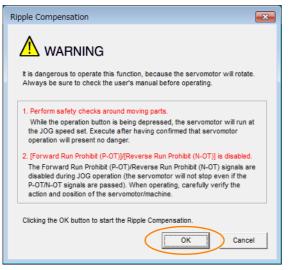
The following table lists the tools that you can use to set up speed ripple compensation.

| Tool                                                                          | Fn No./Function Name                                                   | Reference                          |  |
|-------------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------|--|
| Digital Operator                                                              | You cannot set up speed ripple compensation from the Digital Operator. |                                    |  |
| SigmaWin+ Diagnostic – Ripple Compensation G Operating Procedure on page 8-61 |                                                                        | G Operating Procedure on page 8-61 |  |

### **Operating Procedure**

Use the following procedure to set up speed ripple compensation.

- 1. Click the <u>I</u> Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Ripple Compensation in the Menu Dialog Box. The Ripple Compensation Dialog Box will be displayed.
- **3.** Click the **OK** Button.



Information 1. Click the **Cancel** Button to cancel ripple compensation. The Main Window will return.



Click the **OK** Button to cancel write prohibition.

8.11.2 Setting Up Speed Ripple Compensation

4. Click the Edit Button.

| leasure Writing Results Ve              | rification 🕶 Confirm | Noasurement                                |                       |
|-----------------------------------------|----------------------|--------------------------------------------|-----------------------|
| ian]                                    | v [plv]              | Ph304 : Jogging Spr<br>500<br>Please execu | te by 100(min-1) Edit |
| 4                                       |                      | 0 <b>5</b>                                 | ervo OFF              |
| 2                                       |                      | Forward                                    | Reverse               |
| 0                                       |                      |                                            | <b>_</b>              |
| -2                                      |                      |                                            | Write                 |
|                                         |                      | . <u>.  </u>                               |                       |
| v 0.0 60.0 120.0 180.0 240.0 30<br>Time |                      | Confirm-                                   | •                     |

5. Enter the jogging speed in the Input Value Box and click the OK Button.

| Edit AXIS#00                           | <b>×</b> |
|----------------------------------------|----------|
| Pn304 Jogging Speed                    |          |
| Input value 500 min 1<br>( 0 - 10000 ) |          |
| ОК                                     | Cancel   |

6. Click the Servo ON Button.

| ₩ Ripple Compensation AXIS#00                    |                                                                 |
|--------------------------------------------------|-----------------------------------------------------------------|
| Measure Writing Results Verification Confin      |                                                                 |
| 0                                                | M         R         Measurement           Ph304 : Jogging Speed |
| [dw]                                             | [div]         600         [min-1]         Edt                   |
| 4                                                | Serve OFF                                                       |
| 2                                                |                                                                 |
| 1<br>0                                           |                                                                 |
| .1                                               |                                                                 |
|                                                  |                                                                 |
| -5 00 60.0 120.0 180.0 240.0 360.0 420.0 480.0 5 | 100 6000                                                        |
| Before adjustment     After adjustment           | Patrix     Reset     Completed                                  |
|                                                  |                                                                 |

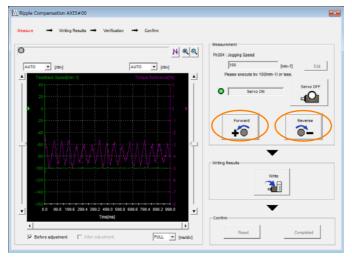
8.11.2 Setting Up Speed Ripple Compensation

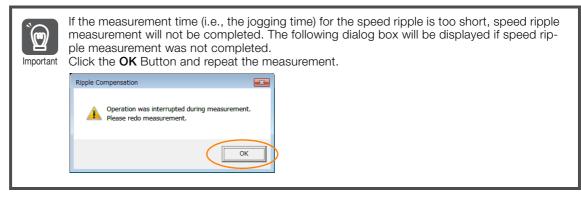
#### 7. Click the Forward Button or the Reverse Button.

Measurement operation is started.

The Servomotor shaft will rotate at the preset jogging speed while you hold down the **Forward** or **Reverse** Button and the speed ripple will be measured.

The feedback speed and torque reference graph will be displayed in the Ripple Compensation Dialog Box during jogging.





- 8. After speed ripple measurement has been completed, click the Write Button. The ripple compensation value will be written to the SERVOPACK.
- 9. After writing has been completed, click the OK Button.

| Ripple Compensat | ion                                                                                                                           | × |
|------------------|-------------------------------------------------------------------------------------------------------------------------------|---|
| Please r         | ple Compensation value was written in.<br>measure again and verify.<br>Ification result is good, please click the "Completed" |   |
|                  | ОК                                                                                                                            |   |

8

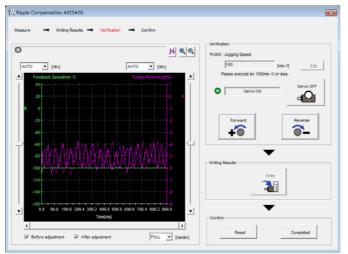
#### 8.11.3 Setting Parameters

#### 10. Click the Forward Button or the Reverse Button.

Verification operation is started.

The Servomotor shaft will rotate at the preset jogging speed while you hold down the **Forward** or **Reverse** Button.

The waveform with speed ripple compensation applied to it will be displayed.



#### **11.** If the verification results are OK, click the **Completed** Button.

Information To discard the setup results, click the **Reset** Button.

This concludes the setup for speed ripple compensation.

### 8.11.3 Setting Parameters

The function is enabled when you perform the operating procedure on *Operating Procedure* on page 8-61. To cancel speed ripple compensation, use  $Pn423 = n.\square\square\square$  (Disable speed ripple compensation) to disable it.

| Parameter |                             | Description                        | When<br>Enabled  | Classifi-<br>cation |
|-----------|-----------------------------|------------------------------------|------------------|---------------------|
| Pn423     | n.□□□0<br>(default setting) | Disable speed ripple compensation. | Immedi-<br>ately | Setup               |
|           | n.0001                      | Enable speed ripple compensation.  |                  |                     |

If you enable speed ripple compensation, a compensation reference will be applied to reduce ripple even when stopped at a 0 speed reference. In speed control mode, this may result in the Servomotor moving slightly. To prevent this, set  $Pn423 = n.\Box X \Box \Box$  (Speed Ripple Compensation Selections) and Pn427 or Pn49F (Speed Ripple Compensation Enable Speed).

| Parameter |                             | Description     | When<br>Enabled  | Classifi-<br>cation |
|-----------|-----------------------------|-----------------|------------------|---------------------|
| Pn423     | n.□0□□<br>(default setting) | Speed reference | After<br>restart | Setup               |
|           | n.🗆1🗆 🗆                     | Motor Speed     | Testart          |                     |

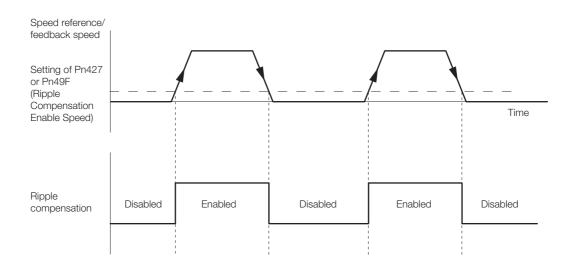
• For Rotary Servomotors

|       | Speed Ripple Compensation Enable Speed |                     |                 |              |                |  |
|-------|----------------------------------------|---------------------|-----------------|--------------|----------------|--|
| Pn427 | Setting Range                          | Setting Unit        | Default Setting | When Enabled | Classification |  |
|       | 0 to 10.000                            | 1 min <sup>-1</sup> | 0               | Immediately  | Tunina         |  |

• For Linear Servomotors

|       | Speed Ripple Compensation Enable Speed |              |                 |              |                |
|-------|----------------------------------------|--------------|-----------------|--------------|----------------|
| Pn49F | Setting Range                          | Setting Unit | Default Setting | When Enabled | Classification |
|       | 0 to 10,000                            | 1 mm/s       | 0               | Immediately  | Tuning         |

8.11.3 Setting Parameters



### **Speed Ripple Compensation Warnings**

The speed ripple compensation value is specific to each Servomotor. If you replace the Servomotor while speed ripple compensation is enabled, an A.942 warning (Speed Ripple Compensation Information Disagreement) will occur to warn you.

- You can use any of the following methods to clear A.942.
- Reset the speed ripple compensation value on the SigmaWin+.
- Disable speed ripple compensation (Pn423 =  $n.\Box\Box\Box$ ).
- Disable detection of A.942 (Pn423 =  $n.\Box\Box1\Box$ ).

| Parameter |                             | Description                 | When<br>Enabled  | Classifi-<br>cation |
|-----------|-----------------------------|-----------------------------|------------------|---------------------|
| Pn423     | n.□□0□<br>(default setting) | Detect A.942 alarms.        | After<br>restart | Setup               |
|           | n.0010                      | Do not detect A.942 alarms. | restart          |                     |

8

8.12.1 Automatic Gain Switching

## 8.12 Additional Adjustment Functions

This section describes the functions that you can use to make adjustments after you perform autotuning without a host reference, autotuning with a host reference, and custom tuning.

| Function                         | Reference |
|----------------------------------|-----------|
| Gain Switching                   | page 8-66 |
| Friction Compensation            | page 8-69 |
| Current Control Mode Selection   | page 8-73 |
| Current Gain Level Setting       | page 8-73 |
| Speed Detection Method Selection | page 8-74 |
| Backlash Compensation            | page 8-74 |

### 8.12.1 Automatic Gain Switching

You can use gain switching to shorten the positioning time by increasing the gains during positioning and suppressing vibration by decreasing the gains while stopping.

| Parameter |                             | Function                          | When Enabled | Classification |
|-----------|-----------------------------|-----------------------------------|--------------|----------------|
| Pn139     | n.□□□0<br>(default setting) | Disable automatic gain switching. | Immediately  | Tuning         |
|           | n.□□□2                      | Enable automatic gain switching.  |              |                |

Note:  $Pn139 = n.\square\square\square1$  is a reserved parameter. Do not change.

### **Gain Switching Combinations**

| Selected<br>Gains  | Speed Loop<br>Gain                   | Speed Loop<br>Integral Time<br>Constant                | Position Loop<br>Gain                     | Torque Reference<br>Filter                                                  | Friction<br>Compensation<br>Gain                |
|--------------------|--------------------------------------|--------------------------------------------------------|-------------------------------------------|-----------------------------------------------------------------------------|-------------------------------------------------|
| Gain<br>Settings 1 | Speed Loop<br>Gain (Pn100)           | Speed Loop Inte-<br>gral Time Constant<br>(Pn101)      | Position Loop<br>Gain (Pn102)             | First Stage First<br>Torque Reference<br>Filter Time Con-<br>stant (Pn401)  | Friction<br>Compensation<br>Gain (Pn121)        |
| Gain<br>Settings 2 | Second<br>Speed Loop<br>Gain (Pn104) | Second Speed<br>Loop Integral Time<br>Constant (Pn105) | Second Posi-<br>tion Loop Gain<br>(Pn106) | First Stage Second<br>Torque Reference<br>Filter Time Con-<br>stant (Pn412) | Second Friction<br>Compensation<br>Gain (Pn122) |

Note: Automatic gain switching is not supported for the model following control gain and the model following control gain correction.

#### The switching condition is specified by using the following setting.

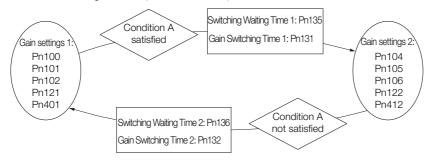
| Parameter |        | Switching<br>Condition    | Selected Gains                          | Switching<br>Waiting Time                 | Switching Time                    |
|-----------|--------|---------------------------|-----------------------------------------|-------------------------------------------|-----------------------------------|
| Pn139     |        | Condition A satisfied     | Gain settings 1 to gain set-<br>tings 2 | Gain Switching<br>Waiting Time 1<br>Pn135 | Gain Switching<br>Time 1<br>Pn131 |
|           | n.0002 | Condition A not satisfied | Gain settings 2 to gain set-<br>tings 1 | Gain Switching<br>Waiting Time 2<br>Pn136 | Gain Switching<br>Time 2<br>Pn132 |

8.12.1 Automatic Gain Switching

| Parameter |                             | Position Control Gain<br>Switching Condition A                                   | For Control Methods<br>Other Than Position<br>Control (No Switching) | When<br>Enabled | Classification |
|-----------|-----------------------------|----------------------------------------------------------------------------------|----------------------------------------------------------------------|-----------------|----------------|
|           | n.□□0□<br>(default setting) | /COIN (Positioning Com-<br>pletion Output) signal<br>turns ON.                   | Gain settings 1 used.                                                |                 | Tuning         |
|           | n.0010                      | /COIN (Positioning Com-<br>pletion Output) signal<br>turns OFF.                  | Gain settings 2 used.                                                |                 |                |
| Pn139     | n.0020                      | /NEAR (Near Output) sig-<br>nal turns ON.                                        | Gain settings 1 used.                                                | Immediately     |                |
|           | n.🗆 🗆 3 🗆                   | /NEAR (Near Output) sig-<br>nal turns OFF.                                       | Gain settings 2 used.                                                |                 |                |
|           | n.0040                      | Position reference filter<br>output is 0 and position<br>reference input is OFF. | Gain settings 1 used.                                                |                 |                |
|           | n.0050                      | Position reference input is ON.                                                  | Gain settings 2 used.                                                |                 |                |

Select one of the following settings for switching condition A.

Automatic Switching Pattern 1 (Pn139 =  $n.\Box\Box\Box$ 2)



#### Information

#### /COIN (Positioning Completion Output) Signal and /NEAR (Near Output) Signal

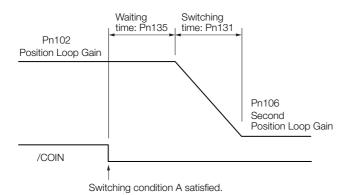
- A SERVOPACK with a DeviceNet Module does not have /COIN (Positioning Completion Output) and /NEAR (Near Output) signals. Here, the following conditions are treated as the active signal status.
- /COIN (Positioning Completion Output) signal: The conditions for both Pn522 (Positioning Completed Width) and Pn207 (/COIN (Positioning Completion Output) Signal Output Timing) have been met.
- /NEAR (Near Output) signal: The current condition is equal to or less than the setting of Pn524 (Near Signal Width).

#### Relationship between the Waiting Times and Switching Times for Gain Switching

In this example, an ON /COIN (Positioning Completion Output) signal is set as the condition for automatic gain switching. The position loop gain is changed from the value in Pn102 (Position Loop Gain) to the value in Pn106 (Second Position Loop Gain). When the /COIN signal turns ON, the switching operation begins after the waiting time (Pn135). The switching operation changes the position loop gain linearly from the gain set in Pn102 to the gain set in Pn106 over the switching time (Pn131).

8

#### 8.12.1 Automatic Gain Switching



Information You can use gain switching for either PI control or I-P control (Pn10B =  $n.\square\square0\square$  or  $\square\square1\square$ ).

## Related Parameters

|       | Speed Loop Gain            |                      |                   |              |                |  |  |
|-------|----------------------------|----------------------|-------------------|--------------|----------------|--|--|
| Pn100 | Setting Range              | Setting Unit         | Default Setting   | When Enabled | Classification |  |  |
|       | 10 to 20,000               | 0.1 Hz               | 400               | Immediately  | Tuning         |  |  |
|       | Speed Loop Integra         | l Time Constant      |                   |              |                |  |  |
| Pn101 | Setting Range              | Setting Unit         | Default Setting   | When Enabled | Classification |  |  |
|       | 15 to 51,200               | 0.01 ms              | 2,000             | Immediately  | Tuning         |  |  |
|       | Position Loop Gain         |                      |                   |              |                |  |  |
| Pn102 | Setting Range              | Setting Unit         | Default Setting   | When Enabled | Classification |  |  |
|       | 10 to 20,000               | 0.1/s                | 400               | Immediately  | Tuning         |  |  |
|       | First Stage First Tor      | que Reference Filter | Time Constant     |              |                |  |  |
| Pn401 | Setting Range              | Setting Unit         | Default Setting   | When Enabled | Classification |  |  |
|       | 0 to 65,535                | 0.01 ms              | 100               | Immediately  | Tuning         |  |  |
|       | Friction Compensation Gain |                      |                   |              |                |  |  |
| Pn121 | Setting Range              | Setting Unit         | Default Setting   | When Enabled | Classification |  |  |
|       | 10 to 1,000                | 1%                   | 100               | Immediately  | Tuning         |  |  |
|       | Second Speed Loop Gain     |                      |                   |              |                |  |  |
| Pn104 | Setting Range              | Setting Unit         | Default Setting   | When Enabled | Classification |  |  |
|       | 10 to 20,000               | 0.1 Hz               | 400               | Immediately  | Tuning         |  |  |
|       | Second Speed Loop          | o Integral Time Cons | tant              |              |                |  |  |
| Pn105 | Setting Range              | Setting Unit         | Default Setting   | When Enabled | Classification |  |  |
|       | 15 to 51,200               | 0.01 ms              | 2,000             | Immediately  | Tuning         |  |  |
|       | Second Position Lo         | op Gain              |                   |              |                |  |  |
| Pn106 | Setting Range              | Setting Unit         | Default Setting   | When Enabled | Classification |  |  |
|       | 10 to 20,000               | 0.1/s                | 400               | Immediately  | Tuning         |  |  |
|       | First Stage Second         | Torque Reference Fi  | ter Time Constant |              |                |  |  |
| Pn412 | Setting Range              | Setting Unit         | Default Setting   | When Enabled | Classification |  |  |
|       | 0 to 65,535                | 0.01 ms              | 100               | Immediately  | Tuning         |  |  |
|       | Second Friction Cor        | mpensation Gain      |                   |              |                |  |  |
| Pn122 | Setting Range              | Setting Unit         | Default Setting   | When Enabled | Classification |  |  |
|       | 10 to 1,000                | 1%                   | 100               | Immediately  | Tuning         |  |  |

### Parameters Related to Automatic Gain Switching

|       | Gain Switching Time 1         |                               |                 |              |                |  |  |
|-------|-------------------------------|-------------------------------|-----------------|--------------|----------------|--|--|
| Pn131 | Setting Range                 | Setting Unit                  | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 65,535                   | 1 ms                          | 0               | Immediately  | Tuning         |  |  |
|       | Gain Switching Time           | e 2                           |                 |              |                |  |  |
| Pn132 | Setting Range                 | Setting Unit                  | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 65,535                   | 1 ms                          | 0               | Immediately  | Tuning         |  |  |
|       | Gain Switching Waiting Time 1 |                               |                 |              |                |  |  |
| Pn135 | Setting Range                 | Setting Unit                  | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 65,535                   | 1 ms                          | 0               | Immediately  | Tuning         |  |  |
|       | Gain Switching Wait           | Gain Switching Waiting Time 2 |                 |              |                |  |  |
| Pn136 | Setting Range                 | Setting Unit                  | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 65,535                   | 1 ms                          | 0               | Immediately  | Tuning         |  |  |

### **Related Monitoring**

• SigmaWin+

You can monitor gain switching with the status monitor or with tracing.

Analog Monitors

| Parameter | Analog Monitor  | Monitor Name        | Output Value | Description                  |
|-----------|-----------------|---------------------|--------------|------------------------------|
| Pn006     | n. <b>DD</b> 0B | Active Gain Monitor | 1 V          | Gain settings 1 are enabled. |
| Pn007     | n.LLUB          | Active Gain Monitor | 2 V          | Gain settings 2 are enabled. |

## 8.12.2 Friction Compensation

Friction compensation is used to compensate for viscous friction fluctuations and regular load fluctuations.

You can automatically adjust friction compensation with autotuning without a host reference, autotuning with a host reference, or custom tuning, or you can manually adjust it with the following procedure.

### **Required Parameter Settings**

The following parameter settings are required to use friction compensation.

| Parameter |                                            | Fund                    | tion            | When Enabled | Classification |  |
|-----------|--------------------------------------------|-------------------------|-----------------|--------------|----------------|--|
| Pn408     | n.0□□□<br>(default setting)                | Disable friction comper | nsation.        | Immediately  | Setup          |  |
|           | n.1000                                     | Enable friction compen- | sation.         |              |                |  |
|           | Friction Compension                        | sation Gain             |                 |              |                |  |
| Pn121     | Setting Range                              | Setting Unit            | Default Setting | When Enabled | Classification |  |
|           | 10 to 1,000                                | 1%                      | 100             | Immediately  | Tuning         |  |
|           | Second Friction Compensation Gain          |                         |                 |              |                |  |
| Pn122     | Setting Range                              | Setting Unit            | Default Setting | When Enabled | Classification |  |
|           | 10 to 1,000                                | 1%                      | 100             | Immediately  | Tuning         |  |
|           | Friction Compensation Coefficient          |                         |                 |              |                |  |
| Pn123     | Setting Range                              | Setting Unit            | Default Setting | When Enabled | Classification |  |
|           | 0 to 100                                   | 1%                      | 0               | Immediately  | Tuning         |  |
|           | Friction Compensation Frequency Correction |                         |                 |              |                |  |
| Pn124     | Setting Range                              | Setting Unit            | Default Setting | When Enabled | Classification |  |
|           | -10,000 to 10,00                           | 0 0.1 Hz                | 0               | Immediately  | Tuning         |  |
|           | Friction Compensation Gain Correction      |                         |                 |              |                |  |
| Pn125     | Setting Range                              | Setting Unit            | Default Setting | When Enabled | Classification |  |
|           | 1 to 1,000                                 | 1%                      | 100             | Immediately  | Tuning         |  |

#### 8.12.2 Friction Compensation

## **Operating Procedure for Friction Compensation**

Use the following procedure to perform friction compensation.

#### 

• Before you execute friction compensation, set the moment of inertia ratio (Pn103) as accurately as possible. If the setting greatly differs from the actual moment of inertia, vibration may occur.

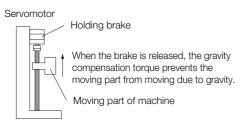
| Step | Operation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |  |  |  |  |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|
| 1    | <ul> <li>Set the following parameters related to friction compensation to their default settings.</li> <li>Friction compensation gain (Pn121): 100</li> <li>Second friction compensation gain (Pn122): 100</li> <li>Friction compensation coefficient (Pn123): 0</li> <li>Friction compensation frequency correction (Pn124): 0</li> <li>Friction compensation gain correction (Pn125): 100</li> <li>Note: Always use the default settings for the friction compensation frequency correction (Pn124) and friction compensation gain correction (Pn125).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |  |  |  |  |
| 2    | <ul> <li>Gradually increase the friction compensation coefficient (Pn123) to check the effect of friction compensation.</li> <li>Note: Usually, set the friction compensation coefficient (Pn123) to 95% or less.<br/>If the effect is insufficient, increase the friction compensation gain (Pn121) by 10% increments until vibration stops.</li> <li>Effect of Adjusted Parameters</li> <li>Pn121: Friction Compensation Gain and Pn122: Second Friction Compensation Gain<br/>These parameters set the response to external disturbances. The higher the setting is, the better the response will be. If the machine has a resonance frequency, however, vibration may occur if the setting is too high.</li> <li>Pn123: Friction Compensation Coefficient<br/>This parameter sets the effect of friction compensation. The higher the setting is, the more effective friction compensation will be. If the setting is too high, however, vibration will occur more easily. Usually, set the value to 95% or less.</li> </ul> |  |  |  |  |  |
| 3    | Effect of Adjustments<br>The following graphs show the response with and without adjustment.<br>Poor response<br>because of friction<br>Low friction<br>Position deviation<br>High friction<br>Before Friction Compensation<br>High Friction Compensation<br>After Friction Compensation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |  |  |  |  |

8.12.3 Gravity Compensation

## 8.12.3 Gravity Compensation

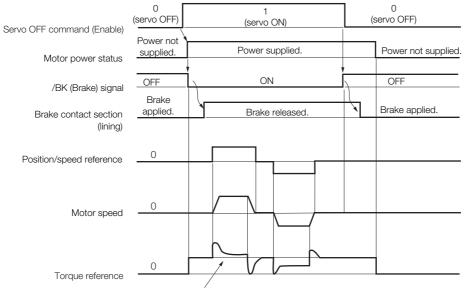
When the Servomotor is used with a vertical axis, gravity compensation prevents the moving part from falling due to the machine's own weight when the brake is released.

SERVOPACKs with software version 0023 or higher support gravity compensation.



A timing chart for when the moving part is raised then lowered is provided below. Refer to the following section for details on brake operation timing.

#### [ ₹ 5.11.1 Brake Operating Sequence on page 5-30



Gravity compensation torque (Pn476)

### **Required Parameter Settings**

The following parameter settings are required to use gravity compensation.

| Parameter |                             | Description                   |                 | When Enabled  | Classification |  |
|-----------|-----------------------------|-------------------------------|-----------------|---------------|----------------|--|
| Pn475     | n.□□□0<br>(default setting) | Disable gravity compensation. |                 | After restart | Setup          |  |
|           | n.0001                      | Enable gravity comper         | nsation.        |               |                |  |
|           | Gravity Compensation Torque |                               |                 |               |                |  |
| Pn476     | Setting Range               | Setting Unit                  | Default Setting | When Enabled  | Classification |  |
|           | -1,000 to 1,000             | 0.1%                          | 0               | Immediately   | Tuning         |  |

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8.12.3 Gravity Compensation

### **Operating Procedure for Gravity Compensation**

Use the following procedure to perform gravity compensation.

- 1. Set Pn475 to n. DDD1 (Enable gravity compensation).
- **2.** To enable changes to the settings, turn the power supply to the SERVOPACK OFF and ON again.
- **3.** Use SigmaWin+ or an analog monitor to find the torque reference value when the motor is stopped with the servo ON.
- 4. Set the torque reference value found in step 3 in Pn476 (Gravity Compensation Torque).
- **5.** Turn the servo ON and OFF a few times and fine-tune Pn476 so that the moving part of the machine does not fall.

8.12.4 Current Control Mode Selection

## 8.12.4 Current Control Mode Selection

Current control mode selection reduces high-frequency noise while the Servomotor is being stopped.

The setting depends on the capacity of the SERVOPACK.

To use current control mode selection, use current control mode 2 (set Pn009 to  $n.\Box\Box1\Box$  or  $n.\Box\Box2\Box$ ).

• SERVOPACK Models SGD7S-R70A, -R90A, -1R6A, -2R8A, -3R8A, -5R5A, and -7R6A

| Parameter |                              | Meaning                                 | When Enabled  | Classification |  |
|-----------|------------------------------|-----------------------------------------|---------------|----------------|--|
|           | n. 🗆 🗆 🛛 🗆                   |                                         |               |                |  |
|           | n. DD1D<br>(default setting) | Use current control mode 1.             | After restart | Tuning         |  |
|           | n. 🗆 🗆 2 🗆                   | Use current control mode 2 (low noise). |               |                |  |

• SERVOPACK Models SGD7S-120A, -180A, -200A, -330A, -470A, -550A, -590A, and -780A

| Parameter |                                         | Meaning                                 | When Enabled  | Classification |
|-----------|-----------------------------------------|-----------------------------------------|---------------|----------------|
|           | n. 🗆 🗆 🗆                                | Use current control mode 1.             |               |                |
| Pn009     | n. DD1D<br>(default setting)<br>n. DD2D | Use current control mode 2 (low noise). | After restart | Tuning         |

## **Ì**

If current control mode 2 is selected, the load ratio may increase while the Servomotor is being stopped.

## 8.12.5 Current Gain Level Setting

You can set the current gain level to reduce noise by adjusting the parameter for current control inside the SERVOPACK according to the speed loop gain (Pn100). The noise level can be reduced by decreasing the current gain level (Pn13D) from its default setting of 2,000% (disabled). However, if the setting is decreased, the level of noise will be lowered, but the response characteristic of the SERVOPACK will also be reduced. Adjust the current gain level within the range that maintains the SERVOPACK response characteristic.

|       | Current Gain Level |              |                 |              |                |  |  |
|-------|--------------------|--------------|-----------------|--------------|----------------|--|--|
| Pn13D | Setting Range      | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 100 to 2,000       | 1%           | 2,000           | Immediately  | Tuning         |  |  |



If the current gain level is changed, the response characteristic of the speed loop will also change. Servo tuning must therefore be performed again.

8.12.6 Speed Detection Method Selection

### 8.12.6 Speed Detection Method Selection

You can use the speed detection method selection to ensure smooth Servomotor speed changes during operation. To ensure smooth motor speed changes during operation, set Pn009 to  $n.\Box 1\Box \Box$  (Use speed detection 2).

With a Linear Servomotor, you can reduce the noise level of the running motor when the linear encoder scale pitch is large.

| P     | Parameter                                           | Meaning                | When Enabled  | Classification |
|-------|-----------------------------------------------------|------------------------|---------------|----------------|
| Pn009 | n. DODD<br>(default setting) Use speed detection 1. |                        | After restart | Tuning         |
|       | n. 🗆 1 🗆 🗆                                          | Use speed detection 2. |               |                |



If the speed detection method is changed, the response characteristic of the speed loop will also change. Servo tuning must therefore be performed again.

### 8.12.7 Speed Feedback Filter

You can set a first order lag filter for the speed feedback in the speed loop. This ensures smooth changes in the feedback speed to reduce vibration. If a large value is set, it will increase the delay and make response slower.

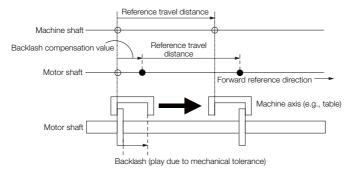
|       | Speed Feedback Filter Time Constant   |              |                 |              |                |  |
|-------|---------------------------------------|--------------|-----------------|--------------|----------------|--|
| Pn308 | Setting Range                         | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | 0 to 65,535<br>(0.00 ms to 655.35 ms) | 0.01 ms      | 0<br>(0.00 ms)  | Immediately  | Setup          |  |

### 8.12.8 Backlash Compensation

### Outline

If you drive a machine that has backlash, there will be deviation between the travel distance in the position reference that is managed by the host controller and the travel distance of the actual machine. Use backlash compensation to add the backlash compensation value to the position reference and use the result to drive the Servomotor. This will ensure that the travel distance of the actual machine will be the same as the travel distance in the host controller.

Note: Backlash compensation can be used only with a Rotary Servomotor.



8.12.8 Backlash Compensation

### **Related Parameters**

Set the following parameters to use backlash compensation.

#### Backlash Compensation Direction

Set the direction in which to apply backlash compensation.

| F     | Parameter                                                 | Meaning                        | When Enabled  | Classification |
|-------|-----------------------------------------------------------|--------------------------------|---------------|----------------|
| Pn230 | n. DDD0<br>(default setting) Compensate forward reference |                                | After restart | Setup          |
|       | n. 🗆 🗆 🗆 1                                                | Compensate reverse references. |               |                |

#### Backlash Compensation Value

Set the amount of backlash compensation to add to the position reference. The amount is set in increments of 0.1 reference unit. However, when the amount is converted to encoder pulses, it is rounded off at the decimal point.

When Pn231 = 6,553.6 [reference units] and electronic gear ratio (Pn20E/Pn210) = 4/1: 6,553.6 × 4 = 26,214.4 [pulses]

 $\Rightarrow$  The backlash compensation will be 26,214 encoder pulses.

|           | Backlash Compensation                                                                                                                                                                                                                                                                                                                                                  | า                      |                 |                     |                |  |  |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------|---------------------|----------------|--|--|
| Pn231     | Setting Range                                                                                                                                                                                                                                                                                                                                                          | Setting Unit           | Default Setting | When Enabled        | Classification |  |  |
| 111201    | -500,000 to 500,000                                                                                                                                                                                                                                                                                                                                                    | 0.1 reference<br>units | 0               | Immediately         | Setup          |  |  |
|           |                                                                                                                                                                                                                                                                                                                                                                        |                        |                 |                     |                |  |  |
| <u>ُن</u> | The backlash compensition is not performed if                                                                                                                                                                                                                                                                                                                          |                        |                 | wing formula. Backl | ash compensa-  |  |  |
| Important | Pn231 $\leq \frac{\text{Pn210}}{\text{Pn20E}} \times \frac{\text{Maximum motor speed [min-1]}}{60} \times \text{Encoder resolution*} \times 0.00025$                                                                                                                                                                                                                   |                        |                 |                     |                |  |  |
|           | <ul> <li>*Refer to the following section for the encoder resolution.</li> <li>I 5.14 Electronic Gear Settings on page 5-40</li> <li>With fully-closed loop control, substitute the number of external encoder pulses per motor rotation for the encoder resolution in the above formula.</li> </ul>                                                                    |                        |                 |                     |                |  |  |
|           | Example 1:<br>Pn20E = 4, Pn210 = 1, Maximum motor speed = 6,000 [min <sup>-1</sup> ], and Encoder resolution = 16,777,216 (24 bits)<br>$1/4 \times 6,000/60 \times 16,777,216 \times 0.00025 = 104,857.6$ [reference units]<br>$\Rightarrow$ The backlash compensation will be limited to 104,857.6 reference units.                                                   |                        |                 |                     |                |  |  |
|           | Example 2:<br>Pn20E = 4, Pn210 = 1, Maximum motor speed = 6,000 [min <sup>-1</sup> ], Number of External Encoder<br>Pitches (Pn20A) = 500, and Use of the JZDP-H00 $\square$ -000 (signal resolution: 1/256):<br>1/4 × 6,000/60 × (500 × 256) × 0.00025 = 800.0 [reference units]<br>$\Rightarrow$ The backlash compensation will be limited to 800.0 reference units. |                        |                 |                     |                |  |  |
|           | Do not exceed the upp<br>limit on the operation r                                                                                                                                                                                                                                                                                                                      |                        |                 | on value. You can c | heck the upper |  |  |

8

Example

8.12.8 Backlash Compensation

#### Backlash Compensation Time Constant

You can set a time constant for a first order lag filter for the backlash compensation value (Pn231) that is added to the position reference.

If you set Pn233 (Backlash Compensation Time Constant) to 0, the first order lag filter is disabled.

|       | Backlash Compensatio | n Time Constant |                 |              |                |
|-------|----------------------|-----------------|-----------------|--------------|----------------|
| Pn233 | Setting Range        | Setting Unit    | Default Setting | When Enabled | Classification |
|       | 0 to 65,535          | 0.01 ms         | 0               | Immediately  | Setup          |

Note: Changes to the settings are applied when there is no reference pulse input and the Servomotor is stopped. The current operation is not affected if the setting is changed during Servomotor operation.

### **Related Monitoring**

You can monitor the following values on the operation monitor of the SigmaWin+.

| Displayed Value                           | Setting Unit        |
|-------------------------------------------|---------------------|
| Current Backlash Compensation Value       | 0.1 reference units |
| Backlash Compensation Value Setting Limit | 0.1 reference units |

### **Compensation Operation**

This section describes the operation that is performed for backlash compensation.

Note: The following figures are for when backlash compensation is applied to references in the forward direction (Pn230 = n.  $\Box \Box \Box \Box$ ). The following monitor information is provided in the figures: TPOS (target position in the reference coordinate system), POS (reference position in the reference coordinate system), and APOS (feed-back position in the machine coordinate system). The monitor information includes the feedback position in machine coordinate system (APOS) and other feedback information.

The backlash compensation value is subtracted from the feedback positions in the monitor information, so it is not necessary for the host controller to consider the backlash compensation value.



• The encoder divided pulse output will output the number of encoder pulses for which driving was actually performed, including the backlash compensation value. If you use the encoder output pulses for position feedback at the host controller, you must consider the backlash compensation value.

#### Operation When the Servo Is ON

The backlash compensation value (Pn231) is added in the backlash compensation direction when the servo is ON (i.e., while power is supplied to the motor) and a reference is input in the same direction as the backlash compensation direction (Pn230.0 =  $n.\square\square\squareX$ ).

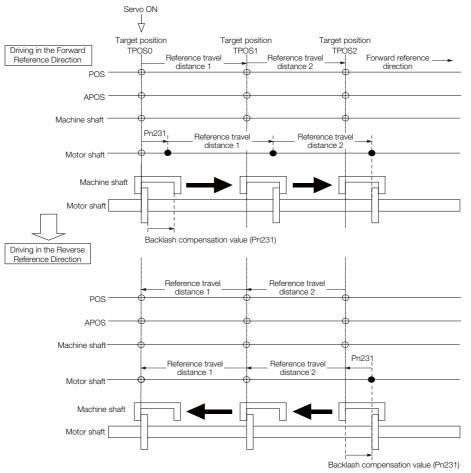
When there is a reference input in the direction opposite to the backlash compensation direction, the backlash compensation value is not added (i.e., backlash compensation is not performed).

The relationship between APOS and the motor shaft position is as follows:

- If a reference is input in the compensation direction: APOS = Motor shaft position Pn231
- If a reference is input in the direction opposite to the compensation direction: APOS = Motor shaft position

The following figure shows driving the Servomotor in the forward direction from target position TPOS0 to TPOS1 and then to TPOS2, and then returning from TPOS2 to TPOS1 and then to TPOS0.

Backlash compensation is applied when moving from TPOS0 to TPOS1, but not when moving from TPOS2 to TPOS1.



8.12.8 Backlash Compensation

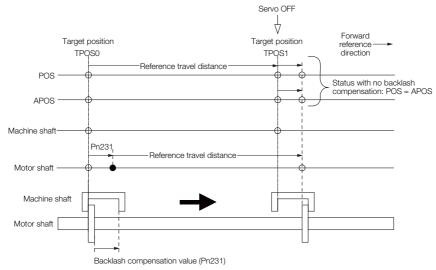
#### Operation When the Servo Is OFF

Backlash compensation is not applied when the servo is OFF (i.e., when power is not supplied to motor). Therefore, the reference position POS is moved by only the backlash compensation value.

The relationship between APOS and the motor shaft position is as follows:

• When servo is OFF: APOS = Servomotor shaft position

The following figure shows what happens when the servo is turned OFF after driving the Servomotor in the forward direction from target position TPOS0 to TPOS1. Backlash compensation is not applied when the servo is OFF. (The SERVOPACK manages the position data so that APOS and POS are the same.)



#### Operation When There Is Overtravel

When there is overtravel (i.e., when driving is prohibited due to an overtravel signal or software limit), the operation is the same as for when the servo is OFF ( $\blacklozenge$  Operation When the Servo Is OFF on page 8-78), i.e., backlash compensation is not applied.

### **Related Monitoring**

You can monitor the following values on the operation monitor of the SigmaWin+.

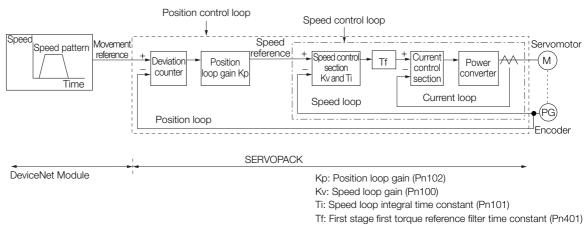
| Displayed Value                        | Unit                        | Specification                                                                           |
|----------------------------------------|-----------------------------|-----------------------------------------------------------------------------------------|
| Input Reference Pulse Speed            | min <sup>-1</sup>           | Displays the input reference pulse speed before backlash compensation.                  |
| Position Deviation                     | Reference units             | Displays the position deviation for the position reference after backlash compensation. |
| Input Reference Pulse<br>Counter       | Reference units             | Displays the input reference pulse counter before back-<br>lash compensation.           |
| Feedback Pulse Counter                 | Encoder pulses              | Displays the number of pulses from the actually driven motor encoder.                   |
| Fully-Closed Feedback Pulse<br>Counter | External encoder resolution | Displays the number of pulses of the actually driven exter-<br>nal encoder.             |
| Feedback Pulse Counter                 | Reference units             | Displays the number of pulses from the actually driven encoder in reference units.      |

## 8.13 Manual Tuning

This section describes manual tuning.

## 8.13.1 Tuning the Servo Gains

### Servo Gains



In order to manually tune the servo gains, you must understand the configuration and characteristic of the SERVOPACK and adjust the servo gains individually. In most cases, if you greatly change any one parameter, you must adjust the other parameters again. To check the response characteristic, you must prepare a measuring instrument to monitor the output waveforms from the analog monitor.

The SERVOPACK has three feedback systems (the position loop, speed loop, and current loop), and the response characteristic must be increased more with the inner loops. If this relationship is not maintained, the response characteristic will suffer and vibration will occur more easily.

A sufficient response characteristic is ensured for the current loop. There is never a need for it to be adjusted by the user.

### Outline

You can use manual tuning to set the servo gains in the SERVOPACK to increase the response characteristic of the SERVOPACK and to reduce the positioning time.

Use manual tuning in the following cases.

- When tuning with autotuning without a host reference or autotuning with a host reference does not achieve the desired results
- When you want to increase the servo gains higher than the gains that resulted from autotuning without a host reference or autotuning with a host reference
- · When you want to determine the servo gains and moment of inertia ratio yourself

You start manual tuning either from the default parameter settings or from the gain settings that resulted from autotuning without a host reference or autotuning with a host reference.

Tuning

### Applicable Tools

You can monitor the servo gains with the SigmaWin+ or with the analog monitor.

### Precautions

Vibration may occur while you are tuning the servo gains. We recommend that you enable vibration alarms (Pn310 =  $n.\square\square\square$ 2) to detect vibration. Refer to the following section for information on vibration detection.

 $\fbox{3}$  6.11 Initializing the Vibration Detection Level on page 6-26

Vibration alarms are not detected for all vibration. Also, an emergency stop method is necessary to stop the machine safely when an alarm occurs. You must provide an emergency stop device and activate it immediately whenever vibration occurs.

### Tuning Procedure Example

| Step | Description                                                                                                                                                                 |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Adjust the first stage first torque reference filter time constant (Pn401) so that vibration does not occur.                                                                |
| 2    | Increase the position loop gain (Pn100) and reduce the speed loop integral time constant (Pn101) as far as possible within the range that does not cause machine vibration. |
| 3    | Repeat steps 1 and 2 and return the settings about 10% to 20% from the values that you set.                                                                                 |
| 4    | Increase the position loop gain (Pn102) within the range that does not cause vibration.                                                                                     |

Information If you greatly change any one servo gain parameter, you must adjust the other parameters again. Do not increase the setting of just one parameter. As a guideline, adjust the settings of the servo gains by approximately 5% each. As a rule, change the servo parameters in the following order.

- To Increase the Response Speed
- 1. Reduce the torque reference filter time constant.
- 2. Increase the speed loop gain.
- 3. Decrease the speed loop integral time constant.
- 4. Increase the position loop gain.
- To Reduce Response Speed and to Stop Vibration and Overshooting
- 1. Reduce the position loop gain.
- 2. Increase the speed loop integral time constant.
- 3. Decrease the speed loop gain.
- 4. Increase the torque filter time constant.

### **Adjusted Servo Gains**

You can set the following gains to adjust the response characteristic of the SERVOPACK.

- Pn100: Speed Loop Gain
- Pn101: Speed Loop Integral Time Constant
- Pn102: Position Loop Gain
- Pn401: First Stage First Torque Reference Filter Time Constant

#### Position Loop Gain

The position loop gain determines the response characteristic of the position loop in the SER-VOPACK. If you can increase the setting of the position loop gain, the response characteristic will improve and the positioning time will be shortened. However, you normally cannot increase the position loop gain higher than the inherit vibration frequency of the machine system. Therefore, to increase the setting of the position loop gain, you must increase the rigidity of the machine to increase the inherit vibration frequency of the machine.

|       | Position Loop Gain |              |                 |              |                |  |
|-------|--------------------|--------------|-----------------|--------------|----------------|--|
| Pn102 | Setting Range      | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | 10 to 20,000       | 0.1/s        | 400             | Immediately  | Tuning         |  |

For machines for which a high position loop gain (Pn102) cannot be set, overflow alarms can Information occur during high-speed operation. If that is the case, you can increase the setting of the following parameter to increase the level for alarm detection.

Use the following condition as a guideline for determining the setting.

 $Pn520 \ge \frac{Maximum feed speed [reference units/s]}{2.0} \times 2.0$ Pn102 ÷ 10 (1/s)

If you use a position reference filter, transient deviation will increase due to the filter time constant. When you make the setting, consider deviation accumulation that may result from the filter.

|        | Position Deviation Overflow Alarm Level |                     |                 |              |                |
|--------|-----------------------------------------|---------------------|-----------------|--------------|----------------|
| Pn520  | Setting Range                           | Setting Unit        | Default Setting | When Enabled | Classification |
| 111020 | 1 to<br>1,073,741,823                   | 1 reference<br>unit | 5,242,880       | Immediately  | Setup          |

#### Speed Loop Gain

This parameter determines the response characteristic of the speed loop. If the response characteristic of the speed loop is low, it becomes a delay factor for the position loop located outside of the speed loop. This will result in overshooting and vibration in the speed reference. Therefore, setting the speed loop gain as high as possible within the range that will not cause the machine system to vibrate will produce a stable servo system with a good response characteristic.

|       | Speed Loop Gain |              |                 |              |                     |  |
|-------|-----------------|--------------|-----------------|--------------|---------------------|--|
| Pn100 | Setting Range   | Setting Unit | Default Setting | When Enabled | Classifica-<br>tion |  |
|       | 10 to 20,000    | 0.1 Hz       | 400             | Immediately  | Tuning              |  |

Setting of Pn103 =  $\frac{\text{Load moment of inertia at motor shaft } (J_L)}{\text{Servomotor moment of inertia } (L_M)} \times 100(\%)$ 

The default setting of Pn103 (Moment of Inertia Ratio) is 100. Before you tune the servo, calculate the moment of inertia ratio with the above formula and set Pn103 to the calculation result.

|       | Moment of Inertia Ratio |              |                 |              |                     |
|-------|-------------------------|--------------|-----------------|--------------|---------------------|
| Pn103 | Setting Range           | Setting Unit | Default Setting | When Enabled | Classifica-<br>tion |
|       | 0 to 20,000             | 1%           | 100             | Immediately  | Tuning              |

#### Speed Loop Integral Time Constant

To enable response to even small inputs, the speed loop has an integral element. The integral element becomes a delay factor in the servo system. If the time constant is set too high, overshooting will occur, positioning settling time will increase, and the response characteristic will suffer.

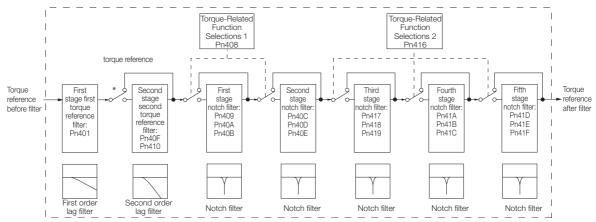
|       | Speed Loop Integral Time Constant |              |                 |              |                     |  |  |
|-------|-----------------------------------|--------------|-----------------|--------------|---------------------|--|--|
| Pn101 | Setting Range                     | Setting Unit | Default Setting | When Enabled | Classifica-<br>tion |  |  |
|       | 15 to 51,200                      | 0.01 ms      | 2,000           | Immediately  | Tuning              |  |  |

8

#### ♦ Torque Reference Filter

As shown in the following diagram, the torque reference filter contains a first order lag filter and notch filters arranged in series, and each filter operates independently.

The notch filters can be enabled and disabled with  $Pn408 = n.\Box X \Box X$  and  $Pn416 = n.\Box X X X$ .



\* The second stage second torque reference filter is disabled when Pn40F is set to 5,000 (default setting) and it is enabled when Pn40F is set to a value lower than 5,000.

#### Torque Reference Filter

If you suspect that machine vibration is being caused by the Servo Drive, try adjusting the torque reference filter time constant. This may stop the vibration. The lower the value, the better the control response characteristic will be, but there may be a limit depending on the machine conditions.

|       | First Stage First Torque Reference Filter Time Constant |              |                 |              |                |  |  |
|-------|---------------------------------------------------------|--------------|-----------------|--------------|----------------|--|--|
| Pn401 | Setting Range                                           | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 65,535                                             | 0.01 ms      | 100             | Immediately  | Tuning         |  |  |
|       | Second Stage Second Torque Reference Filter Frequency   |              |                 |              |                |  |  |
| Pn40F | Setting Range                                           | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 100 to 5,000                                            | 1 Hz         | 5,000*          | Immediately  | Tuning         |  |  |
|       | Second Stage Second Torque Reference Filter Q Value     |              |                 |              |                |  |  |
| Pn410 | Setting Range                                           | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 50 to 100                                               | 0.01         | 50              | Immediately  | Tuning         |  |  |

\* The filter is disabled if you set the parameter to 5,000.

#### Notch Filters

The notch filter can eliminate specific frequency elements generated by the vibration of sources such as resonance of the shaft of a ball screw.

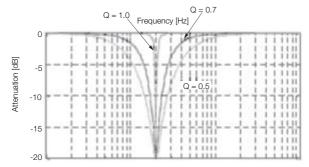
The notch filter puts a notch in the gain curve at the specific vibration frequency (called the notch frequency). The frequency components near the notch frequency can be reduced or removed with a notch filter.

Notch filters are set with three parameters for the notch filter frequency, notch filter Q value, and notch filter depth. This section describes the notch filter Q value and notch filter depth.

#### Notch filter Q Value

The setting of the notch filter Q value determines the width of the frequencies that are filtered for the notch filter frequency. The width of the notch changes with the notch filter Q value. The larger the notch filter Q value is, the steeper the notch is and the narrower the width of frequencies that are filtered is.

The notch filter frequency characteristics for different notch filter Q values are shown below.

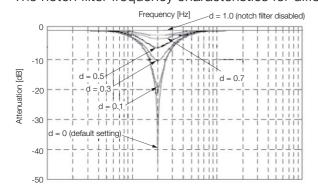


Note: The above notch filter frequency characteristics are based on calculated values and may be different from actual characteristics.

#### • Notch Filter Depth

The setting of the notch filter depth determines the depth of the frequencies that are filtered for the notch filter frequency. The depth of the notch changes with the notch filter depth. The smaller the notch filter depth is, the deeper the notch is, increasing the effect of vibration suppression. However, if the value is too small, vibration can actually increase.

The notch filter is disabled if the notch filter depth, d, is set to 1.0 (i.e., if Pn419 is set to 1,000). The notch filter frequency characteristics for different notch filter depths are shown below.



Note: The above notch filter frequency characteristics are based on calculated values and may be different from actual characteristics.

You can enable or disable the notch filter with Pn408 and Pn416.

| Parameter |                             | Meaning                            | When Enabled | Classification |  |
|-----------|-----------------------------|------------------------------------|--------------|----------------|--|
|           | n.□□□0<br>(default setting) | Disable first stage notch filter.  |              |                |  |
| Dn 109    | n.0001                      | Enable first stage notch filter.   |              |                |  |
| Pn408     | n.□0□□<br>(default setting) | Disable second stage notch filter. |              |                |  |
|           | n.0100                      | Enable second stage notch filter.  | Immediately  | Setup          |  |
|           | n.□□□0<br>(default setting) | Disable third stage notch filter.  |              |                |  |
|           | n.0001                      | Enable third stage notch filter.   |              |                |  |
| Pn416     | n.□□0□<br>(default setting) | Disable fourth stage notch filter. |              |                |  |
|           | n.0010                      | Enable fourth stage notch filter.  |              |                |  |
|           | n.□0□□<br>(default setting) | Disable fifth stage notch filter.  |              |                |  |
|           | n.0100                      | Enable fifth stage notch filter.   |              |                |  |

Set the machine vibration frequencies in the notch filter parameters.

| First Stage Notch Filter FrequencyPn409Setting RangeSetting UnitDefault SettingWhen EnabledClassifica50 to 5,0001 Hz5,000ImmediatelyTuningFirst Stage Notch Filter Q ValuePn40ASetting RangeSetting UnitDefault SettingWhen EnabledClassifica50 to 1,0000.0170ImmediatelyTuningFirst Stage Notch Filter DepthPn40BSetting RangeSetting UnitDefault SettingWhen EnabledClassifica0 to 1,0000.0010ImmediatelyTuningSecond Stage Notch Filter FrequencyPn40CSetting RangeSetting UnitDefault SettingWhen EnabledClassifica50 to 5,0001 Hz5,000ImmediatelyTuningSecond Stage Notch Filter Q ValuePn40DSetting RangeSetting UnitDefault SettingWhen EnabledClassifica50 to 1,0000.0170ImmediatelyTuningSecond Stage Notch Filter Q ValuePn40DSetting RangeSetting UnitDefault SettingWhen EnabledClassifica50 to 1,0000.0170ImmediatelyTuningPn404Setting RangeSetting UnitDefault SettingWhen EnabledClassifica50 to 1,0000.0010ImmediatelyTuningPn405Setting RangeSetting UnitDefault SettingWhen EnabledClassificaPn406Setting RangeSetting Unit <th>ation<br/>g<br/>ation<br/>g<br/>ation<br/>g<br/>ation<br/>g<br/>ation</th>                                     | ation<br>g<br>ation<br>g<br>ation<br>g<br>ation<br>g<br>ation      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
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| 0 to 1,0000.0010ImmediatelyTuningPn40CSecond Stage Notch Filter FrequencySetting RangeSetting UnitDefault SettingWhen EnabledClassifica50 to 5,0001 Hz5,000ImmediatelyTuningPn40DSecond Stage Notch Filter Q ValueSecond Stage Notch Filter Q ValueTuningPn40DSetting RangeSetting UnitDefault SettingWhen EnabledClassifica50 to 1,0000.0170ImmediatelyTuningSecond Stage Notch Filter DepthSecond Stage Notch Filter DepthTuningPn40ESetting RangeSetting UnitDefault SettingWhen EnabledClassifica0 to 1,0000.0010ImmediatelyTuningPn417Setting RangeSetting UnitDefault SettingWhen EnabledClassifica50 to 5,0001 Hz5,000ImmediatelyTuning50 to 5,0001 Hz5,000ImmediatelyTuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ation<br>g<br>ation<br>g<br>ation<br>g<br>ation                    |
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| Second Stage Notch Filter Q Value           Pn40D         Setting Range         Setting Unit         Default Setting         When Enabled         Classifica           50 to 1,000         0.01         70         Immediately         Tuning           Second Stage Notch Filter Depth         Setting Range         Setting Unit         Default Setting         When Enabled         Classifica           Pn40E         Setting Range         Setting Unit         Default Setting         When Enabled         Classifica           Pn40E         Setting Range         Setting Unit         Default Setting         When Enabled         Classifica           O to 1,000         0.001         0         Immediately         Tuning           Third Stage Notch Filter Frequency         Setting Range         Setting Unit         Default Setting         When Enabled         Classifica           50 to 5,000         1 Hz         5,000         Immediately         Tuning                                                                                                                                                                              | ation<br>g<br>ation                                                |
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| 50 to 1,000       0.01       70       Immediately       Tuning         Pn40E       Second Stage Notch Filter Depth       Setting Range       Setting Unit       Default Setting       When Enabled       Classification         0 to 1,000       0.001       0       Immediately       Tuning         Pn417       Third Stage Notch Filter Frequency       Third Stage Notch Filter Frequency         Setting Range       Setting Unit       Default Setting       When Enabled       Classification         50 to 5,000       1 Hz       5,000       Immediately       Tuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ation                                                              |
| Second Stage Notch Filter Depth         Default Setting         When Enabled         Classifical           0 to 1,000         0.001         0         Immediately         Tuning           Pn417         Setting Range         Setting Unit         Default Setting         When Enabled         Classifical           Pn417         Third Stage Notch Filter Frequency         Tuning         Setting Range         Setting Unit         Default Setting         When Enabled         Classifical           50 to 5,000         1 Hz         5,000         Immediately         Tuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | ation<br>g                                                         |
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| O to 1,000         0.001         O         Immediately         Tuning           Pn417         Third Stage Notch Filter Frequency         Setting Range         Setting Unit         Default Setting         When Enabled         Classification           50 to 5,000         1 Hz         5,000         Immediately         Tuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | g                                                                  |
| Pn417         Third Stage Notch Filter Frequency         Default Setting         When Enabled         Classifica           50 to 5,000         1 Hz         5,000         Immediately         Tuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                    |
| Pn417Setting RangeSetting UnitDefault SettingWhen EnabledClassifical50 to 5,0001 Hz5,000ImmediatelyTuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ation                                                              |
| 50 to 5,000 1 Hz 5,000 Immediately Tuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ation                                                              |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                    |
| Third Stage Notch Filter Q Value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | g                                                                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                    |
| Pn418 Setting Range Setting Unit Default Setting When Enabled Classifica                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ation                                                              |
| 50 to 1,000 0.01 70 Immediately Tuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | g                                                                  |
| Third Stage Notch Filter Depth                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                    |
| Pn419 Setting Range Setting Unit Default Setting When Enabled Classifica                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ation                                                              |
| 0 to 1,000 0.001 0 Immediately Tuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | g                                                                  |
| Fourth Stage Notch Filter Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                    |
| Pn41A Setting Range Setting Unit Default Setting When Enabled Classifica                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ation                                                              |
| 50 to 5,000 1 Hz 5,000 Immediately Tuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | g                                                                  |
| Fourth Stage Notch Filter Q Value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                    |
| Pn41B Setting Range Setting Unit Default Setting When Enabled Classifica                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ation                                                              |
| 50 to 1,000 0.01 70 Immediately Tuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | g                                                                  |
| Fourth Stage Notch Filter Depth                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                    |
| Pn41C Setting Range Setting Unit Default Setting When Enabled Classifica                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ation                                                              |
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| Fifth Stage Notch Filter Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                    |
| Pn41D Setting Range Setting Unit Default Setting When Enabled Classifica                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ation                                                              |
| 50 to 5,000 1 Hz 5,000 Immediately Tuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | g                                                                  |
| Fifth Stage Notch Filter Q Value                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                    |
| Pn41E Setting Range Setting Unit Default Setting When Enabled Classifica                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                    |
| 50 to 1,0000.0170ImmediatelyTuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | g                                                                  |
| Fifth Stage Notch Filter Depth                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                    |
| Pn41F         Setting Range         Setting Unit         Default Setting         When Enabled         Classifica                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                    |
| 0 to 1,000 0.001 0 Immediately Tuning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | g                                                                  |

1 Important • Do not set notch filter frequencies (Pn409, Pn40C, Pn417, Pn41A, and Pn41D) that are close to the speed loop's response frequency. Set a frequency that is at least four times the speed loop gain (Pn100). (However, Pn103 (Moment of Inertia Ratio) must be set correctly. If the setting is not correct, vibration may occur and the machine may be damaged.

 Change the notch filter frequencies (Pn409, Pn40C, Pn417, Pn41A, and Pn41D) only while the Servomotor is stopped. Vibration may occur if a notch filter frequency is changed during operation.

### **Guidelines for Manually Tuning Servo Gains**

When you manually adjust the parameters, make sure that you completely understand the information in the product manual and use the following conditional expressions as guidelines. The appropriate values of the parameter settings are influenced by the machine specifications, so they cannot be determined universally. When you adjust the parameters, actually operate the machine and use the SigmaWin+ or analog monitor to monitor operating conditions. Even if the status is stable while the Servomotor is stopped, an unstable condition may occur when an operation reference is input. Therefore, input operation references and adjust the servo gains as you operate the Servomotor.

Stable gain: Settings that provide a good balance between parameters.

However, if the load moment of inertia is large and the machine system contains elements prone to vibration, you must sometimes use a setting that is somewhat higher to prevent the machine from vibrating.

Critical gain: Settings for which the parameters affect each other

Depending on the machine conditions, overshooting and vibration may occur and operation may not be stable. If the critical gain condition expressions are not met, operation will become more unstable, and there is a risk of abnormal motor shaft vibration and round-trip operation with a large amplitude. Always stay within the critical gain conditions.

If you use the torque reference filter, second torque reference filter, and notch filters together, the interference between the filters and the speed loop gain will be superimposed. Allow leeway in the adjustments.



The following adjusted value guidelines require that the setting of Pn103 (Moment of Inertia Ratio) is correctly set for the actual machine.

### ♦ When Pn10B = n.□□0□ (PI Control)

Guidelines are given below for gain settings 1.

The same guidelines apply to gain settings 2 (Pn104, Pn105, Pn106, and Pn412).

- Speed Loop Gain (Pn100 [Hz]) and Position Loop Gain (Pn102 [/s]) Stable gain: Pn102 [/s]  $\leq 2\pi \times$  Pn100/4 [Hz] Critical gain: Pn102 [/s]  $< 2\pi \times$  Pn100 [Hz]
- Speed Loop Gain (Pn100 [Hz]) and Speed Loop Integral Time Constant (Pn101 [ms]) Stable gain: Pn101 [ms] ≥ 4,000/(2π × Pn100 [Hz]) Critical gain: Pn101 [ms] > 1,000/(2π × Pn100 [Hz])
- Speed Loop Gain (Pn100 [Hz]) and First Stage First Torque Reference Filter Time Constant (Pn401 [ms])

Stable gain: Pn401 [ms]  $\leq$  1,000/(2 $\pi$  × Pn100 [Hz] × 4) Critical gain: Pn401 [ms] < 1,000/(2 $\pi$  × Pn100 [Hz] × 1)

- Speed Loop Gain (Pn100 [Hz]) and Second Stage Second Torque Reference Filter Frequency (Pn40F [Hz])
   Critical gain: Pn40F [Hz] > 4 × Pn100 [Hz]
   Note: Set the second stage second torque reference filter Q value (Pn410) to 0.70.
- Speed Loop Gain (Pn100 [Hz]) and First Stage Notch Filter Frequency (Pn409 [Hz]) (or Second Stage Notch Filter Frequency (Pn40C [Hz])) Critical gain: Pn409 [Hz] > 4 × Pn100 [Hz]
- Speed Loop Gain (Pn100 [Hz]) and Speed Feedback Filter Time Constant (Pn308 [ms]) Stable gain: Pn308 [ms]  $\leq$  1,000/(2 $\pi$  × Pn100 [Hz] × 4) Critical gain: Pn308 [ms] < 1,000/(2 $\pi$  × Pn100 [Hz] × 1)

#### • When $Pn10B = n.\Box\Box1\Box$ (I-P Control)

Guidelines are given below for gain settings 1.

The same guidelines apply to gain settings 2 (Pn104, Pn105, Pn106, and Pn412).

For I-P control, the relationships between the speed loop integral time constant, speed loop gain, and position loop gain are different from the relationships for PI control. The relationship between other servo gains is the same as for PI control.

- Speed Loop Gain (Pn100 [Hz]) and Speed Loop Integral Time Constant (Pn101 [ms]) Stable gain: Pn100 [Hz] ≥ 320/Pn101 [ms]
- Position Loop Gain (Pn102 [/s]) and Speed Loop Integral Time Constant (Pn101 [ms]) Stable gain: Pn102 [/s] ≤ 320/Pn101 [ms]

#### Information Selecting the Speed Loop Control Method (PI Control or I-P Control) Usually, I-P control is effective for high-speed positioning and high-speed, high-precision processing applications. With I-P control, you can use a lower position loop gain than for PI control to reduce the positioning time and reduce arc radius reduction. However, if you can use mode switching to change to proportional control to achieve the desired application, then using PI control would be the normal choice.

#### Decimal Points in Parameter Settings

For the SGD7S SERVOPACKs, decimal places are given for the settings of parameters on the Digital Operator, Panel Operator, and in the manual. For example with Pn100 (Speed Loop Gain), Pn100 = 40.0 is used to indicate a setting of 40.0 Hz. In the following adjusted value guidelines, the decimal places are also given.

**Example** • Speed Loop Gain (Pn100 [Hz]) and Speed Loop Integral Time Constant (Pn101 [ms]) Stable gain: Pn101 [ms]  $\geq$  4,000/( $2\pi \times$  Pn100 [Hz]), therefore If Pn100 = 40.0 [Hz], then Pn101 = 4,000/( $2\pi \times$  40.0)  $\approx$  15.92 [ms].

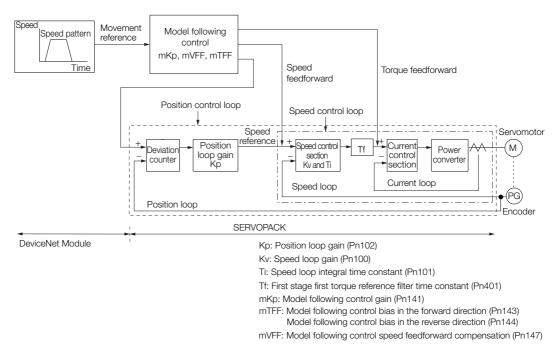
### **Model Following Control**

You can use model following control to improve response characteristic and shorten positioning time. You can use model following control only with position control.

Normally, the parameters that are used for model following control are automatically set along with the servo gains by executing autotuning or custom tuning. However, you must adjust them manually in the following cases.

- When the tuning results for autotuning or custom tuning are not acceptable
- When you want to increase the response characteristic higher than that achieved by the tuning results for autotuning or custom tuning
- · When you want to determine the servo gains and model following control parameters yourself

The block diagram for model following control is provided below.



#### ◆ Manual Tuning Procedure

Use the following tuning procedure for using model following control.

| Step | Description                                                                                                                                                                                                                                                                                                                                                |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1    | Friction compensation must also be used. Set the friction compensation parameters. Refer to the following section for the setting procedure.                                                                                                                                                                                                               |
|      | Adjust the servo gains. Refer to the following section for an example procedure.                                                                                                                                                                                                                                                                           |
| 2    | <ul> <li>Note: 1. Set the moment of inertia ratio (Pn103) as accurately as possible.</li> <li>2. Refer to the guidelines for manually tuning the servo gains and set a stable gain for the position loop gain (Pn102).</li> <li>Guidelines for Manually Tuning Servo Gains on page 8-85</li> </ul>                                                         |
| 3    | Increase the model following control gain (Pn141) as much as possible within the range in which overshooting and vibration do not occur.                                                                                                                                                                                                                   |
| 4    | If overshooting occurs or if the response is different for forward and reverse operation, fine-tune model following control with the following settings: model following control bias in the forward direction (Pn143), model following control bias in the reverse direction (Pn144), and model following control speed feedforward compensation (Pn147). |

#### Related Parameters

Next we will describe the following parameters that are used for model following control.

- Pn140 (Model Following Control-Related Selections)
- Pn141 (Model Following Control Gain)
- Pn143 (Model Following Control Bias in the Forward Direction)
- Pn144 (Model Following Control Bias in the Reverse Direction)
- Pn147 (Model Following Control Speed Feedforward Compensation)

#### Model Following Control-Related Selections

Set  $Pn140 = n.\square\square\squareX$  to specify whether to use model following control.

If you use model following control with vibration suppression, set Pn140 to  $n.\Box\Box1\Box$  or Pn140 =  $n.\Box\Box2\Box$ . When you also perform vibration suppression, adjust vibration suppression with custom tuning in advance.

Note: If you use vibration suppression (Pn140 =  $n.\square\square\square$  or Pn140 =  $n.\square\square\square$ ), always set Pn140 to  $n.\square\square\square$  (Use model following control).

| Parameter |                             | Function                                                    | When Enabled | Classification |
|-----------|-----------------------------|-------------------------------------------------------------|--------------|----------------|
| Pn140     | n.□□□0<br>(default setting) | Do not use model following control.                         |              | Tuning         |
|           | n.0001                      | Use model following control.                                |              |                |
|           | n.□□0□<br>(default setting) | Do not perform vibration suppression.                       | Immediately  |                |
|           | n.0010                      | Perform vibration suppression for a specific frequency.     |              |                |
|           | n.0020                      | Perform vibration suppression for two specific frequencies. |              |                |

#### Model Following Control Gain

The model following control gain determines the response characteristic of the servo system. If you increase the setting of the model following control gain, the response characteristic will improve and the positioning time will be shortened. The response characteristic of the servo system is determined by this parameter, and not by Pn102 (Position Loop Gain).

|       | Model Following Co |              |                 |              |                |
|-------|--------------------|--------------|-----------------|--------------|----------------|
| Pn141 | Setting Range      | Setting Unit | Default Setting | When Enabled | Classification |
|       | 10 to 20,000       | 0.1/s        | 500             | Immediately  | Tuning         |

**Information** For machines for which a high model following control gain cannot be set, the size of the position deviation in model following control will be determined by the setting of the model following control gain. For a machine with low rigidity, in which a high model following control gain cannot be set, position deviation overflow alarms may occur during high-speed operation. If that is the case, you can increase the setting of the following parameter to increase the level for alarm detection.

Use the following conditional expression for reference in determining the setting.

 $Pn \ 520 \ge \frac{Maximum \ feed \ speed \ [reference \ units/s]}{Pn \ 141/10 \ [1/s]} \times 2.0$ 

|  | <br> | <br>.1 |  |   |
|--|------|--------|--|---|
|  |      |        |  |   |
|  |      |        |  |   |
|  |      |        |  | _ |

|         | Position Deviation Overflow Alarm Level |                     |                 |              |                |  |  |
|---------|-----------------------------------------|---------------------|-----------------|--------------|----------------|--|--|
| Pn520   | Setting Range                           | Setting Unit        | Default Setting | When Enabled | Classification |  |  |
| 1 11020 | 1 to<br>1,073,741,823                   | 1 reference<br>unit | 5,242,880       | Immediately  | Setup          |  |  |

#### Model Following Control Bias in the Forward Direction and Model Following Control Bias in the Reverse Direction

If the response is different for forward and reverse operation, use the following parameters for fine-tuning.

If you decrease the settings, the response characteristic will be lowered but overshooting will be less likely to occur.

|       | Model Following Control Bias in the Forward Direction |              |                 |              |                |  |  |  |
|-------|-------------------------------------------------------|--------------|-----------------|--------------|----------------|--|--|--|
| Pn143 | Setting Range                                         | Setting Unit | Default Setting | When Enabled | Classification |  |  |  |
|       | 0 to 10,000                                           | 0.1%         | 1,000           | Immediately  | Tuning         |  |  |  |
|       | Model Following Control Bias in the Reverse Direction |              |                 |              |                |  |  |  |
| Pn144 | Setting Range                                         | Setting Unit | Default Setting | When Enabled | Classification |  |  |  |
|       | 0 to 10,000                                           | 0.1%         | 1,000           | Immediately  | Tuning         |  |  |  |

#### Model Following Control Speed Feedforward Compensation

If overshooting occurs even after you adjust the model following control gain, model following control bias in the forward direction, and model following control bias in the reverse direction, you may be able to improve performance by setting the following parameter.

If you decrease the settings, the response characteristic will be lowered but overshooting will be less likely to occur.

|       | Model Following Co | ntrol Speed Feedfor | ward Compensation |              |                |
|-------|--------------------|---------------------|-------------------|--------------|----------------|
| Pn147 | Setting Range      | Setting Unit        | Default Setting   | When Enabled | Classification |
|       | 0 to 10,000        | 0.1%                | 1,000             | Immediately  | Tuning         |

#### Model Following Control Type Selection

When you enable model following control, you can select the model following control type. Normally, set Pn14F to n. DDD1 (Use model following control type 2) (default setting). If compatibility with previous models is required, set Pn14F to n. DDD0 (Use model following control type 1).

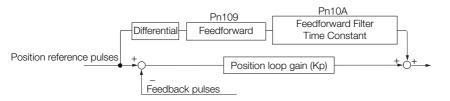
| Parameter |                             | Meaning                             | When Enabled  | Classification |
|-----------|-----------------------------|-------------------------------------|---------------|----------------|
| Pn14F     | n.🗆 🗆 🗆 0                   | Use model following control type 1. |               |                |
|           | n.□□□1<br>(default setting) | Use model following control type 2. | After restart | Tuning         |

### 8.13.2 Compatible Adjustment Functions

The compatible adjustment functions are used together with manual tuning. You can use these functions to improve adjustment results. These functions allow you to use the same functions as for  $\Sigma$ -III-Series SERVOPACKs to adjust  $\Sigma$ -7-Series SERVOPACKs.

### Feedforward

The feedforward function applies feedforward compensation to position control to shorten the positioning time.



|       | Feedforward                      |              |                 |              |                |  |  |
|-------|----------------------------------|--------------|-----------------|--------------|----------------|--|--|
| Pn109 | Setting Range                    | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 100                         | 1%           | 0               | Immediately  | Tuning         |  |  |
|       | Feedforward Filter Time Constant |              |                 |              |                |  |  |
| Pn10A | Setting Range                    | Setting Unit | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 6,400                       | 0.01 ms      | 0               | Immediately  | Tuning         |  |  |

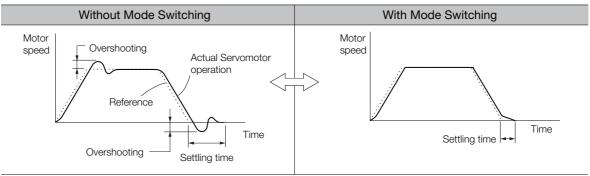
Note: If you set the feedforward value too high, the machine may vibrate. As a guideline, use a setting of 80% or less.

8.13.2 Compatible Adjustment Functions

# Mode Switching (Changing between Proportional and PI Control)

You can use mode switching to automatically change between proportional control and PI control.

Overshooting caused by acceleration and deceleration can be suppressed and the settling time can be reduced by setting the switching condition and switching levels.



#### Related Parameters

Select the switching condition for mode switching with  $Pn10B = n.\Box\Box\BoxX$ .

| ſ         | Parameter                   | Mode Switching                                           | Parameter That Sets the<br>Level |                      | When        | Classification |
|-----------|-----------------------------|----------------------------------------------------------|----------------------------------|----------------------|-------------|----------------|
| rarameter |                             | Selection Rotary<br>Servomotor S                         |                                  | Linear<br>Servomotor | Enabled     | Classification |
|           | n.□□□0<br>(default setting) | Use the internal torque reference as the condition.      | as Pn10C                         |                      |             |                |
|           | n.0001                      | Use the speed ref-<br>erence as the con-<br>dition.      | Pn10D                            | Pn181                | *           |                |
| Pn10B     | n.0002                      | Use the accelera-<br>tion reference as<br>the condition. | Pn10E                            | Pn182                | Immediately | Setup          |
|           | n.0003                      | Use the position deviation as the condition.             | Pn10F                            |                      | T           |                |
|           | n.0004                      | Do not use mode switching.                               | -                                | -                    |             |                |

#### Parameters That Set the Switching Levels

Rotary Servomotors

|       | Mode Switching Level for Torque Reference   |                        |                 |              |                |  |  |
|-------|---------------------------------------------|------------------------|-----------------|--------------|----------------|--|--|
| Pn10C | Setting Range                               | Setting Unit           | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 800                                    | 1%                     | 200             | Immediately  | Tuning         |  |  |
|       | Mode Switching L                            | evel for Speed Refe    | erence          |              |                |  |  |
| Pn10D | Setting Range                               | Setting Unit           | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 10,000                                 | 1 min <sup>-1</sup>    | 0               | Immediately  | Tuning         |  |  |
|       | Mode Switching Level for Acceleration       |                        |                 |              |                |  |  |
| Pn10E | Setting Range                               | Setting Unit           | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 30,000                                 | 1 min <sup>-1</sup> /s | 0               | Immediately  | Tuning         |  |  |
|       | Mode Switching Level for Position Deviation |                        |                 |              |                |  |  |
| Pn10F | Setting Range                               | Setting Unit           | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 10,000                                 | 1 reference unit       | 0               | Immediately  | Tuning         |  |  |

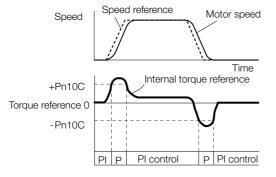
• Linear Servomotors

|       | Mode Switching Level for Force Reference    |                     |                 |              |                |  |  |
|-------|---------------------------------------------|---------------------|-----------------|--------------|----------------|--|--|
| Pn10C | Setting Range                               | Setting Unit        | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 800                                    | 1%                  | 200             | Immediately  | Tuning         |  |  |
|       | Mode Switching L                            | evel for Speed Refe | erence          |              |                |  |  |
| Pn181 | Setting Range                               | Setting Unit        | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 10,000                                 | 1 mm/s              | 0               | Immediately  | Tuning         |  |  |
|       | Mode Switching Level for Acceleration       |                     |                 |              |                |  |  |
| Pn182 | Setting Range                               | Setting Unit        | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 30,000                                 | 1 mm/s <sup>2</sup> | 0               | Immediately  | Tuning         |  |  |
|       | Mode Switching Level for Position Deviation |                     |                 |              |                |  |  |
| Pn10F | Setting Range                               | Setting Unit        | Default Setting | When Enabled | Classification |  |  |
|       | 0 to 10,000                                 | 1 reference unit    | 0               | Immediately  | Tuning         |  |  |

 Using the Internal Torque Reference as the Mode Switching Condition (Default Setting)

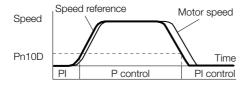
When the Internal torque reference equals or exceeds the torque set for the mode switching level for torque reference (Pn10C), the speed loop is changed to P control.

The default setting for the torque reference level is 200%.



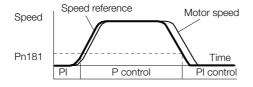
- Using the Speed Reference as the Mode Switching Condition
- Rotary Servomotors

When the speed reference equals or exceeds the speed set for the mode switching level for a speed reference (Pn10D), the speed loop is changed to P control.



• Linear Servomotors

When the speed reference equals or exceeds the speed set for the mode switching level for a speed reference (Pn181), the speed loop is changed to P control.

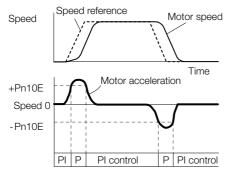


8

8.13.2 Compatible Adjustment Functions

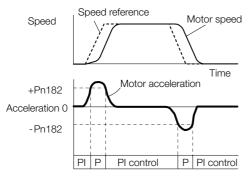
- Using the Acceleration as the Mode Switching Condition
- Rotary Servomotors

When the speed reference equals or exceeds the acceleration rate set for the mode switching level for acceleration (Pn10E), the speed loop is changed to P control.



• Linear Servomotors

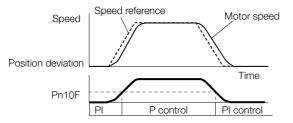
When the speed reference equals or exceeds the acceleration rate set for the mode switching level for acceleration (Pn182), the speed loop is changed to P control.



#### Using the Position Deviation as the Mode Switching Condition

When the position deviation equals or exceeds the value set for the mode switching level for position deviation (Pn10F), the speed loop is changed to P control.

This setting is enabled only for position control.



### **Position Integral**

The position integral is the integral function of the position loop. It is used for the electronic cams and electronic shafts when using the SERVOPACK with a Yaskawa MP3000-Series Machine Controller.

|       | Position Integral Tin | al Time Constant |                 |              |                |
|-------|-----------------------|------------------|-----------------|--------------|----------------|
| Pn11F | Setting Range         | Setting Unit     | Default Setting | When Enabled | Classification |
|       | 0 to 50,000           | 0.1 ms           | 0               | Immediately  | Tuning         |

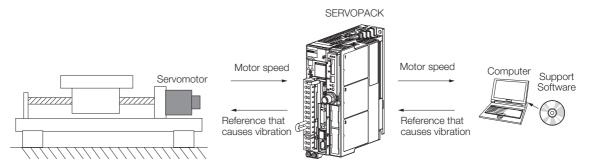
8.14.1 Mechanical Analysis

## 8.14 Diagnostic Tools

## 8.14.1 Mechanical Analysis

#### Overview

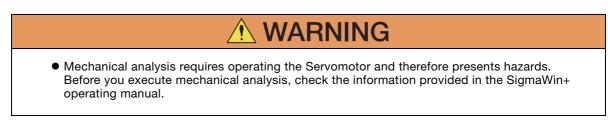
You can connect the SERVOPACK to a computer to measure the frequency characteristics of the machine. This allows you to measure the frequency characteristics of the machine without using a measuring instrument.



The Servomotor is used to cause machine vibration and then the speed frequency characteristics for the motor torque are measured. The measured frequency characteristics can be used to determine the machine resonance.

You determine the machine resonance for use in servo tuning and as reference for considering changes to the machine. The performance of the servo cannot be completely utilized depending on the rigidity of the machine. You may need to consider making changes to the machine. The information can also be used as reference for servo tuning to help you adjust parameters, such as the servo rigidity and torque filter time constant.

You can also use the information to set parameters, such as the notch filters.

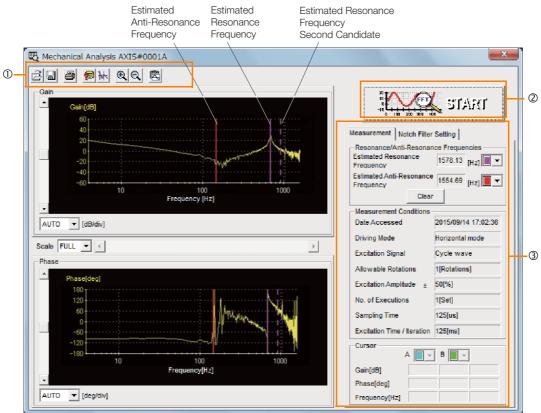


8.14.1 Mechanical Analysis

### **Frequency Characteristics**

The Servomotor is used to cause the machine to vibrate and the frequency characteristics from the torque to the motor speed are measured to determine the machine characteristics. For a normal machine, the resonance frequencies are clear when the frequency characteristics are plotted on graphs with the gain and phase (Bode plots). The Bode plots show the size (gain) of the response of the machine to which the torque is applied, and the phase delay (phase) in the response for each frequency. Also, the machine resonance frequency can be determined from the maximum frequency of the valleys (anti-resonance) and peaks (resonance) of the gain and the phase delay.

For a Servomotor without a load or for a rigid mechanism, the gain and phase change gradually in the Bode plots.



① Toolbar

② START Button

Click the **START** Button to start analysis.

③ Measurement and Notch Filter Setting Tab Pages

Measurement Tab Page: Displays detailed information on the results of analysis.

Notch Filter Setting Tab Page: Displays the notch filter frequencies. You can set these values in the parameters.

8.14.2 Easy FFT

## 8.14.2 Easy FFT

The machine is made to vibrate and a resonance frequency is detected from the generated vibration to set notch filters according to the detected resonance frequencies. This is used to eliminate high-frequency vibration and noise.

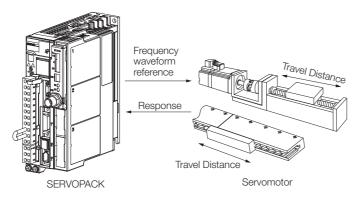
During execution of Easy FFT, a frequency waveform reference is sent from the SERVOPACK to the Servomotor to automatically cause the shaft to rotate multiple times within 1/4th of a rotation, thus causing the machine to vibrate.

Execute Easy FFT after the servo is turned OFF if operation of the SERVOPACK results in high-frequency noise and vibration.

- Never touch the Servomotor or machine during execution of Easy FFT. Doing so may result in injury.



• Use Easy FFT when the servo gain is low, such as in the initial stage of servo tuning. If you execute Easy FFT after you increase the gain, the machine may vibrate depending on the machine characteristics or gain balance.



Easy FFT is built into the SERVOPACK for compatibility with previous products. Normally use autotuning without a host reference for tuning.

### Preparations

Always check the following before you execute Easy FFT.

- The parameters must not be write prohibited.
- The main circuit power supply must be ON.
- The test without a motor function must be disabled (Pn00C =  $n.\Box\Box\Box$ ).
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- The servo must be OFF.
- There must be no overtravel.
- An external reference must not be input.

8.14.2 Easy FFT

### **Applicable Tools**

The following table lists the tools that you can use to perform EasyFFT.

| Tool             | Fn No./Function Name  | Operating Procedure Reference                                                               |
|------------------|-----------------------|---------------------------------------------------------------------------------------------|
| Digital Operator | Fn206                 | Ω Σ-7-Series Servo Drive Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+        | Diagnostic - Easy FFT | G Operating Procedure on page 8-96                                                          |

### **Operating Procedure**

Use the following procedure for Easy FFT.

- 1. Click the <u>I</u> Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- Select Easy FFT in the Menu Dialog Box. The Easy FFT Dialog Box will be displayed. Click the Cancel Button to cancel Easy FFT. You will return to the main window.
- 3. Click the OK Button.



4. Click the Servo ON Button.

| Easy FFT AXIS#00                          | <b>X</b>             |
|-------------------------------------------|----------------------|
| Servo ON/OFF operation                    |                      |
| Servo OFF                                 | Servo ON             |
| Measurement start / Stopping operation    |                      |
| Measurement condition                     |                      |
| Stimulus signal Frequency                 | Start                |
| Instruction amplitude 15 (%)<br>(1 - 800) |                      |
| Rotation (moving) Forward                 |                      |
| Measurement result                        |                      |
| Detected resonance frequency              | [Hz]                 |
| Optimal notch filter frequency            | [Hz]                 |
| Notch filter selection                    |                      |
|                                           | Measurement complete |

8.14.2 Easy FFT

 Select the instruction (reference) amplitude and the rotation direction in the Measurement condition Area, and then click the Start Button. The Servomotor shaft will rotate and measurements will start.

| Easy FFT AXIS#                 |                   | <b>—</b> ×           |
|--------------------------------|-------------------|----------------------|
| - Servo ON/OFF operat          | ion               |                      |
| Serv                           | ro ON             | Servo OFF            |
| - Measurement start / S        | topping operation |                      |
| -Measurement condi             | ion               |                      |
| Stimulus signal                | Frequency         | start<br>I           |
| Instruction amplitude          | 15 🕂 [%]          |                      |
|                                | (1 - 800)         |                      |
| Rotation (moving)<br>direction | Forward 💌         |                      |
| -Measurement result -          |                   |                      |
| Detected resonanc              | e frequency       | [Hz]                 |
| Optimal notch filter           | frequency         | [Hz]                 |
| Notch filter selectio          | n 📃               |                      |
|                                |                   | Measurement complete |

When measurements have been completed, the measurement results will be displayed.

6. Check the results in the Measurement result Area and then click the Measurement complete Button.

| Easy FFT AXIS#00                                                                                                                                                            | ×                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| Servo ONOFF operation                                                                                                                                                       | Servo OFF            |
| Measurement start / Stopping operation<br>Measurement condition<br>Stimulus signal Frequency<br>Instruction amplitude 15 - [76]<br>(1 - 800)<br>Rotation (moving) Forward • | Start<br>T           |
| Messurement result Detected resonance frequency 502 Optimal notch filter frequency 502 Notch filter selection The 1st step                                                  | [Hz]<br>[Hz]         |
|                                                                                                                                                                             | Measurement complete |

8.14.2 Easy FFT

7. Click the **Result Writing** Button if you want to set the measurement results in the parameters.

| Easy FFT AXIS#00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ×      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Notch filter selection                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |        |
| Pn408:Torque-Related Function Selections digit 0 Notch Filter Selection 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |        |
| 0:Disable first stage notch filter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | _      |
| _                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |
| 1:Enable first stage notch filter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | _      |
| ,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |
| Notch filter frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |        |
| Pn409:First Stage Notch Filter Frequency                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |        |
| 5000 [Hz] <b>5</b> 02 [Hz]                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |        |
| · · · · · · · · · · · · · · · · · · ·                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |
| Please click a button, when you reflect a measurement result in User Param                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ieter. |
| and the second se |        |
| Result Writing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |        |

This concludes the procedure to set up Easy FFT.

### **Related Parameters**

The following parameters are automatically adjusted or used as reference when you execute Easy FFT.

Do not change the settings of these parameters during execution of Easy FFT.

| Parameter | Name                                | Automatic Changes |
|-----------|-------------------------------------|-------------------|
| Pn408     | Torque-Related Function Selections  | Yes               |
| Pn409     | First Stage Notch Filter Frequency  | Yes               |
| Pn40A     | First Stage Notch Filter Q Value    | No                |
| Pn40C     | Second Stage Notch Filter Frequency | Yes               |
| Pn40D     | Second Stage Notch Filter Q Value   | No                |
| Pn456     | Sweep Torque Reference Amplitude    | No                |

Yes: The parameter is automatically set.

No: The parameter is not automatically set, but the setting is read during execution.

# Monitoring

9

This chapter provides information on monitoring SERVO-PACK product information and SERVOPACK status.

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9.1.1 Items That You Can Monitor

## 9.1 Monitoring Product Information

### 9.1.1 Items That You Can Monitor

The items that you can monitor in the SigmaWin+ Product Information Window are listed below.

|                               | Monitor Items                                                                                                                                                                                                                       |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Information on SERVOPACKs     | <ul> <li>SERVOPACK model</li> <li>SERVOPACK software version</li> <li>SERVOPACK special specifications</li> <li>SERVOPACK serial number</li> <li>SERVOPACK manufacturing date</li> </ul>                                            |
| Information on Servomotors    | <ul> <li>Servomotor model</li> <li>Servomotor serial number</li> <li>Servomotor manufacturing date</li> </ul>                                                                                                                       |
| Information on Encoders       | <ul> <li>Encoder model</li> <li>Rotary encoder resolution and linear encoder pitch resolution</li> <li>Encoder type</li> <li>Encoder software version</li> <li>Encoder serial number</li> <li>Encoder manufacturing date</li> </ul> |
| Information on Option Modules | <ul> <li>Option Module model</li> <li>Option Module software version</li> <li>Option Module special specifications</li> <li>Option Module serial number</li> <li>Option Module manufacturing date</li> </ul>                        |

### 9.1.2 Operating Procedures

Use the following procedure to display the product information monitor dialog box.

• Select *Read Product Information* in the Menu Dialog Box of the SigmaWin+. The Read Product Information Window will be displayed.

| GD7S-1R6AE0A<br>Command-Option module type single<br>Iodel/Type<br>GM7J-02A7A21<br>ITTAI-B24RH<br>Iodel/Type<br>GDV 02A224 | Number<br>20131204<br>Serial Number | Manufacturing Date<br>2015.01<br>Manufacturing Date<br>2013.12<br>2013.12<br>Manufacturing Date<br>2014.06 | SW Ver.<br>001D<br>SW Ver.<br>0001<br>0001<br>SW Ver. | Remarks         [Specification] : Standard         Remarks         [Resolution] : 16777216 [Pulse/rev]         [Encoder type] : absolute         Remarks |
|----------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| GD7S-1R6AE0A<br>Command-Option module type single<br>todel/Type<br>GM7J-02A7A21<br>ITTAI-B24RH<br>todel/Type<br>GDV-OCA03A | Number<br>20131204<br>Serial Number | 2015.01<br>Manufacturing Date<br>2013.12<br>2013.12<br>Manufacturing Date                                  | 001D<br>SW Ver.                                       | [Specification] : Standard<br>Remarks<br>[Resolution] : 16777216 [Pulse/rev]<br>[Encoder type] : absolute                                                |
| Command-Option module type single<br>lodd/Type<br>GM7J-02A7A21<br>ITTAI-B24RH<br>loddl/Type<br>GDV-OCA03A                  | Number<br>20131204<br>Serial Number | Manufacturing Date<br>2013.12<br>2013.12<br>Manufacturing Date                                             | SW Ver.                                               | Remarks<br>[Resolution] : 16777216 [Pulse/rev]<br>[Encoder type] : absolute                                                                              |
| GM7J-02A7A21<br>ITTAI-B24RH<br>Iodel/Type<br>GDV-OCA03A                                                                    | 20131204<br>Serial Number           | 2013.12<br>2013.12<br>Manufacturing Date                                                                   | 0001                                                  | [Resolution] : 16777216 [Pulse/rev]<br>[Encoder type] : absolute                                                                                         |
| ITTAI-B24RH<br>Iodel/Type<br>GDV-OCA03A                                                                                    | Serial Number                       | 2013.12<br>Manufacturing Date                                                                              |                                                       | [Encoder type] : absolute                                                                                                                                |
| Iodel/Type<br>GDV-OCA03A                                                                                                   |                                     | Manufacturing Date                                                                                         |                                                       |                                                                                                                                                          |
| GDV-OCA03A                                                                                                                 |                                     |                                                                                                            | SW Ver.                                               | Remarks                                                                                                                                                  |
|                                                                                                                            | D0146D352110007                     | 2014.06                                                                                                    |                                                       |                                                                                                                                                          |
|                                                                                                                            |                                     | 2014.00                                                                                                    | 0006                                                  |                                                                                                                                                          |
|                                                                                                                            |                                     |                                                                                                            |                                                       |                                                                                                                                                          |
|                                                                                                                            |                                     |                                                                                                            |                                                       |                                                                                                                                                          |

Information

With the Digital Operator, you can use Fn011, Fn012, and Fn01E to monitor this information. Refer to the following manual for the differences in the monitor items compared with the SigmaWin+.

Ω Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)

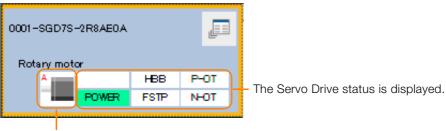
9.2.1 System Monitor

# 9.2 Monitoring SERVOPACK Status

### 9.2.1 System Monitor

Use one of the following methods to display the System Monitor Window.

• Start the SigmaWin+. The Servo Drive status will be automatically displayed when you go online with a SERVOPACK.



The Servomotor type is displayed.

### 9.2.2 Monitoring Operation, Status, and I/O

### Items That You Can Monitor

The items that you can monitor on the Operation Pane, Status Pane, and I/O Pane are listed below.

Operation Pane

| Monit                                                                                                                                                                                                                                                                                                                                                                                                                                                    | or Items                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul> <li>Motor Speed</li> <li>Speed Reference</li> <li>Internal Torque Reference</li> <li>Angle of Rotation 1 (Number of encoder pulses from origin within one encoder rotation)</li> <li>Angle of Rotation 2 (angle from origin within one encoder rotation)</li> <li>Input Reference Pulse Speed</li> <li>Deviation Counter (Position Deviation)</li> <li>Cumulative Load</li> <li>Regenerative Load</li> <li>DB Resistor Consumption Power</li> </ul> | <ul> <li>Input Reference Pulse Counter</li> <li>Feedback Pulse Counter</li> <li>Fully Closed Feedback Pulse Counter</li> <li>Total Operating Time</li> <li>Active Gain Monitor</li> <li>Main Circuit Power Supply Voltage Value</li> <li>Current Backlash Compensation Value</li> <li>Backlash Compensation Value Setting Limit</li> <li>Absolute Encoder Multiturn Data</li> <li>Absolute Encoder Position within One Rotation</li> <li>Current Alarm State</li> <li>DB Resistor Energy Consumption</li> </ul> |

#### Status Pane

| N                                                 | Ionitor Items                                                   |
|---------------------------------------------------|-----------------------------------------------------------------|
| Polarity Sensor Signal Monitor                    | CLR (Position Deviation Clear Input Signal)                     |
| Active Gain Monitor                               | Position Reference Direction                                    |
| Main Circuit                                      | <ul> <li>Surge Current Limiting Resistor Short Relay</li> </ul> |
| <ul> <li>Encoder (PGRDY)</li> </ul>               | Regenerative Transistor                                         |
| <ul> <li>Motor Power (Request)</li> </ul>         | Regenerative Error Detection                                    |
| Motor Power ON                                    | AC Power ON                                                     |
| <ul> <li>Dynamic Brake (DB)</li> </ul>            | Overcurrent                                                     |
| <ul> <li>Rotation (Movement) Direction</li> </ul> | Origin Not Passed                                               |
| Mode Switch                                       | <ul> <li>Moment of Inertia Identification</li> </ul>            |
| <ul> <li>Speed Reference (V-Ref)</li> </ul>       | <ul> <li>Polarity Detection in Progress</li> </ul>              |
| Torque Reference (T-Ref)                          | <ul> <li>Completion of Polarity Detection</li> </ul>            |
| Position Reference (PULS)                         | Ripple Compensation in Progress                                 |

9.2.2 Monitoring Operation, Status, and I/O

• I/O Pane

|                     | Monitor Items                                                                                                                                                                                         |                             |                                                                                                                                                                                                                                                                                                                                                            |  |  |  |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| Input Signal Status | <ul> <li>CCW-OT (CCW Drive Prohibit Input Signal)</li> <li>CW-OT (CW Drive Prohibit Input Singal)</li> <li>/HOME (Origin Signal Input Signal)</li> <li>EXSTOP (External Stop Input Signal)</li> </ul> | <b>Output Signal Status</b> | <ul> <li>ALM (Servo Alarm Output Signal)</li> <li>/S-RDY (Servo Ready Output Signal)</li> <li>/BK (Brake Signal)</li> <li>/WARN (Warning Signal Output Signal)</li> <li>PAO (Encoder Divided Pulse Output Phase A Signal)</li> <li>PBO (Encoder Divided Pulse Output Phase B Signal)</li> <li>PCO (Encoder Divided Pulse Output Phase C Signal)</li> </ul> |  |  |  |

### **Operating Procedure**

Use the following procedure to display the Operation Pane, Status Pane, and I/O Pane for the SERVOPACK.

- Select **Monitor** in the SigmaWin+ Menu Dialog Box.
- The Operation Pane, Status Pane, and I/O Pane will be displayed in the Monitor Window.

|                 |                      |            | YAS                          | SKAWA SigmaWin+ | Ver.7              |
|-----------------|----------------------|------------|------------------------------|-----------------|--------------------|
|                 | Monitor              |            |                              |                 |                    |
| corred.         | Operation            | _          |                              |                 |                    |
|                 | Control              | I/F        | Item                         | Unit            | 0001-SGD<br>Axis A |
| D7S-1 RSAEDA    | POS SPD TAQ          | Common     | Motor rotating speed         | min-1           | 0                  |
| A.C90 HEB P-07  |                      | Common     | Speed reference              | min-1           | 0                  |
| POWER FSTP N-OT | POS SPD TRQ          | Common     | Internal torque reference    | 96              | 0                  |
|                 | POS SPD TRO          | Common     | Rotational angle 1 (encoder  | encoder puls    | 0                  |
|                 | POS SPD TRO          | Common     | Rotational angle 2 (from pol | deg             | 0                  |
|                 | POS 5PD 110          | Common     | Input reference pulse speed  | min-1           | 0                  |
|                 | POS SPD 18Q          | Common     | Position error amount        | reference ur    | 0                  |
|                 | POS SPD TRQ          | Common     | Accumulated load ratio       | 96              | 0                  |
|                 | POS SPD TRO          | Common     | Recenerative load ratio      | 9h              | 0                  |
|                 | Status 1/0<br>Status | 1          |                              |                 |                    |
|                 | Control              | I/F        | Item                         |                 | 0001-SGD<br>Axis A |
|                 | POS SPD TRO          | Common     | Main Circuit                 | -               | OFF                |
|                 | POS SPD TRO          |            | Encoder (PGRDY)              | -               | OFF                |
|                 | POS SED TEQ          |            | Motor Power (Request)        | -               | OFF                |
|                 | POS 5FD 18Q          | Common     | Dynamic Brake (DB)           | ON(ALL)         | ON                 |
|                 | POS SPD TRQ          | Common     | Rotation Direction           | -               | OFF                |
|                 | POS SPD              | Common     | Mode Switch                  | -               | OFF                |
|                 | 500                  | Common     | Speed Reference (V-Ref)      | -               | OFF                |
|                 | 110                  | Common     | Torque Reference (T-Ref)     | -               | OFF                |
| ₽, . 🛛          | Filter 🔄 Hid         | ie 🕺 Stand | lard 🖄 Clear                 |                 |                    |

Information

You can flexibly change the contents that are displayed in the Monitor Window. Refer to the following manual for details.

C Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

9.2.3 I/O Signals Status Monitor

### 9.2.3 I/O Signals Status Monitor

Use the following procedure to check the status of the I/O signals.

- 1. Click the *P* Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select I/O Signal Allocation in the Menu Dialog Box. The I/O Signal Allocation Window will be displayed.

#### 3. Click the Input Signal Tab.

|                           | cation : 0001    | _                    |                                    |             |                                                 |     |            |                                                          |             |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                  |           |
|---------------------------|------------------|----------------------|------------------------------------|-------------|-------------------------------------------------|-----|------------|----------------------------------------------------------|-------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 0001-SGD                  | 75-R70F20A       |                      |                                    |             |                                                 |     |            |                                                          |             |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                  |           |
| Write                     | Change<br>Method |                      | y List                             |             |                                                 |     |            |                                                          |             |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                  |           |
|                           | Allocate Sig     |                      |                                    |             |                                                 |     |            |                                                          |             |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                  |           |
| iput Signal<br>put Signal | Output Sig       | sal                  |                                    |             |                                                 | • 1 | Manual     |                                                          |             |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                  |           |
|                           |                  |                      |                                    |             |                                                 |     |            |                                                          |             |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                  |           |
|                           | and March        | Status               |                                    |             |                                                 | *   | 4.5 I/O SI | anal Connection                                          | 5           |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                  |           |
| CN1-13                    | xis Nam          | Hi                   |                                    |             |                                                 |     | 4.5.1 1/0  | Signal Connecto                                          | r (CN1) Nam | es and Functions                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                  |           |
| CN1-7                     |                  | Hi                   |                                    |             |                                                 |     | 4.5        | I/O Si                                                   | anal        | Connection                                                                                                                                                                                                                     | 5                                                                                                                                                                                                                                                                                |           |
| CN1-8                     |                  | Hi                   |                                    |             |                                                 |     |            |                                                          | 9           |                                                                                                                                                                                                                                | •                                                                                                                                                                                                                                                                                |           |
| CN1-9                     | Axis A           | н                    |                                    |             |                                                 |     | 4.5.1      |                                                          | nal Co      | ppostor (CN1)                                                                                                                                                                                                                  | Names and Functions                                                                                                                                                                                                                                                              |           |
| CN1-10<br>CN1-11          |                  | Hi I                 |                                    |             |                                                 |     | 4.0.1      |                                                          |             |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                  |           |
| CN1-12                    |                  | H                    |                                    |             |                                                 | *   |            | The followin<br>default setti                            |             | es the pin numbers, na                                                                                                                                                                                                         | mes, and functions the I/O signal pin                                                                                                                                                                                                                                            | s for the |
| Allegatio                 | on Method        | . Unar               | allocations                        |             |                                                 |     |            |                                                          |             |                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                  |           |
|                           | _                |                      |                                    |             |                                                 |     |            | Input S                                                  |             | ven in parentheses.                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                  |           |
|                           | xis Nam          | Allocation           |                                    | Polarity    | Status                                          |     |            | Signal                                                   | Pin No.     | Name                                                                                                                                                                                                                           | Function                                                                                                                                                                                                                                                                         | Reference |
| P-OT<br>N-OT              |                  | Possible<br>Possible | Always inactive<br>Always inactive |             | Allow Forward Run<br>Allow Reverse Run          |     |            | /\$/1+                                                   |             | General-purpose                                                                                                                                                                                                                | You can allocate the input signal to use                                                                                                                                                                                                                                         |           |
| /P-CL                     |                  | Possible             | Always inactive                    |             | No Forward External Torque                      |     |            | (P-OT)                                                   | 1           | Sequence Input 1 (For-<br>ward Drive Prohibit Input)                                                                                                                                                                           | with a parameter.<br>(Stops Servomotor drive (to prevent over-                                                                                                                                                                                                                   |           |
| /N-CL                     |                  | Possible             | Always inactive                    |             | No Forward Reverse Torque                       |     |            | /\$12* 8                                                 | 8           | General-purpose<br>Sequence Input 2                                                                                                                                                                                            | travel) when the moving part of the<br>machine exceeds the range of move-                                                                                                                                                                                                        | page 5-27 |
| /DEC                      | Axis A           | Possible             | CN1-9                              | Normal      | Deceleration Limit Switch In                    |     |            | (N-OT)                                                   | 0           | (Reverse Drive Prohibit<br>Input)                                                                                                                                                                                              | ment.)                                                                                                                                                                                                                                                                           |           |
| /EXT1                     |                  | Possible             | CN1-10                             | Normal      | No EXT1 Interrupt Request                       |     |            | /5/3*                                                    |             | General-purpose<br>Sequence Input 3 (Ori-                                                                                                                                                                                      | You can allocate the input signal to use<br>with a parameter.                                                                                                                                                                                                                    |           |
|                           |                  | Possible             | CN1-11                             | Normal      | No EXT2 Interrupt Request                       |     |            | (/DEC)                                                   | 9           | gin Return Deceleration                                                                                                                                                                                                        | (Connects the deceleration limit switch for                                                                                                                                                                                                                                      | -         |
| /EXT2                     |                  | Doctible             | CN1-12                             | Normal      | No SYT2 Internet Remiest                        |     |            | 1                                                        |             | Switch Input)                                                                                                                                                                                                                  | origin return.)                                                                                                                                                                                                                                                                  |           |
| /EXT2<br>/EXT3<br>FSTP    |                  | Possible<br>Possible | CN1-12<br>Always inactive          | Normal -    | No EXT3 Interrupt Request<br>Emergency stop off |     |            | /SI4+<br>(/EXT1)                                         | 10          | Switch Input)<br>General-purpose<br>Sequence Input 4 (Exter-<br>nal Latch Input 1)                                                                                                                                             | origin return.)                                                                                                                                                                                                                                                                  |           |
| /EXT3                     |                  |                      |                                    | -           |                                                 |     |            | /514+                                                    | 10          | General-purpose<br>Sequence Input 4 (Exter-                                                                                                                                                                                    | You can allocate the input signals to use<br>with parameters.<br>(Connect the external signals that latch                                                                                                                                                                        | -         |
| /EXT3                     |                  |                      |                                    | Normal<br>- |                                                 |     |            | /514*<br>(/EXT1)<br>/515*                                |             | General-purpose<br>Sequence Input 4 (Exter-<br>nal Latch Input 1)<br>General-purpose<br>Sequence Input 5 (Exter-                                                                                                               | You can allocate the input signals to use<br>with parameters.                                                                                                                                                                                                                    | -         |
| /EXT3                     |                  |                      |                                    | Normal<br>- |                                                 |     |            | /\$14*<br>(/EXT1)<br>/\$15*<br>(/EXT2)<br>/\$16*         | 11          | General-purpose<br>Sequence input 4 (Exter-<br>nal Latch Input 1)<br>General-purpose<br>Sequence Input 5 (Exter-<br>nal Latch Input 2)<br>General-purpose<br>Sequence Input 6 (Exter-                                          | You can allocate the input signals to use<br>with parameters.<br>(Connect the external signals that latch                                                                                                                                                                        | -         |
| /EXT3                     |                  |                      |                                    | Normal<br>- |                                                 |     |            | /SI4*<br>(/EXT1)<br>/SI5*<br>(/EXT2)<br>/SI6*<br>(/EXT3) | 11          | General-purpose<br>Sequence input 4 (Exter-<br>nal Latch input 5)<br>General-purpose<br>Sequence input 5 (Exter-<br>nal Latch input 2)<br>General-purpose<br>Sequence input 6 (Exter-<br>nal Latch input 3)<br>General-purpose | You can abcode the input signals to use<br>which powerholds.<br>(Convect the external signals that tatch<br>the current feedback pulse counter.)<br>You can allocate the input signal to use<br>with a parameter,<br>aparenter,<br>monter the signal in the IO monter in the IO. |           |

Check the status of the input signals.

#### 4. Click the Output Signal Tab.

| put Sign     | Jutput Sig | nal        |                   |               |                            |
|--------------|------------|------------|-------------------|---------------|----------------------------|
| /tput Signal |            |            |                   |               |                            |
| Monitor      | Mode       | Forced     | Output Mode       |               |                            |
|              | xis Nam    | Status     |                   |               |                            |
| CN1-1.2      | -          | н          |                   |               |                            |
| CN1-23.24    | Axis A     | Hi         |                   |               |                            |
| CN1-25,26    |            | н          |                   |               |                            |
|              |            | _          |                   |               |                            |
|              |            |            |                   |               |                            |
|              |            |            |                   |               |                            |
|              |            |            |                   |               |                            |
|              | _          |            |                   |               |                            |
|              | xis Nam    | Allocation |                   | Polarity      | Status                     |
| /COBN        |            | Possible   | Disabled (not use |               | Positioning Incomplete     |
| /V-CMP       |            | Possible   | Disabled (not use | -             | Speed Non-Coincidence      |
| /TGON        |            | Possible   | Disabled (not use | -             | Motor Stopped              |
| /S-RDY       |            | Possible   | Disabled (not use | -             | Servo Preparation Incomple |
| /CLT         | Axis A     | Possible   | Disabled (not use | -             | No Torque/Thrust Limit De  |
| /VLT         | AND A      | Possible   | Disabled (not use | -             | No Speed Limit Detected    |
| /8K          |            | Possible   | CN1-1,2           | Normal output | Braking                    |
| /WARN        |            | Possible   | Disabled (not use | -             | Normal                     |
| /NEAR        |            | Possible   | Disabled (not use | -             | No Positioning Completion  |
| /PM          |            |            | Disabled (not use |               | Preventative Maintenance I |

Check the status of the output signals.

#### 9.2.3 I/O Signals Status Monitor

Information You can also use the above window to check wiring.

- Checking Input Signal Wiring
  - Change the signal status at the host controller. If the input signal status on the window changes accordingly, then the wiring is correct.
- Checking Output Signal Wiring
- Click the **Force Output Mode** Button. This will force the output signal status to change. If the signal status at the host controller changes accordingly, then the wiring is correct. You cannot use the **Force Output Mode** Button while the servo is ON.
- For details, refer to the following manual.

AC Servo Drive Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

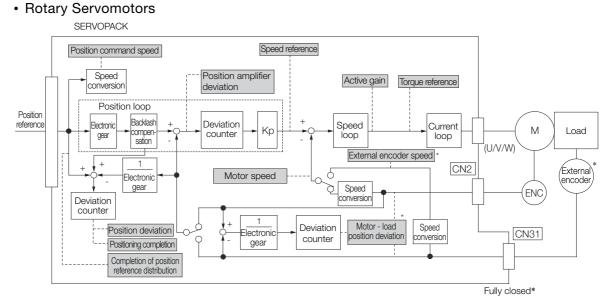
9.3.1 Items That You Can Monitor

## 9.3 Monitoring Machine Operation Status and Signal Waveforms

To monitor waveforms, use the SigmaWin+ trace function or a measuring instrument, such as a memory recorder.

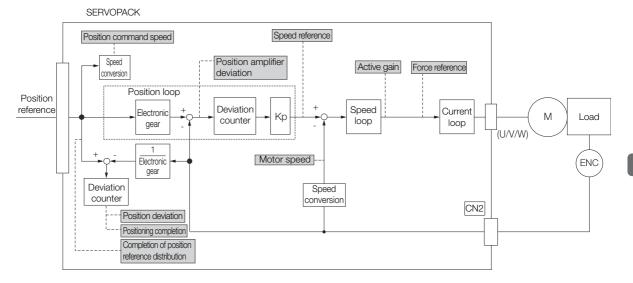
### 9.3.1 Items That You Can Monitor

You can use the SigmaWin+ or a measuring instrument to monitor the shaded items in the following block diagram.



\* This speed is available when fully-closed loop control is being used.

#### Linear Servomotors



Monitoring

9.3.2 Using the SigmaWin+

### 9.3.2 Using the SigmaWin+

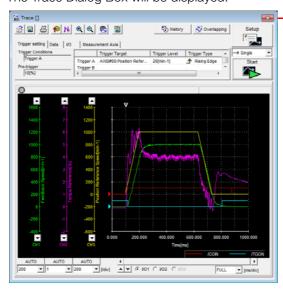
This section describes how to trace data and I/O with the SigmaWin+.

Refer to the following manual for detailed operating procedures for the SigmaWin+.

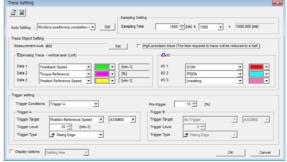
C Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

### **Operating Procedure**

- 1. Click the <u>I</u> Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Trace in the Menu Dialog Box. The Trace Dialog Box will be displayed.



Click this button to display the Trace Setting Dialog Box shown below, and set the data to trace and the trace conditions.



### **Trace Objects**

You can trace the following items.

Data Tracing

| Trace                                                                                                                                                                                                     | Objects                                                                                                                                                                      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul> <li>Torque Reference</li> <li>Feedback Speed</li> <li>Reference Speed</li> <li>Position Reference Speed</li> <li>Position Error (Deviation)</li> <li>Position Amplifier Error (Deviation)</li> </ul> | <ul> <li>Motor - Load Position Deviation</li> <li>Speed Feedforward</li> <li>Torque Feedforward</li> <li>Effective (Active) Gain</li> <li>Main Circuit DC Voltage</li> </ul> |

9.3.2 Using the SigmaWin+

#### • I/O Tracing

|                  | Trace C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Objects                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Input<br>Signals | <ul> <li>/S-ON (Servo ON Input Signal)</li> <li>/P-CON (Proportional Control Input Signal)</li> <li>P-OT (Forward Drive Prohibit Input Signal)</li> <li>N-OT (Reverse Drive Prohibit Input Signal)</li> <li>/ALM-RST (Alarm Reset Input Signal)</li> <li>/P-CL (Forward External Torque/Force Limit Input Signal)</li> <li>/N-CL (Reverse External Torque/Force Limit Input Signal)</li> <li>/N-CL (Reverse External Torque/Force Limit Input Signal)</li> <li>/P-DET (Polarity Detection Input Signal)</li> <li>/DEC (Origin Return Deceleration Switch Input Signal)</li> <li>/EXT1 (External Latch Input 1 Signal)</li> <li>/EXT2 (External Latch Input 3 Signal)</li> <li>/FSTP (Forced Stop Input Signal)</li> <li>/HWBB1 (Hard Wire Base Block Input 1 Signal)</li> <li>/HWBB2 (Hard Wire Base Block Input 2 Signal)</li> </ul> | Output<br>Signals<br>Internal<br>Status | <ul> <li>ALM (Servo Alarm Output Signal)</li> <li>/COIN (Positioning Completion Output<br/>Signal)</li> <li>/V-CMP (Speed Coincidence Detection<br/>Output Signal)</li> <li>/TGON (Rotation Detection Output Signal)</li> <li>/S-RDY (Servo Ready Output Signal)</li> <li>/CLT (Torque Limit Detection Output Signal)</li> <li>/VLT (Speed Limit Detection Output Signal)</li> <li>/VLT (Speed Limit Detection Output Signal)</li> <li>/WARN (Warning Output Signal)</li> <li>/NEAR (Near Output Signal)</li> <li>ALO1 (Alarm Code Output Signal)</li> <li>ALO2 (Alarm Code Output Signal)</li> <li>ALO3 (Alarm Code Output Signal)</li> <li>PAO (Encoder Divided Pulse Output<br/>Phase A Signal)</li> <li>PBO (Encoder Divided Pulse Output<br/>Phase B Signal)</li> <li>PCO (Encoder Divided Pulse Output<br/>Phase C Signal)</li> <li>PDETCMP (Polarity Detection Completed Signal)</li> <li>DEN (Position Reference Distribution<br/>Completed Signal)</li> </ul> |

### 9.3.3 Using the Analog Monitors

Connect a measuring instrument, such as a memory recorder, to the analog monitor connector (CN5) on the SERVOPACK to monitor analog signal waveforms. The measuring instrument is not provided by Yaskawa.

Refer to the following section for details on the connection. *4.8.3 Analog Monitor Connector (CN5)* on page 4-50

### Setting the Monitor Object

Use  $Pn006 = n.\square\squareXX$  and  $Pn007 = n.\square\squareXX$  (Analog Monitor 1 and 2 Signal Selections) to set the items to monitor.

| Line Color      | Signal           | Parameter Setting |
|-----------------|------------------|-------------------|
| White           | Analog monitor 1 | Pn006 = n.□□XX    |
| Red             | Analog monitor 2 | Pn007 = n.□□XX    |
| Black (2 lines) | GND              | -                 |

| Parameter   |                                            | Description                                      |                                                                                                              |                                                                        |  |  |
|-------------|--------------------------------------------|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|--|--|
| Fan         | ameter                                     | Monitor Signal                                   | Output Unit                                                                                                  | Remarks                                                                |  |  |
|             | n.□□00<br>(default<br>setting of<br>Pn007) | Motor Speed                                      | <ul> <li>Rotary Servomotor: 1 V/1,000 min<sup>-1</sup></li> <li>Linear Servomotor: 1 V/1,000 mm/s</li> </ul> | -                                                                      |  |  |
|             | n.□□01                                     | Speed Reference                                  | <ul> <li>Rotary Servomotor:1 V/1,000 min<sup>-1</sup></li> <li>Linear Servomotor:1 V/1,000 mm/s</li> </ul>   | _                                                                      |  |  |
|             | n.□□02<br>(default<br>setting of<br>Pn006) | Torque Reference                                 | 1 V/100% rated torque                                                                                        | -                                                                      |  |  |
|             | n.□□03                                     | Position Deviation                               | 0.05 V/Reference unit                                                                                        | -                                                                      |  |  |
|             | n.□□04                                     | Position Amplifier Devi-<br>ation                | 0.05 V/encoder pulse unit                                                                                    | Position deviation<br>after electronic gear<br>conversion              |  |  |
|             | n.□□05                                     | Position Command<br>Speed                        | <ul> <li>Rotary Servomotor:1 V/1,000 min<sup>-1</sup></li> <li>Linear Servomotor:1 V/1,000 mm/s</li> </ul>   | -                                                                      |  |  |
| Pn006<br>or | n.□□06                                     | Reserved parameter (Do not change.)              | -                                                                                                            | -                                                                      |  |  |
| Pn007       | n.ロロ07                                     | Motor - Load Position<br>Deviation               | 0.01 V/Reference unit                                                                                        | _                                                                      |  |  |
|             | n.□□08                                     | Positioning Completion                           | Positioning completed: 5 V<br>Positioning not completed: 0 V                                                 | Completion is indi-<br>cated by the output voltage.                    |  |  |
|             | n.□□09                                     | Speed Feedforward                                | <ul> <li>Rotary Servomotor:1 V/1,000 min<sup>-1</sup></li> <li>Linear Servomotor:1 V/1,000 mm/s</li> </ul>   | -                                                                      |  |  |
|             | n.□□0A                                     | Torque Feedforward                               | 1 V/100% rated torque                                                                                        | -                                                                      |  |  |
|             | n.□□0B                                     | Active Gain*                                     | 1st gain: 1 V<br>2nd gain: 2 V                                                                               | The gain that is<br>active is indicated<br>by the output volt-<br>age. |  |  |
|             | n.□□0C                                     | Completion of Position<br>Reference Distribution | Distribution completed: 5 V<br>Distribution not completed: 0 V                                               | Completion is indi-<br>cated by the output<br>voltage.                 |  |  |
|             | n.□□0D                                     | External Encoder<br>Speed                        | 1 V/1,000 min <sup>-1</sup>                                                                                  | Value calculated at the motor shaft                                    |  |  |
|             | n.□□10                                     | Main Circuit DC Voltage                          | 1 V/100 V (main circuit DC voltage)                                                                          | -                                                                      |  |  |

\* Refer to the following section for details.

3.12.1 Automatic Gain Switching on page 8-66

### **Changing the Monitor Factor and Offset**

You can change the monitor factors and offsets for the output voltages for analog monitor 1 and analog monitor 2. The relationships to the output voltages are as follows:

| Analog monitor 1                                | Analog Monitor 1 Signal      | Analog Monitor 1                          | Analog Monitor 1       |
|-------------------------------------------------|------------------------------|-------------------------------------------|------------------------|
| output voltage = $(-1) \times \langle$          | Selection (Pn006 = n.□□XX) × | Magnification (Pn552) <sup>+</sup>        | Offset Voltage (Pn550) |
| Analog monitor 2 = $(-1) \times$ output voltage |                              | Analog Monitor 2<br>Magnification (Pn553) | Analog Monitor 2       |

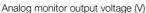
The following parameters are set.

|       | Analog Monitor 1 Offset Voltage |              |                 |              |                |  |
|-------|---------------------------------|--------------|-----------------|--------------|----------------|--|
| Pn550 | Setting Range                   | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | -10,000 to 10,000               | 0.1 V        | 0               | Immediately  | Setup          |  |
|       | Analog Monitor 2 Of             | fset Voltage |                 |              |                |  |
| Pn551 | Setting Range                   | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | -10,000 to 10,000               | 0.1 V        | 0               | Immediately  | Setup          |  |
|       | Analog Monitor 1 Magnification  |              |                 |              |                |  |
| Pn552 | Setting Range                   | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | -10,000 to 10,000               | ×0.01        | 100             | Immediately  | Setup          |  |
|       | Analog Monitor 2 Ma             | agnification |                 |              | ·              |  |
| Pn553 | Setting Range                   | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | -10,000 to 10,000               | ×0.01        | 100             | Immediately  | Setup          |  |

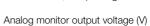
• Example for Setting the Item to Monitor to the Motor Speed (Pn006 = n.□□00) Example

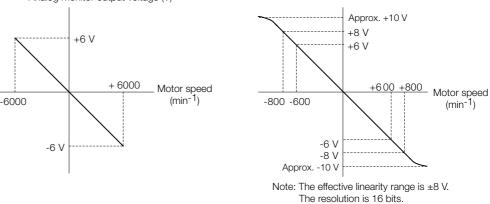
When Pn552 = 100 (Setting Unit: ×0.01)

When Pn552 = 1,000 (Setting Unit: ×0.01)









### Adjusting the Analog Monitor Output

You can manually adjust the offset and gain for the analog monitor outputs for the torque reference monitor and motor speed monitor.

The offset is adjusted to compensate for offset in the zero point caused by output voltage drift or noise in the monitoring system.

The gain is adjusted to match the sensitivity of the measuring system.

The offset and gain are adjusted at the factory. You normally do not need to adjust them.

#### Adjustment Example

An example of adjusting the output of the motor speed monitor is provided below.

| Offset Adju             | istment                                | Gain Adjustment                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                          |  |
|-------------------------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|--|
| Analog monitor output   | voltage<br>t adjustment<br>Motor speed | Analog monitor output                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Voltage<br>Gain<br>adjustment<br>000 [min <sup>-1</sup> ]<br>Motor speed |  |
| Item                    | Specification                          | Item                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Specification                                                            |  |
| Offset Adjustment Range | -2.4 V to 2.4 V                        | Gain Adjustment Range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 100 ±50%                                                                 |  |
| Adjustment Unit         | 18.9 mV/LSB                            | Adjustment Unit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.4%/LSB                                                                 |  |
|                         |                                        | <ul> <li>The gain adjustment range is made using a 100% put value (gain adjustment of 0) as the reference with an adjustment range of 50% to 150%.</li> <li>A setting example is given below.</li> <li>Setting the Adjustment Value to -125 100 + (-125 × 0.4) = 50 [%]<br/>Therefore, the monitor output voltage goes to 5 of the original value.</li> <li>Setting the Adjustment Value to 125 100 + (125 × 0.4) = 150 [%]<br/>Therefore, the monitor output voltage goes to 1 of the original value.</li> </ul> |                                                                          |  |

**Information** • The adjustment values do not use parameters, so they will not change even if the parameter settings are initialized.

- Adjust the offset with the measuring instrument connected so that the analog monitor output value goes to zero. The following setting example achieves a zero output.
  - While power is not supplied to the Servomotor, set the monitor signal to the torque reference.
  - In speed control, set the monitor signal to the position deviation.

#### Preparations

Always check the following before you adjust the analog monitor output.

• The parameters must not be write prohibited.

#### ♦ Applicable Tools

You can use the following tools to adjust analog monitor outputs.

• Offset Adjustment

| Tool Fn No./Function Name C |                                              | Operating Procedure Reference                                                 |
|-----------------------------|----------------------------------------------|-------------------------------------------------------------------------------|
| Digital Operator            | Fn00C                                        | Ω-7-Series Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+                   | Others – Adjust the Analog<br>Monitor Output | G                                                                             |

• Gain Adjustment

| Tool             | Fn No./Function Name                         | Operating Procedure Reference                                                 |
|------------------|----------------------------------------------|-------------------------------------------------------------------------------|
| Digital Operator | Fn00D                                        | Ω-7-Series Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+        | Others – Adjust the Analog<br>Monitor Output |                                                                               |

#### Operating Procedure

Use the following procedure to adjust the analog monitor output.

- 1. Click the <u>I</u> Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Adjust the Analog Monitor Output in the Menu Dialog Box. The Adjust the Analog Monitor Output Dialog Box will be displayed.
- 3. Click the Zero Adjustment or Gain Adjustment Tab.

| Adjust the Analog Monitor Output AXIS#00           |
|----------------------------------------------------|
|                                                    |
| Zero Adjustment Gain Adjustment                    |
| Channel CH1                                        |
| 0 Offset +1 ᠿ∱<br>-1 ᠿ∤                            |
| Monitor Signal Torque reference (1 V/100% rated to |

**4.** While watching the analog monitor, use the +1 and -1 Buttons to adjust the offset. There are two channels: CH1 and CH2. If necessary, click the down arrow on the **Channel** Box and select the channel.

| Adjust the Analog Monitor Output AXIS#00           |
|----------------------------------------------------|
| Zero Adjustment Gain Adjustment                    |
| Analog Monitor Output Offset                       |
| Channel CH1                                        |
| 0 offset<br>0 -1 Q↓                                |
| Monitor Signal Torque reference (1 V/100% rated to |

This concludes adjusting the analog monitor output.

9.4.1 Items That You Can Monitor

# 9.4 Monitoring Product Life

## 9.4.1 Items That You Can Monitor

| Monitor Item                                          | Description                                                                                                                                                                                                                                                                                                           |
|-------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SERVOPACK Installation Envi-<br>ronment               | <ul> <li>The operating status of the SERVOPACK in terms of the installation environment is displayed. Implement one or more of the following actions if the monitor value exceeds 100%.</li> <li>Lower the surrounding temperature.</li> <li>Decrease the load.</li> </ul>                                            |
| Servomotor Installation Environ-<br>ment              | <ul> <li>The operating status of the SERVOPACK in terms of the installation environment is displayed. Implement one or more of the following actions if the monitor value exceeds 100%.</li> <li>Lower the surrounding temperature.</li> <li>Decrease the load.</li> </ul>                                            |
| Built-in Fan Service Life Predic-<br>tion             | The unused status of the SERVOPACK is treated as the 100% value. The value decreases each time the main circuit power supply is turned ON and each time the servo is turned OFF. Use a monitor value of 0% as a guideline for the replacement period. Refer to the following section for part replacement guidelines. |
| Capacitor Service Life Predic-<br>tion                | The unused status of the SERVOPACK is treated as the 100% value. The value decreases each time the main circuit power supply is turned ON and each time the servo is turned OFF. Use a monitor value of 0% as a guideline for the replacement period. Refer to the following section for part replacement guidelines. |
| Surge Prevention Circuit Ser-<br>vice Life Prediction | The unused status of the SERVOPACK is treated as the 100% value. The value decreases each time the main circuit power supply is turned ON and each time the servo is turned OFF. Use a monitor value of 0% as a guideline for the replacement period. Refer to the following section for part replacement guidelines. |
| Dynamic Brake Circuit Service<br>Life Prediction      | The unused status of the SERVOPACK is treated as the 100% value. The value decreases each time the main circuit power supply is turned ON and each time the servo is turned OFF. Use a monitor value of 0% as a guideline for the replacement period. Refer to the following section for part replacement guidelines. |

### 9.4.2 Operating Procedure

Use the following procedure to display the installation environment and service life prediction monitor dialog boxes.

- 1. Click the <u>I</u> Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Life Monitor in the Menu Dialog Box. The Life Monitor Dialog Box will be displayed.

Information With the Digital Operator, you can use Un025 to Un02A to monitor this information.

| Life Monitor AXIS                      | 5#00      |                  |                    | × |  |  |  |
|----------------------------------------|-----------|------------------|--------------------|---|--|--|--|
| Installation Environment Monitor       |           |                  |                    |   |  |  |  |
| Servopack Motor<br>Good(55%) Good(59%) |           |                  |                    |   |  |  |  |
| Life Prediction Monito                 | or        |                  |                    |   |  |  |  |
| Built-in Far                           | Capacitor | Surge Prevention | Circuit DB Circuit |   |  |  |  |
| 99.99%                                 | 99.98%    | 99.98%           | 99.97%             |   |  |  |  |
| 0                                      | 0         | 0                | 0                  |   |  |  |  |
| Close                                  |           |                  |                    |   |  |  |  |

 A value of 100% indicates that the SERVOPACK has not yet been used. The percentage decreases as the SERVOPACK is used and reaches 0% when it is time to replace the SERVOPACK.

### 9.4.3 Preventative Maintenance

You can use preventative maintenance warnings for preventative maintenance.

The SERVOPACK can notify the host controller when it is time to replace any of the main parts.

### **Preventative Maintenance Warning**

An A.9b0 warning (Preventative Maintenance Warning) is detected when any of the following service life prediction values drops to 10% or less: SERVOPACK built-in fan life, capacitor life, inrush current limiting circuit life, and dynamic brake circuit life. You can change the setting of  $PnO0F = n.\square\square\squareX$  to enable or disable these warnings.

| Parameter Description  |                             | Description                                      | When<br>Enabled  | Classifi-<br>cation |
|------------------------|-----------------------------|--------------------------------------------------|------------------|---------------------|
| Pn00F                  | n.□□□0<br>(default setting) | Do not detect preventative maintenance warnings. | After<br>restart | Setup               |
| n.□□□1 Detect preventa |                             | Detect preventative maintenance warnings.        | restart          |                     |

9.5.1 Data for Which Alarm Tracing Is Performed

#### **Alarm Tracing** 9.5

Alarm tracing records data in the SERVOPACK from before and after an alarm occurs. This data helps you to isolate the cause of the alarm.

You can display the data recorded in the SERVOPACK as a trace waveform on the SigmaWin+.

- Information
  Alarms that occur when the power supply is turned ON are not recorded.
  Alarms that occur during the recording of alarm trace data are not recorded.
  - - · Alarms that occur while utility functions are being executed are not recorded.
    - · Alarms that occur while the data tracing function of the SigmaWin+ is being executed are not recorded.

#### Data for Which Alarm Tracing Is Performed 9.5.1

Two types of data are recorded for alarm tracing: numeric data and I/O signal ON/OFF data.

| ON/OFF Data                           |  |  |
|---------------------------------------|--|--|
| ALM                                   |  |  |
| Servo ON command (/S-ON)              |  |  |
| Proportional control command (/P-CON) |  |  |
| Forward torque command (/P-CL)        |  |  |
| Reverse torque command (/N-CL)        |  |  |
| G-SEL1 signal (/G-SEL1)               |  |  |
| ACON                                  |  |  |
|                                       |  |  |

#### Applicable Tools 9.5.2

The following table lists the tools that you can use to perform alarm tracing.

| Tool             | Fn No./Function Name         Operating Procedure Reference       |                                                                                |  |  |
|------------------|------------------------------------------------------------------|--------------------------------------------------------------------------------|--|--|
| Digital Operator | You cannot display alarm tracing data from the Digital Operator. |                                                                                |  |  |
| SigmaWin+        | Troubleshooting –<br>Alarm Trace                                 | C Engineering Tool SigmaWin+<br>Operation Manual (Manual No.: SIET S800001 34) |  |  |

# Fully-Closed Loop Control

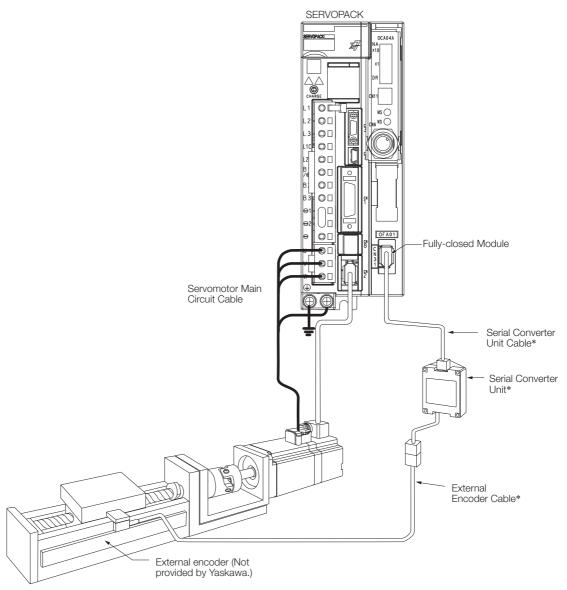
This chapter provides detailed information on performing fully-closed loop control with the SERVOPACK.

| 10.1 | Fully- | Closed System 10-2                                                          |
|------|--------|-----------------------------------------------------------------------------|
| 10.2 | SERV   | OPACK Commissioning Procedure . 10-3                                        |
| 10.3 | Parame | eter Settings for Fully-Closed Loop Control 10-5                            |
|      | 10.3.1 | Control Block Diagram for Fully-Closed Loop Control                         |
|      | 10.3.2 | Setting the Motor Direction and the Machine<br>Movement Direction           |
|      | 10.3.3 |                                                                             |
|      | 10.3.4 | Setting the PAO, PBO, and PCO                                               |
|      | 10.3.5 | (Encoder Divided Pulse Output) Signals 10-7<br>Electronic Gear Setting 10-8 |
|      | 10.3.6 | Alarm Detection Settings 10-8                                               |
|      | 10.3.7 | Analog Monitor Signal Settings 10-9                                         |
|      | 10.3.8 | Setting to Use an External Encoder<br>for Speed Feedback 10-9               |

# 10.1 Fully-Closed System

With a fully-closed system, an externally installed encoder is used to detect the position of the controlled machine and the machine's position information is fed back to the SERVOPACK. High-precision positioning is possible because the actual machine position is fed back directly. With a fully-closed system, looseness or twisting of mechanical parts may cause vibration or oscillation, resulting in unstable positioning.

Refer to the following manual for details on Fully-closed Modules.  $\square \Sigma$ -7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32) The following figure shows an example of the system configuration.



\* The connected devices and cables depend on the type of external linear encoder that is used.

Note: Refer to the following section for details on connections that are not shown above, such as connections to power supplies and peripheral devices.

2.4 Examples of Standard Connections between SERVOPACKs and Peripheral Devices on page 2-27

# **10.2 SERVOPACK Commissioning Procedure**

First, confirm that the SERVOPACK operates correctly with semi-closed loop control, and then confirm that it operates correctly with fully-closed loop control. The commissioning procedure for the SERVOPACK for fully-closed loop control is given below.

Con-**Required Parameter** Step Description Operation trolling Settings Device Set the parameters so that the Check operation of the SERVOPACK operates correctly in entire sequence with semi-closed loop control without a semi-closed loop control load and check the following and without a load. points. Set Pn002 to n.0 DD to Items to Check specify semi-closed loop control. Pn000 (Basic Function • Power supply circuit Select Switch 0) · Are there any errors in the SER-• Pn001 (Basic Function VOPACK? wiring Servomotor wiring Does jogging function correctly Select Switch 1) SERVO-• Pn002 = n.X Encoder wiring when you operate the SERVO-PACK or • Wiring of I/O signal PACK without a load? (External Encoder 1 host conlines from the host con-• Do the I/O signals turn ON and Usage) troller troller OFF correctly? Pn20E (Electronic Gear Servomotor rotation · Is power supplied to the Servo-Ratio (Numerator)) • Pn210 (Electronic Gear motor when the Servo ON comdirection, motor speed, Ratio (Denominator)) and multiturn data mand is sent from the host Operation of safety controller? mechanisms, such as Does the Servomotor operate the brakes and the correctly when a position reference is input by the host controlovertravel mechanisms ler? Check operation with the Servomotor connected to the machine with Connect the Servomotor to the semi-closed loop control. Items to Check machine. Set the moment of inertia · Initial response of the ratio in Pn103 using autotuning system connected to without a host reference. Moment of Inertia Ratio Host con-2 the machine Check that the machine's move-(Pn103) troller Movement direction, ment direction, travel distance, and travel distance, and movement speed agree with the references from the host controller. movement speed as specified by the references from the host controller Set the parameters related to fully-• Pn002 = n.X□□□ closed loop control and move the (External Encoder machine with your hand without Usage) turning ON the power supply to the Pn20A (Number of Servomotor. Check the following **External Scale Pitches**) status with the Digital Operator or Pn20E (Electronic Gear SigmaWin+. Ratio (Numerator)) Check the external • Does the fully-closed feedback • Pn210 (Electronic Gear encoder. pulse counter count up when the Ratio (Denominator)) Items to Check Servomotor moves in the forward 3 • Pn281 (Encoder Output Is the signal from the direction? Resolution) external encoder · Is the travel distance of the • Pn51B (Motor-Load received correctly? machine visually about the same **Position Deviation** as the amount counted by the **Overflow Detection** fully-closed feedback pulse Level) counter? Pn522 (Positioning Note: The unit for the fully-closed feed-Completed Width) back pulse counter is pulses, Pn52A (Multiplier per which is equivalent to the exter-Fully-closed Rotation) nal encoder sine wave pitch.

Continued on next page.

#### Con-**Required Parameter** trolling Step Description Operation Settings Device Perform a program jog-Perform a program jogging operaging operation. tion and confirm that the travel dis-Items to Check tance is the same as the reference Program jogging-related SERVO-4 Does the fully-closed value in Pn531. parameters (Pn530 to PACK When you perform program jogsystem operate correctly . Pn536) for the SERVOPACK ging, start from a low speed and gradually increase the speed. without a load? Operate the SERVO-PACK. Input a position reference and confirm that the SERVOPACK oper-Items to Check Host con-5 Does the fully-closed ates correctly. troller Start from a low speed and gradusystem operate correctly, including the host conally increase the speed. troller?

#### Continued from previous page.

10.3.1 Control Block Diagram for Fully-Closed Loop Control

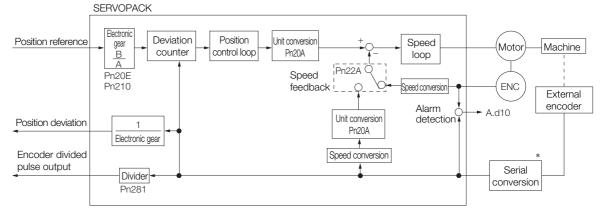
## 10.3 Parameter Settings for Fully-Closed Loop Control

This section describes the parameter settings that are related to fully-closed loop control.

| Parameter to Set                               | Setting                                                                     | Reference   |
|------------------------------------------------|-----------------------------------------------------------------------------|-------------|
| Pn000 = n.□□□X                                 | Motor direction                                                             | - page 10-6 |
| Pn002 = n.X□□□                                 | Pn002 = n.X                                                                 |             |
| Pn20A                                          | Number of external scale pitches                                            | page 10-7   |
| Pn281                                          | Encoder divided pulse output signals (PAO, PBO, and PCO) from the SERVOPACK | page 10-7   |
| Pn20E and Pn210                                | Electronic gear ratio                                                       | page 5-40   |
| Pn51B                                          | Excessive deviation level between Servomotor and load positions             | page 10.9   |
| Pn52A Multiplier for one fully-closed rotation |                                                                             | – page 10-8 |
| Pn006/Pn007                                    | Analog monitor signal                                                       | page 10-9   |
| Pn22A = n.X□□□                                 | Speed feedback method during fully-closed loop control                      | page 10-9   |

### 10.3.1 Control Block Diagram for Fully-Closed Loop Control

The control block diagram for fully-closed loop control is provided below.



\* The connected device depends on the type of external encoder.

Note: You can use either an incremental or an absolute encoder. If you use an absolute encoder, set Pn002 to n.  $\Box 1 \Box \Box$  (Use the absolute encoder as an incremental encoder).

10.3.2 Setting the Motor Direction and the Machine Movement Direction

# 10.3.2 Setting the Motor Direction and the Machine Movement Direction

You must set the motor direction and the machine movement direction. To perform fully-closed loop control, you must set the motor rotation direction with both  $Pn000 = n.\square\square\squareX$  (Direction Selection) and  $Pn002 = n.X\square\square\square$  (External Encoder Usage).

| Parameter                                    |          |                        | Pn002 = n.XDDD (External Encoder Usage) |                      |                     |                      |
|----------------------------------------------|----------|------------------------|-----------------------------------------|----------------------|---------------------|----------------------|
| Falameter                                    |          | n.1000                 |                                         | n.3000               |                     |                      |
| Pn000<br>=n.□□□X<br>(Direction<br>Selection) |          | Reference<br>direction | Forward reference                       | Reverse<br>reference | Forward reference   | Reverse<br>reference |
|                                              | n.□□□0   | Motor direction        | CCW                                     | CW                   | CCW                 | CW                   |
|                                              |          | External<br>encoder    | Forward movement                        | Reverse<br>movement  | Reverse<br>movement | Forward<br>movement  |
|                                              | n.0001 M | Reference<br>direction | Forward reference                       | Reverse<br>reference | Forward reference   | Reverse<br>reference |
|                                              |          | Motor direction        | CW                                      | CCW                  | CW                  | CCW                  |
|                                              |          | External<br>encoder    | Forward movement                        | Reverse<br>movement  | Reverse<br>movement | Forward<br>movement  |

• Phase B leads in the divided pulses for a forward reference regardless of the setting of Pn000 =  $n.\Box\Box\BoxX$ .

• Forward direction: The direction in which the pulses are counted up.

• Reverse direction: The direction in which the pulses are counted down.

### **Related Parameters**

#### ♦ Pn000 = n.□□□X

Refer to the following section for details. 5.4 Motor Direction Setting on page 5-16

### ♦ Pn002 = n.X□□□

When you perform fully-closed loop control, set Pn002 to  $n.1\square\square\square$  or  $n.3\square\square\square$ .

| Pa    | arameter                         | Name          | Meaning                                                             | When<br>Enabled | Classifi-<br>cation |
|-------|----------------------------------|---------------|---------------------------------------------------------------------|-----------------|---------------------|
|       | n.0□□□<br>(default set-<br>ting) |               | Do not use an external encoder.                                     |                 |                     |
| Pn002 | n.1000                           | External      | External encoder moves in forward direction for CCW motor rotation. | After restart   | Setup               |
|       | n.2000                           | Encoder Usage | Reserved parameter (Do not change.)                                 |                 |                     |
|       | n.3000                           |               | External encoder moves in reverse direction for CCW motor rotation. |                 |                     |
|       | n.4000                           |               | Reserved parameter (Do not change.)                                 |                 |                     |

Information

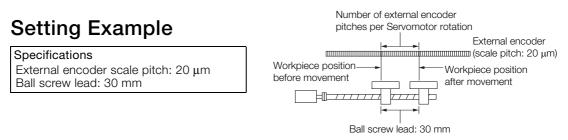
Determine the setting of Pn002 =  $n.X\square\square\square$  as described below.

- Set Pn000 to n. DD (Use the direction in which the linear encoder counts up as the forward direction) and set Pn002 to n.1DD (The external encoder moves in the forward direction for CCW motor rotation).
- Manually rotate the motor shaft counterclockwise.
- If the fully-closed feedback pulse counter counts up, do not change the setting of Pn002 (Pn002 = n.1□□□).
- If the fully-closed feedback pulse counter counts down, set Pn002 to n.3

10.3.3 Setting the Number of External Encoder Scale Pitches

### 10.3.3 Setting the Number of External Encoder Scale Pitches

Set the number of external encoder scale pitches per Servomotor rotation in Pn20A.



If the external encoder is connected directly to the Servomotor, the setting will be 1,500

(30 mm/0.02 mm = 1,500).

Note: 1. If there is a fraction, round off the digits below the decimal point.

2. If the number of external encoder scale pitches per Servomotor rotation is not an integer, there will be deviation in the position loop gain (Kp), feedforward, and position reference speed monitor. This is not relevant for the position loop and it therefore does not interfere with the position accuracy.

### **Related Parameters**

|          | Number of External Scale Pitches |                               |                 |               |                |  |  |
|----------|----------------------------------|-------------------------------|-----------------|---------------|----------------|--|--|
| Pn20A    | Setting Range                    | Setting Unit                  | Default Setting | When Enabled  | Classification |  |  |
| 1 112071 | 4 to 1,048,576                   | 1 scale pitch/revo-<br>lution | 32,768          | After restart | Setup          |  |  |

# 10.3.4 Setting the PAO, PBO, and PCO (Encoder Divided Pulse Output) Signals

Set the position resolution in Pn281 (Encoder Output Resolution).

Enter the number of phase A and phase B edges for the setting.

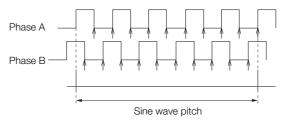
### Setting Example

Specifications External encoder scale pitch: 20 μm Ball screw lead: 30 mm Speed:1,600 mm/s

If a single pulse (multiplied by 4) is output for 1  $\mu$ m, the setting would be 20.

If a single pulse (multiplied by 4) is output for 0.5  $\mu$ m, the setting would be 40.

The encoder divided pulse output would have the following waveform if the setting is 20.



"1" indicates the edge positions. In this example, the set value is 20 and therefore the number of edges is 20.

Note: The upper limit of the encoder signal output frequency (multiplied by 4) is 6.4 Mpps. Do not set a value that would cause the output to exceed 6.4 Mpps. If the output exceeds the upper limit, an A.511 alarm (Overspeed of Encoder Output Pulse Rate) will be output. 10.3.5 Electronic Gear Setting

Example If the setting is 20 and the speed is 1,600 mm/s, the output frequency would be 1.6 Mpps 1600 mm/s

$$\frac{1000 \text{ mm/s}}{0.001 \text{ mm}} = 1,600,000 = 1.6 \text{ Mpps}$$

Because 1.6 Mpps is less than 6.4 Mpps, this setting can be used.

### **Related Parameters**

|       | Encoder Output Re | solution     |                 |               |                |
|-------|-------------------|--------------|-----------------|---------------|----------------|
| Pn281 | Setting Range     | Setting Unit | Default Setting | When Enabled  | Classification |
|       | 1 to 4,096        | 1 edge/pitch | 20              | After restart | Setup          |

Note: 1. The maximum setting for the encoder output resolution is 4,096. If the resolution of the external encoder exceeds 4,096, pulse output will no longer be possible at the reso-

If the resolution of the external encoder exceeds 4,096, pulse output will no longer be possible at the resolution given in *Feedback Resolution of Linear Encoder* on page 5-43.

2. If the setting of Pn281 exceeds the resolution of the external encoder, the A.041 alarm (Encoder Output Pulse Setting Error) will be output.

### 10.3.5 Electronic Gear Setting

Refer to the following section for details.

5.14 Electronic Gear Settings on page 5-40

With fully-closed loop control, the same setting as for a Linear Servomotor is used.

### 10.3.6 Alarm Detection Settings

This section describes the alarm detection settings (Pn51B and Pn52A).

# Pn51B (Motor-Load Position Deviation Overflow Detection Level)

This setting is used to detect the difference between the feedback position of the Servomotor encoder and the feedback load position of the external encoder for fully-closed loop control. If the detected difference exceeds the setting, an A.d10 alarm (Motor-Load Position Error Overflow) will be output.

|       | Motor-Load Position Deviation Overflow Detection Level |                  |                 |              |                     |  |
|-------|--------------------------------------------------------|------------------|-----------------|--------------|---------------------|--|
| Pn51B | Setting Range                                          | Setting Unit     | Default Setting | When Enabled | Classifica-<br>tion |  |
|       | 0 to<br>1,073,741,824                                  | 1 reference unit | 1000            | Immediately  | Setup               |  |

Note: If you set this parameter to 0, A.d10 alarms will not be output and the machine may be damaged.

### Pn52A (Multiplier per Fully-closed Rotation)

Set the coefficient of the deviation between the Servomotor and the external encoder per Servomotor rotation.

This setting can be used to prevent the Servomotor from running out of control due to damage to the external encoder or to detect belt slippage.

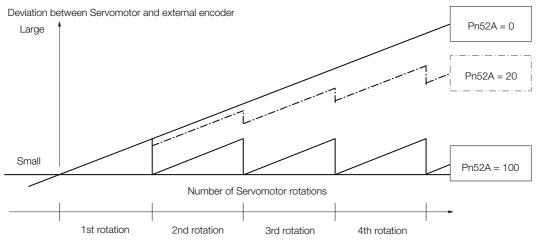
10.3.7 Analog Monitor Signal Settings

### Setting Example

Increase the value if the belt slips or is twisted excessively.

If this parameter is set to 0, the external encoder value will be read as it is.

If you use the default setting of 20, the second rotation will start with the deviation for the first Servomotor rotation multiplied by 0.8.



### Related Parameters

|       | Multiplier per Fully-closed Rotation |              |                 |              |                |  |
|-------|--------------------------------------|--------------|-----------------|--------------|----------------|--|
| Pn52A | Setting Range                        | Setting Unit | Default Setting | When Enabled | Classification |  |
|       | 0 to 100                             | 1%           | 20              | Immediately  | Setup          |  |

## 10.3.7 Analog Monitor Signal Settings

You can monitor the position deviation between the Servomotor and load with an analog monitor.

| Parameter |        | Name                                 | Meaning                                                                         | When<br>Enabled | Classifi-<br>cation |
|-----------|--------|--------------------------------------|---------------------------------------------------------------------------------|-----------------|---------------------|
| Pn006     | n.ロロ07 | Analog Monitor 1<br>Signal Selection | Position deviation between motor and load (output unit: 0.01 V/reference unit). | Immedi-         | Setup               |
| Pn007     | $\sim$ |                                      | Position deviation between motor and load (output unit: 0.01 V/reference unit). | ately           | Selup               |

### 10.3.8 Setting to Use an External Encoder for Speed Feedback

For fully-closed loop control, you normally set a parameter to specify using the motor encoder speed (Pn22A =  $n.0\square\square\square$ ).

If you will use a Direct Drive Servomotor and a high-resolution external encoder, set the parameter to specify using the speed of the external encoder ( $Pn22A = n.1 \square \square \square$ ).

| Parameter |                             | Meaning                     | When<br>Enabled | Classification |
|-----------|-----------------------------|-----------------------------|-----------------|----------------|
| Pn22A     | n.0□□□<br>(default setting) | Use motor encoder speed.    | After restart   | Setup          |
|           | n.1000                      | Use external encoder speed. |                 |                |

Note: This parameter cannot be used if Pn002 is set to n.0 [[] (Do not use external encoder).

10.3.8 Setting to Use an External Encoder for Speed Feedback

# **Safety Functions**

This chapter provides detailed information on the safety functions of the SERVOPACK.

(11)

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11.1.1 Safety Functions

## **11.1 Introduction to the Safety Functions**

### 11.1.1 Safety Functions

Safety functions are built into the SERVOPACK to reduce the risks associated with using the machine by protecting workers from the hazards of moving machine parts and otherwise increasing the safety of machine operation.

Especially when working in hazardous areas inside guards, such as for machine maintenance, the safety function can be used to avoid hazardous moving machine parts.

Refer to the following section for information on the safety function and safety parameters. *Compliance with UL Standards, EU Directives, UK Regulations, and Other Safety Standards* on page xxvi



Products that display the TÜV mark on the nameplate have met the safety standards.

### 11.1.2 Precautions for Safety Functions

#### WARNING To confirm that the HWBB function satisfies the safety requirements of the system, you must conduct a risk assessment of the system. Incorrect use of the safety function may cause injury. • The Servomotor will move if there is an external force (e.g., gravity on a vertical axis) even when the HWBB function is operating. Use a separate means, such as a mechanical brake, that satisfies the safety requirements. Incorrect use of the safety function may cause injury. • While the HWBB function is operating, the Servomotor may move within an electric angle of 180° or less as a result of a SERVOPACK failure. Use the HWBB function for an application only after confirming that movement of the Servomotor will not result in a hazardous condition. Incorrect use of the safety function may cause injury. • The dynamic brake and the brake signal are not safety-related elements. You must design the system so that SERVOPACK failures will not cause a hazardous condition while the HWBB function is operating. Incorrect use of the safety function may cause injury. • Connect devices that satisfy the safety standards for the signals for safety functions. Incorrect use of the safety function may cause injury. The HWBB function does not shut OFF the power to the SERVOPACK or electrically isolate it. Implement measures to shut OFF the power supply to the SERVOPACK before you perform maintenance on it.

There is a risk of electric shock.

11.2.1 Risk Assessment

# 11.2 Hard Wire Base Block (HWBB)

A hard wire base block (abbreviated as HWBB) is a safety function that is designed to shut OFF the current to the Servomotor with a hardwired circuit.

The drive signals to the Power Module that controls the motor current are controlled by the circuits that are independently connected to the two input signal channels to turn OFF the Power Module and shut OFF the motor current.

For safety function signal connections, the input signal is the 0-V common and the output signal is a source output.

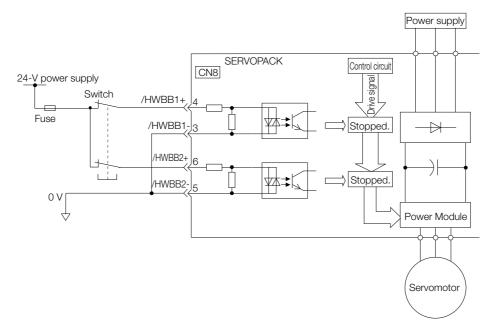
This is opposite to other signals described in this manual.

To avoid confusion, the ON and OFF status of signals for the safety function are defined as follows:

ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.

OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.

The input signal uses the 0-V common. The following figure shows a connection example.



# \_\_\_\_\_

### 11.2.1 Risk Assessment

When using the HWBB, you must perform a risk assessment of the servo system in advance to confirm that the safety level of the standards is satisfied. Refer to the following section for details on the standards.

Compliance with UL Standards, EU Directives, UK Regulations, and Other Safety Standards on page xxvi

Note: To meet performance level e (PLe) in EN ISO 13849-1 and SIL3 in IEC 61508, the EDM1 signal must be monitored by the host controller. If the EDM1 signal is not monitored by the host controller, the level will be safety performance level c (PLc) and SIL1.

The following hazards exist even when the HWBB is operating. These hazards must be included in the risk assessment.

- The Servomotor will move if an external force is applied to it (for example, gravity on a vertical axis). Implement measures to hold the Servomotor, such as installing a separate mechanical brake.
- If a failure occurs such as a Power Module failure, the Servomotor may move within an electric angle of 180°. Ensure safety even if the Servomotor moves.

The rotational angle or travel distance depends on the type of Servomotor as follows:

• Rotary Servomotor: 1/6 rotation max. (rotational angle calculated at the motor shaft)

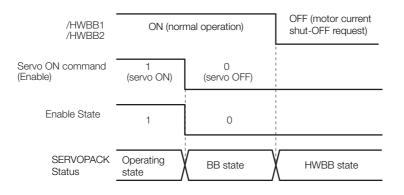
11.2.2 Hard Wire Base Block (HWBB) State

- Direct Drive Servomotor: 1/20 rotation max. (rotational angle calculated at the motor shaft)
- Linear Servomotor: 50 mm max.
- The HWBB does not shut OFF the power to the SERVOPACK or electrically isolate it. Implement measures to shut OFF the power supply to the SERVOPACK before you perform maintenance on it.

### 11.2.2 Hard Wire Base Block (HWBB) State

The SERVOPACK will be in the following state if the HWBB operates. If the /HWBB1 or /HWBB2 signal turns OFF, the HWBB will operate and the SERVOPACK will enter a HWBB state.

• When HWBB Operates after Servo OFF (Power Not Supplied to Motor)



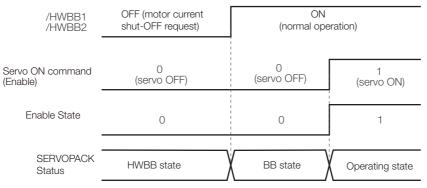
• When HWBB Operates While Power Is Supplied to Servomotor

| /HWBB1<br>/HWBB2             | ON (normal operation) | OFF<br>(motor current shut-OFF request) |
|------------------------------|-----------------------|-----------------------------------------|
| Servo ON command<br>(Enable) | 1 (servo ON)          |                                         |
| Enable State                 | 1                     | 0                                       |
| SERVOPACK<br>Status          | Operating state       | HWBB state                              |

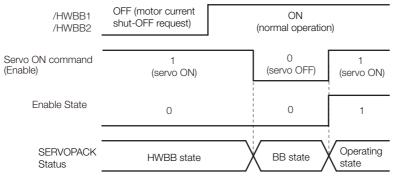
11.2.3 Resetting the HWBB State

### 11.2.3 Resetting the HWBB State

Normally, after the Servo OFF (Enable = 0) command is received and power is no longer supplied to the Servomotor, the /HWBB1 and /HWBB2 signals will turn OFF and the SERVOPACK will enter the HWBB state. If you turn ON the /HWBB1 and /HWBB2 signals in this state, the SERVOPACK will enter a base block (BB) state and will be ready to acknowledge the Servo ON command (Enable = 1).



If the /HWBB1 and /HWBB2 signals are OFF and the Servo ON command (Enable = 1) is received, the HWBB state will be maintained even after the /HWBB1 and /HWBB2 signals are turned ON. Send the SV\_OFF command (Enable = 0) to place the SERVOPACK in the BB state and then send the Servo ON command (Enable = 1).



Note: If the SERVOPACK is placed in the BB state while the main circuit power supply is OFF, the HWBB state will be maintained until the Servo OFF command (Enable = 0) is received.

### 11.2.4 Detecting Errors in HWBB Signal

If only the /HWBB1 or the /HWBB2 signal is input, an A.Eb1 alarm (Safety Function Signal Input Timing Error) will occur unless the other signal is input within 10 seconds. This makes it possible to detect failures, such as disconnection of an HWBB signal.

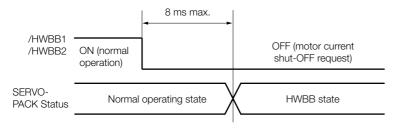


• The A.Eb1 alarm (Safety Function Signal Input Timing Error) is not a safety-related element. Keep this in mind when you design the system.

11.2.5 HWBB Input Signal Specifications

### 11.2.5 HWBB Input Signal Specifications

If an HWBB is requested by turning OFF the two HWBB input signal channels (/HWBB1 and / HWBB2), the power supply to the Servomotor will be turned OFF within 8 ms.



Note: 1. The OFF status is not recognized if the OFF interval of the /HWBB1 or /HWBB2 signal is 0.5 ms or shorter. 2. You can check the status of the input signals by using monitor displays.

### 11.2.6 Operation without a Host Controller

The HWBB will operate even for operation without a host controller.

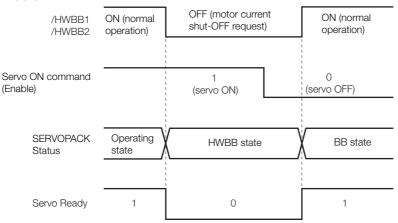
However, if the HWBB operates during execution of the following functions, leave the execution mode for the function and then enter it again to restart operation. Operation will not be restarted simply by turning OFF the /HWBB1 and /HWBB2 signals.

| Applicable Functions                                                                                                                                                                                                    | Resetting the HWBB State                                                                                                                                                                                                                                |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| <ul> <li>Jogging</li> <li>Origin search</li> <li>Program jogging</li> <li>Automatic adjustment without<br/>host reference</li> <li>Easy FFT</li> <li>Adjustment of motor current<br/>detection signal offset</li> </ul> | Function execution status       Function execution mode       Function for the function execution mode       Not function execution mode         /HWBB1       ON (normal /HWBB1       ON (normal /HWBB1       ON (normal /HWBB1       ON (normal /HWBB1 |  |  |
|                                                                                                                                                                                                                         | SERVOPACK Operating HWBB state BB state Operating state                                                                                                                                                                                                 |  |  |

### 11.2.7 Servo Ready

The Servo ON command (Enable = 1) signal will not be acknowledged in the HWBB state. Therefore, the Servo Ready bit will be 0. The Servo Ready bit will change to 1 when both the /HWBB1 and /HWBB2 signals are ON and the servo is OFF (BB state).

The following example is for when a servo alarm does not occur when the main circuit power supply is turned ON.



### 11.2.8 /BK (Brake Output) Signal

If the HWBB operates when the /HWBB1 or /HWBB2 signal is OFF, the /BK (Brake) signal will turn OFF. At that time, the setting in Pn506 (Brake Reference - Servo OFF Delay Time) will be disabled. Therefore, the Servomotor may be moved by external force until the actual brake becomes effective after the /BK signal turns OFF.



 The brake signal is not a safety-related element. You must design the system so that a hazardous condition does not occur even if the brake signal fails in the HWBB state. Also, if a Servomotor with a Brake is used, keep in mind that the brake in the Servomotor is used only to prevent the moving part from being moved by gravity or an external force and it cannot be used to stop the Servomotor.

11.2.9 Stopping Methods

### 11.2.9 Stopping Methods

If the /HWBB1 or /HWBB2 signal turns OFF and the HWBB operates, the Servomotor will stop according to the stop mode that is set for stopping the Servomotor when the servo turns OFF (Pn001 =  $n.\square\square\squareX$ ). However, if the dynamic brake is enabled (Pn001 =  $n.\square\square\squareO$  or  $n.\square\square\square$ ), observe the following precautions.



- The dynamic brake is not a safety-related element. You must design the system so that a hazardous condition does not occur even if the Servomotor coasts to a stop in the HWBB state. Normally, we recommend that you use a sequence that returns to the HWBB state after stopping for a reference.
- If the application frequently uses the HWBB, stopping with the dynamic brake may result in the deterioration of elements in the SERVOPACK. To prevent internal elements from deteriorating, use a sequence in which the HWBB state is returned to after the Servomotor has come to a stop.

### 11.2.10 ALM (Servo Alarm) Signal

The ALM (Servo Alarm) signal is not output in the HWBB state.

11.3.1 EDM1 Output Signal Specifications

## 11.3 EDM1 (External Device Monitor)

The EDM1 (External Device Monitor) signal is used to monitor failures in the HWBB. Connect the monitor signal as a feedback signal, e.g., to the Safety Unit.

Note: To meet performance level e (PLe) in EN ISO 13849-1 and SIL3 in IEC 61508, the EDM1 signal must be monitored by the host controller. If the EDM1 signal is not monitored by the host controller, the level will be safety performance level c (PLc) and SIL1.

#### • Failure Detection Signal for EDM1 Signal

The relationship between the EDM1, /HWBB1, and /HWBB2 signals is shown below.

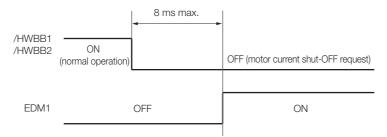
Detection of failures in the EDM1 signal circuit can be achieved by using the status of the /HWBB1, /HWBB2, and EDM1 signals in the following table. A failure can be detected by checking the failure status, e.g., when the power supply is turned ON.

| Signal | Logic |     |     |     |
|--------|-------|-----|-----|-----|
| /HWBB1 | ON    | ON  | OFF | OFF |
| /HWBB2 | ON    | OFF | ON  | OFF |
| EDM1   | OFF   | OFF | OFF | ON  |

• The EDM1 signal is not a safety output. Use it only for monitoring for failures.

## 11.3.1 EDM1 Output Signal Specifications

If an HWBB is requested by turning OFF the two HWBB input signal channels (/HWBB1 and /HWBB2) when the safety function is operating normally, the EDM1 output signal will be turned ON within 8 ms.



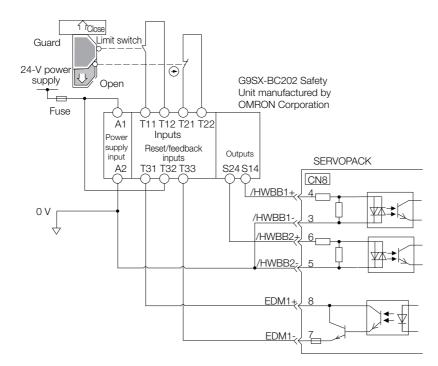
11.4.1 Connection Example

## **11.4 Applications Examples for Safety Functions**

This section provides examples of using the safety functions.

## 11.4.1 Connection Example

In the following example, a Safety Unit is used and the HWBB operates when the guard is opened.



When the guard is opened, both the /HWBB1 and the /HWBB2 signals turn OFF, and the EDM1 signal turns ON. Because the feedback circuit is ON while the guard is closed, the Safety Unit is reset, the /HWBB1 and the / HWBB2 signals turn ON, and the operation is enabled.

Note: The EDM1 signal is used as a source output. Connect the EDM1 so that the current flows from EMD1+ to EMD1-.

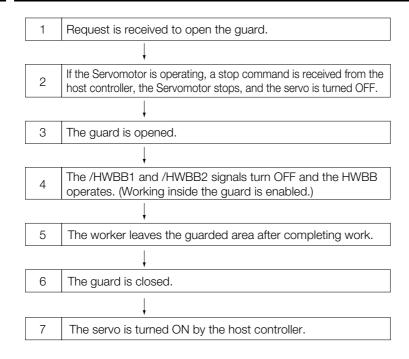
## 11.4.2 Failure Detection Method

If a failure occurs (e.g., the /HWBB1 or the /HWBB2 signal remains ON), the Safety Unit is not reset when the guard is closed because the EDM1 signal remains OFF. Therefore starting is not possible and a failure is detected.

In this case the following must be considered: an error in the external device, disconnection of the external wiring, short-circuiting in the external wiring, or a failure in the SERVOPACK. Find the cause and correct the problem.

11.4.3 Procedure

## 11.4.3 Procedure



## **11.5 Validating Safety Functions**

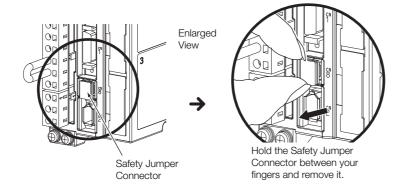
When you commission the system or perform maintenance or SERVOPACK replacement, you must always perform the following validation test on the HWBB function after completing the wiring. (It is recommended that you keep the confirmation results as a record.)

- When the /HWBB1 and /HWBB2 signals turn OFF, confirm that the Digital Operator displays **Hbb** and that the Servomotor does not operate.
- Monitor the ON/OFF status of the /HWBB1 and /HWBB2 signals. If the ON/OFF status of the signals do not coincide with the display, the following must be considered: an error in the external device, disconnection of the external wiring, short-circuiting in the external wiring, or a failure in the SERVOPACK. Find the cause and correct the problem.
- Confirm that the EDM1 signal is OFF while in normal operation by using the feedback circuit input display of the connected device.

# 11.6 Connecting a Safety Function Device

Use the following procedure to connect a safety function device.

1. Remove the Safety Jumper Connector from the connector for the safety function device (CN8).



- 2. Connect the safety function device to the connector for the safety function device (CN8).
- Note: If you do not connect a safety function device, leave the Safety Jumper Connector connected to the connector for the safety function device (CN8). If the SERVOPACK is used without the Safety Jumper Connector connected to CN8, no current will be supplied to the Servomotor and no motor torque will be output. In this case, **Hbb** will be displayed on the Digital Operator.

# **DeviceNet Functions**

Setting the Coordinate System ..... 12-2 12.1 Coordinate System Selection ..... 12-2 12.1.1 Setting the Reference Units per Machine 12.1.2 12.2 Origin Returns ..... 12-3 Origin Return Type ..... 12-3 12.2.1 12.2.2 Parameter Settings ..... 12-3 12.2.3 Setting the Origin ..... 12-5 12.3 Positioning .....12-6 Acceleration/Deceleration Patterns ..... 12-6 12.3.1 12.3.2 Parameter Settings ..... 12-11 12.4 Positioning after Continuous Operation ...... 12-13 12.4.1 Positioning Patterns after Continuous 12.4.2 Parameter Settings ..... 12-14 12.5 12.5.1 Action Definition Settings ..... 12-16 12.5.2 Initialization Functions ..... 12-17

This chapter provides details on settings required to use the DeviceNet functions.

12.1.1 Coordinate System Selection

## 12.1 Setting the Coordinate System

You must set whether the SERVOPACK is used with a linear machine or a rotary machine. If a rotary system is specified, you can clear the current position to 0 each time the machine revolves one time.

## 12.1.1 Coordinate System Selection

You must change the setting of this parameter to use a rotary machine. If you specify a rotary system, you can set the unit for the current position and other values (for example, to 0.001°) by setting the gear ratio and the number of reference units per machine revolution. Also if you specify a rotary system, the valid range for software limits and other settings will be one machine revolution.

| Parameter |                       | Meaning                                                                                                                                                                     |  |
|-----------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| PnB12     | b.0000 0000 0000 0000 | Use the SERVOPACK with a machine with a linear coordinate system.<br>(Default setting)                                                                                      |  |
|           | b.0000 0000 0000 0001 | Use the SERVOPACK with a machine with a rotary coordinate system. You can set PnB13 so that the current position will be cleared to 0 after each revolution of the machine. |  |

## 12.1.2 Setting the Reference Units per Machine Revolution

If the SERVOPACK is connected to a machine with a rotary coordinate system, the number of reference units per revolution of the machine can be set in PnB13 so that the current position is automatically cleared to 0. For example, if an electronic gear is set for a reference unit of 0.001°, the current position will be given between 0.000° and 359.999°.

The setting of this parameter is ignored when a linear coordinate system is specified.

|       | Reference Units per Machine Revolution                  |                  |         |               |
|-------|---------------------------------------------------------|------------------|---------|---------------|
| PnB13 | Setting Range Setting Unit Default Setting When Enabled |                  |         |               |
|       | 1 to 1,500,000                                          | 1 reference unit | 360,000 | After restart |

## 12.2 Origin Returns

An origin return must be performed after the power supply is turned ON to align the position of the Servomotor with the position of the machine. An origin return, however, is not required if an absolute encoder is used.

## 12.2.1 Origin Return Type

The SERVOPACK supports the following three types of origin returns.

| Origin Return Type | Function                                                                                                                                         |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Туре 0             | An origin return is based on the Home Flag and the detection of phase C of the encoder.                                                          |
| Туре 1             | An origin return is based only on the Home Flag.<br>The axis travels at the origin approach speed in the specified origin return direc-<br>tion. |
| Туре 3             | An origin return is based only on the detection of phase C of the encoder.                                                                       |

Refer to the following section for details on origin returns. *13.3.3 Origin Returns* on page 13-15

## 12.2.2 Parameter Settings

### **Connecting the Origin Signal Input**

To use an origin return, wire the SERVOPACK CN1 connector pin that corresponds to the switch for the origin signal input shown in the following table.

| Туре  | Signal Name | Connector Pin | Meaning             |
|-------|-------------|---------------|---------------------|
| Input | /HOME       | CN1-11        | Origin Signal Input |

## Enabling/Disabling the Origin Signal Input

You can disable the origin signal input by changing the settings of a parameter in the SERVO-PACK. If the input is disabled, wiring the origin signal input is not required.

|       | Parameter             | Meaning                                                                   |
|-------|-----------------------|---------------------------------------------------------------------------|
|       | b.0000 0000 0000 0000 | The origin signal input is disabled.                                      |
| PnBA4 | b.0000 0000 1000 0000 | The origin signal input (HOME) is input from CN1-11.<br>(Default setting) |

## Setting the Origin Signal Input Polarity

This parameter sets the polarity of the origin signal input that will be active.

|       | Parameter             | Meaning                                                                                                                                                                                                      |  |
|-------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| PnBA3 | b.0000 0000 0000 0000 | The origin signal input is active while the external switch is<br>open.<br>(Default setting)<br>With this setting, the position where the external switch<br>changes from closed to open will be the origin. |  |
|       | b.0000 0000 1000 0000 | The origin signal input is active while the external switch is closed.<br>With this setting, the position where the external switch changes from open to closed will be the origin.                          |  |

12.2.2 Parameter Settings

## Setting the Origin Return Direction

The following parameter sets the origin return direction.

If the origin signal input is active when an origin return starts (i.e., if the machine is near the origin), the machine will first move in the opposite direction from the specified origin return direction. Then, when the origin signal input becomes inactive, the machine will move in the origin return direction and the origin return will be started.

|       | Parameter             | Meaning                                                                     |
|-------|-----------------------|-----------------------------------------------------------------------------|
|       | b.0000 0000 0000 0000 | Origin returns are performed in the forward direction.                      |
| PnB01 | b.0000 0000 0000 0001 | Origin returns are performed in the reverse direction.<br>(Default setting) |

## Setting the Origin Return Speeds

The following parameters set the speeds for origin returns.

The speed that is set for the Origin Return Approach Speed is used from the start of an origin return until the origin signal input or phase C of the encoder is detected. The speed that is set for the Origin Return Creep Speed is used from when the origin signal input or phase C of the encoder is detected to position to the origin.

Refer to the following section for details.

13.3.3 Origin Returns on page 13-15

|       | Origin Approach Speed     |                    |                 |              |  |
|-------|---------------------------|--------------------|-----------------|--------------|--|
| PnB03 | Setting Range             | Setting Unit       | Default Setting | When Enabled |  |
|       | 1 to 115,343,500          | 1 reference unit/s | 20,000          | Immediately  |  |
|       | Origin Return Creep Speed |                    |                 |              |  |
| PnB04 | Setting Range             | Setting Unit       | Default Setting | When Enabled |  |
|       | 1 to 115,343,500          | 1 reference unit/s | 10,000          | Immediately  |  |

## Final Travel Distance for Origin Return

The Final Travel Distance for Origin Return parameter sets the final origin position a certain distance away from the origin signal input or phase C of the encoder. For example, if reverse is the origin return direction and the Final Travel Distance for Origin Returns parameter is set to 100, the origin will be set to 100 reference units in the reverse direction from where the origin signal input was detected.

|       | Final Travel Distance for Origin Return                 |                  |   |             |  |
|-------|---------------------------------------------------------|------------------|---|-------------|--|
| PnB05 | Setting Range Setting Unit Default Setting When Enabled |                  |   |             |  |
|       | 0 to 2,147,483,647                                      | 1 reference unit | 0 | Immediately |  |

## **Origin Offset**

If an absolute encoder is used, the offset from the origin of the encoder to the origin of the machine must be recorded in the SERVOPACK.

|       | Origin Offset                      |                  |                 |              |  |
|-------|------------------------------------|------------------|-----------------|--------------|--|
| PnB09 | Setting Range                      | Setting Unit     | Default Setting | When Enabled |  |
| THEOU | -2,147,483,647 to<br>2,147,483,647 | 1 reference unit | 0               | Immediately  |  |

## 12.2.3 Setting the Origin

There are the following two ways to set the origin when an absolute encoder is used.

### **Editing Parameters to Set Origin**

Use the following procedure to set the origin by editing parameters.

- 1. Use continuous operation or other means to move the axis to the origin position of the machine.
- 2. Read the current position.
  - Read the current position from the response data.
  - Use an explicit message to read the Current Position attribute
- **3.** Reverse the sign of the current position and write it to the parameter. For example, if the current position is 1,000, write -1,000 to PnB09.
- 4. Reset the Module.

When the Module is reset, the data set in PnB09 will be written to nonvolatile memory in the SERVO-PACK.

### Using an Explicit Message to Set Origin

Use the following procedure to set the origin with an explicit message.

- 1. Use continuous operation or other means to move the axis to the origin position of the machine.
- 2. Write a value to attribute 17 of object 0x24.

It does not matter what value is used. The offset amount will be calculated in the SERVOPACK and written to PnB09.

3. Reset the Module.

When the Module is reset, the data set in PnB09 will be written to nonvolatile memory in the SERVO-PACK.

12.3.1 Acceleration/Deceleration Patterns

# 12.3 Positioning

## 12.3.1 Acceleration/Deceleration Patterns

The following acceleration/deceleration patterns can be achieved by combining acceleration/ deceleration types with filter selections.

|                           |                                                                         | Accelera                                                                                                          | tion/Deceleration Type (Pr                                                                                        | 1B26)                                                                                                              |
|---------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Parameter                 |                                                                         | 0000h: None.                                                                                                      | 0001h:<br>Symmetric Linear                                                                                        | 0003h:<br>Asymmetric Linear                                                                                        |
|                           | 0000h: None.                                                            | No acceleration/deceleration                                                                                      | Symmetric linear accel-<br>eration/deceleration<br>Constant acceleration/<br>deceleration rates <sup>*1</sup>     | Asymmetric linear accel-<br>eration/deceleration<br>Constant acceleration/<br>deceleration rates <sup>*1</sup>     |
| Filter                    | 0001h: Expo-<br>nential accel-<br>eration/<br>deceleration              | Exponential acceleration/<br>deceleration<br>Constant acceleration/<br>deceleration times <sup>*2</sup>           | _                                                                                                                 | _                                                                                                                  |
| Selec-<br>tion<br>(PnB29) | 0002h: Expo-<br>nential accel-<br>eration/<br>deceleration<br>with bias | Exponential acceleration/<br>deceleration with bias<br>Constant acceleration/<br>deceleration times <sup>*2</sup> | _                                                                                                                 | _                                                                                                                  |
|                           | 0003h: Mov-<br>ing<br>average                                           | Symmetric linear accelera-<br>tion/deceleration<br>Constant acceleration/<br>deceleration times <sup>*2</sup>     | Symmetric S-curve<br>acceleration/decelera-<br>tion<br>Constant acceleration/<br>deceleration rates <sup>*1</sup> | Asymmetric S-curve<br>acceleration/decelera-<br>tion<br>Constant acceleration/<br>deceleration rates <sup>*1</sup> |

\*1. "Constant acceleration/deceleration rates" indicates that the rate of acceleration and deceleration will be constant. If the feed speed is changed, the time that is required for acceleration/deceleration will change.

\*2. "Constant acceleration/deceleration times" indicates that even if the feed speed is changed, the time that is required for acceleration/deceleration will not change and the acceleration/deceleration rates will change.

Note: Any combination that is not shown above must not be used because acceleration/deceleration will not be performed correctly.

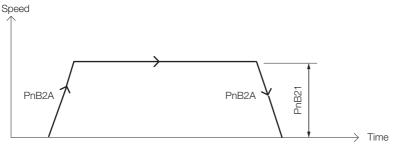
# Symmetric Linear Acceleration/Deceleration (Constant Acceleration/Deceleration Rates)

With symmetric linear acceleration/deceleration, the acceleration/deceleration rates are determined by the Acceleration Rate parameter.

The time T that is required during a positioning operation for the reference to reach the feed speed in PnB21 is calculated as follows:

 $T[s] = \frac{Feed Speed (PnB21)}{Acceleration Rate (PnB2A)}$ 

If this acceleration/deceleration pattern is used, the acceleration/deceleration rates will remain constant even if the feed speed in PnB21 is changed.



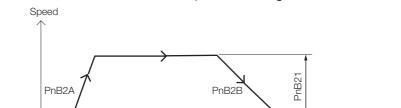
# Asymmetric Linear Acceleration/Deceleration (Constant Acceleration/Deceleration Rates)

With asymmetric linear acceleration/deceleration, the acceleration and deceleration rates can be set separately.

For example, for the deceleration rate, the time T that is required to stop during a positioning operation from when the reference is at the feed speed set in PnB21 can be calculated as follows:

 $T[s] = \frac{Feed Speed (PnB21)}{Deceleration Rate (PnB2B)}$ 

If this acceleration/deceleration pattern is used, the acceleration/deceleration rates will remain constant even if the feed speed is changed.

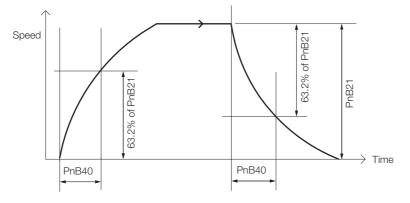


#### Exponential Acceleration/Deceleration (Constant Acceleration/Deceleration Times)

→ Time

With exponential acceleration/deceleration, the acceleration/deceleration rates are determined by two parameters, PnB21 (Feed Speed) and PnB40 (Time Constant for Exponential Acceleration/Deceleration). For PnB40 (Time Constant for Exponential Acceleration/Deceleration), set the time that is required to reach 63.2% of the feed speed set in PnB21. The acceleration/ deceleration time will be approx. 3.91 times the value of PnB40 in milliseconds.

If this acceleration/deceleration pattern is used, the acceleration/deceleration times will remain constant even if the feed speed in PnB21 is changed.



12.3.1 Acceleration/Deceleration Patterns

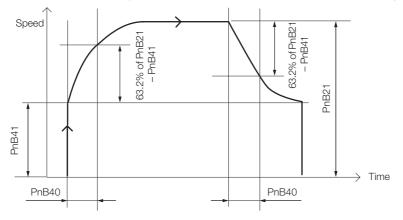
# Exponential Acceleration/Deceleration with Bias (Constant Acceleration/Deceleration Times)

For exponential acceleration/deceleration with a bias, a bias is applied to the acceleration rate and deceleration rate. Set the time that is required for the feed speed to reach the following speed set in PnB40 (Time Constant for Exponential Acceleration/Deceleration).

Feed speed = PnB41 (Exponential Acceleration/Deceleration Bias Speed) + (PnB21 (Feed Speed) – PnB41 (Exponential Acceleration/Deceleration Bias Speed)) × 0.632

The acceleration/deceleration time will be approx. 3.91 times the value of PnB40 in milliseconds.

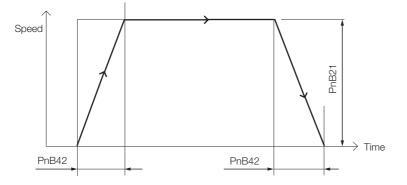
If this acceleration/deceleration pattern is used, the acceleration/deceleration times will remain constant even if the feed speed is changed. If the Exponential Acceleration/Deceleration Bias Speed parameter is set to 0, the operation will be exactly the same as for *Exponential Acceleration/Decelerati* 



# Symmetric Linear Acceleration/Deceleration (Constant Acceleration/Deceleration Times)

With symmetric linear acceleration/deceleration, the acceleration/deceleration rates are determined by two parameters, PnB21 (Feed Speed) and PnB42 (Average Movement Time Filter Time Constant).

If this acceleration/deceleration pattern is used, the acceleration/deceleration times will remain constant even if the feed speed in PnB21 is changed.



12-8

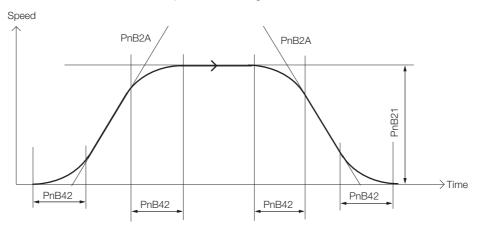
# Symmetric S-Curve Acceleration/Deceleration (Constant Acceleration/Deceleration Rates)

First, symmetric S-curve acceleration/deceleration is the same as symmetric linear acceleration/deceleration in that the acceleration and deceleration rates are both determined by PnB2A (Acceleration Rate). With an S-curve pattern, however, the corners when starting and just before and after the feed speed set in PnB21 are rounded by using a filter. Set the time for rounding off the corners in PnB42 (Average Movement Time Filter Time Constant).

The time T that is required during a positioning operation for the reference to reach the feed speed in PnB21 is calculated as follows:

 $T [ms] = PnB42 + (\frac{PnB21}{PnB2A}) \times 1,000$ 

If this acceleration/deceleration pattern is used, the acceleration/deceleration rates will remain constant even if the feed speed is changed.



12.3.1 Acceleration/Deceleration Patterns

# Asymmetric S-Curve Acceleration/Deceleration (Constant Acceleration/Deceleration Rates)

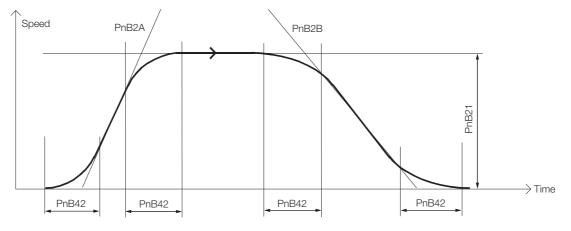
With Asymmetric S-Curve Acceleration/Deceleration, the operation is the same as for symmetric S-curve acceleration/deceleration except that the acceleration and deceleration rates can be set separately.

First, the operation is the same as for asymmetric linear acceleration/deceleration in that the acceleration and deceleration rates are created from PnB2A (Acceleration Rate) and PnB2B (Deceleration Rate). With an S-curve pattern, however, the corners when starting and completing positioning and just before and after the feed speed set in PnB21 are rounded by using a filter. Set the time for rounding off the corners in PnB42 (Average Movement Time Filter Time Constant).

The time T that is required during a positioning operation for the reference to reach the feed speed in PnB21 is calculated as follows:

 $T [ms] = PnB42 + (\frac{PnB21}{PnB2A}) \times 1000$ 

If this acceleration/deceleration pattern is used, the acceleration/deceleration rates will remain constant even if the feed speed is changed.



## 12.3.2 Parameter Settings

## **Feed Speed**

This parameter sets the feed speed to use for positioning. You can change the setting of this parameter with a command message.

|       | Feed Speed       |                    |                 |              |
|-------|------------------|--------------------|-----------------|--------------|
| PnB21 | Setting Range    | Setting Unit       | Default Setting | When Enabled |
|       | 1 to 115,343,500 | 1 reference unit/s | 400,000         | Immediately  |

## Setting the Acceleration/Deceleration Pattern

The acceleration/deceleration pattern is set in PnB26 (Acceleration/Deceleration Type) and PnB29 (Filter Selection).

| Par               | Parameter Meaning |                                                                 |
|-------------------|-------------------|-----------------------------------------------------------------|
| 0000h No accelera |                   | No acceleration/deceleration                                    |
| PnB26             | 0001h             | Symmetrical linear acceleration/deceleration                    |
|                   | 0003h             | Asymmetrical linear acceleration/deceleration (Default setting) |
|                   | 0000h             | No filter (Default setting)                                     |
| PnB29             | 0001h             | Exponential filter                                              |
| PIID29            | 0002h             | Exponential filter with bias                                    |
|                   | 0003h             | Average movement time filter                                    |

The relationship between PnB26 (Acceleration/Deceleration Type) and PnB29 (Filter Selection) when editing the Profile Type in object 0x25 via DeviceNet is shown in the following table.

| Profile Type | Acceleration/Deceleration Pattern                                                          | PnB26 | PnB29 |
|--------------|--------------------------------------------------------------------------------------------|-------|-------|
| 0            | Asymmetric linear acceleration/deceleration (constant acceleration/deceleration rates)     | 0003h | 0000h |
| 1            | Asymmetric S-curve acceleration/deceleration (constant acceleration/deceleration rates)    | 0003h | 0003h |
| 2            | Exponential acceleration/deceleration (constant accelera-<br>tion/deceleration times)      | 0000h | 0001h |
| 240          | Symmetric linear acceleration/deceleration (constant acceleration/deceleration rates)      | 0001h | 0000h |
| 242          | Exponential acceleration/deceleration with bias (constant acceleration/deceleration times) | 0000h | 0002h |
| 243          | Symmetric linear acceleration/deceleration (constant acceleration/deceleration times)      | 0000h | 0003h |
| 244          | Symmetric S-curve acceleration/deceleration (constant acceleration/deceleration rates)     | 0001h | 0003h |
| 245          | No acceleration/deceleration                                                               | 0000h | 0000h |

## Setting the Acceleration Rate and Deceleration Rate

These parameters set the acceleration and deceleration rates that are used for positioning, origin returns, and continuous operation.

|        | Acceleration Rate          |                                 |                 |              |
|--------|----------------------------|---------------------------------|-----------------|--------------|
| PnB2A  | Setting Range              | Setting Unit                    | Default Setting | When Enabled |
| T HBER | 15,625 to<br>2,047,968,750 | 1 reference unit/s <sup>2</sup> | 4,000,000       | Immediately  |
|        | Deceleration Rate          |                                 |                 |              |
| PnB2B  | Setting Range              | Setting Unit                    | Default Setting | When Enabled |
|        | 15,625 to<br>2,047,968,750 | 1 reference unit/s <sup>2</sup> | 4,000,000       | Immediately  |

12.3.2 Parameter Settings

## Setting the Exponential Acceleration/Deceleration Rate

This parameter sets the time constant for the exponential acceleration/deceleration filter when exponential acceleration/deceleration is used.

|       | Time Constant for Exponential Acceleration/Deceleration |              |                 |              |
|-------|---------------------------------------------------------|--------------|-----------------|--------------|
| PnB40 | Setting Range                                           | Setting Unit | Default Setting | When Enabled |
|       | 4 to 1,000                                              | 1 ms         | 4               | Immediately  |

This parameter sets the bias speed when exponential acceleration/deceleration with a bias is used.

|   |       | Exponential Acceleration/Deceleration Bias Speed |                    |                 |              |
|---|-------|--------------------------------------------------|--------------------|-----------------|--------------|
| 1 | PnB41 | Setting Range                                    | Setting Unit       | Default Setting | When Enabled |
|   |       | 0 to 115,343,500                                 | 1 reference unit/s | 0               | Immediately  |

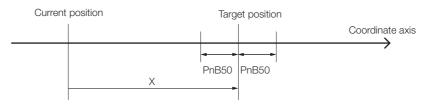
## Setting the Average Movement Time Filter

This parameter sets the time constant for the average movement time filter when S-curve acceleration/deceleration or linear acceleration/deceleration with constant acceleration/deceleration times is used.

|       | Average Movement Time Filter Time Constant |              |                 |              |
|-------|--------------------------------------------|--------------|-----------------|--------------|
| PnB42 | Setting Range                              | Setting Unit | Default Setting | When Enabled |
|       | 4 to 4,000                                 | 1 ms         | 25              | Immediately  |

## Setting a Positioning Completed Check

This parameter sets the positioning completed width that is used after starting positioning to determine when positioning has been completed. If the positioning completed width is set to 0, a check for the completion of positioning will not be performed. Also, the On Target Position bit in the response message for I/O communications will not change to 1.



Positioning will be considered to be completed in the above diagram when the following condition has been met. When this occurs, the On Target Position bit in the response message for I/ O communications will change to 1.

 $X = (Target position - Current position) \le PnB50$ 

|       | Positioning Completed Width |                  |                 |              |
|-------|-----------------------------|------------------|-----------------|--------------|
| PnB50 | Setting Range               | Setting Unit     | Default Setting | When Enabled |
|       | 0 to 255                    | 1 reference unit | 5               | Immediately  |

There is also a function that monitors the time from the completion of distribution of the movement reference to the SERVOPACK until the completion of positioning. If the positioning completed width set in PnB50 is not entered within the time that is set in PnB51 (Positioning Completion Timeout Time) after distribution of the movement reference has been completed, an A.A90 warning will occur. If this parameter is set to 0, the check time will be infinitely long.

|       | Positioning Completion Timeout Time |              |                 |              |
|-------|-------------------------------------|--------------|-----------------|--------------|
| PnB51 | Setting Range                       | Setting Unit | Default Setting | When Enabled |
|       | 0 to 65,535                         | 1 ms         | 0               | Immediately  |

12.4.1 Positioning Patterns after Continuous Operation

## 12.4 Positioning after Continuous Operation

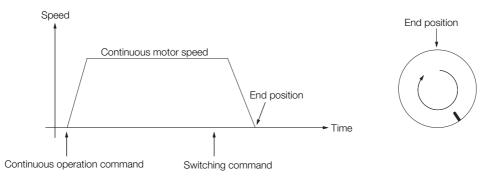
## 12.4.1 Positioning Patterns after Continuous Operation

When the SERVOPACK receives a command to switch to positioning during continuous operation, the following three types of positioning can be performed depending on the parameter settings. These positioning patterns can be used when a rotary coordinate system is specified.

- Direct positioning
- · Positioning in specified rotation direction
- Positioning by the near course

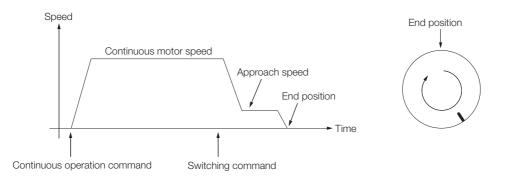
## **Direct Positioning**

For direct positioning, the Servomotor rotates in the direction that was specified for continuous operation until a switching command is received. After receiving the switching command, the Servomotor starts positioning and moves to the end position. In this mode, the Servomotor rotates only in the direction that was specified for continuous operation. Also, the approach speed is not used and positioning is performed at the high speed.



## **Positioning in Specified Rotation Direction**

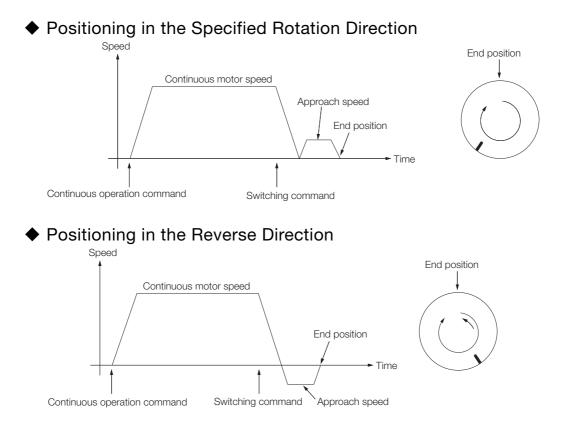
For positioning in the specified rotation direction, the Servomotor rotates in the direction that was specified for continuous operation until a switching command is received. After receiving a switching command, the Servomotor decelerates to the approach speed and stops at the end position. In this mode, the Servomotor rotates only in the direction that was specified for continuous operation.



12.4.2 Parameter Settings

## Positioning by the Near Course

For positioning by the near course, the Servomotor rotates in the direction that was specified for continuous operation until a switching command is received. After a switching command is received, the Servomotor decelerates to a stop. Then the SERVOPACK positions the Servomotor to the end position in the nearest direction.



## 12.4.2 Parameter Settings

## Setting the Coordinate System

To perform positioning after continuous operation, the Coordinate Type Selection and Reference Units per Machine Revolution parameters must be set correctly.

## Approach Speed

If PnB59 (Approach Mode) is set to 1 or 2, the approach speed must be set to perform positioning after continuous operation. The approach speed is the positioning speed that is used to position to the end position after stopping continuous operation.

|       | Positioning Approach Speed |                    |                 |              |
|-------|----------------------------|--------------------|-----------------|--------------|
| PnB54 | Setting Range              | Setting Unit       | Default Setting | When Enabled |
|       | 1 to 115,343,500           | 1 reference unit/s | 400,000         | Immediately  |

## **End Position**

This parameter sets the target position for positioning when positioning after continuous operation. If bit 15 in PnBA5 (Action Definition Settings) is set to 1, the target position is set in the command message and the Target Position parameter does not need to be set.

If the setting exceeds the value that is set for the Reference Units per Machine Revolution parameter, correct operation will not be possible.

|       | End Position       |                  |                 |              |
|-------|--------------------|------------------|-----------------|--------------|
| PnB55 | Setting Range      | Setting Unit     | Default Setting | When Enabled |
|       | 0 to 2,147,483,647 | 1 reference unit | 0               | Immediately  |

## Approach Mode

This parameter sets the positioning pattern to move to the end position when positioning after continuous operation.

| Parameter Meaning |       | Meaning                                     |
|-------------------|-------|---------------------------------------------|
|                   | 0000h | Direct positioning                          |
| PnB59             | 0001h | Positioning in specified rotation direction |
|                   | 0002h | Positioning by the near course              |

12.5.1 Action Definition Settings

# 12.5 Special Functions

## 12.5.1 Action Definition Settings

The action definition settings define the operation of the SERVOPACK.

## Automatic Execution for Module Reset

You can specify whether to automatically reset the SERVOPACK after attribute 24 (Reference Direction) of object 0x25 is changed. This is defined with bit 11 of PnBA5.

|       | Parameter             | Meaning                                                      |  |  |  |
|-------|-----------------------|--------------------------------------------------------------|--|--|--|
| DpRA5 | b.0000 0000 0000 0000 | Do not automatically reset the SERVOPACK. (Default setting)  |  |  |  |
| PnBA5 | b.0000 1000 0000 0000 | Automatically reset the SERVOPACK when attribute is changed. |  |  |  |

## **Command Error Clear Method**

You can define the timing for clearing command errors that have occurred. This is defined with bit 12 of PnBA5.

|       | Parameter             | Meaning                                                                                           |  |  |  |
|-------|-----------------------|---------------------------------------------------------------------------------------------------|--|--|--|
| PnBA5 | b.0000 0000 0000 0000 | Clear the error when the Valid Data bit changes to 0 in the command message.<br>(Default setting) |  |  |  |
|       | b.0001 0000 0000 0000 | Clear the error when the data in the command message becomes normal.                              |  |  |  |

## Main Circuit Power Supply Error Mask

You can mask warnings for main circuit power supply errors. This is defined with bit 13 of PnBA5.

|       | Parameter             | Meaning                                                       |
|-------|-----------------------|---------------------------------------------------------------|
| PnBA5 | b.000 000 000 0000    | Detect main circuit power supply errors.<br>(Default setting) |
|       | b.0010 0000 0000 0000 | Do not detect main circuit power supply errors.               |

## Main Circuit/Control Power Supply Alarm Clearing Method

You can define the method for clearing warnings when main circuit or control power supply errors occur in the SERVOPACK. This is defined with bit 14 of PnBA5.

|        | Parameter             | Meaning                                                      |
|--------|-----------------------|--------------------------------------------------------------|
| PnBA5  | b.0000 0000 0000 0000 | Use the Alarm Clear command.<br>(Default setting)            |
| PIIDAD | b.0100 0000 0000 0000 | Automatically clear warnings when the power supply recovers. |

## Positioning Command Method after Continuous Operation

You can define the command to use to perform positioning after continuous operation. This is defined with bit 15 of PnBA5.

|       | Parameter                | Meaning                                           |
|-------|--------------------------|---------------------------------------------------|
| PnBA5 | 45 b.0000 0000 0000 0000 | Use a positioning reference.<br>(Default setting) |
|       | b.1000 0000 0000 0000    | Use a switching command.                          |

## 12.5.2 Initialization Functions

## **Resetting the Absolute Encoder**

You can reset the absolute encoder via DeviceNet without using a Digital Operator. This is set with bit 0 of PnBA7.

|       | Parameter             | Meaning                                                 |
|-------|-----------------------|---------------------------------------------------------|
| PnBA7 | b.0000 0000 0000 0000 | Do not reset the absolute encoder.<br>(Default setting) |
|       | b.0000 0000 0000 0001 | Reset the absolute encoder.                             |

If PnBA7 is set to reset the absolute encoder as shown above and then the SERVOPACK module is reset, the absolute encoder that is connected to the SERVOPACK will also be reset.

Refer to the following section for a detailed operating procedure for resetting the Module. *13.5.3 Executing a Module Reset* on page 13-33

## Parameter Initialization

You can initialize the parameters via DeviceNet. This is set with bit 1 of PnBA7.

|       | Parameter             | Meaning                                                |
|-------|-----------------------|--------------------------------------------------------|
| PnBA7 | b.0000 0000 0000 0000 | Do not initialize the parameters.<br>(Default setting) |
|       | b.0000 0000 0000 0010 | Initialize the parameters.                             |

If PnBA7 is set to initialize the parameters as shown above and then the SERVOPACK module is reset, the parameters will be initialized to the values that are stored in the SERVOPACK.

Refer to the following section for a detailed operating procedure for resetting the Module. *13.5.3 Executing a Module Reset* on page 13-33

## Restrictions

Parameter initialization and absolute encoder reset cannot be executed at the same time. Parameter initialization is given priority.

12.5 Special Functions

12.5.2 Initialization Functions

# DeviceNet Communications

This chapter provides details on DeviceNet communications.

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13.5

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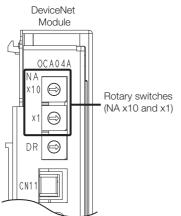
13.1.1 Setting the Node Address

## **13.1 DeviceNet Communications Settings**

This section describes the switch settings and indicator operation for DeviceNet communications.

## 13.1.1 Setting the Node Address

Use the NA rotary switches (x1 and x10) on the front panel of the DeviceNet Module to set the DeviceNet node address.



The node address can be set to between 0 and 63. If you make a setting outside this range, a setting error will occur.

Use the following table to set the node address on the switches on the DeviceNet Module.

| Rot<br>Swi<br>Setting | tch | Node<br>Address | Rot<br>Swi<br>Settin |    | Node<br>Address | Rotary<br>Switch<br>Setting (NA) |    | Node<br>Address | Rotary<br>Switch<br>Setting (NA) |    | Node<br>Address | Sw  | tary<br>itch<br>g (NA) | Node<br>Address |
|-----------------------|-----|-----------------|----------------------|----|-----------------|----------------------------------|----|-----------------|----------------------------------|----|-----------------|-----|------------------------|-----------------|
| ×10                   | ×1  |                 | ×10                  | ×1 |                 | ×10                              | ×1 |                 | ×10                              | ×1 |                 | ×10 | ×1                     |                 |
| 0                     | 0   | 0               | 2                    | 0  | 20              | 4                                | 0  | 40              | 6                                | 0  | 60              | 8   | 0                      | Setting error   |
| 0                     | 1   | 1               | 2                    | 1  | 21              | 4                                | 1  | 41              | 6                                | 1  | 61              | 8   | 1                      | Setting error   |
| 0                     | 2   | 2               | 2                    | 2  | 22              | 4                                | 2  | 42              | 6                                | 2  | 62              | 8   | 2                      | Setting error   |
| 0                     | 3   | 3               | 2                    | 3  | 23              | 4                                | 3  | 43              | 6                                | 3  | 63              | 8   | 3                      | Setting error   |
| 0                     | 4   | 4               | 2                    | 4  | 24              | 4                                | 4  | 44              | 6                                | 4  | Setting error   | 8   | 4                      | Setting error   |
| 0                     | 5   | 5               | 2                    | 5  | 25              | 4                                | 5  | 45              | 6                                | 5  | Setting error   | 8   | 5                      | Setting error   |
| 0                     | 6   | 6               | 2                    | 6  | 26              | 4                                | 6  | 46              | 6                                | 6  | Setting error   | 8   | 6                      | Setting error   |
| 0                     | 7   | 7               | 2                    | 7  | 27              | 4                                | 7  | 47              | 6                                | 7  | Setting error   | 8   | 7                      | Setting error   |
| 0                     | 8   | 8               | 2                    | 8  | 28              | 4                                | 8  | 48              | 6                                | 8  | Setting error   | 8   | 8                      | Setting error   |
| 0                     | 9   | 9               | 2                    | 9  | 29              | 4                                | 9  | 49              | 6                                | 9  | Setting error   | 8   | 9                      | Setting error   |
| 1                     | 0   | 10              | 3                    | 0  | 30              | 5                                | 0  | 50              | 7                                | 0  | Setting error   | 9   | 0                      | Setting error   |
| 1                     | 1   | 11              | 3                    | 1  | 31              | 5                                | 1  | 51              | 7                                | 1  | Setting error   | 9   | 1                      | Setting error   |
| 1                     | 2   | 12              | 3                    | 2  | 32              | 5                                | 2  | 52              | 7                                | 2  | Setting error   | 9   | 2                      | Setting error   |
| 1                     | 3   | 13              | 3                    | 3  | 33              | 5                                | 3  | 53              | 7                                | 3  | Setting error   | 9   | 3                      | Setting error   |
| 1                     | 4   | 14              | 3                    | 4  | 34              | 5                                | 4  | 54              | 7                                | 4  | Setting error   | 9   | 4                      | Setting error   |
| 1                     | 5   | 15              | 3                    | 5  | 35              | 5                                | 5  | 55              | 7                                | 5  | Setting error   | 9   | 5                      | Setting error   |
| 1                     | 6   | 16              | 3                    | 6  | 36              | 5                                | 6  | 56              | 7                                | 6  | Setting error   | 9   | 6                      | Setting error   |
| 1                     | 7   | 17              | 3                    | 7  | 37              | 5                                | 7  | 57              | 7                                | 7  | Setting error   | 9   | 7                      | Setting error   |
| 1                     | 8   | 18              | 3                    | 8  | 38              | 5                                | 8  | 58              | 7                                | 8  | Setting error   | 9   | 8                      | Setting error   |
| 1                     | 9   | 19              | 3                    | 9  | 39              | 5                                | 9  | 59              | 7                                | 9  | Setting error   | 9   | 9                      | Setting error   |

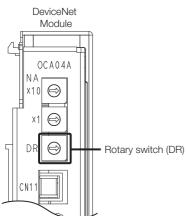


To enable the new setting, turn the power supply to the SERVOPACK OFF and ON again after you change the setting.

13.1.2 Setting the Baud Rate

## 13.1.2 Setting the Baud Rate

Use the DR rotary switch on the front panel of the DeviceNet Module to set the DeviceNet baud rate.



| Rotary Switch<br>Setting (DR) | Baud Rate Setting |
|-------------------------------|-------------------|
| 0                             | 125 kbps          |
| 1                             | 250 kbps          |
| 2                             | 500 kbps          |
| 3 to 9                        | Setting error     |



To enable the new setting, turn the power supply to the SERVOPACK OFF and ON again after you change the setting.

# **13.2 Communications Methods**

The DeviceNet Module supports two types of communications: I/O communications and explicit message communications.

## 13.2.1 I/O Communications

This section describes the command messages that are sent from the master device to the SERVOPACK and the response messages that are returned by the SERVOPACK. These are required for I/O communications.

## **Command Format**

The following table gives the data format of the command messages sent to the SERVOPACK from the master device. Command messages consist of 8 bytes. Bytes 0 to 3 have the same format for all commands. Byte 0 contains command bits. Bytes 4 to 7 store data that depends on the command assembly code in byte 2.

| Bytes | Bit 7                               | Bit 6                 | Bit 5        | 5 Bit 4 Bit 3          |  | Bit 2                    | Bit 1          | Bit 0               |  |  |  |
|-------|-------------------------------------|-----------------------|--------------|------------------------|--|--------------------------|----------------|---------------------|--|--|--|
| 0     | Enable                              | Valid<br>Data         | Hard<br>Stop |                        |  | Absolute/<br>Incremental | Start<br>Block | Start<br>Trajectory |  |  |  |
| 1     | Block Number                        |                       |              |                        |  |                          |                |                     |  |  |  |
| 2     | Axis Instance Command Assembly Code |                       |              |                        |  |                          |                |                     |  |  |  |
| 3     |                                     | Axis Instance         | Э            | Response Assembly Code |  |                          |                |                     |  |  |  |
| 4     |                                     | Data Low Byte         |              |                        |  |                          |                |                     |  |  |  |
| 5     |                                     | Data Low Middle Byte  |              |                        |  |                          |                |                     |  |  |  |
| 6     |                                     | Data High Middle Byte |              |                        |  |                          |                |                     |  |  |  |
| 7     | Data High Byte                      |                       |              |                        |  |                          |                |                     |  |  |  |

#### ♦ Start Trajectory

Use the Start Trajectory bit to start a move operation. A move operation starts when this bit changes from 0 to 1 for any of the following command assembly codes.

| Command<br>Assembly Code | Command Data             | Operation             |
|--------------------------|--------------------------|-----------------------|
| 0x01                     | Target position          | Positioning           |
| 0x11                     | Continuous motor speed   | Continuous operation  |
| 0x12                     | Origin return type       | Origin return         |
| 0x1E                     | Alarm clear              | Alarm clear           |
| 0x1F                     | (Switch to positioning)* | Switch to positioning |

\* The value of PnB55 is the end position.

The SERVOPACK detects when this bit is set to 1. The operation will continue even if it is cleared to 0 during axis travel.

To stop the move operation before it is completed, set the Smooth Stop bit or the Hard Stop bit to 1.

#### Start Block

Use the Start Block bit to start the execution of command blocks stored in the SERVOPACK. You can change this bit from 0 to 1 to execute the commands in the command blocks that have been registered in advance. If this bit is cleared from 1 to 0 during execution of the command blocks, execution of the command blocks will be stopped.

Refer to the following section for details on the command blocks. 3.4.2 Command Blocks on page 13-23

#### Absolute/Incremental

Use the Absolute/Incremental bit to specify whether the target position data that is stored in bytes 4 to 7 specifies an absolute position or an incremental position. This data is enabled when the Start Trajectory bit changes from 0 to 1.

0: Absolute position

1: Incremental position

#### Direction

The Direction bit specifies the rotation direction for continuous operation. This bit is valid only when the command assembly code is 0x11 (continuous motor speed).

0: Negative direction

1: Positive direction

#### Smooth Stop

Change this bit from 0 to 1 to stop travel at the current acceleration/deceleration type and deceleration rate settings. The Valid Data bit does not affect this command bit.

#### Hard Stop

Change this bit from 0 to 1 to stop travel at the maximum deceleration rate. The Valid Data bit does not affect this command bit.

#### Valid Data

The SERVOPACK refreshes the command assembly code, response assembly code, and command data that are received only while the Valid Data bit is set to 1. The Enable, Smooth Stop, and Hard Stop bits in byte 0 are refreshed regardless of the status of the Valid Data bit.

0: Data is not valid

1: Data is valid

If the Valid Data bit is changed to 0 in a command message when there is a command error, the Command Error bit in the response message will be cleared to 0.

#### Enable

The Enable bit controls turning the servo ON and OFF. This bit is level triggered. It must remain set to 1 whenever the servo is to be ON. Also, if the External Stop command is cleared while the Enable bit is set to 1, the servo will turn ON immediately.

0: Servo OFF

1: Servo ON

#### Block Number

Set the Block Number Field to the block number from which to start the command blocks.

#### Axis Instance

Set the Axis Instance Field to the axis number. Always set the Axis Instance Field to 1. A command error will occur for any other value.

#### Command Assembly Code

The command assembly code defines the command data in bytes 4 to 7.

| Command Assembly Code | Command Data                                        | Data Types |
|-----------------------|-----------------------------------------------------|------------|
| 0x00                  | NOP                                                 | -          |
| 0x01                  | Target position (reference units)                   | DINT       |
| 0x02                  | Target speed (reference unit/s)                     | DINT       |
| 0x03                  | Acceleration rate (reference units/s <sup>2</sup> ) | DINT       |

Continued on next page.

| Continued | from | previous | page  |
|-----------|------|----------|-------|
| Continueu | nom  | previous | page. |

|                       |                                                     | 1 1 0      |
|-----------------------|-----------------------------------------------------|------------|
| Command Assembly Code | Command Data                                        | Data Types |
| 0x04                  | Deceleration rate (reference units/s <sup>2</sup> ) | DINT       |
| 0x05 to 0x10          | Reserved.                                           | -          |
| 0x11                  | Continuous motor speed (reference unit/s)           | DINT       |
| 0x12                  | Origin return type                                  | USINT      |
| 0x13 to 0x1D          | Reserved.                                           | -          |
| 0x1E                  | Alarm clear                                         | BOOL       |
| 0x1F                  | Switch to positioning*                              | DINT       |

\* The value of PnB55 is the end position.

#### Response Assembly Code

The response assembly code specifies the response data that is in the response message, such as the current position or the current speed.

| Response Assembly Code | Response Data                        | Data Type |
|------------------------|--------------------------------------|-----------|
| 0x00                   | NOP                                  | -         |
| 0x01                   | Current position (reference units)   | DINT      |
| 0x02                   | Reference position (reference units) | DINT      |
| 0x03                   | Current speed (reference unit/s)     | DINT      |
| 0x04                   | Reserved.                            | -         |
| 0x05                   | Torque monitor (%)                   | DINT      |
| 0x06 to 0x1D           | Reserved.                            | -         |
| 0x1E                   | Alarm code                           | DINT      |
| 0x1F                   | Reserved.                            | -         |

#### Command Data

Set the command data to the data that is defined for the command assembly code.

## **Command Data Specifications**

#### NOP (Command Assembly Code = 0x00)

The command data has no meaning for this code.

#### Target Position (Command Assembly Code = 0x01)

Set the command data to the target position in reference units. This data is enabled when the Valid Data bit is set to 1.

Positioning starts when the Start Trajectory bit is set to 1 after the target position is set. The data and the bit can also be set at the same time.

The handling of the target position depends on the Absolute/Incremental bit, as shown below.

- Absolute/Incremental bit = 0 (Absolute Position) If the current position is +200 and the command data is +300, the target position will be +300.
- Absolute/Incremental bit = 1 (Relative Position) If the current position is +200 and the command data is +300, the target position will be +500.

Refer to the following section for information on positioning. (3.3.1 Positioning on page 13-13

#### Target Speed (Command Assembly Code = 0x02)

Set the command data to the target speed for positioning. This data is enabled when the Valid Data bit is set to 1. Make sure that this data is always a positive value. Set the speed in reference units/s.

#### Acceleration Rate (Command Assembly Code = 0x03)

Set the command data to the acceleration rate for positioning, continuous operation, and origin returns. This data is enabled when the Valid Data bit is set to 1. Make sure that this data is always a positive value. Set the acceleration rate in reference units/s<sup>2</sup>.

#### Deceleration Rate (Command Assembly Code = 0x04)

Set the command data to the deceleration rate for positioning, continuous operation, and origin returns. This data is enabled when the Valid Data bit is set to 1. Make sure that this data is always a positive value. Set the deceleration rate in reference units/s<sup>2</sup>.

#### Continuous Motor Speed (Command Assembly Code = 0x11)

Set the command data to the target speed for continuous operation. This data is enabled when the Valid Data bit is set to 1. Make sure that this data is always a positive value. The direction of rotation is determined by the Direction bit. Set the speed in reference units/s.

Continuous operation starts when the Start Trajectory bit is set to 1 after the target position is set. The data and the bit can also be set at the same time.

Refer to the following section for information on continuous operation. 3.3.2 Continuous Operation on page 13-14

#### Origin Return Type (Command Assembly Code = 0x12)

Set the command data to the origin return type. This data is enabled when the Valid Data bit is set to 1. Continuous operation starts when the Start Trajectory bit is set to 1 after the target position is set. The data and the bit can also be set at the same time.

Refer to the following section for information on origin returns. 13.3.3 Origin Returns on page 13-15

| Bytes | Bit 7 | Bit 6              | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|-------|-------|--------------------|-------|-------|-------|-------|-------|-------|
| 4     |       | Origin Return Type |       |       |       |       |       |       |
| 5     | 0x00  |                    |       |       |       |       |       |       |
| 6     | 0x00  |                    |       |       |       |       |       |       |
| 7     |       | 0x00               |       |       |       |       |       |       |

#### ◆ Alarm Clear (Command Assembly Code = 0x1E)

This command code clears SERVOPACK alarms. Set the Alarm Clear bit to 1 and then set the Valid Data bit to 1 and the Start Trajectory bit to 1. Any alarms in the SERVOPACK will be cleared when the Start Trajectory bit is set to 1.

| Bytes | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0       |  |
|-------|-------|-------|-------|-------|-------|-------|-------|-------------|--|
| 4     | 0     | 0     | 0     | 0     | 0     | 0     | 0     | Alarm Clear |  |
| 5     |       | 0x00  |       |       |       |       |       |             |  |
| 6     |       | 0x00  |       |       |       |       |       |             |  |
| 7     |       | 0x00  |       |       |       |       |       |             |  |

#### Switch to Positioning (Command Assembly Code = 0x1F)

This command code switches from continuous operation to positioning. This data is enabled when the Valid Data bit is set to 1. The end position in PnB55 is used as the target position. Set bytes 4 to 7 of the command data to 0x00.

This command is enabled only when the 15th bit of the action definition settings in PnBA5 is set to 1. If the 15th bit of PnBA5 is cleared to 0, sending a Positioning command during continuous operation will change to positioning operation. In that case, the target position is specified in the command data.

Refer to the following section for information on switching to positioning. 3.3.4 Switching to Positioning on page 13-18

## **Response Format**

This section describes the response messages from the SERVOPACK to the master device.

The following table gives the data format of the response messages that are sent from the SERVOPACK to the master device. A response message consists of 8 bytes. Bytes 0 to 3 have the same format for all commands that are sent from the master device. Byte 0 and byte 2 show the status of the SERVOPACK in bits. Bytes 4 to 7 store data that depends on the response assembly code in byte 3.

| Bytes | Bit 7                  | Bit 6          | Bit 5                       | Bit 4                         | Bit 3                         | Bit 2                    | Bit 1                    | Bit 0                        |
|-------|------------------------|----------------|-----------------------------|-------------------------------|-------------------------------|--------------------------|--------------------------|------------------------------|
| 0     | Enable<br>State        | Valid<br>Data  | Home<br>Flag                | External<br>Stop<br>Input     | Alarm                         | On<br>Target<br>Position | Block<br>In<br>Execution | Trajectory<br>In<br>Progress |
| 1     | Executing Block Number |                |                             |                               |                               |                          |                          |                              |
| 2     | Com-<br>mand<br>Error  | Block<br>Fault | Trajectory<br>Start<br>Echo | Negative<br>Software<br>Limit | Positive<br>Software<br>Limit | CCW<br>Hardware<br>Limit | CW<br>Hardware<br>Limit  | Servo<br>Ready               |
| 3     |                        | Axis Instance  | )                           |                               | Respo                         | nse Assembly             | y Code                   |                              |
| 4     |                        |                |                             | Data Lo                       | ow Byte                       |                          |                          |                              |
| 5     | Data Low Middle Byte   |                |                             |                               |                               |                          |                          |                              |
| 6     | Data High Middle Byte  |                |                             |                               |                               |                          |                          |                              |
| 7     |                        |                |                             | Data Hi                       | gh Byte                       |                          |                          |                              |

#### ◆ Trajectory In Progress

This bit is set to 1 during positioning, continuous operation, or origin returns. The Trajectory In Progress bit is set to 1 when operation starts after the Valid Data and the Start Trajectory bits are set to 1 in the data from the master device. The bit is cleared to 0 when the operation is completed.

#### Block In Execution

This bit is set to 1 during the execution of block commands for the Start Block bit. It is cleared to 0 when the block commands have been completed or when block error occurs (as shown by the Block Fault bit).

#### ♦ On Target Position

This bit is set to 1 when the current position is within the positioning completed width. The value of PnB50 (Positioning Completed Width) is used as the positioning completed width.

#### Alarm

This bit is set to 1 if an alarm occurs in the SERVOPACK. Use the Alarm Clear command to clear the alarm.

### ♦ External Stop Input

This bit is used to monitor the external stop input signal of the SERVOPACK. This bit is set to 1 when the external stop input signal is active.

#### ♦ Home Flag

This bit is used to monitor the origin signal input to the SERVOPACK. This bit is set to 1 when the current position is any position other than the origin. This bit is cleared to 0 when the current position is the origin.

#### Valid Data

This bit is set to 1 after the Valid Data bit is set to 1 in a command message from the master device and the SERVOPACK has verified that the data in the command message from the master device was received normally. If the Valid Data bit in the command message is set to 1, the SERVOPACK will check the command data and if no problems are found, the Valid Data bit in the response message will be set to 1. If there is an error in the command data, the Command Error Flag will be set to 1 and the Valid Data bit will also be set to 1.

#### Executing Block Number

This field contains the command block number (0 to 255) that is currently being executed. The Executing Block Number Field is cleared to 0 when the block commands have been completed or when a block error occurs (as shown by the Block Fault bit).

#### Enable State

This bit is set to 1 when the servo is ON. If the servo is OFF in the SERVOPACK, the SERVO-PACK will ignore the Start Trajectory bit even if it is set to 1 in a command message. Make sure that this bit is set to 1 before setting the Start Trajectory bit.

#### ♦ Servo Ready

This bit is set to 1 when the SERVOPACK is ready and the servo can be turned ON.

#### CW Hardware Limit

This bit monitors the CW Drive Prohibit Input signal (the clockwise limit signal, as viewed from the load end of the motor) that is connected to the SERVOPACK. It is set to 1 when the CW Drive Prohibit Input signal is active.

#### CCW Hardware Limit

This bit monitors the CCW-OT (CCW Drive Prohibit Input) signal (the counterclockwise limit signal, as viewed from the load end of the motor) that is connected to the SERVOPACK. It is set to 1 when the CCW-OT (CCW Drive Prohibit Input) signal is active.

#### Positive Software Limit

This bit changes to 1 if the forward software limit is exceeded. The forward software limit is set in PnB16 (Forward Software Limit).

#### ◆ Negative Software Limit

This bit changes to 1 if the reverse software limit is exceeded. The reverse software limit is set in PnB17 (Reverse Software Limit).

#### Trajectory Start Echo

This bit is set to 1 if a command message is normally received from the master device with the Start Trajectory bit set to 1. By checking this bit, the master device can check whether the SERVOPACK received the Start Trajectory bit status normally.

#### Block Fault

This bit changes to 1 if an error occurs during a block operation. If an error occurs, the block operation will be stopped.

#### Command Error

This bit changes to 1 if an error is found in the command data in a command message. The method to use to clear command errors depends on the setting of the 12th bit of the action definition settings in PnBA5.

- PnBA5 bit 12 = 0: Clear the Valid Data bit in the command messages to 0.
- PnBA5 bit 12 = 1: The command error is cleared automatically when the command data in the command mes-

#### ◆ Response Assembly Code

The response assembly code defines the response data in bytes 4 to 7.

Refer to the following section for details on the response assembly code. *Command Format* on page 13-5

#### Axis Instance

sage is corrected.

The axis instance is always set to 1 (the axis number).

#### ♦ Response Data

The response data is set to the data that is defined for the response assembly code.

## 13.2.2 Explicit Message Communications

This section describes messages that are used to read and change attributes. These are required for explicit message communications.

#### **Command Format**

The following table gives the command format for explicit messages.

| 7 | 6            | 5            | 4      | 3 | 2 | 1 | 0 |  |  |
|---|--------------|--------------|--------|---|---|---|---|--|--|
| 0 | 0/1          |              | MAC ID |   |   |   |   |  |  |
| 0 |              | Service Code |        |   |   |   |   |  |  |
|   | Class ID     |              |        |   |   |   |   |  |  |
|   | Instance ID  |              |        |   |   |   |   |  |  |
|   | Attribute ID |              |        |   |   |   |   |  |  |
|   | Service Data |              |        |   |   |   |   |  |  |

#### MAC ID

Specify the node address of the device to receive the message.

#### Service Code

Specify the code of the requested service (edit, read, etc.).

#### Class ID

Specify the class ID of the object from which to request the service.

#### Instance ID

Specify the instance ID of the object from which to request the service.

13.2.2 Explicit Message Communications

#### Attribute ID

Specify the attribute ID of the object from which to request the service. The following services of the Command Block objects (class ID = 0x27) do not have attribute IDs: Get\_Attribute\_All (service code = 0x01) and Set\_Attribute\_All (service code = 0x02).

#### ♦ Service Data

Set the data that is required by the service, such as the data to write to the attribute of the object from which the service is being requested. Set the lower byte first. The service data depends on the service that is being requested.

### **Response Format**

The following table gives the response format for explicit messages.

| 7 | 6                     | 5      | 4 | 3 | 2 | 1 | 0 |  |
|---|-----------------------|--------|---|---|---|---|---|--|
| 0 | 0/1                   | MAC ID |   |   |   |   |   |  |
| 1 | Service Code          |        |   |   |   |   |   |  |
|   | Response Service Data |        |   |   |   |   |   |  |

#### ♦ MAC ID

The node address of the device that sent the message is specified.

#### ♦ Service Code

The code of the requested service (edit, read, etc.) is specified.

#### Response Service Data

The data from the requested service, such as read data, is set with the lower bytes first and then the higher bytes.

The response data depends on the service that was requested.

# 13.3 Controlling Operation from the Host Controller

This section describes the operation of the SERVOPACK for I/O communications from the host controller.

### 13.3.1 Positioning

Positioning can be performed to specified target positions. The procedure and an example operation are given below.

#### **Using Commands**

The command method and procedure for positioning are given below.

- 1. If it is necessary to change the current parameters, set the target speed, acceleration rate, deceleration rate, etc.
- 2. In the Absolute/Incremental bit in the command message, specify whether the target position is an absolute or relative position.
- **3.** Set the command assembly code to 0x01 and set the target position in the command message.
- 4. Set the Valid Data bit to 1 in the command message, and then set the Start Trajectory bit to 1. You can set both the Valid Data bit and the Start Trajectory bit to 1 at the same time.
- 5. After positioning starts, the Trajectory In Progress bit in the response message is set to 1. It is then cleared to 0 after the reference pulses to the target position have all been distributed.

### **Positioning Operation Example**

An example of a command message for positioning is given in the following table. In this example, an absolute position with a target position of 128,000 reference units (= 0x0001F400) is specified. The SERVOPACK assumes that the data, such as that for the target position, is valid when the Valid Data bit in the command message is set to 1. Therefore, set bytes 1 to 7 first, and then set byte 0.

| Bytes | Bit 7             | Bit 6              | Bit 5             | Bit 4                       | Bit 3                      | Bit 2                              | Bit 1               | Bit 0                    |
|-------|-------------------|--------------------|-------------------|-----------------------------|----------------------------|------------------------------------|---------------------|--------------------------|
| 0     | 1<br>Enable       | 1<br>Valid<br>Data | 0<br>Hard<br>Stop | 0<br>Smooth<br>Stop         | 0<br>Direction<br>(V mode) | 0<br>Absolute/<br>Incremen-<br>tal | 0<br>Start<br>Block | 1<br>Start<br>Trajectory |
| 1     |                   | 0x00 Block Number  |                   |                             |                            |                                    |                     |                          |
| 2     | 0x1 Axis Instance |                    |                   | 0x01 Command Assembly Code  |                            |                                    |                     |                          |
| 3     | 0x                | 1 Axis Instan      | се                | 0x03 Response Assembly Code |                            |                                    |                     |                          |
| 4     |                   |                    | 0x                | 00 Target Po                | sition Low B               | yte                                |                     |                          |
| 5     |                   |                    | 0xF4              | Target Positic              | on Low Midd                | le Byte                            |                     |                          |
| 6     |                   |                    | 0x01 7            | Target Positic              | on High Midd               | le Byte                            |                     |                          |
| 7     |                   |                    | Ox                | 00 Target Po                | sition High B              | Syte                               |                     |                          |

#### 13.3.2 Continuous Operation

|                                       |                                |                               |                                         |                               | A1                                                                |                    | V1              |                 | D1               |                          |                  |            |
|---------------------------------------|--------------------------------|-------------------------------|-----------------------------------------|-------------------------------|-------------------------------------------------------------------|--------------------|-----------------|-----------------|------------------|--------------------------|------------------|------------|
| Motor speed                           |                                |                               |                                         |                               |                                                                   |                    | <u> P1</u>      | <br>            |                  | <u> </u><br>             | <u> </u>         |            |
| Enable                                | 1                              | <u>L</u>                      |                                         |                               |                                                                   |                    |                 |                 | <br> <br>        |                          |                  |            |
| Start Trajectory                      | 1                              |                               |                                         |                               |                                                                   | - <del> </del>     | <br> <br> <br>  | <br> <br> <br>  | +<br> <br> <br>  | +                        |                  |            |
| Trajectory In<br>Progress             | 1                              |                               |                                         |                               |                                                                   |                    |                 |                 |                  | <br>+<br> <br> <br> <br> |                  |            |
| Command Assembly Code<br>Command Data | 02<br>V1                       | _                             | 03h<br>A1                               | 04h<br>D1                     | 01h<br>P1                                                         | 1                  | 1               | 1               | 1                | 1                        |                  |            |
| ous oper<br>• Make sur                | ation c<br>e that<br>/ bit. If | or an or<br>the Ena<br>you se | igin returr<br>able State<br>et the Ena | n, is being e<br>bit in the r | other operatio<br>executed, the<br>esponse mes<br>the Start Traje | Positic<br>sage is | oning of set to | comm<br>o 1, ar | nand v<br>nd the | will be<br>en set        | ignore<br>the St | ed.<br>art |

#### 13.3.2 Continuous Operation

This command performs continuous operation at a fixed speed. The procedure and an example operation are given below.

#### **Using Commands**

The command method and procedure for continuous operation are given below.

- 1. If it is necessary to change the current parameters, set the acceleration rate, deceleration rate, etc.
- 2. Set the Direction bit in the command message.
- **3.** Set the command assembly code to 0x11 and set the continuous motor speed in the command message.
- 4. Set the Valid Data bit to 1 in the command message, and then set the Start Trajectory bit to 1. You can set both the Valid Data bit and the Start Trajectory bit to 1 at the same time.
- 5. After continuous operation starts, the Trajectory In Progress bit in the response message is set to 1.
- 6. You can change the continuous Servomotor speed and rotation direction during continuous operation. To do so, change the Valid Data bit and Start Trajectory bit from 0 to 1.
- 7. To stop continuous operation, set the Smooth Stop bit or the Hard Stop bit to 1. You can also stop continuous operation by setting the continuous motor speed to 0.

#### **Continuous Operation Example**

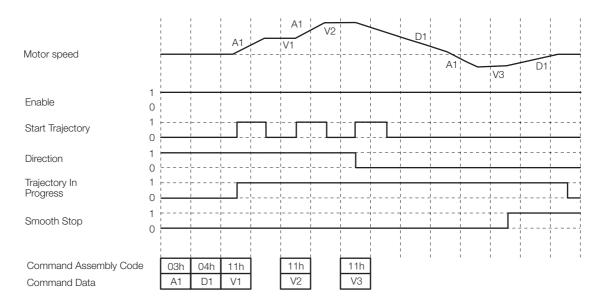
An example of a command message for continuous operation is given in the following table. In this example, forward rotation with a target speed of 8,000 reference units/s (= 0x00001F40) is specified. The SERVOPACK assumes that the data, such as that for the continuous motor speed, is valid when the Valid Data bit in the command message is set to 1. Therefore, set bytes 1 to 7 first, and then set byte 0.

13.3.3 Origin Returns

| Bytes | Bit 7             | Bit 6              | Bit 5             | Bit 4                       | Bit 3                      | Bit 2                              | Bit 1               | Bit 0                    |
|-------|-------------------|--------------------|-------------------|-----------------------------|----------------------------|------------------------------------|---------------------|--------------------------|
| 0     | 1<br>Enable       | 1<br>Valid<br>Data | 0<br>Hard<br>Stop | 0<br>Smooth<br>Stop         | 1<br>Direction<br>(V mode) | 0<br>Absolute/<br>Incremen-<br>tal | 0<br>Start<br>Block | 1<br>Start<br>Trajectory |
| 1     |                   | 0x00 Block Number  |                   |                             |                            |                                    |                     |                          |
| 2     | 0x1 Axis Instance |                    |                   | 0x11 Command Assembly Code  |                            |                                    |                     |                          |
| 3     | 0x                | 1 Axis Instan      | се                | 0x03 Response Assembly Code |                            |                                    |                     |                          |
| 4     |                   |                    | 0x                | 40 Target Ve                | locity Low B               | yte                                |                     |                          |
| 5     |                   |                    | 0x1F              | Target Veloci               | ty Low Middl               | le Byte                            |                     |                          |
| 6     |                   |                    | 0x00              | Target Veloci <sup>.</sup>  | ty High Midd               | le Byte                            |                     |                          |
| 7     |                   |                    | 0x                | 00 Target Ve                | locity High B              | yte                                |                     |                          |



If an alarm occurs, the servo is OFF, or another operation command, such as positioning or an origin return, is being executed, the continuous operation command will be ignored.
Make sure that the Enable State bit in the response message is set to 1, and then set the Start Trajectory bit. If you set the Enable bit and the Start Trajectory bit at the same time, the Start Trajectory bit will be ignored.



### 13.3.3 Origin Returns

The origin return operation returns the current position to the machine origin. Three types of origin returns are supported.

- Type 0: Operation Based on Home Flag and Encoder Phase C Detection
- Type 1: Operation Based on Only the Home Flag
- Type 3: Operation Based on Only Encoder Phase C Detection

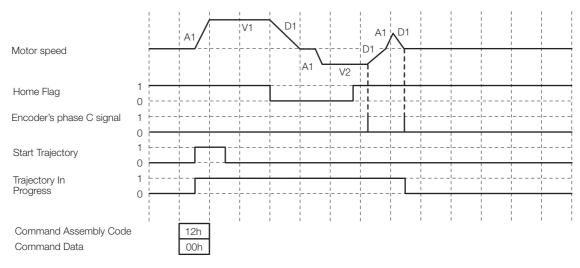
#### Type 0

Origin returns are based on the Home Flag and the detection of phase C of the encoder.

- 1. The axis travels at the origin approach speed in the specified origin return direction.
- 2. When the status of the Home Flag changes, the axis will change the direction. The axis will then travel at the origin return creep speed until the status of the Home Flag changes again.

#### 13.3.3 Origin Returns

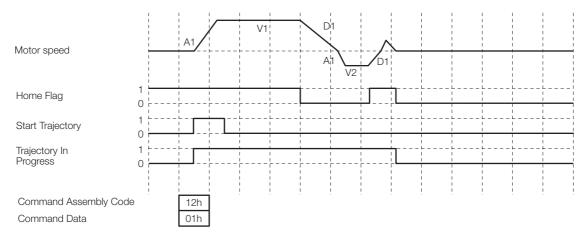
- **3.** After the status of the Home Flag changes, the axis will continue to travel until the first phase C is detected.
- 4. When phase C is detected, the axis will decelerate and travel to the position where phase C was detected.



#### Type 1

Origin returns are based only on the detection of the Home Flag.

- 1. The axis travels at the origin approach speed in the specified origin return direction.
- 2. When the status of the Home Flag changes, the axis will change the direction. It will then return at the origin return creep speed to the position where the status of the Home Flag changed.
- **3.** When the position where the Home Flag changes to the original status is detected, the axis direction will change and the axis will return to the position where the change in the status of the Home Flag was detected.

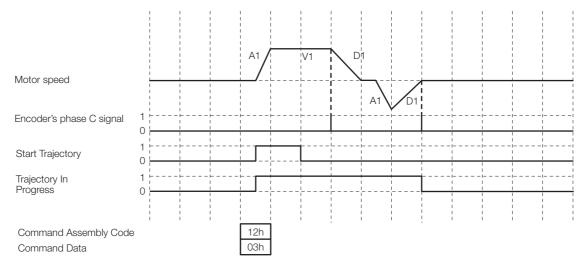


13.3.3 Origin Returns

### Туре 3

Origin returns are based only on the detection of phase C of the encoder.

- 1. The axis travels at the origin approach speed in the specified origin return direction.
- 2. When the first phase C is detected, the axis will stop, reverse direction, and travel to the position where phase C was detected.



## **Origin Return Operation Example**

An example of a command message for an origin return is given in the following table. A type 0 origin return is used in this example. The SERVOPACK assumes that the data, such as the Start Trajectory bit, is valid when the Valid Data bit in the command message is set to 1. Therefore, set bytes 1 to 7 first, and then set byte 0.

| Bytes | Bit 7       | Bit 6              | Bit 5             | Bit 4                       | Bit 3                      | Bit 2                              | Bit 1               | Bit 0                    |  |
|-------|-------------|--------------------|-------------------|-----------------------------|----------------------------|------------------------------------|---------------------|--------------------------|--|
| 0     | 1<br>Enable | 1<br>Valid<br>Data | 0<br>Hard<br>Stop | 0<br>Smooth<br>Stop         | 0<br>Direction<br>(V mode) | 0<br>Absolute/<br>Incremen-<br>tal | 0<br>Start<br>Block | 1<br>Start<br>Trajectory |  |
| 1     |             | 0x00 Block Number  |                   |                             |                            |                                    |                     |                          |  |
| 2     | 0x          | 0x1 Axis Instance  |                   |                             | 0x12 Command Assembly Code |                                    |                     |                          |  |
| 3     | 0x          | 1 Axis Instan      | ice               | 0x03 Response Assembly Code |                            |                                    |                     |                          |  |
| 4     |             |                    |                   | 0x00 (Hor                   | ming Type)                 |                                    |                     |                          |  |
| 5     |             |                    |                   | 0x                          | :00                        |                                    |                     |                          |  |
| 6     |             |                    |                   | 0x                          | :00                        |                                    |                     |                          |  |
| 7     |             |                    |                   | 0×                          | :00                        |                                    |                     |                          |  |



If an alarm occurs, the servo is OFF, or another operation command, such as positioning or an origin return, is being executed, the origin return command will be ignored.
Make sure that the Enable State bit in the response message is set to 1, and then set the Start

Trajectory bit. If you set the Enable bit and the Start Trajectory bit at the same time, the Start Trajectory bit will be ignored.

13.3.4 Switching to Positioning

## 13.3.4 Switching to Positioning

When the SERVOPACK receives a command to switch to positioning during continuous operation, the following three types of positioning can be performed depending on the parameter settings.

- Direct positioning
- · Positioning in specified rotation direction
- · Positioning by the near course

All of the following conditions must be met to switch to positioning.

- A rotational coordinate system must be set.
- Symmetrical linear acceleration/deceleration (PnB26 = 0001h) or asymmetrical linear acceleration/deceleration (PnB26 = 0003h) must be set.

Refer to the following section for details on the positioning patterns.

12.4.1 Positioning Patterns after Continuous Operation on page 12-13

The Switch to Positioning Command depends on the setting of the 15th bit of PnBA5 (Action Definition Setting) as follows:

- PnBA5 bit 15 = 0: Execute a normal Positioning command (command assembly code = 0x01) to switch from continuous operation to positioning.
- PnBA5 bit 15 = 1: Execute a Switch to Positioning command (command assembly code = 0x1F) to switch from continuous operation to positioning.

### Switch to Positioning Operation

- 1. Set the parameters required for this operation.
- 2. Set the Direction bit in the command message.
- **3.** Set the command assembly code to 0x11 and set the motor speed in the command message.
- **4.** In the command message, set the Valid Data bit to 1, and then set the Start Trajectory bit to 1.
- 5. After the required time has passed, change the command assembly code to the Positioning command (0x01) or to the Switch to Positioning command (0x1F). Then clear the Start Trajectory bit to 0 and set it to 1 again. If the Positioning command (0x01) is used, the end position must be set in the command data.

# **Operation Example**

An example of a command message to switch to positioning is given in the following table. In this example, clockwise rotation with a motor speed of 8,000 reference units/s (= 0x00001F40) is specified. The SERVOPACK assumes that the data, such as that for the motor speed, is valid when the Valid Data bit in the command (0x01) message is set to 1. Therefore, set bytes 1 to 7 first, and then set byte 0.

| Bytes | Bit 7       | Bit 6                      | Bit 5             | Bit 4                      | Bit 3                      | Bit 2                              | Bit 1               | Bit 0                    |
|-------|-------------|----------------------------|-------------------|----------------------------|----------------------------|------------------------------------|---------------------|--------------------------|
| 0     | 1<br>Enable | 1<br>Valid<br>Data         | 0<br>Hard<br>Stop | 0<br>Smooth<br>Stop        | 1<br>Direction<br>(V mode) | 0<br>Absolute/<br>Incremen-<br>tal | 0<br>Start<br>Block | 1<br>Start<br>Trajectory |
| 1     |             | 0x00 Block Number          |                   |                            |                            |                                    |                     |                          |
| 2     | 0x          | 1 Axis Instan              | се                | 0x11 Command Assembly Code |                            |                                    |                     |                          |
| 3     | 0x          | 1 Axis Instan              | се                |                            | 0x03 Res                   | ponse Assen                        | nbly Code           |                          |
| 4     |             | 0x40 Target Speed Low Byte |                   |                            |                            |                                    |                     |                          |
| 5     |             |                            | 0x1F              | Target Spee                | d Low Middle               | e Byte                             |                     |                          |

13.3.4 Switching to Positioning

| Bytes | Bit 7 | Bit 6 | Bit 5 | Bit 4        | Bit 3         | Bit 2  | Bit 1 | Bit 0 |
|-------|-------|-------|-------|--------------|---------------|--------|-------|-------|
| 6     |       |       | 0x00  | Target Speed | d High Middle | e Byte |       |       |
| 7     |       |       | 0>    | 00 Target Si | beed High By  | /te    |       |       |

After rotating the motor for the required time, send the following command message.

#### ◆ PnBA5 Bit 15 = 0 (Positioning Command)

A Positioning command (command assembly code = 0x01) is used.

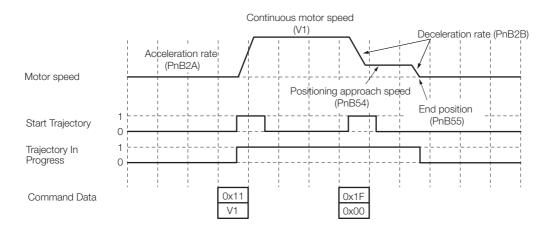
| Bytes | Bit 7       | Bit 6              | Bit 5             | Bit 4                       | Bit 3                      | Bit 2                              | Bit 1               | Bit 0                    |  |
|-------|-------------|--------------------|-------------------|-----------------------------|----------------------------|------------------------------------|---------------------|--------------------------|--|
| 0     | 1<br>Enable | 1<br>Valid<br>Data | 0<br>Hard<br>Stop | 0<br>Smooth<br>Stop         | 0<br>Direction<br>(V mode) | 0<br>Absolute/<br>Incremen-<br>tal | 0<br>Start<br>Block | 1<br>Start<br>Trajectory |  |
| 1     |             | 0x00 Block Number  |                   |                             |                            |                                    |                     |                          |  |
| 2     | 0x          | 0x1 Axis Instance  |                   |                             | 0x01 Command Assembly Code |                                    |                     |                          |  |
| 3     | 0x          | 1 Axis Instan      | се                | 0x03 Response Assembly Code |                            |                                    |                     |                          |  |
| 4     |             |                    | 0x                | 00 Target Pc                | sition Low B               | yte                                |                     |                          |  |
| 5     |             |                    | 0xF4              | Target Positio              | on Low Midd                | le Byte                            |                     |                          |  |
| 6     |             |                    | 0x01 7            | Farget Positic              | on High Midd               | le Byte                            |                     |                          |  |
| 7     |             |                    | Ox                | 00 Target Po                | sition High B              | yte                                |                     |                          |  |

#### PnBA5 Bit 15 = 1 (Switch to Positioning Command)

The Switch to Positioning command (command assembly code = 0x1F) is used.

| Bytes | Bit 7       | Bit 6              | Bit 5             | Bit 4                       | Bit 3                      | Bit 2                              | Bit 1               | Bit 0                    |  |
|-------|-------------|--------------------|-------------------|-----------------------------|----------------------------|------------------------------------|---------------------|--------------------------|--|
| 0     | 1<br>Enable | 1<br>Valid<br>Data | 0<br>Hard<br>Stop | 0<br>Smooth<br>Stop         | 0<br>Direction<br>(V mode) | 0<br>Absolute/<br>Incremen-<br>tal | 0<br>Start<br>Block | 1<br>Start<br>Trajectory |  |
| 1     |             | 0x00 Block Number  |                   |                             |                            |                                    |                     |                          |  |
| 2     | 0x          | 0x1 Axis Instance  |                   |                             | 0x1F Command Assembly Code |                                    |                     |                          |  |
| 3     | 0x          | 1 Axis Instan      | ice               | 0x03 Response Assembly Code |                            |                                    |                     |                          |  |
| 4     |             |                    |                   | 0×                          | :00                        |                                    |                     |                          |  |
| 5     |             |                    |                   | 0×                          | :00                        |                                    |                     |                          |  |
| 6     |             |                    |                   | 0x00                        |                            |                                    |                     |                          |  |
| 7     |             |                    |                   | 0×                          | :00                        |                                    |                     |                          |  |

Example: Using the Switch to Positioning Command



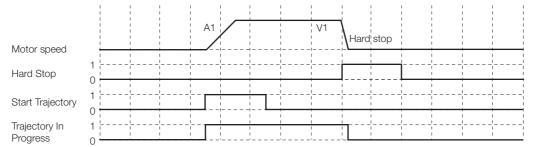
#### 13.3.5 Hard Stop Operation

| portant | PnDDD                                                                                                | Parame                     | eter Name                                      | Value                    |  |  |  |
|---------|------------------------------------------------------------------------------------------------------|----------------------------|------------------------------------------------|--------------------------|--|--|--|
|         | PnB12                                                                                                | Coordinate Type Se         | election                                       | 0001h                    |  |  |  |
|         | PnB13                                                                                                | Reference Units pe         | r Machine Revolution                           |                          |  |  |  |
|         | PnB54                                                                                                | Positioning Approa         | ch Speed                                       | Depends on the           |  |  |  |
|         | PnB55                                                                                                | End Position               |                                                | system.                  |  |  |  |
|         | PnB59                                                                                                | Approach Mode              |                                                |                          |  |  |  |
|         | Using an Explicit Message     Make sure that the following attributes are set to the correct values. |                            |                                                |                          |  |  |  |
|         | Make sure tha                                                                                        | at the following attrib    |                                                |                          |  |  |  |
|         |                                                                                                      |                            |                                                | rect values.<br>te Name  |  |  |  |
|         | Make sure the Object                                                                                 | at the following attrib    |                                                | te Name                  |  |  |  |
|         | Make sure tha                                                                                        | at the following attribute | Attribut                                       | te Name                  |  |  |  |
|         | Make sure the Object                                                                                 | Attribute<br>200           | Attribut<br>Approach speed for                 | te Name                  |  |  |  |
|         | Make sure the Object                                                                                 | Attribute<br>200<br>201    | Attribut<br>Approach speed for<br>End position | te Name<br>r positioning |  |  |  |

### 13.3.5 Hard Stop Operation

To execute a Hard Stop command, the maximum deceleration is used to stop the Servomotor.

- **1.** If the Hard Stop bit is set to 1 while the Servomotor is moving, the Servomotor will decelerate to a stop using the maximum deceleration rate.
- **2.** After the motor stops, the target position is set to the current position, and the On Target Position bit is set to 1.
- **3.** The hard stop status can be cleared by clearing the Hard Stop bit to 0. Execution of the Hard Stop command will continue even if the Hard Stop bit is cleared to 0 during command execution (i.e., during deceleration).

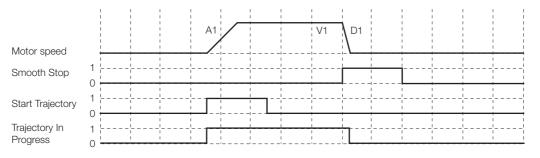


13.3.6 Smooth Stop Operation

# 13.3.6 Smooth Stop Operation

To execute a Smooth Stop command, the deceleration rate that is set for the Servomotor is used to stop the Servomotor.

- **1.** If the Smooth Stop bit is set to 1 while the Servomotor is moving, the Servomotor decelerates to a stop at the specified deceleration rate.
- **2.** After the motor stops, the target position is set to the current position, and the On Target Position bit is set to 1.
- **3.** The smooth stop status can be cleared by clearing the Smooth Stop bit to 0. Execution of the Smooth Stop command will continue even if the Smooth Stop bit is cleared to 0 during command execution (i.e., during deceleration).

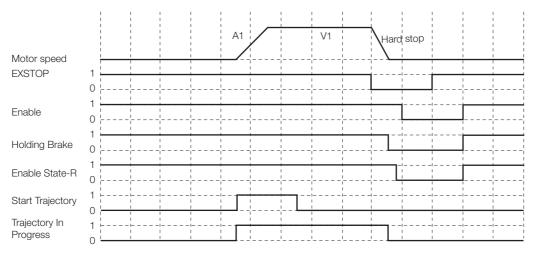


# 13.3.7 External Stop Operation

For the external stop operation, an emergency stop is performed in response to an external signal.

If the external stop input signal (EXSTOP) is made active (turned OFF) while the Servomotor is moving, a hard stop operation is performed. After the Servomotor has stopped, the servo is turned OFF. If the brake function has been set, the brake will be turned ON, and then the servo will be turned OFF.

To return to normal operation, make EXSTOP inactive (turn ON). If the Enable bit is already set to 1, the servo is turned ON automatically.



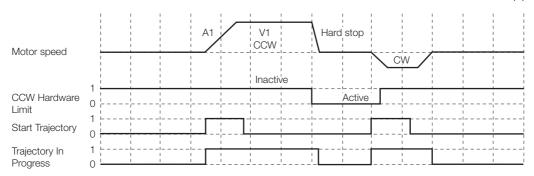
13.3.8 Hardware Limit Operation

### 13.3.8 Hardware Limit Operation

The hardware limit operation monitors the CW-OT (CW Drive Prohibit Input) signal and the CCW-OT (CCW Drive Prohibit Input) signal from limit switches. If either signal becomes active, the Servomotor is stopped.

If the counterclockwise hardware limit is reached while the Servomotor is rotating counterclockwise, a hard stop is performed. Similarly, if the clockwise hardware limit is reached while the Servomotor is rotating clockwise, a hard stop is performed. After the hard stop has been performed, only movement away from the hardware limit is permitted.

The hardware limits in both directions are monitored while the Servomotor is stopped.

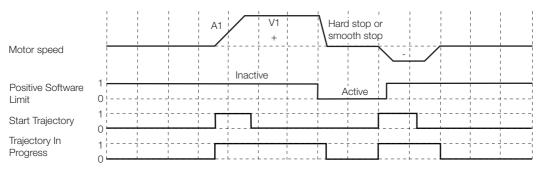


## 13.3.9 Software Limit Operation

The software limit operation decelerates the Servomotor to a stop if a specified software limit is reached.

If the current position of the Servomotor exceeds a specified software limit, the Servomotor will decelerate to a stop. After the Servomotor has stopped, it can move only in the direction that will return it to be within the software limit. The positions that are managed by the SERVOPACK before an origin return is performed do not match the positions in the machine coordinate system. Therefore, the software limits have no meaning before an origin return is performed.

If a rotary coordinate system is specified, the software limits are active only within one machine revolution.



13.4.1 What Is Programmed Operation?

# 13.4 Programmed Operation

# 13.4.1 What Is Programmed Operation?

Programmed operation allows you to set the sequential execution of command blocks in advance. You can store up to 255 command blocks and specify the execution flow by specifying the next block to execute with the Link Number attribute.

# 13.4.2 Command Blocks

#### **Command Block Structure**

A command block consists of up to seven attributes, as shown in the following table. The number of attributes that are used depends on the block command code.

| Attribute | Name                 | Description                                                   | Data Type |  |  |  |
|-----------|----------------------|---------------------------------------------------------------|-----------|--|--|--|
| 1         | Block Command Code   | Command Number<br>Defines the structure of the command block. | USINT     |  |  |  |
| 2         | Link Number          | Specifies the number of the next command block to execute.    | USINT     |  |  |  |
| 3         | Depends on the comma | Depends on the command.                                       |           |  |  |  |
| 4         | Depends on the comma | nd.                                                           |           |  |  |  |
| 5         | Depends on the comma | nd.                                                           |           |  |  |  |
| 6         | Depends on the comma | nd.                                                           |           |  |  |  |
| 7         | Depends on the comma | nd.                                                           |           |  |  |  |

#### **Block Command List**

The following table lists the block commands that are supported for programmed operation.

| Command Name                          | Code | Function                                                                                                        |  |
|---------------------------------------|------|-----------------------------------------------------------------------------------------------------------------|--|
| Attribute Change command              | 0x01 | Changes the value of an attribute.                                                                              |  |
| Wait Equals command                   | 0x02 | Stops the execution of the next command block until the speci-<br>fied attribute reaches the set value.         |  |
| Conditional Link Greater Than command | 0x03 | Branches to the specified block if the value of the specified attri-<br>bute is greater than a specified value. |  |
| Conditional Link Less Than command    | 0x04 | Branches to the specified block if the specified attribute is smaller than the specified value.                 |  |
| Decrement Counter com-<br>mand        | 0x05 | Decrements by one the value of the counter that is used for lo control.                                         |  |
| Delay command                         | 0x06 | Inserts a waiting time between the execution of other blocks.                                                   |  |
| Trajectory command                    | 0x07 | Starts positioning.                                                                                             |  |
| Trajectory and Wait command           | 0x08 | Starts positioning and waits until the target position is reached.                                              |  |
| Target Speed Change com-<br>mand      | 0x09 | Changes the target speed.                                                                                       |  |
| Goto Origin command                   | 0x10 | Moves the axis to the origin.                                                                                   |  |

13.4.3 Block Command Details

## 13.4.3 Block Command Details

#### Attribute Change Command

Use the Attribute Change command to change the value of an attribute. You can change the values of only the attributes that are listed in the following table. No other attributes can be changed.

The table that is provided below gives the data format for the Attribute Change command.

| Class | Instance | Attribute | Description of Attribute |
|-------|----------|-----------|--------------------------|
| 0x25  | 1        | 8         | Acceleration rate        |
| 0x25  | 1        | 9         | Deceleration rate        |
| 0x26  | 1        | 6         | Counter                  |

| Attribute | Name               | Data Type | Description of Attribute                     |
|-----------|--------------------|-----------|----------------------------------------------|
| 1         | Block Command Code | USINT     | Code = 0x01                                  |
| 2         | Link Number        | USINT     | Number of the next command block to execute* |
| 3         | Target Class       | USINT     | Class of attribute to change                 |
| 4         | Target Instance    | USINT     | Instance ID of attribute to change           |
| 5         | Attribute Number   | USINT     | ID of attribute to change                    |
| 6         | Attribute Value    | DINT      | New value of attribute to change             |

\* If the link number is 0, the block is the final block in the sequence.

### Wait Equals Command

The Wait Equals command stops the execution of a sequence of blocks until the value of a specified attribute equals a set value. When the specified attribute equals the set value, the block will end and the next linked block will be executed.

| Class         | Instance            | Attribute             | Description of Attribute |
|---------------|---------------------|-----------------------|--------------------------|
| The following | y lable gives the a | illindules that can i | be compared.             |

| Class     | Instance       | At           | tribute |      | Description of Attribute                                                                                                                                                       |
|-----------|----------------|--------------|---------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x25      | 1              |              | 13      | Curr | ent position (reference units)                                                                                                                                                 |
| 0x25      | 1              |              | 15      | Refe | rence position (reference units)                                                                                                                                               |
| Attribute | Name           | Name Data Ty |         | e    | Description of Attribute                                                                                                                                                       |
| 1         | Block Command  | d Code       | USINT   |      | Code = 0x02                                                                                                                                                                    |
| 2         | Link Numb      | er           | USINT   |      | Number of the next command block to execute*                                                                                                                                   |
| 3         | Target Clas    | ss           | USINT   |      | Class of attribute to compare                                                                                                                                                  |
| 4         | Target Instar  | nce          | USINT   |      | Instance ID of attribute to compare                                                                                                                                            |
| 5         | Attribute Nun  | nber         | USINT   |      | ID of attribute to compare                                                                                                                                                     |
| 6         | Compare timeou | ut value     | DINT    |      | If the values do not match within the set<br>time, a timeout will occur.<br>Setting range: 0 to 0x7FFFFFF<br>Unit: ms<br>Set the timeout value to 0 to wait indefi-<br>nitely. |
| 7         | Compare va     | lue          | DINT    |      | Value to compare to value of attribute                                                                                                                                         |
|           |                |              |         |      |                                                                                                                                                                                |

\* If the link number is 0, the block is the final block in the sequence.

#### Conditional Link Greater Than Command

If the value of the specified attribute is greater than or equal to the value of the Compare Data attribute, execution will branch to the block that is specified in the Compare Link Number attribute. If the value of the specified attribute is smaller than the value of the Compare Data attribute, execution will branch to the block that is specified in the Link Number attribute.

The following table gives the attributes that can be compared.

| Class | Instance | Attribute | Description of Attribute             |
|-------|----------|-----------|--------------------------------------|
| 0x25  | 1        | 13        | Current position (reference units)   |
| 0x25  | 1        | 15        | Reference position (reference units) |
| 0x26  | 1        | 6         | Counter                              |

The following table gives the data format of the Conditional Link Greater Than command.

| Attribute | Name                     | Data Type | Description of Attribute                                                                                                                        |
|-----------|--------------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 1         | Block Command<br>Code    | USINT     | Code = 0x03                                                                                                                                     |
| 2         | Link Number              | USINT     | Number of the next command block to exe-<br>cute if the value of the attribute is smaller<br>than the value of the Compare Data attri-<br>bute* |
| 3         | Target Class             | USINT     | Class of attribute to compare                                                                                                                   |
| 4         | Target Instance          | USINT     | Instance ID of attribute to compare                                                                                                             |
| 5         | Attribute Number         | USINT     | ID of attribute to compare                                                                                                                      |
| 6         | Compare Link Num-<br>ber | USINT     | Number of the next command block to exe-<br>cute if the value of the attribute is larger than<br>the value of the Compare Data attribute        |
| 7         | Compare Data             | DINT      | Value to compare                                                                                                                                |

\* If the link number is 0, the block is the final block in the sequence.

### **Conditional Link Less Than Command**

If the value of the specified attribute is smaller than or equal to the value of the Compare Data attribute, execution will branch to the block that is specified in the Compare Link Number attribute. If the value of the specified attribute is larger than the value of the Compare Data attribute, execution will branch to the block that is specified in the Link Number attribute.

The following table gives the attributes that can be compared.

| Class | Instance | Attribute | Description of Attribute             |
|-------|----------|-----------|--------------------------------------|
| 0x25  | 1        | 13        | Current position (reference units)   |
| 0x25  | 1        | 15        | Reference position (reference units) |
| 0x26  | 1        | 6         | Counter                              |

The following table gives the data format of the Conditional Link Less Than command.

| Attribute | Name                | Data Type | Description of Attribute                                                                                                                   |
|-----------|---------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1         | Block Command Code  | USINT     | Code = 0x04                                                                                                                                |
| 2         | Link Number         | USINT     | Number of the next command block to<br>execute if the value of the attribute is<br>larger than the value of the Compare<br>Data attribute* |
| 3         | Target Class        | USINT     | Class of attribute to compare                                                                                                              |
| 4         | Target Instance     | USINT     | Instance ID of attribute to compare                                                                                                        |
| 5         | Attribute Number    | USINT     | ID of attribute to compare                                                                                                                 |
| 6         | Compare Link Number | USINT     | Number of the next command block to<br>execute if the value of the attribute is<br>smaller than the value of the Compare<br>Data attribute |
| 7         | Compare Data        | DINT      | Value to compare                                                                                                                           |

\* If the link number is 0, the block is the final block in the sequence.

13.4.3 Block Command Details

### **Decrement Counter Command**

The Decrement Counter command decrements by one the counter that is used for loop control. The following table gives the data format for the Decrement Counter command.

| Attribute | Name               | Data Type | Description of Attribute                      |
|-----------|--------------------|-----------|-----------------------------------------------|
| 1         | Block Command Code | USINT     | Code = 0x05                                   |
| 2         | Link Number        | USINT     | Number of next command block to exe-<br>cute* |

\* If the link number is 0, the block is the final block in the sequence.

## **Delay Command**

The Delay command inserts a delay time before the execution of the next command block. Set the delay time in increments of 4 ms. If you specify any value that is not a multiple of 4 ms, the value will be rounded down to the nearest multiple of 4 ms. The following table gives the data format for the Delay command.

| Attribute | Name               | Data Type | Description of Attribute                                                   |
|-----------|--------------------|-----------|----------------------------------------------------------------------------|
| 1         | Block Command Code | USINT     | Code = 0x06                                                                |
| 2         | Link Number        | USINT     | Number of next command block to exe-<br>cute*                              |
| 3         | Delay              | DINT      | Delay timer value<br>Setting range: 0x00000001 to<br>0x7FFFFFF<br>Unit: ms |

\* If the link number is 0, the block is the final block in the sequence.

### **Trajectory Command**

The Trajectory command starts positioning. After the SERVOPACK starts positioning, the next command block is executed. The following table gives the data format for the Trajectory command.

| Attribute | Name                 | Data Type | Description of Attribute                      |
|-----------|----------------------|-----------|-----------------------------------------------|
| 1         | Block Command Code   | USINT     | Code = 0x07                                   |
| 2         | Link Number          | USINT     | Number of next command block to exe-<br>cute* |
| 3         | Target Position      | DINT      | Target position (reference units)             |
| 4         | Target Velocity      | DINT      | Target speed (reference unit/s)               |
| 5         | Absolute/Incremental | BOOL      | Absolute (0)/Incremental (1)                  |

\* If the link number is 0, the block is the final block in the sequence.

## **Trajectory and Wait Command**

The Trajectory and Wait command starts positioning. The next command block is not executed until positioning has been completed. The next command block is executed only after the positioning operation is completed. The following table gives the data format for the Trajectory and Wait command.

| Attribute | Name                 | Data Type | Description of Attribute                      |
|-----------|----------------------|-----------|-----------------------------------------------|
| 1         | Block Command Code   | USINT     | Code = 0x08                                   |
| 2         | Link Number          | USINT     | Number of next command block to exe-<br>cute* |
| 3         | Target Position      | DINT      | Target position (reference units)             |
| 4         | Target Velocity      | DINT      | Target speed (reference unit/s)               |
| 5         | Absolute/Incremental | BOOL      | Absolute (0)/Incremental (1)                  |

\* If the link number is 0, the block is the final block in the sequence.

13.4.3 Block Command Details

#### Target Speed Change Command

Use the Target Speed Change command to change the target speed. The following table gives the data format for the Target Speed Change command.

| Attribute | Name               | Data Type | Description of Attribute                      |
|-----------|--------------------|-----------|-----------------------------------------------|
| 1         | Block Command Code | USINT     | Code = 0x09                                   |
| 2         | Link Number        | USINT     | Number of next command block to exe-<br>cute* |
| 3         | Target Velocity    | DINT      | Target speed (reference unit/s)               |

\* If the link number is 0, the block is the final block in the sequence.

## **Goto Origin Command**

The Goto Origin command moves the axis to the origin. Before executing this command with an incremental encoder, make sure that an origin return has been completed normally.

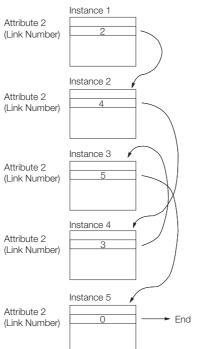
| Attribute | Name               | Data Type | Description of Attribute                                                                                                                                       |
|-----------|--------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1         | Block Command Code | USINT     | Code = 0x10                                                                                                                                                    |
| 2         | Link Number        | USINT     | Number of next command block to exe-<br>cute*                                                                                                                  |
| 3         | Home offset        | DINT      | The sum of the offset and the value of the<br>Origin Position attribute is the absolute<br>value target position.<br>Setting range: 0x80000001 to<br>0x7FFFFFF |
| 4         | Target Velocity    | DINT      | Target speed (reference unit/s)                                                                                                                                |

\* If the link number is 0, the block is the final block in the sequence.

13.4.4 Command Block Links

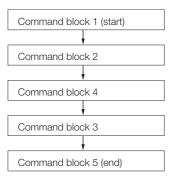
### 13.4.4 Command Block Links

Command blocks are linked as shown below depending on the link numbers in attribute 2 (Link Number) of the command blocks.



The command block number is equivalent to the instance ID of the command block object. If the link number that is stored in attribute 2 is 0, this command block will be the final block in the sequence of command blocks.

If command block 1 is executed from the host controller with the command blocks stored as shown in the preceding example, the command blocks are executed in the following sequence.



# 13.4.5 Creating and Changing Command Blocks

You can use explicit messages to create and change Command Block objects (class ID: 0x27). You can use the following two services.

| Service<br>Code | Name              | Meaning                                         | Remarks                                                                                                                                                                    |
|-----------------|-------------------|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x02            | Set_Attribute_All | Changes all the data of the specified instance. | Use this service to set all of the attribute data in<br>a command block at the same time. We recom-<br>mend that you normally use this service to write<br>command blocks. |

#### 13.4.5 Creating and Changing Command Blocks

Continued from previous page.

| Service<br>Code | Name                 | Meaning                                       | Remarks                                                                                                                                                                                                                                                                                                                                                                        |
|-----------------|----------------------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0x10            | Set_Attribute_Single | Changes the value of the specified attribute. | Use this service to change only one attribute in<br>a command block.<br>If you change the command assembly code of<br>the command block in attribute 1, all data from<br>attribute 2 to attribute 7 will be initialized.<br>If you change the command block with this ser-<br>vice, change the attributes in sequence starting<br>with the attribute with the smallest number. |

**Example** The following example is for when the Target Speed Change command is sent. The following Target Speed Change command is used.

| 0x09 | Target Speed Change command                 |
|------|---------------------------------------------|
| 0x02 | Number of the next command block to execute |
| 0x40 |                                             |
| 0x1F | Target speed = 8,000 reference units/s      |
| 0x00 |                                             |
| 0x00 |                                             |

The following table shows an example of when this command is stored in command block 1 by using the Set\_Attribute\_All service.

| 7 | 6    | 5 | 5 4 3 2 1 0 |            |   |  |  |  |  |  |
|---|------|---|-------------|------------|---|--|--|--|--|--|
| 0 | 0    |   |             | (          | ) |  |  |  |  |  |
| 0 |      |   |             | 0x02       |   |  |  |  |  |  |
|   |      |   | 0x27 (obje  | ct number) |   |  |  |  |  |  |
|   |      |   | 0x01 (ins   | stance ID) |   |  |  |  |  |  |
|   |      |   | 0x          | .09        |   |  |  |  |  |  |
|   |      |   | 0x          | .02        |   |  |  |  |  |  |
|   |      |   | 0x          | 40         |   |  |  |  |  |  |
|   | 0x1F |   |             |            |   |  |  |  |  |  |
|   | 0x00 |   |             |            |   |  |  |  |  |  |
|   | 0x00 |   |             |            |   |  |  |  |  |  |

• Command (Master Device to SERVOPACK)

#### • Response (SERVOPACK to Master Device)

| 7 | 6    | 5 | 5 4 3 2 1 0 |    |   |  |  |  |  |
|---|------|---|-------------|----|---|--|--|--|--|
| 0 | 0    |   |             | (  | ) |  |  |  |  |
| 1 |      |   | 0x02        |    |   |  |  |  |  |
|   |      |   | 0x          | 09 |   |  |  |  |  |
|   |      |   | 0x          | 02 |   |  |  |  |  |
|   |      |   | 0x          | 40 |   |  |  |  |  |
|   |      |   | 0x          | 1F |   |  |  |  |  |
|   | 0x00 |   |             |    |   |  |  |  |  |
|   | 0x00 |   |             |    |   |  |  |  |  |

Note: If the Set\_Attribute\_Single service is used, you must write the data in the following order: the Target Speed Change command, the next command block number, and then the target speed.



If you change a command block under the following conditions, an error will occur.

• The current block is still being executed.

• An alarm has occurred in the SERVOPACK.

13.4.6 Starting Programmed Operation

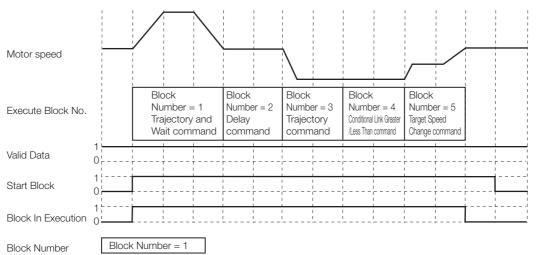
### 13.4.6 Starting Programmed Operation

To start programmed operation, specify the starting command block number in a command message in I/O communications. When programmed operation starts, the SERVOPACK will continuously execute the command blocks. The host controller does not need to continuously send commands to the SERVOPACK using command messages.

Use the following procedure to start programmed operation.

- 1. Set the block number of the first block to execute in the Block Number field (byte 1).
- 2. Set the Valid Data bit to 1.
- **3.** Set the Start Block bit to 1.

| 1     0x01 Block Number       2     0x1 Axis Instance     0x00 Command Assembly Code       3     0x1 Axis Instance     0x01 Response Assembly Code       4     0x00       5     0x00       6     0x00 | Bytes | Bit 7           | Bit 6        | Bit 5 | Bit 4    | Bit 3      | Bit 2        | Bit 1     | Bit 0 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|-----------------|--------------|-------|----------|------------|--------------|-----------|-------|
| 20x1 Axis Instance0x00 Command Assembly Code30x1 Axis Instance0x01 Response Assembly Code40x0050x0060x00                                                                                              | 0     | 1<br>Enable     |              | Hard  | Smooth   | Direction  | Absolute/    |           | -     |
| 3         0x1 Axis Instance         0x01 Response Assembly Code           4         0x00           5         0x00           6         0x00                                                            | 1     |                 |              |       | 0x01 Blo | ock Number |              |           |       |
| 4         0x00           5         0x00           6         0x00                                                                                                                                      | 2     | 0x <sup>-</sup> | 1 Axis Insta | nce   |          | 0x00 Cor   | nmand Assem  | nbly Code |       |
| 5         0x00           6         0x00                                                                                                                                                               | 3     | 0x <sup>-</sup> | 1 Axis Insta | nce   |          | 0x01 Res   | sponse Assem | bly Code  |       |
| 6 0x00                                                                                                                                                                                                | 4     |                 |              |       | C        | )x00       |              |           |       |
|                                                                                                                                                                                                       | 5     |                 | 0x00         |       |          |            |              |           |       |
| 7                                                                                                                                                                                                     | 6     | 0x00            |              |       |          |            |              |           |       |
| 7 0000                                                                                                                                                                                                | 7     | 0x00            |              |       |          |            |              |           |       |



When programmed operation starts, the SERVOPACK executes the block command that is registered in attribute 1 of the command block that is specified with the command block number (which is the instance ID).

The command block with the block number that is set in the Link Number attribute (attribute 2) will be executed next. The command blocks will then be executed in sequence until the link number is 0x00.

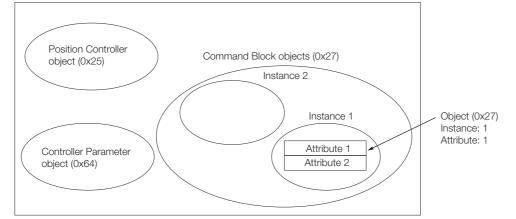
While the command blocks are being executed, the Block In Execution bit will be set to 1. After all the command blocks have been executed, the Block In Execution bit will be cleared to 0.

13.5.1 DeviceNet Data Management

# **13.5 Reading and Changing Attributes**

# 13.5.1 DeviceNet Data Management

In DeviceNet, all parameters and command blocks are managed as objects, instances, and attributes. The following diagram illustrates this.



SERVOPACKs have the following objects.

| Object Name                                                             | Instance | Function                                                    |  |  |  |  |  |
|-------------------------------------------------------------------------|----------|-------------------------------------------------------------|--|--|--|--|--|
| Identity                                                                | 1        | Manages the device type and serial number.                  |  |  |  |  |  |
| Message Router                                                          | 1        | Distributes explicit messages to other objects.             |  |  |  |  |  |
| DeviceNet                                                               | 1        | Manages the physical connection to DeviceNet.               |  |  |  |  |  |
| Accombly                                                                | 1        | Manages response messages.                                  |  |  |  |  |  |
| Assembly                                                                | 2        | Manages command messages.                                   |  |  |  |  |  |
| Connection                                                              | 1        | Manages explicit messages.                                  |  |  |  |  |  |
| Connection                                                              | 2        | Manages polled I/O messages.                                |  |  |  |  |  |
| Position Controller<br>Supervisor                                       | 1        | Manages command assembly codes and response assembly codes. |  |  |  |  |  |
| Position Controller                                                     | 1        | Manages motion parameters.                                  |  |  |  |  |  |
| Block Sequencer                                                         | 1        | Manages command blocks.                                     |  |  |  |  |  |
| Command Block                                                           | 1 to 255 | Stores a command block.                                     |  |  |  |  |  |
| Control Parameter         1         Manages detailed motion parameters. |          | Manages detailed motion parameters.                         |  |  |  |  |  |
| SERVOPACK parameter                                                     | 1        | Manages SERVOPACK parameters.                               |  |  |  |  |  |

Instances of objects have attributes. The attributes hold the settings and status of the SERVO-PACK. To read or change an attribute via DeviceNet, specify the class ID, instance ID, and attribute ID.

For example, when reading a Current Position attribute, which holds the current position, specify the attribute as follows:

Position Controller Object

- Class: 0x25
- Instance ID: 1
- Attribute ID: 13

13.5.2 Reading and Changing Attributes

### 13.5.2 Reading and Changing Attributes

You can use messages with explicit messages communications to read or change attributes.

#### Basic Format

The following table shows the basic format for explicit messages.

• Commands (Master Device to SERVOPACK)

| 7 | 6            | 5 4 3 2 1 0 |        |              |   |  |  |  |  |
|---|--------------|-------------|--------|--------------|---|--|--|--|--|
| 0 | 0/1          |             | MAC ID |              |   |  |  |  |  |
| 0 |              |             | :      | Service Code | Э |  |  |  |  |
|   |              |             | Clas   | ss ID        |   |  |  |  |  |
|   |              |             | Instar | nce ID       |   |  |  |  |  |
|   | Attribute ID |             |        |              |   |  |  |  |  |
|   | Service Data |             |        |              |   |  |  |  |  |

#### • Responses (SERVOPACK to Master Device)

| 7 | 6                     | 5 4 3 2 1 0  |  |  |  |  |  |  |  |
|---|-----------------------|--------------|--|--|--|--|--|--|--|
| 0 | 0/1                   | MAC ID       |  |  |  |  |  |  |  |
| 1 |                       | Service Code |  |  |  |  |  |  |  |
|   | Response Service Data |              |  |  |  |  |  |  |  |

#### Example of Reading the Acceleration Attribute

The following table shows an example using master device MAC ID of 0 and reading the acceleration (class ID 0x25, instance ID 1, and attribute ID 8) with the Get\_Attribute\_Single service (service code: 0x0E).

#### • Commands (Master Device to SERVOPACK)

| 7 | 6    | 5 4 3 2 1 0 |    |      |  |  |  |  |  |  |
|---|------|-------------|----|------|--|--|--|--|--|--|
| 0 | 0    |             | 0  |      |  |  |  |  |  |  |
| 0 |      |             |    | 0x0E |  |  |  |  |  |  |
|   |      |             | 0x | 25   |  |  |  |  |  |  |
|   |      | 0x01        |    |      |  |  |  |  |  |  |
|   | 0x08 |             |    |      |  |  |  |  |  |  |

#### • Responses (SERVOPACK to Master Device)

| 7 | 6                     | 5 4 3 2 1 0 |            |             |  |  |  |  |  |  |
|---|-----------------------|-------------|------------|-------------|--|--|--|--|--|--|
| 0 | 0                     | 0           |            |             |  |  |  |  |  |  |
| 1 |                       |             |            | 0x0E        |  |  |  |  |  |  |
|   |                       |             | 0x34 (lowe | rmost byte) |  |  |  |  |  |  |
|   |                       |             | 0x         | 12          |  |  |  |  |  |  |
|   | 0x00                  |             |            |             |  |  |  |  |  |  |
|   | 0x00 (uppermost byte) |             |            |             |  |  |  |  |  |  |

Refer to user documentation for the master device for details on explicit messages.

13.5.3 Executing a Module Reset

## 13.5.3 Executing a Module Reset

You can use an explicit message to reset the SERVOPACK by executing the Reset service for the Identity object. The following example is for a master device with a MAC ID of 0.

#### Commands (Master Device to SERVOPACK)

| 7                  | 6                      | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------------|------------------------|---|---|---|---|---|---|
| 0                  | 0                      | 0 |   |   |   |   |   |
| 0                  | 0x05                   |   |   |   |   |   |   |
|                    | 0x01 (Identity object) |   |   |   |   |   |   |
| 0x01 (Instance: 1) |                        |   |   |   |   |   |   |

When the Module is reset, the same processing as when the power supply is turned ON will be performed by the SERVOPACK. This means that DeviceNet communications will be interrupted.

If the Master device does not support automatic recovery of DeviceNet communications, it will be necessary to reconnect DeviceNet communications.

The following operations will be performed when the Module is reset.

- All parameters are stored in non-volatile memory.
- The parameters that require turning the power supply OFF and ON again are enabled.

13.5.3 Executing a Module Reset

# Maintenance

(14)

This chapter provides information on the meaning of, causes of, and corrections for alarms and warnings.

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|------|--------------------------------------------------------------------|-----------------------------------------------------------------------------|
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| 14.2 | Alarm                                                              | Displays14-5                                                                |
|      | 14.2.1<br>14.2.2<br>14.2.3<br>14.2.4<br>14.2.5<br>14.2.6<br>14.2.7 | List of Alarms                                                              |
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|      |                                                                    | List of Warnings                                                            |
| 14.4 | Troublesh                                                          | ooting Based on the Operation and Conditions of the Servomotor 14-57        |

14.1.1 Inspections

# 14.1 Inspections and Part Replacement

This section describes inspections and part replacement for SERVOPACKs.

### 14.1.1 Inspections

Perform the inspections given in the following table at least once every year for the SERVO-PACK. Daily inspections are not required.

| Item         | Frequency            | Inspection                                                                           | Correction                                     |
|--------------|----------------------|--------------------------------------------------------------------------------------|------------------------------------------------|
| Exterior     | At least once a year | Check for dust, dirt, and oil on the surfaces.                                       | Clean with compressed air or a cloth.          |
| Loose Screws |                      | Check for loose terminal block<br>and connector screws and for<br>other loose parts. | Tighten any loose screws or other loose parts. |

## 14.1.2 Guidelines for Part Replacement

The following electric or electronic parts are subject to mechanical wear or deterioration over time. Use one of the following methods to check the standard replacement period.

- Use the service life prediction function of the SERVOPACK.
   Refer to the following section for information on service life predictions.
   *I* 9.4 Monitoring Product Life on page 9-14
- Use the following table.

| Part                   | Standard Replace-<br>ment Period | Remarks                                                                                                                                                                                        |
|------------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cooling Fan            | 4 years to 5 years               | The standard replacement periods given on the left are for                                                                                                                                     |
| Electrolytic Capacitor | 10 years                         | <ul> <li>the following operating conditions.</li> <li>Surrounding air temperature: Annual average of 30°C</li> <li>Load factor: 80% max.</li> <li>Operation rate: 20 hours/day max.</li> </ul> |
| Relays                 | 100,000 power ON operations      | Power ON frequency: Once an hour                                                                                                                                                               |
| Battery                | 3 years without power supplied   | Surrounding temperature without power supplied: 20°C                                                                                                                                           |

When any standard replacement period is close to expiring, contact your Yaskawa representative. After an examination of the part in question, we will determine whether the part should be replaced.



The parameters of any SERVOPACKs that are sent to Yaskawa for part replacement are reset to the factory settings before they are returned to you. Always keep a record of the parameter settings. And, always confirm that the parameters are properly set before starting operation.

# 14.1.3 Replacing the Battery

If the battery voltage drops to approximately 2.7 V or less, an A.830 alarm (Encoder Battery Alarm) or an A.930 warning (Encoder Battery Warning) will be displayed.

If this alarm or warning is displayed, the battery must be replaced. Refer to the following section for the battery replacement procedure.

### **Battery Alarm/Warning Selection**

Whether to display an alarm or a warning is determined by the setting of  $Pn008 = n.\Box\Box\BoxX$  (Low Battery Voltage Alarm/Warning Selection).

| Parameter |                             | Meaning                                         | When Enabled  | Classification |
|-----------|-----------------------------|-------------------------------------------------|---------------|----------------|
| Pn008     | n.□□□0<br>(default setting) | Output alarm (A.830) for low battery voltage.   | After restart | Setup          |
|           | n.0001                      | Output warning (A.930) for low battery voltage. |               |                |

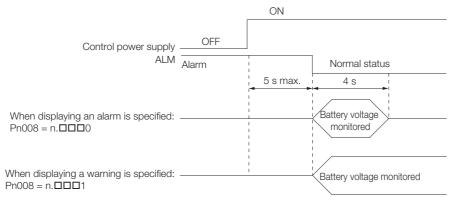
• Pn008 = n.□□□0

The ALM (Servo Alarm) signal is output for up to five seconds when the control power supply is turned ON, and then the battery voltage is monitored for four seconds.

No alarm will be displayed even if the battery voltage drops below the specified value after these four seconds.

• Pn008 = n.□□□1

The ALM (Servo Alarm) signal is output for up to five seconds when the control power supply is turned ON, and then the battery voltage is monitored continuously.



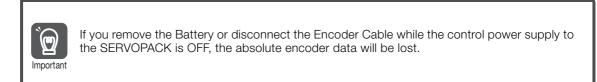
### **Battery Replacement Procedure**

- When Installing a Battery on the Host Controller
- 1. Turn ON only the control power supply to the SERVOPACK.
- 2. Remove the old battery and mount a new battery.
- **3.** Turn OFF the control power supply to the SERVOPACK to clear the A.830 alarm (Absolute Encoder Battery Error).
- 4. Turn ON the control power supply to the SERVOPACK again.
- 5. Make sure that the alarm has been cleared and that the SERVOPACK operates normally.

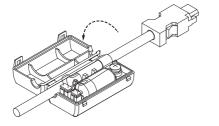
#### 14.1.3 Replacing the Battery

#### When Using an Encoder Cable with a Battery Case

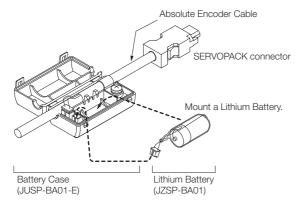
1. Turn ON only the control power supply to the SERVOPACK.



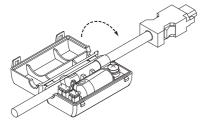
2. Open the cover of the Battery Case.



3. Remove the old Battery and mount a new Battery.



4. Close the cover of the Battery Case.



- **5.** Turn OFF the power supply to the SERVOPACK to clear the A.830 alarm (Absolute Encoder Battery Error).
- 6. Turn ON the power supply to the SERVOPACK.
- 7. Make sure that the alarm has been cleared and that the SERVOPACK operates normally.

4.2 Alarm Displays

If an error occurs in the SERVOPACK, an alarm number will be displayed on the panel display. However, if no alarm number appears on the panel display, this indicates a SERVOPACK system error. Replace the SERVOPACK.

If there is an alarm, the display will change in the following order.

Example: Alarm A.020

```
\overset{\text{Status}}{\longrightarrow} \text{Not lit.} \longrightarrow \textbf{R} \longrightarrow \longrightarrow \textbf{R}
```

This section provides a list of the alarms that may occur and the causes of and corrections for those alarms.

## 14.2.1 List of Alarms

The list of alarms gives the alarm name, alarm meaning, alarm stopping method, alarm reset possibility, and alarm code output in order of the alarm numbers.

#### Servomotor Stopping Method for Alarms

Refer to the following section for information on the stopping method for alarms. 5.12.2 Servomotor Stopping Method for Alarms on page 5-35

### Alarm Reset Possibility

Yes: You can use an alarm reset to clear the alarm. However, this assumes that the cause of the alarm has been removed. No: You cannot clear the alarm.

### List of Alarms

| Alarm<br>Number | Alarm Name                     | Alarm Meaning                                                    | Servo-<br>motor<br>Stop-<br>ping<br>Method | Alarm<br>Reset<br>Possi-<br>ble? |
|-----------------|--------------------------------|------------------------------------------------------------------|--------------------------------------------|----------------------------------|
| A.020           | Parameter Checksum<br>Error    | There is an error in the parameter data in the SERVOPACK.        | Gr.1                                       | No                               |
| A.021           | Parameter Format Error         | There is an error in the parameter data format in the SERVOPACK. | Gr.1                                       | No                               |
| A.022           | System Checksum Error          | There is an error in the parameter data in the SERVOPACK.        | Gr.1                                       | No                               |
| A.024           | System Alarm                   | An internal program error occurred in the SER-<br>VOPACK.        | Gr.1                                       | No                               |
| A.025           | System Alarm                   | An internal program error occurred in the SER-<br>VOPACK.        | Gr.1                                       | No                               |
| A.030           | Main Circuit Detector<br>Error | There is an error in the detection data for the main circuit.    | Gr.1                                       | Yes                              |
| A.040           | Parameter Setting Error        | A parameter setting is outside of the setting range.             | Gr.1                                       | No                               |

Continued on next page.

Continued from previous page. Servo-Alarm motor Alarm Reset Alarm Name Alarm Meaning Stop-Number Possiping ble? Method The setting of Pn212 (Encoder Output Pulses) or **Encoder Output Pulse** Pn281 (Encoder Output Resolution) is outside of A.041 Gr.1 No Setting Error the setting range or does not satisfy the setting conditions. Parameter Combination The combination of some parameters exceeds A.042 Gr.1 No Error the setting range. Semi-Closed/Fully-Closed The settings of the Option Module and Pn002 = A.044 Loop Control Parameter n.XDDD (External Encoder Usage) do not Gr 1 No Setting Error match. There is a setting error in a system reserved A.04A Parameter Setting Error 2 Gr.1 No parameter. The capacities of the SERVOPACK and Servomo-A.050 Combination Error Gr.1 Yes tor do not match. **Unsupported Device** A.051 Gr 1 No An unsupported device was connected. Alarm Motor Type Change The connected motor is a different type of motor A.070 Gr.1 No Detected from the previously connected motor. Linear Encoder Pitch Set-The setting of Pn282 (Linear Encoder Pitch) has A.080 Gr.1 No not been changed from the default setting. tina Error A Servo ON command (Enable = 1) was input Invalid Servo ON Com-A.0b0 from the host controller after a utility function that Gr.1 Yes mand Alarm turns ON the Servomotor was executed. An overcurrent flowed through the power trans-A.100 **Overcurrent Detected** Gr.1 No former or the heat sink overheated. Motor Overcurrent The current to the motor exceeded the allowable A.101 Gr.1 No Detected current. A.300 There is an error related to regeneration. Gr.1 Yes **Regeneration Error** A.320 Gr.2 Yes **Regenerative Overload** A regenerative overload occurred. • The AC power supply input setting or DC power Main Circuit Power Supply A.330 supply input setting is not correct. Gr.1 Yes Wiring Error • The power supply wiring is not correct. A.400 Overvoltage The main circuit DC voltage is too high. Gr.1 Yes A.410 Undervoltage The main circuit DC voltage is too low. Gr.2 Yes A.510 Overspeed Gr.1 Yes The motor exceeded the maximum speed. · Rotary Servomotor: The pulse output speed for the setting of Pn212 (Encoder Output Pulses) **Encoder Output Pulse** was exceeded. A.511 Gr.1 Yes Overspeed • Linear Servomotor: The motor speed upper limit for the setting of Pn281 (Encoder Output Resolution) was exceeded. Abnormal oscillation was detected in the motor A.520 Vibration Alarm Gr.1 Yes speed Vibration was detected during autotuning for the A.521 Autotuning Alarm Gr.1 Yes tuning-less function. Maximum Speed Setting The setting of Pn385 (Maximum Motor Speed) is A.550 Gr.1 Yes greater than the maximum motor speed. Frror The Servomotor was operating for several sec-A.710 Instantaneous Overload onds to several tens of seconds under a torque Gr 2 Yes that largely exceeded the rating. The Servomotor was operating continuously A.720 Continuous Overload Gr.1 Yes under a torque that exceeded the rating. When the dynamic brake was applied, the rota-A.730 Dynamic Brake Overload tional or linear kinetic energy exceeded the Gr.1 Yes A.731 capacity of the dynamic brake resistor.

| Continued from p | orevious | page. |
|------------------|----------|-------|
|------------------|----------|-------|

| Alarm<br>Number | Alarm Name                                                             | Alarm Meaning                                                                                                                      | Servo-<br>motor<br>Stop-<br>ping<br>Method | Alarm<br>Reset<br>Possi-<br>ble? |
|-----------------|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|----------------------------------|
| A.740           | Inrush Current Limiting<br>Resistor Overload                           | The main circuit power supply was frequently turned ON and OFF.                                                                    | Gr.1                                       | Yes                              |
| A.7A1           | Internal Temperature Error<br>1 (Control Board Tempera-<br>ture Error) |                                                                                                                                    |                                            | Yes                              |
| A.7A2           | Internal Temperature Error<br>2 (Power Board Tempera-<br>ture Error)   | The surrounding temperature of the power PCB is abnormal.                                                                          | Gr.2                                       | Yes                              |
| A.7A3           | Internal Temperature Sen-<br>sor Error                                 | An error occurred in the temperature sensor cir-<br>cuit.                                                                          | Gr.2                                       | No                               |
| A.7Ab           | SERVOPACK Built-in Fan<br>Stopped                                      | The fan inside the SERVOPACK stopped.                                                                                              | Gr.1                                       | Yes                              |
| A.810           | Encoder Backup Alarm                                                   | The power supplies to the encoder all failed and the position data was lost.                                                       | Gr.1                                       | No                               |
| A.820           | Encoder Checksum Error                                                 | There is an error in the checksum results for encoder memory.                                                                      | Gr.1                                       | No                               |
| A.830           | Encoder Battery Alarm                                                  | The battery voltage was lower than the specified level after the control power supply was turned ON.                               | Gr.1                                       | Yes                              |
| A.840           | Encoder Data Alarm                                                     | There is an internal data error in the encoder.                                                                                    | Gr.1                                       | No                               |
| A.850           | Encoder Overspeed                                                      | The encoder was operating at high speed when the power was turned ON.                                                              | Gr.1                                       | No                               |
| A.860           | Encoder Overheated                                                     | The internal temperature of encoder is too high.                                                                                   | Gr.1                                       | No                               |
| A.861           | Motor Overheated                                                       | The internal temperature of motor is too high.                                                                                     | Gr.1                                       | No                               |
| A.862           | Overheat Alarm                                                         | The input voltage (temperature) of the overheat protection input (TH) signal exceeded the setting of Pn61B (Overheat Alarm Level). | Gr.1                                       | Yes                              |
| A.890           | Encoder Scale Error                                                    | A failure occurred in the linear encoder.                                                                                          | Gr.1                                       | No                               |
| A.891           | Encoder Module Error                                                   | An error occurred in the linear encoder.                                                                                           | Gr.1                                       | No                               |
| A.8A0           | External Encoder Error                                                 | An error occurred in the external encoder.                                                                                         | Gr.1                                       | Yes                              |
| A.8A1           | External Encoder Module<br>Error                                       | An error occurred in the Serial Converter Unit.                                                                                    | Gr.1                                       | Yes                              |
| A.8A2           | External Incremental<br>Encoder Sensor Error                           | An error occurred in the external encoder.                                                                                         | Gr.1                                       | Yes                              |
| A.8A3           | External Absolute Encoder<br>Position Error                            | An error occurred in the position data of the external encoder.                                                                    | Gr.1                                       | Yes                              |
| A.8A5           | External Encoder Over-<br>speed                                        | An overspeed error occurred in the external encoder.                                                                               | Gr.1                                       | Yes                              |
| A.8A6           | External Encoder Over-<br>heated                                       | An overheating error occurred in the external encoder.                                                                             | Gr.1                                       | Yes                              |
| A.AA0           | Resetting Failure                                                      | Resetting the Module failed.                                                                                                       | Gr.1                                       | No                               |
| A.AE6           | Address Error                                                          | The same node address already exists on the DeviceNet network.                                                                     | Gr.1                                       | No                               |
| A.AE8           | Rotary Switch Setting<br>Error                                         | There is an error in the node address or baud rate setting.                                                                        | Gr.1                                       | No                               |
| A.AE9           | Bus-OFF Error                                                          | A bus-OFF error occurred in DeviceNet commu-<br>nications.                                                                         | Gr.1                                       | No                               |
| A.b33           | Current Detection Error 3                                              | An error occurred in the current detection circuit.                                                                                | Gr.1                                       | No                               |
| A.bC0           | System Alarm 10                                                        | Internal program error 10 occurred in the SER-<br>VOPACK.                                                                          | Gr.1                                       | No                               |
| A.bF0           | System Alarm 0                                                         | Internal program error 0 occurred in the SERVO-<br>PACK.                                                                           | Gr.1                                       | No                               |

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Servo-Alarm motor Alarm Reset Alarm Name Alarm Meaning Stop-Number Possiping ble? Method Internal program error 1 occurred in the SERVO-A.bF1 System Alarm 1 Gr.1 No PACK. Internal program error 2 occurred in the SERVO-A.bF2 Gr.1 No System Alarm 2 PACK. Internal program error 3 occurred in the SERVO-Gr.1 A.bF3 System Alarm 3 No PACK. Internal program error 4 occurred in the SERVO-A.bF4 System Alarm 4 Gr.1 No PACK. Internal program error 5 occurred in the SERVO-A.bF5 System Alarm 5 Gr.1 No PACK. Internal program error 6 occurred in the SERVO-A.bF6 System Alarm 6 Gr 1 No PACK. Internal program error 7 occurred in the SERVO-A.bF7 System Alarm 7 Gr.1 No PACK. Internal program error 8 occurred in the SERVO-A.bF8 System Alarm 8 Gr.1 No PACK. A.C10 Gr.1 Servomotor Out of Control The Servomotor ran out of control. Yes A.C20 Phase Detection Error The detection of the phase is not correct. Gr.1 No A.C21 Polarity Sensor Error An error occurred in the polarity sensor. Gr.1 No Phase Information Dis-A.C22 The phase information does not match. Gr.1 No agreement A.C50 Polarity Detection Failure The polarity detection failed. Gr.1 No **Overtravel Detected** The overtravel signal was detected during polarity A.C51 Gr.1 Yes during Polarity Detection detection. Polarity Detection Not The servo was turned ON before the polarity was A.C52 Gr.1 Yes detected. Completed Out of Range of Motion for The travel distance exceeded the setting of A.C53 Gr.1 No Pn48E (Polarity Detection Range). **Polarity Detection** Polarity Detection Failure A.C54 The polarity detection failed. Gr.1 No 2 Encoder Clear Error or The multiturn data for the absolute encoder was A.C80 Multiturn Limit Setting Gr.1 No not correctly cleared or set. Error **Encoder Communications** Communications between the encoder and SER-A.C90 Gr.1 No VOPACK is not possible. Frror **Encoder Communications** An error occurred in calculating the position data A.C91 **Position Data Acceleration** Gr.1 No of the encoder. Rate Error **Encoder Communications** An error occurred in the communications timer A.C92 Gr.1 No between the encoder and SERVOPACK. Timer Error A.CA0 Encoder Parameter Error The parameters in the encoder are corrupted. Gr.1 No The contents of communications with the A.Cb0 Encoder Echoback Error Gr.1 No encoder are incorrect. Multiturn Limit Disagree-Different multiturn limits have been set in the A.CC0 Gr.1 No encoder and the SERVOPACK. ment Reception Failed Error in Receiving data from the Feedback Option Mod-A.CF1 Feedback Option Module Gr.1 No ule failed. Communications Timer Stopped Error in An error occurred in the timer for communica-A.CF2 Feedback Option Module Gr.1 No tions with the Feedback Option Module. Communications

Continued from previous page.

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| Alarm<br>Number | Alarm Name                                                                              | Alarm Meaning                                                                                                                                                                                                                                                                                                                                         | Servo-<br>motor<br>Stop-<br>ping<br>Method | Alarm<br>Reset<br>Possi-<br>ble? |
|-----------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|----------------------------------|
| A.d00           | Position Deviation Over-<br>flow                                                        | The setting of Pn520 (Excessive Position Devia-<br>tion Alarm Level) was exceeded by the position<br>deviation.                                                                                                                                                                                                                                       | Gr.1                                       | Yes                              |
| A.d01           | Position Deviation Over-<br>flow Alarm at Servo ON                                      | The servo was turned ON after the position devi-<br>ation exceeded the setting of Pn526 (Excessive<br>Position Deviation Alarm Level at Servo ON) while<br>the servo was OFF.                                                                                                                                                                         | Gr.1                                       | Yes                              |
| A.d02           | Position Deviation Over-<br>flow Alarm for Speed Limit<br>at Servo ON                   | If position deviation remains in the deviation<br>counter, the setting of Pn529 or Pn584 (Speed<br>Limit Level at Servo ON) limits the speed when<br>the servo is turned ON. This alarm occurs if a<br>position reference is input and the setting of<br>Pn520 (Excessive Position Deviation Alarm Level)<br>is exceeded before the limit is cleared. | Gr.2                                       | Yes                              |
| A.d10           | Motor-Load Position Devi-<br>ation Overflow                                             | There was too much position deviation between<br>the motor and load during fully-closed loop con-<br>trol.                                                                                                                                                                                                                                            | Gr.2                                       | Yes                              |
| A.d30           | Position Data Overflow                                                                  | The position feedback data exceeded ±1,879,048,192.                                                                                                                                                                                                                                                                                                   | Gr.1                                       | No                               |
| A.E00           | Command Option Module<br>IF Initialization Timeout<br>Error                             | Communications initialization failed between the SERVOPACK and the Command Option Module.                                                                                                                                                                                                                                                             | Gr.2                                       | Yes                              |
| A.E02           | Command Option Module<br>IF Synchronization Error 1                                     | A synchronization error occurred between the SERVOPACK and the Command Option Module.                                                                                                                                                                                                                                                                 | Gr.1                                       | Yes                              |
| A.E03           | Command Option Module<br>IF Communications Data<br>Error                                | An error occurred in the communications data between the SERVOPACK and the Command Option Module.                                                                                                                                                                                                                                                     | Gr.1                                       | Yes                              |
| A.E70           | Command Option Module<br>Detection Failure                                              | Detection of the Command Option Module failed.                                                                                                                                                                                                                                                                                                        | Gr.1                                       | No                               |
| A.E71           | Safety Option Module<br>Detection Failure                                               | Detection of the Safety Option Module failed.                                                                                                                                                                                                                                                                                                         | Gr.1                                       | No                               |
| A.E72           | Feedback Option Module<br>Detection Failure                                             | Detection of the Feedback Option Module failed.                                                                                                                                                                                                                                                                                                       | Gr.1                                       | No                               |
| A.E73           | Unsupported Command<br>Option Module                                                    | An unsupported Command Option Module was connected.                                                                                                                                                                                                                                                                                                   | Gr.1                                       | No                               |
| A.E74           | Unsupported Safety<br>Option Module                                                     | An unsupported Safety Option Module was connected.                                                                                                                                                                                                                                                                                                    | Gr.1                                       | No                               |
| A.E75           | Unsupported Feedback<br>Option Module                                                   | An unsupported Feedback Option Module was connected.                                                                                                                                                                                                                                                                                                  | Gr.1                                       | No                               |
| A.E80           | Command Option Module<br>Detection Inconsistency                                        | The Command Option Module was replaced with a different model.                                                                                                                                                                                                                                                                                        | Gr.1                                       | No                               |
| A.EA0           | Initialization Error                                                                    | Communications initialization failed between the SERVOPACK and the Command Option Module.                                                                                                                                                                                                                                                             | Gr.1                                       | No                               |
| A.EA2           | Alarm in Current Commu-<br>nications between the<br>DeviceNet Module and<br>SERVOPACK 1 | An error occurred in communications between<br>the DeviceNet Module and SERVOPACK during<br>operation.                                                                                                                                                                                                                                                | Gr.2                                       | Yes                              |
| A.EA3           | Alarm in Current Commu-<br>nications between the<br>DeviceNet Module and<br>SERVOPACK 2 | An error occurred in communications between<br>the DeviceNet Module and SERVOPACK during<br>operation.                                                                                                                                                                                                                                                | Gr.1                                       | Yes                              |
| A.Eb1           | Safety Function Signal<br>Input Timing Error                                            | An error occurred in the input timing of the safety function signal.                                                                                                                                                                                                                                                                                  | Gr.1                                       | No                               |
| A.EC8           | Gate Drive Error 1                                                                      | An error occurred in the gate drive circuit.                                                                                                                                                                                                                                                                                                          | Gr.1                                       | No                               |

Maintenance

|                 | Continued from previous page.                                         |                                                                                                      |                                            |                                  |  |
|-----------------|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|--------------------------------------------|----------------------------------|--|
| Alarm<br>Number | Alarm Name                                                            | Alarm Meaning                                                                                        | Servo-<br>motor<br>Stop-<br>ping<br>Method | Alarm<br>Reset<br>Possi-<br>ble? |  |
| A.EC9           | Gate Drive Error 2                                                    | An error occurred in the gate drive circuit.                                                         | Gr.1                                       | No                               |  |
| A.Ed1           | Command Option Module<br>IF Communications Com-<br>mand Timeout Error | Processing of command from the Command Option Module was not completed.                              | Gr.2                                       | Yes                              |  |
| A.F10           | Power Supply Line Open<br>Phase                                       | The voltage was low for more than one second for phase R, S, or T when the main power supply was ON. | Gr.2                                       | Yes                              |  |
| FL-1*           |                                                                       |                                                                                                      |                                            |                                  |  |
| FL-2*           |                                                                       | An internal program error occurred in the SER-<br>VOPACK.                                            |                                            |                                  |  |
| FL-3*           |                                                                       |                                                                                                      |                                            |                                  |  |
| FL-4*           | System Alarm                                                          |                                                                                                      |                                            | No                               |  |
| FL-5*           |                                                                       |                                                                                                      |                                            |                                  |  |
| FL-6*           |                                                                       |                                                                                                      |                                            |                                  |  |
| FL-7*           |                                                                       |                                                                                                      |                                            |                                  |  |
| CPF00           | Digital Operator Commu-<br>nications Error 1                          | Communications were not possible between the Digital Operator (model: JUSP-OP05A-1-E) and            |                                            | No                               |  |
| CPF01           | Digital Operator Commu-<br>nications Error 2                          | the SERVOPACK (e.g., a CPU error occurred).                                                          | _                                          | INU                              |  |

Continued from previous page.

\* These alarms are not stored in the alarm history. They are only displayed on the panel display.

The causes of and corrections for the alarms are given in the following table. Contact your Yaskawa representative if you cannot solve a problem with the correction given in the table.

| Alarm Number:<br>Alarm Name                                                                                    | Possible Cause                                                                                                                                           | Confirmation                                                                                                                                               | Correction                                                                                                                                              | Reference |
|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|                                                                                                                | The power supply voltage suddenly dropped.                                                                                                               | Measure the power supply voltage.                                                                                                                          | Set the power supply volt-<br>age within the specified<br>range, and initialize the<br>parameter settings.                                              | page 5-10 |
|                                                                                                                | The power supply<br>was shut OFF while<br>writing parameter set-<br>tings.                                                                               | Check the timing of shutting OFF the power supply.                                                                                                         | Initialize the parameter settings and then set the parameters again.                                                                                    |           |
| A.020:<br>Parameter                                                                                            | The number of times<br>that parameters were<br>written exceeded the<br>limit.                                                                            | Check to see if the<br>parameters were fre-<br>quently changed from<br>the host controller.                                                                | The SERVOPACK may be<br>faulty. Replace the SER-<br>VOPACK.<br>Reconsider the method<br>for writing the parame-<br>ters.                                | -         |
| Checksum Error<br>(There is an error<br>in the parameter<br>data in the SER-<br>VOPACK.)                       | A malfunction was<br>caused by noise from<br>the AC power supply,<br>ground, static elec-<br>tricity, or other source.                                   | Turn the power supply<br>to the SERVOPACK<br>OFF and ON again. If<br>the alarm still occurs,<br>noise may be the<br>cause.                                 | Implement countermea-<br>sures against noise.                                                                                                           | page 4-6  |
|                                                                                                                | Gas, water drops, or<br>cutting oil entered the<br>SERVOPACK and<br>caused failure of the<br>internal components.                                        | Check the installation conditions.                                                                                                                         | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                | -         |
|                                                                                                                | A failure occurred in the SERVOPACK.                                                                                                                     | Turn the power supply<br>to the SERVOPACK<br>OFF and ON again. If<br>the alarm still occurs,<br>the SERVOPACK may<br>have failed.                          | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                | -         |
| A.021:<br>Parameter For-<br>mat Error<br>(There is an error<br>in the parameter<br>data format in the          | The software version<br>of the SERVOPACK<br>that caused the alarm<br>is older than the soft-<br>ware version of the<br>parameters specified<br>to write. | Read the product infor-<br>mation to see if the soft-<br>ware versions are the<br>same. If they are differ-<br>ent, it could be the<br>cause of the alarm. | Write the parameters from<br>another SERVOPACK with<br>the same model and the<br>same software version,<br>and then turn the power<br>OFF and ON again. | page 9-2  |
| data format in the SERVOPACK.)                                                                                 | A failure occurred in the SERVOPACK.                                                                                                                     | -                                                                                                                                                          | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                | -         |
|                                                                                                                | The power supply voltage suddenly dropped.                                                                                                               | Measure the power supply voltage.                                                                                                                          | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                | -         |
| A.022:<br>System Check-<br>sum Error<br>(There is an error<br>in the parameter<br>data in the SER-<br>VOPACK.) | The power supply<br>was shut OFF while<br>setting a utility func-<br>tion.                                                                               | Check the timing of shutting OFF the power supply.                                                                                                         | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                | -         |
|                                                                                                                | A failure occurred in the SERVOPACK.                                                                                                                     | Turn the power supply<br>to the SERVOPACK<br>OFF and ON again. If<br>the alarm still occurs,<br>the SERVOPACK may<br>have failed.                          | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                | -         |

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| Alarm Number:<br>Alarm Name                                                                 | Possible Cause                                                                                                                                                                       | Confirmation                                                                                                                    | Correction                                                                                      | Reference |
|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-----------|
| A.024:<br>System Alarm<br>(An internal pro-<br>gram error<br>occurred in the<br>SERVOPACK.) | A failure occurred in the SERVOPACK.                                                                                                                                                 | _                                                                                                                               | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                        | -         |
| A.025:<br>System Alarm<br>(An internal pro-<br>gram error<br>occurred in the<br>SERVOPACK.) | A failure occurred in the SERVOPACK.                                                                                                                                                 | -                                                                                                                               | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                        | -         |
|                                                                                             | A failure occurred in the SERVOPACK.                                                                                                                                                 | _                                                                                                                               | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                        | -         |
| A.030:<br>Main Circuit<br>Detector Error                                                    | The jumper between<br>the DC Reactor termi-<br>nals ( $\ominus$ 1 and $\ominus$ 2)<br>was removed or there<br>is faulty contact.                                                     |                                                                                                                                 | Correct the wiring                                                                              |           |
|                                                                                             | The cable between<br>the DC Reactor and<br>SERVOPACK is not<br>wired correctly or<br>there is a faulty con-<br>tact.                                                                 | _                                                                                                                               | between the DC Reactor terminals.                                                               | -         |
|                                                                                             | The SERVOPACK and<br>Servomotor capaci-<br>ties do not match<br>each other.                                                                                                          | Check the combination<br>of the SERVOPACK and<br>Servomotor capacities.                                                         | Select a proper combina-<br>tion of SERVOPACK and<br>Servomotor capacities.                     | page 1-14 |
| A.040:<br>Parameter Set-                                                                    | The motor parameter<br>file was not written to<br>the linear encoder.<br>(This applies only<br>when not using a<br>Serial Converter Unit.)                                           | Check to see if the<br>motor parameter file<br>was written to the lin-<br>ear encoder.                                          | Write the motor parame-<br>ter file to the linear<br>encoder.                                   | page 5-18 |
| ting Error<br>(A parameter set-<br>ting is outside of                                       | A failure occurred in the SERVOPACK.                                                                                                                                                 | _                                                                                                                               | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                        | -         |
| the setting<br>range.)                                                                      | A parameter setting is outside of the setting range.                                                                                                                                 | Check the setting<br>ranges of the parame-<br>ters that have been<br>changed.                                                   | Set the parameters to values within the setting ranges.                                         | -         |
|                                                                                             | The electronic gear ratio is outside of the setting range.                                                                                                                           | Check the electronic<br>gear ratio. The ratio<br>must be within the fol-<br>lowing range: 0.001 <<br>(Pn20E/Pn210) <<br>64,000. | Set the electronic gear<br>ratio in the following<br>range: 0.001 < (Pn20E/<br>Pn210) < 64,000. | page 5-41 |
| A.041:<br>Encoder Output<br>Pulse Setting<br>Error                                          | The setting of Pn212<br>(Encoder Output<br>Pulses) or Pn281<br>(Encoder Output Res-<br>olution) is outside of<br>the setting range or<br>does not satisfy the<br>setting conditions. | Check the setting of Pn212 or Pn281.                                                                                            | Set Pn212 or Pn281 to an appropriate value.                                                     | page 6-14 |

Continued from previous page.

| Possible Cause<br>The speed of program<br>jogging went below<br>the setting range<br>when the electronic<br>gear ratio (Pn20E/<br>Pn210) or the Servo-<br>motor was changed.<br>The speed of program<br>jogging went below<br>the setting range<br>when Pn533 or Pn585<br>(Program Jogging<br>Speed) was changed. | Confirmation<br>Check to see if the<br>detection conditions <sup>*1</sup><br>are satisfied.<br>Check to see if the<br>detection conditions <sup>*1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Correction<br>Decrease the setting of<br>the electronic gear ratio<br>(Pn20E/Pn210).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Reference                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| iogging went below<br>the setting range<br>when the electronic<br>gear ratio (Pn20E/<br>Pn210) or the Servo-<br>motor was changed.<br>The speed of program<br>jogging went below<br>the setting range<br>when Pn533 or Pn585<br>(Program Jogging<br>Speed) was changed.                                           | detection conditions <sup>*1</sup><br>are satisfied.<br>Check to see if the<br>detection conditions <sup>*1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | the electronic gear ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | page 5-41                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| iogging went below<br>the setting range<br>when Pn533 or Pn585<br>(Program Jogging<br>Speed) was changed.                                                                                                                                                                                                         | detection conditions <sup>*1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| The movement speed                                                                                                                                                                                                                                                                                                | are satisfied.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Increase the setting of Pn533 or Pn585.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | page 7-12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| of advanced autotun-<br>ing went below the<br>setting range when<br>the electronic gear<br>ratio (Pn20E/ Pn210)<br>or the Servomotor<br>was changed.                                                                                                                                                              | Check to see if the detection conditions <sup>*2</sup> are satisfied.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Decrease the setting of<br>the electronic gear ratio<br>(Pn20E/Pn210).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | page 5-41                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| The setting of the<br>Fully-closed Module<br>does not match the<br>setting of Pn002 =<br>n.X□□□ (External<br>Encoder Usage).                                                                                                                                                                                      | Check the setting of Pn002 = $n.X\square\square\square$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Make sure that the setting of the Fully-closed Module agrees with the setting of Pn002 = $n.X\square\square\square$ .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | page 10-6                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| The setting of a sys-<br>tem reserved parame-<br>ter was changed.                                                                                                                                                                                                                                                 | _                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Change the following<br>reserved parameters to<br>the default settings.<br>Pn200.2, Pn207.1,<br>Pn50A.0, Pn50A.1,<br>Pn50A.2, Pn50C, and<br>Pn50D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | _                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| The SERVOPACK and<br>Servomotor capaci-<br>ties do not match<br>each other.                                                                                                                                                                                                                                       | Confirm that the follow-<br>ing condition is met:<br>$1/4 \le$ (Servomotor<br>capacity/SERVOPACK<br>capacity) $\le 4$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Select a proper combina-<br>tion of the SERVOPACK<br>and Servomotor capaci-<br>ties.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | page 1-14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| A failure occurred in the encoder.                                                                                                                                                                                                                                                                                | Replace the encoder<br>and check to see if the<br>alarm still occurs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Replace the Servomotor or encoder.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | _                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| A failure occurred in the SERVOPACK.                                                                                                                                                                                                                                                                              | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| The motor parameter<br>file was not written to<br>the linear encoder.<br>(This applies only<br>when not using a<br>Serial Converter Unit.)                                                                                                                                                                        | Check to see if the<br>motor parameter file<br>was written to the lin-<br>ear encoder.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Write the motor parame-<br>ter file to the linear<br>encoder.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | page 5-18                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| An unsupported Serial<br>Converter Unit or<br>encoder (e.g., an<br>external encoder) is<br>connected to the<br>SERVOPACK.                                                                                                                                                                                         | Check the product combination specifica-tions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Change to a correct com-<br>bination of models.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| throw TFdsne Ttute TStie Ath Ath Tfith() vs Aceec                                                                                                                                                                                                                                                                 | he electronic gear<br>atio (Pn20E/ Pn210)<br>or the Servomotor<br>vas changed.<br>The setting of the<br>fully-closed Module<br>loes not match the<br>etting of Pn002 =<br>0.X I I I (External<br>Encoder Usage).<br>The setting of a sys-<br>em reserved parame-<br>er was changed.<br>The SERVOPACK and<br>Servomotor capaci-<br>ies do not match<br>each other.<br>A failure occurred in<br>he encoder.<br>A failure occurred in<br>he SERVOPACK.<br>The motor parameter<br>le was not written to<br>he linear encoder.<br>This applies only<br>when not using a<br>Serial Converter Unit.)<br>An unsupported Serial<br>Converter Unit or<br>encoder (e.g., an<br>external encoder) is<br>connected to the | he electronic gear<br>atio (Pn20E/ Pn210)<br>or the Servomotor<br>vas changed.detection conditions -<br>are satisfied.The setting of the<br>fully-closed Module<br>loes not match the<br>etting of Pn002 =<br>$X\square\square\square$ (External<br>Encoder Usage).Check the setting of<br>Pn002 = n.X□□□.The setting of a sys-<br>em reserved parame-<br>er was changedThe SERVOPACK and<br>Servomotor capaci-<br>ies do not match<br>each other.Confirm that the follow-<br>ing condition is met:<br>$1/4 \le (Servomotorcapacity/SERVOPACKcapacity) \le 4The setting of course inhe encoder.Replace the encoderand check to see if thealarm still occurs.A failure occurred inhe linear encoderThe motor parameterle was not written tohe linear encoder.Check to see if themotor parameter filewas written to the lin-ear encoder.A failure Occurred Unit.)Check to see if themotor parameter filewas written to the lin-ear encoder.A failure occurred inhe linear encoder.Check to see if themotor parameter filewas written to the lin-ear encoder.A failure occurred inhe unsupported SerialConverter Unit.)Check the productcombination specifica-tions.$ | he electronic gear<br>atio (Pn20E/ Pn210)       delection conditions -<br>are satisfied.       interfection conditions -<br>are satisfied.         The setting of the<br>fully-closed Module<br>loes not match the<br>etting of Pn002 =<br>.X□□□.       Check the setting of<br>Pn002 = n.X□□□.       Make sure that the setting<br>of the Fully-closed Mod-<br>ule agrees with the setting<br>of Pn002 = n.X□□□.         X□□□.       Check the setting of<br>Pn002 = n.X□□□.       Make sure that the setting<br>of the Fully-closed Mod-<br>ule agrees with the setting<br>of Pn002 = n.X□□□.         N□□.       Check the setting of<br>Pn002 = n.X□□□.       Change the following<br>reserved parameters to<br>the default settings.<br>Pn200.2, Pn207.1,<br>Pn50A.0, Pn50A.1,<br>Pn50A.2, Pn50C, and<br>Pn50D         The SERVOPACK and<br>Servomotor capaci-<br>tes do not match<br>each other.       Confirm that the follow-<br>ing condition is met:<br>1/4 ≤ (Servomotor<br>capacity/SERVOPACK<br>capacity/SERVOPACK<br>capacity/SERVOPACK<br>capacity/SERVOPACK<br>capacity/SERVOPACK<br>capacity/SERVOPACK<br>capacity/SERVOPACK<br>capacity/SERVOPACK<br>and Servomotor capaci-<br>ties.         A failure occurred in<br>he encoder.       Replace the encoder<br>and check to see if the<br>alarm still occurs.       Replace the Servomotor<br>or encoder.         A failure occurred in<br>he SERVOPACK.       -       The SERVOPACK may be<br>faulty. Replace the SER-<br>VOPACK.         The motor parameter<br>le was not written to<br>he linear encoder.       Check to see if the<br>motor parameter file<br>was written to the lin-<br>ar encoder.       Write the motor parame-<br>er file to the linear<br>encoder.         Nu nunsupported Serial<br>Converter Unit or<br>nucceder (e.g., an<br>external encoder) is<br>ionnected to the       Check the product<br>combina |

Continued from previous page.

| Alarm Number:<br>Alarm Name                                                                                                                           | Possible Cause                                                                                                                                               | Confirmation                | Correction                                                                                                                                                    | Reference  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| A.070:<br>Motor Type<br>Change Detected<br>(The connected<br>motor is a differ-<br>ent type of motor<br>from the previ-<br>ously connected<br>motor.) | A Rotary Servomotor<br>was removed and a<br>Linear Servomotor<br>was connected.                                                                              | _                           | Set the parameters for a<br>Linear Servomotor and<br>reset the motor type<br>alarm. Then, turn the<br>power supply to the SER-<br>VOPACK OFF and ON<br>again. | page 14-48 |
|                                                                                                                                                       | A Linear Servomotor<br>was removed and a<br>Rotary Servomotor<br>was connected.                                                                              | _                           | Set the parameters for a<br>Rotary Servomotor and<br>reset the motor type<br>alarm. Then, turn the<br>power supply to the SER-<br>VOPACK OFF and ON<br>again. | page 14-48 |
| A.080:<br>Linear Encoder<br>Pitch Setting<br>Error                                                                                                    | The setting of Pn282<br>(Linear Encoder Pitch)<br>has not been changed<br>from the default set-<br>ting.                                                     | Check the setting of Pn282. | Correct the setting of Pn282.                                                                                                                                 | page 5-17  |
| <b>A.0b0:</b><br>Invalid Servo ON<br>Command Alarm                                                                                                    | A Servo ON com-<br>mand (Enable = 1)<br>was input from the<br>host controller after a<br>utility function that<br>turns ON the Servo-<br>motor was executed. | -                           | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. Or, execute a<br>software reset.                                                               | page 6-24  |

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|                                                                   | Continued from previous page                                                                                                                    |                                                                                                                                                                                                              |                                                                                                                                                     |           |
|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Alarm Number:<br>Alarm Name                                       | Possible Cause                                                                                                                                  | Confirmation                                                                                                                                                                                                 | Correction                                                                                                                                          | Reference |
|                                                                   | The Main Circuit<br>Cable is not wired<br>correctly or there is<br>faulty contact.                                                              | Check the wiring.                                                                                                                                                                                            | Correct the wiring.                                                                                                                                 |           |
|                                                                   | There is a short-circuit<br>or ground fault in a<br>Main Circuit Cable.                                                                         | Check for short-circuits<br>across Servomotor<br>phases U, V, and W, or<br>between the ground<br>and Servomotor phases<br>U, V, and W.                                                                       | The cable may be short-<br>circuited. Replace the<br>cable.                                                                                         |           |
|                                                                   | There is a short-circuit<br>or ground fault inside<br>the Servomotor.                                                                           | Check for short-circuits<br>across Servomotor<br>phases U, V, and W, or<br>between the ground<br>and Servomotor phases<br>U, V, or W.                                                                        | The Servomotor may be faulty. Replace the Servo-<br>motor.                                                                                          | page 4-26 |
| A.100:<br>Overcurrent                                             | There is a short-circuit<br>or ground fault inside<br>the SERVOPACK.                                                                            | Check for short-circuits<br>across the Servomotor<br>connection terminals U,<br>V, and W on the SER-<br>VOPACK, or between<br>the ground and termi-<br>nals U, V, or W.                                      | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                            | 1         |
| Detected<br>(An overcurrent<br>flowed through<br>the power trans- | The regenerative<br>resistor is not wired<br>correctly or there is<br>faulty contact.                                                           | Check the wiring.                                                                                                                                                                                            | Correct the wiring.                                                                                                                                 | page 4-23 |
| former or the heat<br>sink overheated.)                           | The dynamic brake<br>(DB, emergency stop<br>executed from the<br>SERVOPACK) was<br>frequently activated,<br>or a DB overload<br>alarm occurred. | Check the power con-<br>sumed by the DB resis-<br>tor to see how<br>frequently the DB is<br>being used. Or, check<br>the alarm display to see<br>if a DB overload alarm<br>(A.730 or A.731) has<br>occurred. | Change the SERVOPACK<br>model, operating meth-<br>ods, or the mechanisms<br>so that the dynamic brake<br>does not need to be used<br>so frequently. | -         |
|                                                                   | The regenerative pro-<br>cessing capacity was<br>exceeded.                                                                                      | Check the regenerative<br>load ratio in the Sig-<br>maWin+ Motion Monitor<br>Tab Page to see how<br>frequently the regenera-<br>tive resistor is being<br>used.                                              | Recheck the operating conditions and load.                                                                                                          | *3        |
|                                                                   | The SERVOPACK regenerative resistance is too small.                                                                                             | Check the regenerative<br>load ratio in the Sig-<br>maWin+ Motion Monitor<br>Tab Page to see how<br>frequently the regenera-<br>tive resistor is being<br>used.                                              | Change the regenerative<br>resistance to a value<br>larger than the SERVO-<br>PACK minimum allowable<br>resistance.                                 |           |

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| Alarm Number:<br>Alarm Name                                                                                      | Possible Cause                                                                                     | Confirmation                                                                                                                                                            | Correction                                                                                                                                                                 | Reference |
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|                                                                                                                  | A heavy load was<br>applied while the Ser-<br>vomotor was stopped<br>or running at a low<br>speed. | Check to see if the<br>operating conditions<br>exceed Servo Drive<br>specifications.                                                                                    | Reduce the load applied<br>to the Servomotor. Or,<br>increase the operating<br>speed.                                                                                      | -         |
| A.100:<br>Overcurrent<br>Detected<br>(An overcurrent<br>flowed through<br>the power trans-<br>former or the heat | A malfunction was caused by noise.                                                                 | Improve the noise envi-<br>ronment, e.g. by<br>improving the wiring or<br>installation conditions,<br>and check to see if the<br>alarm still occurs.                    | Implement countermea-<br>sures against noise, such<br>as correct wiring of the<br>FG. Use an FG wire size<br>equivalent to the SERVO-<br>PACK's main circuit wire<br>size. | -         |
| sink overheated.)                                                                                                | A failure occurred in the SERVOPACK.                                                               | _                                                                                                                                                                       | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                     | -         |
|                                                                                                                  | The Main Circuit<br>Cable is not wired<br>correctly or there is<br>faulty contact.                 | Check the wiring.                                                                                                                                                       | Correct the wiring.                                                                                                                                                        |           |
|                                                                                                                  | There is a short-circuit<br>or ground fault in a<br>Main Circuit Cable.                            | Check for short-circuits<br>across cable phases U,<br>V, and W, or between<br>the ground and cable<br>phases U, V, and W.                                               | The cable may be short-<br>circuited. Replace the<br>cable.                                                                                                                | page 4-26 |
|                                                                                                                  | There is a short-circuit<br>or ground fault inside<br>the Servomotor.                              | Check for short-circuits<br>across Servomotor<br>phases U, V, and W, or<br>between the ground<br>and Servomotor phases<br>U, V, or W.                                   | The Servomotor may be faulty. Replace the Servo-<br>motor.                                                                                                                 |           |
| A.101:<br>Motor Overcurrent<br>Detected<br>(The current to the<br>motor exceeded<br>the allowable cur-           | There is a short-circuit<br>or ground fault inside<br>the SERVOPACK.                               | Check for short-circuits<br>across the Servomotor<br>connection terminals U,<br>V, and W on the SER-<br>VOPACK, or between<br>the ground and termi-<br>nals U, V, or W. | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                                   |           |
| rent.)                                                                                                           | A heavy load was<br>applied while the Ser-<br>vomotor was stopped<br>or running at a low<br>speed. | Check to see if the<br>operating conditions<br>exceed Servo Drive<br>specifications.                                                                                    | Reduce the load applied<br>to the Servomotor. Or,<br>increase the operating<br>speed.                                                                                      | -         |
|                                                                                                                  | A malfunction was caused by noise.                                                                 | Improve the noise envi-<br>ronment, e.g. by<br>improving the wiring or<br>installation conditions,<br>and check to see if the<br>alarm still occurs.                    | Implement countermea-<br>sures against noise, such<br>as correct wiring of the<br>FG. Use an FG wire size<br>equivalent to the SERVO-<br>PACK's main circuit wire<br>size. | -         |
|                                                                                                                  | A failure occurred in the SERVOPACK.                                                               | -                                                                                                                                                                       | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                     | _         |

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| Alarm Number:<br>Alarm Name     | Possible Cause                                                                                                                                                                                                                                                        | Confirmation                                                                                                                                      | Correction                                                                                                                                                                                                              | Reference |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|                                 | When using the built-<br>in regenerative resis-<br>tor, the jumper<br>between the regener-<br>ative resistor terminals<br>(B2 and B3) was<br>removed from one of<br>the following SERVO-<br>PACKs: SGD7S-<br>3R8A, -5R5A, -7R6A,<br>-120A, -180A, -200A,<br>or -330A. | Check to see if the jumper is connected between power supply terminals B2 and B3.*4                                                               | Correctly connect a jumper.                                                                                                                                                                                             | page 4-23 |
|                                 | The External Regener-<br>ative Resistor or<br>Regenerative Resis-<br>tor Unit is not wired<br>correctly, or was<br>removed or discon-<br>nected.                                                                                                                      | Check the wiring of the<br>External Regenerative<br>Resistor or Regenera-<br>tive Resistor Unit. <sup>*4</sup>                                    | Correct the wiring of the<br>External Regenerative<br>Resistor or Regenerative<br>Resistor Unit.                                                                                                                        |           |
| A.300:<br>Regeneration<br>Error | Pn600 (Regenerative<br>Resistor Capacity) is<br>not set to 0 and an<br>External Regenerative<br>Resistor is not con-<br>nected to one of the<br>following SERVO-<br>PACKs: SGD7S-<br>R70A, -R90A,-1R6A,<br>-2R8A, -R70F, -R90F,<br>-2R1F, or -2R8F.                   | Check it see if an Exter-<br>nal Regenerative Resis-<br>tor is connected and<br>check the setting of<br>Pn600.                                    | Connect an External<br>Regenerative Resistor, or<br>set Pn600 (Regenerative<br>Resistor Capacity) to 0<br>(setting unit: × 10 W) if no<br>Regenerative Resistor is<br>required.                                         | page 5-53 |
|                                 | A Regenerative Resis-<br>tor is not connected<br>to one of the following<br>SERVOPACKs:<br>SGD7S-470A, -550A,<br>-590A, or -780A.                                                                                                                                     | Check to see if an<br>External Regenerative<br>Resistor or a Regenera-<br>tive Resistor Unit is con-<br>nected and check the<br>setting of Pn600. | Connect an External<br>Regenerative Resistor and<br>set Pn600 to an appropri-<br>ate value, or connect a<br>Regenerative Resistor<br>Unit and set Pn600 to 0.                                                           | -         |
|                                 | A failure occurred in the SERVOPACK.                                                                                                                                                                                                                                  | _                                                                                                                                                 | While the main circuit<br>power supply is OFF, turn<br>the control power supply<br>to the SERVOPACK OFF<br>and ON again. If the alarm<br>still occurs, the SERVO-<br>PACK may be faulty.<br>Replace the SERVO-<br>PACK. | -         |

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| Alarm Number:<br>Alarm Name        | Possible Cause                                                                                                                                                      | Confirmation                                                                                                                            | Correction                                                                                                                                                                               | Reference |
|------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|                                    | The power supply voltage exceeded the specified range.                                                                                                              | Measure the power supply voltage.                                                                                                       | Set the power supply volt-<br>age within the specified range.                                                                                                                            | -         |
|                                    | The external regener-<br>ative resistance value<br>or regenerative resis-<br>tor capacity is too<br>small, or there has<br>been a continuous<br>regeneration state. | Check the operating<br>conditions or the<br>capacity using the Sig-<br>maJunmaSize+ Capac-<br>ity Selection Software or<br>other means. | Change the regenerative<br>resistance value or capac-<br>ity.<br>Reconsider the operating<br>conditions using the Sig-<br>maJunmaSize+ Capacity<br>Selection Software or<br>other means. | *3        |
|                                    | There was a continu-<br>ous regeneration state<br>because a negative<br>load was continu-<br>ously applied.                                                         | Check the load applied<br>to the Servomotor<br>during operation.                                                                        | Reconsider the system<br>including the servo,<br>machine, and operating<br>conditions.                                                                                                   | -         |
| A.320:<br>Regenerative<br>Overload | The setting of Pn600<br>(Regenerative Resis-<br>tor Capacity) is<br>smaller than the<br>capacity of the Exter-<br>nal Regenerative<br>Resistor.                     | Check to see if a<br>Regenerative Resistor is<br>connected and check<br>the setting of Pn600.                                           | Correct the setting of Pn600.                                                                                                                                                            | page 5-53 |
|                                    | The setting of Pn603<br>(Regenerative Resis-<br>tor Capacity) is<br>smaller than the<br>capacity of the Exter-<br>nal Regenerative<br>Resistor.                     | Check to see if a<br>Regenerative Resistor is<br>connected and check<br>the setting of Pn603.                                           | Correct the setting of Pn603.                                                                                                                                                            | page 5-53 |
|                                    | The external regener-<br>ative resistance is too<br>high.                                                                                                           | Check the regenerative resistance.                                                                                                      | Change the regenerative<br>resistance to a correct<br>value or use an External<br>Regenerative Resistor of<br>an appropriate capacity.                                                   | *3        |
|                                    | A failure occurred in the SERVOPACK.                                                                                                                                | -                                                                                                                                       | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                                                 | -         |

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| Alarm Number:<br>Alarm Name                                                                                          | Possible Cause                                                                                                                                                                                                                                       | Confirmation                                                                                                   | Correction                                                                                                                                                                                                             | Reference                  |
|----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
|                                                                                                                      | The regenerative<br>resistor was discon-<br>nected when the<br>SERVOPACK power<br>supply voltage was<br>high.                                                                                                                                        | Measure the resistance<br>of the regenerative<br>resistor using a measur-<br>ing instrument.                   | If you are using the regen-<br>erative resistor built into<br>the SERVOPACK, replace<br>the SERVOPACK.<br>If you are using an Exter-<br>nal Regenerative Resis-<br>tor, replace the External<br>Regenerative Resistor. | -                          |
| A.330:                                                                                                               | DC power was sup-<br>plied when an AC<br>power supply input<br>was specified in the<br>settings.                                                                                                                                                     | Check the power sup-<br>ply to see if it is a DC<br>power supply.                                              | Correct the power supply setting to match the actual power supply.                                                                                                                                                     | 2000 E 12                  |
| Main Circuit<br>Power Supply<br>Wiring Error<br>(Detected when<br>the main circuit<br>power supply is<br>turned ON.) | AC power was sup-<br>plied when a DC<br>power supply input<br>was specified in the<br>settings.                                                                                                                                                      | Check the power sup-<br>ply to see if it is an AC<br>power supply.                                             | Correct the power supply setting to match the actual power supply.                                                                                                                                                     | - page 5-13                |
|                                                                                                                      | Pn600 (Regenerative<br>Resistor Capacity) is<br>not set to 0 and an<br>External Regenerative<br>Resistor is not con-<br>nected to one of the<br>following SERVO-<br>PACKs: SGD7S-<br>R70A, -R90A, -1R6A,<br>-2R8A, -R70F, -R90F,<br>-2R1F, or -2R8F. | Check it see if an Exter-<br>nal Regenerative Resis-<br>tor is connected and<br>check the setting of<br>Pn600. | Connect an External<br>Regenerative Resistor, or<br>if an External Regenera-<br>tive Resistor is not<br>required, set Pn600 to 0.                                                                                      | page 4-23,<br>page<br>5-53 |
|                                                                                                                      | A failure occurred in the SERVOPACK.                                                                                                                                                                                                                 | -                                                                                                              | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                                                                               | -                          |

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| Alarm Number:<br>Alarm Name                                   | Possible Cause                                                                               | Confirmation                                                                                      | Correction                                                                                                                                                                                                                 | Reference |
|---------------------------------------------------------------|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|                                                               | The power supply voltage exceeded the specified range.                                       | Measure the power supply voltage.                                                                 | Set the AC/DC power supply voltage within the specified range.                                                                                                                                                             | -         |
|                                                               | The power supply is<br>not stable or was<br>influenced by a light-<br>ning surge.            | Measure the power supply voltage.                                                                 | Improve the power sup-<br>ply conditions, install a<br>surge absorber, and then<br>turn the power supply<br>OFF and ON again. If the<br>alarm still occurs, the<br>SERVOPACK may be<br>faulty. Replace the SER-<br>VOPACK. | -         |
| A.400:<br>Overvoltage<br>(Detected in the                     | The voltage for AC<br>power supply was too<br>high during accelera-<br>tion or deceleration. | Check the power sup-<br>ply voltage and the<br>speed and torque<br>during operation.              | Set the AC power supply voltage within the speci-<br>fied range.                                                                                                                                                           | -         |
| main circuit<br>power supply<br>section of the<br>SERVOPACK.) | The external regener-<br>ative resistance is too<br>high for the operating<br>conditions.    | Check the operating conditions and the regenerative resistance.                                   | Select a regenerative<br>resistance value that is<br>appropriate for the oper-<br>ating conditions and load.                                                                                                               | *3        |
|                                                               | The moment of inertia<br>ratio or mass ratio<br>exceeded the allow-<br>able value.           | Check to see if the<br>moment of inertia ratio<br>or mass ratio is within<br>the allowable range. | Increase the deceleration time, or reduce the load.                                                                                                                                                                        | -         |
|                                                               | A failure occurred in the SERVOPACK.                                                         | _                                                                                                 | While the main circuit<br>power supply is OFF, turn<br>the control power supply<br>to the SERVOPACK OFF<br>and ON again. If the alarm<br>still occurs, the SERVO-<br>PACK may be faulty.<br>Replace the SERVO-<br>PACK.    | -         |

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| Alarm Number:<br>Alarm Name                                                | Possible Cause                                                                                                                   | Confirmation                                                        | Correction                                                                                                                             | Reference    |
|                                                                            | The power supply voltage went below the specified range.                                                                         | Measure the power supply voltage.                                   | Set the power supply volt-<br>age within the specified<br>range.                                                                       | -            |
|                                                                            | The power supply voltage dropped during operation.                                                                               | Measure the power supply voltage.                                   | Increase the power supply capacity.                                                                                                    | -            |
|                                                                            | A momentary power interruption occurred.                                                                                         | Measure the power supply voltage.                                   | If you have changed the<br>setting of Pn509 (Momen-<br>tary Power Interruption<br>Hold Time), decrease the<br>setting.                 | page 6-5     |
| A.410:<br>Undervoltage<br>(Detected in the<br>main circuit<br>power supply | The SERVOPACK fuse is blown out.                                                                                                 | _                                                                   | Replace the SERVO-<br>PACK and connect a<br>reactor to the DC reactor<br>terminals ( $\ominus$ 1 and $\ominus$ 2) on<br>the SERVOPACK. | -            |
| section of the<br>SERVOPACK.)                                              | A failure occurred in the SERVOPACK.                                                                                             | _                                                                   | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                               | -            |
|                                                                            | The jumper between<br>the DC Reactor termi-<br>nals ( $\ominus$ 1 and $\ominus$ 2)<br>was removed or there<br>is faulty contact. |                                                                     | Correct the wiring                                                                                                                     |              |
|                                                                            | The cable between<br>the DC Reactor and<br>SERVOPACK is not<br>wired correctly or<br>there is a faulty con-<br>tact.             | -                                                                   | between the DC Reactor terminals.                                                                                                      | -            |
|                                                                            | The order of phases<br>U, V, and W in the<br>motor wiring is not<br>correct.                                                     | Check the wiring of the Servomotor.                                 | Make sure that the Servo-<br>motor is correctly wired.                                                                                 | _            |
| A.510:<br>Overspeed                                                        | A reference value that<br>exceeded the over-<br>speed detection level<br>was input.                                              | Check the input refer-<br>ence.                                     | Reduce the reference value. Or, adjust the gain.                                                                                       |              |
| (The motor<br>exceeded the<br>maximum speed.)                              | The motor exceeded the maximum speed.                                                                                            | Check the waveform of the motor speed.                              | Reduce the speed refer-<br>ence input gain and<br>adjust the servo gain. Or,<br>reconsider the operating<br>conditions.                | -            |
|                                                                            | A failure occurred in the SERVOPACK.                                                                                             | -                                                                   | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                               | -            |
| A.511:                                                                     | The encoder output<br>pulse frequency<br>exceeded the limit.                                                                     | Check the encoder out-<br>put pulse setting.                        | Decrease the setting of<br>Pn212 (Encoder Output<br>Pulses) or Pn281<br>(Encoder Output Resolu-<br>tion).                              | page 6-14    |
| Encoder Output<br>Pulse Overspeed                                          | The encoder output<br>pulse frequency<br>exceeded the limit<br>because the motor<br>speed was too high.                          | Check the encoder out-<br>put pulse setting and<br>the motor speed. | Reduce the motor speed.                                                                                                                | -            |

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| Alarm Number:<br>Alarm Name                                                                      | Possible Cause                                                                                                                     | Confirmation                                                                                                                                  | Correction                                                                                                                                                                                       | Reference                  |
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|                                                                                                  | Abnormal oscillation<br>was detected in the<br>motor speed.                                                                        | Check for abnormal<br>motor noise, and check<br>the speed and torque<br>waveforms during oper-<br>ation.                                      | Reduce the motor speed.<br>Or, reduce the setting of<br>Pn100 (Speed Loop<br>Gain).                                                                                                              | page 8-79                  |
| A.520:<br>Vibration Alarm                                                                        | The setting of Pn103<br>(Moment of Inertia<br>Ratio) is greater than<br>the actual moment of<br>inertia or was greatly<br>changed. | Check the moment of inertia ratio or mass ratio.                                                                                              | Set Pn103 (Moment of<br>Inertia Ratio) to an appro-<br>priate value.                                                                                                                             | page 8-15                  |
|                                                                                                  | The vibration detec-<br>tion level (Pn312 or<br>Pn384) is not suitable.                                                            | Check that the vibra-<br>tion detection level<br>(Pn312 or Pn384) is<br>suitable.                                                             | Set a suitable vibration<br>detection level (Pn312 or<br>Pn384).                                                                                                                                 | page 6-26                  |
| A.521:<br>Autotuning Alarm<br>(Vibration was<br>detected while<br>executing the<br>custom tuning | The Servomotor<br>vibrated considerably<br>while performing the<br>tuning-less function.                                           | Check the waveform of the motor speed.                                                                                                        | Reduce the load so that<br>the moment of inertia ratio<br>is within the allowable<br>value. Or increase the<br>load level or reduce the<br>rigidity level in the tuning-<br>less level settings. | page 8-12                  |
| custom tuning,<br>Easy FFT, or the<br>tuning-less func-<br>tion.)                                | The Servomotor<br>vibrated considerably<br>while performing cus-<br>tom tuning or Easy<br>FFT.                                     | Check the waveform of the motor speed.                                                                                                        | Check the operating pro-<br>cedure of corresponding<br>function and implement<br>corrections.                                                                                                    | page 8-42,<br>page<br>8-95 |
| A.550:<br>Maximum Speed<br>Setting Error                                                         | The setting of Pn385<br>(Maximum Motor<br>Speed) is greater than<br>the maximum speed.                                             | Check the setting of<br>Pn385, and the upper<br>limits of the maximum<br>motor speed setting<br>and the encoder output<br>resolution setting. | Set Pn385 to a value that does not exceed the max-<br>imum motor speed.                                                                                                                          | page 6-8                   |
|                                                                                                  | The wiring is not cor-<br>rect or there is a faulty<br>connection in the<br>motor or encoder wir-<br>ing.                          | Check the wiring.                                                                                                                             | Make sure that the Servo-<br>motor and encoder are<br>correctly wired.                                                                                                                           | page 4-26                  |
|                                                                                                  | Operation was per-<br>formed that exceeded<br>the overload protec-<br>tion characteristics.                                        | Check the motor over-<br>load characteristics and<br>Run command.                                                                             | Reconsider the load and operating conditions. Or, increase the motor capacity.                                                                                                                   | _                          |
| A.710:<br>Instantaneous<br>Overload<br>A.720:<br>Continuous<br>Overload                          | An excessive load<br>was applied during<br>operation because the<br>Servomotor was not<br>driven due to<br>mechanical problems.    | Check the operation reference and motor speed.                                                                                                | Correct the mechanical problem.                                                                                                                                                                  | -                          |
|                                                                                                  | There is an error in the setting of Pn282 (Lin-<br>ear Encoder Pitch).                                                             | Check the setting of Pn282.                                                                                                                   | Correct the setting of Pn282.                                                                                                                                                                    | page 5-17                  |
|                                                                                                  | There is an error in the<br>setting of Pn080 =<br>n.□□X□ (Motor<br>Phase Selection).                                               | Check the setting of Pn080 = $n.\Box\Box X\Box$ .                                                                                             | Set Pn080 = $n.\Box\Box X\Box$ to an appropriate value.                                                                                                                                          | page 5-22                  |
|                                                                                                  | A failure occurred in the SERVOPACK.                                                                                               | -                                                                                                                                             | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                                                         | -                          |

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| Alarm Number:                                                                                                            | Dessible Cause                                                                                                                                                                | Confirmation                                                                                                                                                                | Continued from pre                                                                                                                                                                                                         |                       |
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| Alarm Name                                                                                                               | Possible Cause                                                                                                                                                                | Confirmation                                                                                                                                                                | Correction                                                                                                                                                                                                                 | Reference             |
| A.730 and                                                                                                                | The Servomotor was rotated by an external force.                                                                                                                              | Check the operation status.                                                                                                                                                 | Implement measures to<br>ensure that the motor will<br>not be rotated by an<br>external force.                                                                                                                             | -                     |
| A.731:<br>Dynamic Brake<br>Overload<br>(An excessive<br>power consump-<br>tion by the<br>dynamic brake<br>was detected.) | When the Servomo-<br>tor was stopped with<br>the dynamic brake,<br>the rotational or linear<br>kinetic energy<br>exceeded the capac-<br>ity of the dynamic<br>brake resistor. | Check the power con-<br>sumed by the DB resis-<br>tor to see how<br>frequently the DB is<br>being used.                                                                     | <ul> <li>Reconsider the following:</li> <li>Reduce the Servomotor command speed.</li> <li>Decrease the moment of inertia ratio or mass ratio.</li> <li>Reduce the frequency of stopping with the dynamic brake.</li> </ul> | _                     |
|                                                                                                                          | A failure occurred in the SERVOPACK.                                                                                                                                          | _                                                                                                                                                                           | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                                                                                   | -                     |
| A.740:<br>Inrush Current<br>Limiting Resistor<br>Overload<br>(The main circuit<br>power supply                           | The allowable fre-<br>quency of the inrush<br>current limiting resis-<br>tor was exceeded<br>when the main circuit<br>power supply was<br>turned ON and OFF.                  | _                                                                                                                                                                           | Reduce the frequency of<br>turning the main circuit<br>power supply ON and<br>OFF.                                                                                                                                         | -                     |
| was frequently<br>turned ON and<br>OFF.)                                                                                 | A failure occurred in the SERVOPACK.                                                                                                                                          | -                                                                                                                                                                           | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                                                                                   | -                     |
|                                                                                                                          | The surrounding tem-<br>perature is too high.                                                                                                                                 | Check the surrounding<br>temperature using a<br>thermometer. Or, check<br>the operating status<br>with the SERVOPACK<br>installation environment<br>monitor.                | Decrease the surround-<br>ing temperature by<br>improving the SERVO-<br>PACK installation condi-<br>tions.                                                                                                                 | page 3-7              |
| A 7A1.                                                                                                                   | An overload alarm<br>was reset by turning<br>OFF the power sup-<br>ply too many times.                                                                                        | Check the alarm display<br>to see if there is an<br>overload alarm.                                                                                                         | Change the method for resetting the alarm.                                                                                                                                                                                 | _                     |
| A.7A1:<br>Internal Tempera-<br>ture Error 1<br>(Control Board<br>Temperature<br>Error)                                   | There was an exces-<br>sive load or operation<br>was performed that<br>exceeded the regen-<br>erative processing<br>capacity.                                                 | Use the accumulated<br>load ratio to check the<br>load during operation,<br>and use the regenera-<br>tive load ratio to check<br>the regenerative pro-<br>cessing capacity. | Reconsider the load and operating conditions.                                                                                                                                                                              | -                     |
|                                                                                                                          | The SERVOPACK<br>installation orientation<br>is not correct or there<br>is insufficient space<br>around the SERVO-<br>PACK.                                                   | Check the SERVOPACK installation conditions.                                                                                                                                | Install the SERVOPACK according to specifica-<br>tions.                                                                                                                                                                    | page 3-4,<br>page 3-6 |
|                                                                                                                          | A failure occurred in the SERVOPACK.                                                                                                                                          | -                                                                                                                                                                           | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                                                                                   | -                     |

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| Alarm Number:<br>Alarm Name                                                                                           | Possible Cause                                                                                                                                | Confirmation                                                                                                                                                                | Correction                                                                                                                                | Reference             |
|-----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
|                                                                                                                       | The surrounding tem-<br>perature is too high.                                                                                                 | Check the surrounding<br>temperature using a<br>thermometer. Or, check<br>the operating status<br>with the SERVOPACK<br>installation environment<br>monitor.                | Decrease the surround-<br>ing temperature by<br>improving the SERVO-<br>PACK installation condi-<br>tions.                                | page 3-7              |
|                                                                                                                       | An overload alarm<br>was reset by turning<br>OFF the power sup-<br>ply too many times.                                                        | Check the alarm display to see if there is an overload alarm.                                                                                                               | Change the method for resetting the alarm.                                                                                                | -                     |
| A.7A2:<br>Internal Tempera-<br>ture Error 2<br>(Power Board<br>Temperature<br>Error)                                  | There was an exces-<br>sive load or operation<br>was performed that<br>exceeded the regen-<br>erative processing<br>capacity.                 | Use the accumulated<br>load ratio to check the<br>load during operation,<br>and use the regenera-<br>tive load ratio to check<br>the regenerative pro-<br>cessing capacity. | Reconsider the load and operating conditions.                                                                                             | _                     |
|                                                                                                                       | The SERVOPACK<br>installation orientation<br>is not correct or there<br>is insufficient space<br>around the SERVO-<br>PACK.                   | Check the SERVOPACK installation conditions.                                                                                                                                | Install the SERVOPACK according to specifica-<br>tions.                                                                                   | page 3-4,<br>page 3-6 |
|                                                                                                                       | A failure occurred in the SERVOPACK.                                                                                                          | -                                                                                                                                                                           | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                  | -                     |
| A.7A3:<br>Internal Tempera-<br>ture Sensor Error<br>(An error<br>occurred in the<br>temperature sen-<br>sor circuit.) | A failure occurred in the SERVOPACK.                                                                                                          | _                                                                                                                                                                           | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                  | -                     |
| A.7Ab:<br>SERVOPACK<br>Built-in Fan<br>Stopped                                                                        | The fan inside the<br>SERVOPACK<br>stopped.                                                                                                   | Check for foreign matter inside the SERVOPACK.                                                                                                                              | Remove foreign matter<br>from the SERVOPACK. If<br>the alarm still occurs, the<br>SERVOPACK may be<br>faulty. Replace the SER-<br>VOPACK. | -                     |
|                                                                                                                       | The power to the absolute encoder was turned ON for the first time.                                                                           | Check to see if the<br>power supply was<br>turned ON for the first<br>time.                                                                                                 | Set up the encoder.                                                                                                                       |                       |
| A.810:                                                                                                                | The Encoder Cable<br>was disconnected<br>and then connected<br>again.                                                                         | Check to see if the<br>power supply was<br>turned ON for the first<br>time.                                                                                                 | Check the encoder con-<br>nection and set up the<br>encoder.                                                                              | page 5-47             |
| Encoder Backup<br>Alarm<br>(Detected at the<br>encoder, but only<br>when an abso-<br>lute encoder is<br>used.)        | Power is not being<br>supplied both from<br>the control power<br>supply (+5 V) from the<br>SERVOPACK and<br>from the battery<br>power supply. | Check the encoder<br>connector battery and<br>the connector status.                                                                                                         | Replace the battery or<br>implement similar mea-<br>sures to supply power to<br>the encoder, and set up<br>the encoder.                   |                       |
|                                                                                                                       | A failure occurred in the absolute encoder.                                                                                                   | _                                                                                                                                                                           | If the alarm still occurs<br>after setting up the<br>encoder again, replace<br>the Servomotor.                                            | -                     |
|                                                                                                                       | A failure occurred in the SERVOPACK.                                                                                                          | -                                                                                                                                                                           | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                  | -                     |

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| Alarm Number:<br>Alarm Name                                            | Possible Cause                                                            | Confirmation                             | Correction                                                                                                                                                                                                                                                                                                                                                                                     | Reference |
| A.820:<br>Encoder Check-<br>sum Alarm<br>(Detected at the<br>encoder.) | A failure occurred in the encoder.                                        | _                                        | <ul> <li>When Using an Absolute Encoder</li> <li>Set up the encoder again.</li> <li>If the alarm still occurs, the Servomotor may be faulty. Replace the Servomotor.</li> <li>When Using a Singleturn Absolute Encoder or Incremental Encoder</li> <li>The Servomotor may be faulty. Replace the Servomotor.</li> <li>The linear encoder may be faulty. Replace the linear encoder.</li> </ul> | page 5-47 |
|                                                                        | A failure occurred in the SERVOPACK.                                      | -                                        | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                                                                                                                                                                                                                                                       | -         |
| A.830:<br>Encoder Battery                                              | The battery connec-<br>tion is faulty or a bat-<br>tery is not connected. | Check the battery con-<br>nection.       | Correct the battery con-<br>nection.                                                                                                                                                                                                                                                                                                                                                           | page 4-27 |
| Alarm<br>(The absolute<br>encoder battery<br>voltage was lower         | The battery voltage is lower than the specified value (2.7 V).            | Measure the battery voltage.             | Replace the battery.                                                                                                                                                                                                                                                                                                                                                                           | page 14-3 |
| than the speci-<br>fied level.)                                        | A failure occurred in the SERVOPACK.                                      | _                                        | The SERVOPACK may be faulty. Replace the SER-<br>VOPACK.                                                                                                                                                                                                                                                                                                                                       | -         |
|                                                                        | The encoder malfunc-<br>tioned.                                           | _                                        | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the Servomotor or<br>linear encoder may be<br>faulty. Replace the Servo-<br>motor or linear encoder.                                                                                                                                                                                              | -         |
|                                                                        | An error occurred in reading data from the linear encoder.                | _                                        | The linear encoder is not<br>mounted within an appro-<br>priate tolerance. Correct<br>the mounting of the linear<br>encoder.                                                                                                                                                                                                                                                                   | -         |
| A.840:<br>Encoder Data<br>Alarm<br>(Detected at the<br>encoder.)       | Excessive speed<br>occurred in the linear<br>encoder.                     | -                                        | Control the motor speed<br>within the range specified<br>by the linear encoder<br>manufacturer and then<br>turn ON the control power<br>supply.                                                                                                                                                                                                                                                | -         |
|                                                                        | The encoder malfunc-<br>tioned due to noise.                              | -                                        | Correct the wiring around<br>the encoder by separating<br>the Encoder Cable from<br>the Servomotor Main Cir-<br>cuit Cable or by ground-<br>ing the encoder.                                                                                                                                                                                                                                   | -         |
|                                                                        | The polarity sensor is not wired correctly.                               | Check the wiring of the polarity sensor. | Correct the wiring of the polarity sensor.                                                                                                                                                                                                                                                                                                                                                     | -         |
|                                                                        | The polarity sensor failed.                                               | _                                        | Replace the polarity sen-<br>sor.                                                                                                                                                                                                                                                                                                                                                              | -         |

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| Alarm Number:                                                                                                                                                                                      |                                                                                                                                         |                                                                        | Continued from pre                                                                                                                                                                                                   |           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Alarm Name                                                                                                                                                                                         | Possible Cause                                                                                                                          | Confirmation                                                           | Correction                                                                                                                                                                                                           | Reference |
| A.850:                                                                                                                                                                                             | Rotary Servomotor:<br>The Servomotor<br>speed was 200 min <sup>-1</sup><br>or higher when the<br>control power supply<br>was turned ON. | Check the motor speed<br>when the power supply<br>is turned ON.        | Reduce the Servomotor<br>speed to a value less than<br>200 min <sup>-1</sup> , and turn ON<br>the control power supply.                                                                                              | -         |
| Encoder Over-<br>speed<br>(Detected when a<br>Rotary Servomo-<br>tor, Absolute Lin-<br>ear Encoder, or<br>Direct Drive Ser-                                                                        | Linear Servomotor:<br>The Servomotor<br>exceeded the speci-<br>fied speed when the<br>control power supply<br>was turned ON.            | Check the motor speed<br>when the power supply<br>is turned ON.        | Control the motor speed<br>within the range specified<br>by the linear encoder<br>manufacturer and then<br>turn ON the control power<br>supply.                                                                      | -         |
| vomotor is con-<br>nected. However,<br>SGMCS Incre-<br>mental Encoder<br>specifications are<br>excluded.)<br>(Detected at the                                                                      | A failure occurred in the encoder.                                                                                                      | -                                                                      | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the Servomotor or<br>linear encoder may be<br>faulty. Replace the Servo-<br>motor or linear encoder.                    | -         |
| encoder end.)                                                                                                                                                                                      | A failure occurred in the SERVOPACK.                                                                                                    | -                                                                      | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                                                               | -         |
| A.860:                                                                                                                                                                                             | The surrounding air temperature around the Servomotor is too high.                                                                      | Measure the surround-<br>ing air temperature<br>around the Servomotor. | Reduce the surrounding<br>air temperature of the<br>Servomotor to 40°C or<br>less.                                                                                                                                   | -         |
| Encoder Over-<br>heated<br>(Detected when a<br>Rotary Servomo-                                                                                                                                     | The Servomotor load is greater than the rated load.                                                                                     | Use the accumulated load ratio to check the load.                      | Operate the Servo Drive<br>so that the motor load<br>remains within the speci-<br>fied range.                                                                                                                        | page 9-3  |
| tor, Absolute Lin-<br>ear Encoder, or<br>Direct Drive Ser-<br>vomotor is con-<br>nected. However<br>this alarm is not<br>detected for<br>SGMCS Servo-<br>motors.)<br>(Detected at the<br>encoder.) | A failure occurred in the encoder.                                                                                                      | _                                                                      | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the Servomotor or<br>absolute linear encoder<br>may be faulty. Replace the<br>Servomotor or absolute<br>linear encoder. | -         |
|                                                                                                                                                                                                    | A failure occurred in the SERVOPACK.                                                                                                    | -                                                                      | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                                                               | -         |

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| Alarm Number:<br>Alarm Name       | Possible Cause                                                                                                                       | Confirmation                                                                                                            | Correction                                                                                                                                                                                                                          | Reference |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|                                   | The surrounding tem-<br>perature around the<br>Servomotor is too<br>high.                                                            | Measure the surround-<br>ing temperature around<br>the Servomotor.                                                      | Reduce the surrounding air temperature of the Servomotor to 40° or less.                                                                                                                                                            | -         |
|                                   | The motor load is greater than the rated load.                                                                                       | Check the load with the<br>accumulated load ratio<br>on the Motion Monitor<br>Tab Page on the Sig-<br>maWin+.           | Operate the Servo Drive<br>so that the motor load<br>remains within the speci-<br>fied range.                                                                                                                                       | page 9-3  |
| A.861:<br>Motor Over-<br>heated   | A failure occurred in<br>the Serial Converter<br>Unit.                                                                               | _                                                                                                                       | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the Serial Con-<br>verter Unit may be faulty.<br>Replace the Serial Con-<br>verter Unit.                                               | -         |
|                                   | A failure occurred in the SERVOPACK.                                                                                                 | -                                                                                                                       | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                                                                              | _         |
|                                   | The surrounding tem-<br>perature is too high.                                                                                        | Check the surrounding temperature using a thermometer.                                                                  | Lower the surrounding<br>temperature by improving<br>the installation conditions<br>of the Linear Servomotor<br>or the machine.                                                                                                     | -         |
|                                   | The overheat protec-<br>tion input signal line is<br>disconnected or<br>short-circuited.                                             | Check the input voltage<br>of the overheat protec-<br>tion input on the Motion<br>Monitor Tab Page on<br>the SigmaWin+. | Repair the line for the overheat protection input signal.                                                                                                                                                                           | -         |
| A.862:                            | An overload alarm<br>was reset by turning<br>OFF the power sup-<br>ply too many times.                                               | Check the alarm display<br>to see if there is an<br>overload alarm.                                                     | Change the method for resetting the alarm.                                                                                                                                                                                          | _         |
| Overheat Alarm                    | Operation was per-<br>formed under an<br>excessive load.                                                                             | Use the accumulated load ratio to check the load during operation.                                                      | Reconsider the load and operating conditions.                                                                                                                                                                                       | -         |
|                                   | A failure occurred in the SERVOPACK.                                                                                                 | _                                                                                                                       | The SERVOPACK may be faulty. Replace the SERVOPACK.                                                                                                                                                                                 | -         |
|                                   | The temperature<br>detection circuit in the<br>Linear Servomotor is<br>faulty or the sensor<br>attached to the<br>machine is faulty. | -                                                                                                                       | The temperature detec-<br>tion circuit in the Linear<br>Servomotor may be faulty<br>or the sensor attached to<br>the machine may be<br>faulty. Replace the Linear<br>Servomotor or repair the<br>sensor attached to the<br>machine. | -         |
| A.890:<br>Encoder Scale<br>Error  | A failure occurred in the linear encoder.                                                                                            | -                                                                                                                       | The linear encoder may be faulty. Replace the linear encoder.                                                                                                                                                                       | -         |
| A.891:<br>Encoder Module<br>Error | A failure occurred in the linear encoder.                                                                                            | -                                                                                                                       | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the linear encoder<br>may be faulty. Replace the<br>linear encoder.                                                                    | -         |

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| Alarm Number:<br>Alarm Name                                                                                        | Possible Cause                                                                                | Confirmation                                                                                                                  | Correction                                                                                                                              | Reference    |
| <b>A.8A0:</b><br>External Encoder<br>Error                                                                         | Setting the origin of<br>the absolute linear<br>encoder failed<br>because the motor<br>moved. | Before you set the ori-<br>gin, use the fully-closed<br>feedback pulse counter<br>to confirm that the<br>motor is not moving. | The motor must be stopped while setting the origin position.                                                                            | page 12-3    |
|                                                                                                                    | A failure occurred in the external encoder.                                                   | _                                                                                                                             | Replace the external encoder.                                                                                                           | -            |
| A.8A1:                                                                                                             | A failure occurred in the external encoder.                                                   | _                                                                                                                             | Replace the external encoder.                                                                                                           | -            |
| External Encoder<br>Module Error                                                                                   | A failure occurred in the Serial Converter Unit.                                              | -                                                                                                                             | Replace the Serial Con-<br>verter Unit.                                                                                                 | -            |
| A.8A2:<br>External Incre-<br>mental Encoder<br>Sensor Error                                                        | A failure occurred in the external encoder.                                                   | -                                                                                                                             | Replace the external encoder.                                                                                                           | -            |
| A.8A3:<br>External Abso-<br>lute Encoder<br>Position Error                                                         | A failure occurred in the external absolute encoder.                                          | _                                                                                                                             | The external absolute<br>encoder may be faulty.<br>Refer to the encoder<br>manufacturer's instruc-<br>tion manual for correc-<br>tions. | -            |
| A.8A5:<br>External Encoder<br>Overspeed                                                                            | An overspeed error<br>was detected in the<br>external encoder.                                | Check the maximum speed of the external encoder.                                                                              | Keep the external<br>encoder below its maxi-<br>mum speed.                                                                              | -            |
| A.8A6:<br>External Encoder<br>Overheated                                                                           | An overheating error was detected in the external encoder.                                    | _                                                                                                                             | Replace the external encoder.                                                                                                           | -            |
| A.AA0:                                                                                                             | An error occurred                                                                             |                                                                                                                               | Initialize the parameters.                                                                                                              | page 5-10    |
| Reset Failure (A failure occurred in                                                                               | when saving parame-<br>ters in non-volatile<br>memory.                                        | _                                                                                                                             | Replace the DeviceNet Module.                                                                                                           | _            |
| resetting the<br>Module.)                                                                                          | The DeviceNet Mod-<br>ule failed.                                                             | -                                                                                                                             | Replace the DeviceNet Module.                                                                                                           | -            |
| A.AE6:<br>Address Error                                                                                            | The same node<br>address already exists<br>on the DeviceNet net-<br>work.                     | Check the node address that was set.                                                                                          | Change the node address.                                                                                                                | page 13-3    |
| A.AE8:<br>Rotary Switch<br>Setting Error<br>(There is an error<br>in the node<br>address or baud<br>rate setting.) | There is an error in the rotary switch settings.                                              | Check the rotary switch settings.                                                                                             | Correct the rotary switch settings.                                                                                                     | page 13-3    |
| A.AE9:<br>Bus-OFF Error (A<br>Bus-OFF error<br>occurred in Devi-<br>ceNet communi-<br>cations.)                    | Terminating resistors are not connected.                                                      | Check network termina-<br>tion.                                                                                               | Connect terminating resistors to the ends of the network.                                                                               |              |
|                                                                                                                    | The network cable<br>length exceeds the<br>maximum network<br>cable length.                   | Check the network cable length.                                                                                               | Correct the network installation.                                                                                                       | page 4-43    |
|                                                                                                                    | DeviceNet connec-<br>tors are not making<br>proper contact.                                   | Check the DeviceNet<br>connectors to see if<br>they are making proper<br>contact.                                             | Tighten the connectors.                                                                                                                 | -            |
|                                                                                                                    | The DeviceNet Mod-<br>ule failed.                                                             | _                                                                                                                             | Replace the DeviceNet Module.                                                                                                           | -            |

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| Alarm Number:<br>Alarm Name              | Possible Cause                                       | Confirmation | Correction                                                                                                                                             | Reference |
|------------------------------------------|------------------------------------------------------|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| A.b33:<br>Current Detec-<br>tion Error 3 | A failure occurred in the current detection circuit. | -            | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK. | _         |
| A.bC0:<br>System Alarm 10                | A failure occurred in the SERVOPACK.                 | _            | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK. | -         |
| <b>A.bF0:</b><br>System Alarm 0          | A failure occurred in the SERVOPACK.                 | -            | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK. | -         |
| A.bF1:<br>System Alarm 1                 | A failure occurred in the SERVOPACK.                 | _            | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK. | _         |
| A.bF2:<br>System Alarm 2                 | A failure occurred in the SERVOPACK.                 | _            | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK. | -         |
| A.bF3:<br>System Alarm 3                 | A failure occurred in the SERVOPACK.                 | -            | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK. | -         |
| A.bF4:<br>System Alarm 4                 | A failure occurred in the SERVOPACK.                 | -            | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK. | -         |
| A.bF5:<br>System Alarm 5                 | A failure occurred in the SERVOPACK.                 | -            | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK. | -         |
| A.bF6:<br>System Alarm 6                 | A failure occurred in the SERVOPACK.                 | _            | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK. | _         |
| A.bF7:<br>System Alarm 7                 | A failure occurred in the SERVOPACK.                 | -            | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK. | -         |

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| Alarm Number:<br>Alarm Name                                                             | Possible Cause                                                                                                                        | Confirmation                                                                                                                                                             | Correction                                                                                                                                                                                                                    | Reference |
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| A.bF8:<br>System Alarm 8                                                                | A failure occurred in the SERVOPACK.                                                                                                  | -                                                                                                                                                                        | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                                                                        | -         |
|                                                                                         | The order of phases<br>U, V, and W in the<br>motor wiring is not<br>correct.                                                          | Check the Servomotor wiring.                                                                                                                                             | Make sure that the Servo-<br>motor is correctly wired.                                                                                                                                                                        | _         |
|                                                                                         | There is an error in the<br>setting of Pn080 =<br>n.                                                                                  | Check the setting of Pn080 = $n.\Box\Box X\Box$ .                                                                                                                        | Set Pn080 = $n.\Box\Box X\Box$ to an appropriate value.                                                                                                                                                                       | page 5-22 |
| A.C10:<br>Servomotor Out<br>of Control<br>(Detected when<br>the servo is<br>turned ON.) | A failure occurred in the encoder.                                                                                                    | _                                                                                                                                                                        | If the motor wiring is cor-<br>rect and the alarm still<br>occurs after turning the<br>power supply OFF and<br>ON again, the Servomotor<br>or linear encoder may be<br>faulty. Replace the Servo-<br>motor or linear encoder. | -         |
|                                                                                         | A failure occurred in the SERVOPACK.                                                                                                  | _                                                                                                                                                                        | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                                                                        | -         |
|                                                                                         | The linear encoder signal level is too low.                                                                                           | Check the voltage of the linear encoder signal.                                                                                                                          | Fine-tune the mounting of<br>the scale head. Or,<br>replace the linear<br>encoder.                                                                                                                                            | -         |
| A.C20:<br>Phase Detection<br>Error                                                      | The count-up direc-<br>tion of the linear<br>encoder does not<br>match the forward<br>direction of the Mov-<br>ing Coil in the motor. | Check the setting of<br>Pn080 = $n.\Box\BoxX\Box$<br>(Motor Phase Selec-<br>tion). Check the installa-<br>tion orientation for the<br>linear encoder and<br>Moving Coil. | Change the setting of<br>Pn080 = $n.\Box\Box X\Box$ .<br>Correctly reinstall the lin-<br>ear encoder or Moving<br>Coil.                                                                                                       | page 5-22 |
|                                                                                         | The polarity sensor<br>signal is being<br>affected by noise.                                                                          | _                                                                                                                                                                        | Correct the FG wiring.<br>Implement countermea-<br>sures against noise for the<br>polarity sensor wiring.                                                                                                                     | -         |
|                                                                                         | The setting of Pn282<br>(Linear Encoder Scale<br>Pitch) is not correct.                                                               | Check the setting of<br>Pn282 (Linear Encoder<br>Scale Pitch).                                                                                                           | Check the specifications of the linear encoder and set a correct value.                                                                                                                                                       | page 5-17 |
| <b>A.C21:</b><br>Polarity Sensor<br>Error                                               | The polarity sensor is protruding from the Magnetic Way of the motor.                                                                 | Check the polarity sen-<br>sor.                                                                                                                                          | Correctly reinstall the<br>Moving Coil or Magnetic<br>Way of the motor.                                                                                                                                                       | -         |
|                                                                                         | The polarity sensor is not wired correctly.                                                                                           | Check the wiring of the polarity sensor.                                                                                                                                 | Correct the wiring of the polarity sensor.                                                                                                                                                                                    | -         |
|                                                                                         | The polarity sensor failed.                                                                                                           | -                                                                                                                                                                        | Replace the polarity sen-<br>sor.                                                                                                                                                                                             | -         |
| A.C22:<br>Phase Informa-<br>tion Disagree-<br>ment                                      | The SERVOPACK<br>phase information is<br>different from the lin-<br>ear encoder phase<br>information.                                 | -                                                                                                                                                                        | Perform polarity detec-<br>tion.                                                                                                                                                                                              | page 5-27 |

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| Alarm Number:<br>Alarm Name                                   | Possible Cause                                                       | Confirmation                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Correction                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Reference               |
|---------------------------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
|                                                               | The parameter set-<br>tings are not correct.                         | Check the linear<br>encoder specifications<br>and feedback signal<br>status.                                                                                                                                                                                                                                                                                                                                                                                    | The settings of Pn282<br>(Linear Encoder Pitch)<br>and Pn080 = n. $\Box$ X $\Box$<br>(Motor Phase Selection)<br>may not match the instal-<br>lation. Set the parame-<br>ters to correct values.                                                                                                                                                                                                                                                                          | page 5-17,<br>page 5-22 |
| A.C50:<br>Polarity Detec-<br>tion Failure                     | There is noise on the scale signal.                                  | Check to make sure<br>that the frame grounds<br>of the Serial Converter<br>Unit and Servomotor<br>are connected to the<br>FG terminal on the SER-<br>VOPACK and that the<br>FG terminal on the SER-<br>VOPACK is connected<br>to the frame ground on<br>the power supply.<br>And, confirm that the<br>shield is properly pro-<br>cessed on the Linear<br>Encoder Cable. Check<br>to see if the detection<br>reference is repeatedly<br>output in one direction. | Implement appropriate<br>countermeasures against<br>noise for the Linear<br>Encoder Cable.                                                                                                                                                                                                                                                                                                                                                                               | -                       |
|                                                               | An external force was<br>applied to the Moving<br>Coil of the motor. | _                                                                                                                                                                                                                                                                                                                                                                                                                                                               | The polarity cannot be<br>properly detected if the<br>detection reference is 0<br>and the speed feedback<br>is not 0 because of an<br>external force, such as<br>cable tension, applied to<br>the Moving Coil. Imple-<br>ment measures to reduce<br>the external force so that<br>the speed feedback goes<br>to 0. If the external force<br>cannot be reduced,<br>increase the setting of<br>Pn481 (Polarity Detection<br>Speed Loop Gain).                              | _                       |
|                                                               | The linear encoder resolution is too low.                            | Check the linear<br>encoder scale pitch to<br>see if it is within 100<br>μm.                                                                                                                                                                                                                                                                                                                                                                                    | If the linear encoder scale<br>pitch is 100 μm or higher,<br>the SERVOPACK cannot<br>detect the correct speed<br>feedback. Use a linear<br>encoder scale pitch with<br>higher resolution. (We rec-<br>ommend a pitch of 40 μm<br>or less.) Or, increase the<br>setting of Pn485 (Polarity<br>Detection Reference<br>Speed). However,<br>increasing the setting of<br>Pn485 will increase the<br>Servomotor movement<br>range that is required for<br>polarity detection. | _                       |
| A.C51:<br>Overtravel<br>Detected during<br>Polarity Detection | The overtravel signal was detected during polarity detection.        | Check the overtravel position.                                                                                                                                                                                                                                                                                                                                                                                                                                  | Wire the overtravel sig-<br>nals. Execute polarity<br>detection at a position<br>where an overtravel sig-<br>nal would not be<br>detected.                                                                                                                                                                                                                                                                                                                               | page 4-37               |

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| Alarm Number:<br>Alarm Name                                     | Possible Cause                                                                                                                                                                                                      | Confirmation | Correction                                                                                                                                                                                                                                                           | Reference    |
| A.C52:<br>Polarity Detec-<br>tion Not Com-<br>pleted            | <ul> <li>The servo was turned<br/>ON under the follow-<br/>ing circumstances.</li> <li>When an absolute<br/>linear encoder was<br/>being used</li> <li>When polarity<br/>detection was not<br/>completed</li> </ul> | _            | Perform polarity detec-<br>tion.                                                                                                                                                                                                                                     | page 5-25    |
| A.C53:<br>Out of Range of<br>Motion for Polar-<br>ity Detection | The travel distance<br>exceeded the setting<br>of Pn48E (Polarity<br>Detection Range) in<br>the middle of detec-<br>tion.                                                                                           | -            | Increase the setting of<br>Pn48E (Polarity Detection<br>Range). Or, increase the<br>setting of Pn481 (Polarity<br>Detection Speed Loop<br>Gain).                                                                                                                     | -            |
| A.C54:<br>Polarity Detec-<br>tion Failure 2                     | An external force was<br>applied to the Servo-<br>motor.                                                                                                                                                            | _            | Increase the setting of<br>Pn495 (Polarity Detection<br>Confirmation Force Refer-<br>ence). Increase the setting<br>of Pn498 (Polarity Detec-<br>tion Allowable Error<br>Range). Increasing the<br>allowable error will also<br>increase the motor tem-<br>perature. | _            |
| A.C80:<br>Encoder Clear                                         | A failure occurred in the encoder.                                                                                                                                                                                  | _            | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the Servomotor or<br>linear encoder may be<br>faulty. Replace the Servo-<br>motor or linear encoder.                                                                    | -            |
| Error or Multiturn<br>Limit Setting Error                       | A failure occurred in the SERVOPACK.                                                                                                                                                                                | _            | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                                                                                                               | -            |

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| Alarm Number:<br>Alarm Name                                                            | Possible Cause                                                                                                                                                                                                                                        | Confirmation                                                 | Correction                                                                                                                                                                      | Reference    |
|                                                                                        | There is a faulty con-<br>tact in the connector<br>or the connector is<br>not wired correctly for<br>the encoder.                                                                                                                                     | Check the condition of the encoder connector.                | Reconnect the encoder connector and check the encoder wiring.                                                                                                                   | page 4-26    |
|                                                                                        | There is a cable dis-<br>connection or short-<br>circuit in the encoder.<br>Or, the cable imped-<br>ance is outside the<br>specified values.                                                                                                          | Check the condition of the Encoder Cable.                    | Use the Encoder Cable within the specified specifications.                                                                                                                      | _            |
| A.C90:<br>Encoder Commu-                                                               | One of the following<br>has occurred: corro-<br>sion caused by<br>improper tempera-<br>ture, humidity, or gas,<br>a short-circuit caused<br>by entry of water<br>drops or cutting oil, or<br>faulty contact in con-<br>nector caused by<br>vibration. | Check the operating environment.                             | Improve the operating<br>environment, and replace<br>the cable. If the alarm still<br>occurs, replace the SER-<br>VOPACK.                                                       | page 3-2     |
| nications Error                                                                        | A malfunction was caused by noise.                                                                                                                                                                                                                    | _                                                            | Correct the wiring around<br>the encoder by separating<br>the Encoder Cable from<br>the Servomotor Main Cir-<br>cuit Cable or by ground-<br>ing the encoder.                    | page 4-6     |
|                                                                                        | A failure occurred in the SERVOPACK.                                                                                                                                                                                                                  | _                                                            | Connect the Servomotor<br>to another SERVOPACK,<br>and turn ON the control<br>power supply. If no alarm<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.    | -            |
|                                                                                        | A failure occurred in the encoder.                                                                                                                                                                                                                    | _                                                            | Connect the Servomotor<br>to another SERVOPACK,<br>and turn ON the control<br>power supply. If the alarm<br>occurs, the Servomotor<br>may be faulty. Replace the<br>Servomotor. | -            |
| A.C91:<br>Encoder Commu-<br>nications Posi-<br>tion Data<br>Acceleration Rate<br>Error | Noise entered on the signal lines because the Encoder Cable is bent or the sheath is damaged.                                                                                                                                                         | Check the condition of the Encoder Cable and connectors.     | Check the Encoder Cable to see if it is installed correctly.                                                                                                                    | page 4-9     |
|                                                                                        | The Encoder Cable is<br>bundled with a high-<br>current line or<br>installed near a high-<br>current line.                                                                                                                                            | Check the installation<br>condition of the<br>Encoder Cable. | Confirm that there is no<br>surge voltage on the<br>Encoder Cable.                                                                                                              | -            |
|                                                                                        | There is variation in<br>the FG potential<br>because of the influ-<br>ence of machines on<br>the Servomotor side,<br>such as a welder.                                                                                                                | Check the installation<br>condition of the<br>Encoder Cable. | Properly ground the machine to separate it from the FG of the encoder.                                                                                                          | -            |

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Alarm Number: **Possible Cause** Confirmation Correction Reference Alarm Name Noise entered on the Implement countermeasignal line from the sures against noise for the page 4-6 encoder. encoder wiring. Reduce machine vibra-Excessive vibration or Check the operating tion. shock was applied to conditions. Correctly install the Serthe encoder. vomotor or linear encoder. Turn the power supply to A.C92: the SERVOPACK OFF and Encoder Commu-ON again. If the alarm still A failure occurred in nications Timer occurs, the Servomotor or \_ the encoder. Error linear encoder may be faulty. Replace the Servomotor or linear encoder. Turn the power supply to the SERVOPACK OFF and A failure occurred in ON again. If the alarm still the SERVOPACK. occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still A failure occurred in occurs, the Servomotor or the encoder. linear encoder may be faulty. Replace the Servo-A.CA0: Encoder Paramemotor or linear encoder. ter Error Turn the power supply to the SERVOPACK OFF and A failure occurred in ON again. If the alarm still the SERVOPACK. occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.

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| Alarm Number:<br>Alarm Name                  | Possible Cause                                                                                                                                             | Confirmation                                                   | Correction                                                                                                                                                                                               | Referenc        |
|                                              | The encoder is wired incorrectly or there is faulty contact.                                                                                               | Check the wiring of the encoder.                               | Make sure that the encoder is correctly wired.                                                                                                                                                           | page 4-26       |
|                                              | The specifications of<br>the Encoder Cable are<br>not correct and noise<br>entered on it.                                                                  | _                                                              | Use a shielded twisted-<br>pair wire cable or a<br>screened twisted-pair<br>cable with conductors of<br>at least 0.12 mm <sup>2</sup> .                                                                  | -               |
|                                              | The Encoder Cable is too long and noise entered on it.                                                                                                     | _                                                              | <ul> <li>Rotary Servomotors:<br/>The Encoder Cable wir-<br/>ing distance must be 50<br/>m max.</li> <li>Linear Servomotors:<br/>The Encoder Cable wir-<br/>ing distance must be 20<br/>m max.</li> </ul> | -               |
| <b>A.Cb0:</b><br>Encoder Echo-<br>back Error | There is variation in<br>the FG potential<br>because of the influ-<br>ence of machines on<br>the Servomotor side,<br>such as a welder.                     | Check the condition of<br>the Encoder Cable and<br>connectors. | Properly ground the machine to separate it from the FG of the encoder.                                                                                                                                   | -               |
|                                              | Excessive vibration or shock was applied to the encoder.                                                                                                   | Check the operating conditions.                                | Reduce machine vibra-<br>tion.<br>Correctly install the Ser-<br>vomotor or linear encoder.                                                                                                               | -               |
|                                              | A failure occurred in the encoder.                                                                                                                         | -                                                              | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the Servomotor or<br>linear encoder may be<br>faulty. Replace the Servo-<br>motor or linear encoder.        | -               |
|                                              | A failure occurred in the SERVOPACK.                                                                                                                       | _                                                              | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                                                   | -               |
|                                              | When using a Direct<br>Drive Servomotor, the<br>setting of Pn205 (Mul-<br>titurn Limit Setting)<br>does not agree with<br>the encoder.                     | Check the setting of Pn205.                                    | Correct the setting of<br>Pn205 (0 to 65,535).                                                                                                                                                           | page 6-20       |
| A.CC0:<br>Multiturn Limit<br>Disagreement    | The multiturn limit of<br>the encoder is differ-<br>ent from that of the<br>SERVOPACK. Or, the<br>multiturn limit of the<br>SERVOPACK has<br>been changed. | Check the setting of<br>Pn205 in the SERVO-<br>PACK.           | Change the setting if the alarm occurs.                                                                                                                                                                  | page 6-20       |
|                                              | A failure occurred in the SERVOPACK.                                                                                                                       | _                                                              | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                                                   | -<br>n next pag |

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| Alarm Number:<br>Alarm Name                                                                                                                                       | Possible Cause                                                                                                                | Confirmation                                                                                                      | Correction                                                                                                                                                  | Reference |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|                                                                                                                                                                   | The cable between<br>the Serial Converter<br>Unit and SERVOPACK<br>is not wired correctly<br>or there is a faulty<br>contact. | Check the wiring of the external encoder.                                                                         | Correctly wire the cable<br>between the Serial Con-<br>verter Unit and SERVO-<br>PACK.                                                                      | page 4-28 |
| A.CF1:<br>Reception Failed<br>Error in Feed-                                                                                                                      | A specified cable is<br>not being used<br>between Serial Con-<br>verter Unit and SER-<br>VOPACK.                              | Check the wiring speci-<br>fications of the external encoder.                                                     | Use a specified cable.                                                                                                                                      | -         |
| back Option<br>Module Commu-<br>nications                                                                                                                         | The cable between<br>the Serial Converter<br>Unit and SERVOPACK<br>is too long.                                               | Measure the length of<br>the cable that connects<br>the Serial Converter<br>Unit.                                 | The length of the cable<br>between the Serial Con-<br>verter Unit and SERVO-<br>PACK must be 20 m or<br>less.                                               | -         |
|                                                                                                                                                                   | The sheath on cable<br>between the Serial<br>Converter Unit and<br>SERVOPACK is bro-<br>ken.                                  | Check the cable that<br>connects the Serial<br>Converter Unit.                                                    | Replace the cable<br>between the Serial Con-<br>verter Unit and SERVO-<br>PACK.                                                                             | -         |
| A.CF2:<br>Timer Stopped<br>Error in Feed-                                                                                                                         | Noise entered the<br>cable between the<br>Serial Converter Unit<br>and SERVOPACK.                                             | _                                                                                                                 | Correct the wiring around<br>the Serial Converter Unit,<br>e.g., separate I/O signal<br>lines from the Main Circuit<br>Cables or ground.                    | -         |
| back Option<br>Module Commu-<br>nications                                                                                                                         | A failure occurred in<br>the Serial Converter<br>Unit.                                                                        | _                                                                                                                 | Replace the Serial Con-<br>verter Unit.                                                                                                                     | -         |
|                                                                                                                                                                   | A failure occurred in the SERVOPACK.                                                                                          | _                                                                                                                 | Replace the SERVO-<br>PACK.                                                                                                                                 | -         |
|                                                                                                                                                                   | The Servomotor U, V,<br>and W wiring is not<br>correct.                                                                       | Check the wiring of the Servomotor's Main Cir-<br>cuit Cables.                                                    | Make sure that there are<br>no faulty contacts in the<br>wiring for the Servomotor<br>and encoder.                                                          | -         |
| A.d00:                                                                                                                                                            | The position com-<br>mand speed is too<br>fast.                                                                               | Reduce the position<br>command speed and<br>try operating the SER-<br>VOPACK.                                     | Reduce the position refer-<br>ence speed or the refer-<br>ence acceleration rate, or<br>reconsider the electronic<br>gear ratio.                            | page 5-41 |
| Position Devia-<br>tion Overflow<br>(The setting of<br>Pn520 (Exces-<br>sive Position<br>Deviation Alarm<br>Level) was<br>exceeded by the<br>position deviation.) | The acceleration of the position reference is too high.                                                                       | Reduce the reference<br>acceleration and try<br>operating the SERVO-<br>PACK.                                     | Reduce the settings of<br>PnB2A (Acceleration<br>Rate) and PnB2B (Decel-<br>eration Rate) to reduce<br>the acceleration rate for<br>positioning references. | -         |
|                                                                                                                                                                   | The setting of Pn520<br>(Excessive Position<br>Deviation Alarm Level)<br>is too low for the<br>operating conditions.          | Check Pn520 (Exces-<br>sive Position Deviation<br>Alarm Level) to see if it<br>is set to an appropriate<br>value. | Optimize the setting of Pn520.                                                                                                                              | page 8-7  |
|                                                                                                                                                                   | A failure occurred in the SERVOPACK.                                                                                          | -                                                                                                                 | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.      | -         |

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| Alarm Number:<br>Alarm Name                                                        | Possible Cause                                                                                                                                                                                                                                                                                                                                            | Confirmation                                                                              | Correction                                                                                                                                                           | Reference    |
| A.d01:<br>Position Devia-<br>tion Overflow<br>Alarm at Servo<br>ON                 | The servo was turned<br>ON after the position<br>deviation exceeded<br>the setting of Pn526<br>(Excessive Position<br>Deviation Alarm Level<br>at Servo ON) while the<br>servo was OFF.                                                                                                                                                                   | Check the position<br>deviation while the<br>servo is OFF.                                | Optimize the setting of<br>Pn526 (Excessive Position<br>Deviation Alarm Level at<br>Servo ON).                                                                       |              |
| A.d02:<br>Position Devia-<br>tion Overflow<br>Alarm for Speed<br>Limit at Servo ON | If position deviation<br>remains in the devia-<br>tion counter, the set-<br>ting of Pn529 or<br>Pn584 (Speed Limit<br>Level at Servo ON)<br>limits the speed when<br>the servo is turned<br>ON. This alarm occurs<br>if a position reference<br>is input and the set-<br>ting of Pn520 (Exces-<br>sive Position Deviation<br>Alarm Level) is<br>exceeded. | _                                                                                         | Optimize the setting of<br>Pn520 (Excessive Position<br>Deviation Alarm Level). Or,<br>adjust the setting of<br>Pn529 or Pn584 (Speed<br>Limit Level at Servo ON).   | page 8-7     |
| A.d10:<br>Motor-Load Posi-<br>tion Deviation                                       | The motor direction<br>and external encoder<br>installation orientation<br>are backward.                                                                                                                                                                                                                                                                  | Check the motor direc-<br>tion and the external<br>encoder installation ori-<br>entation. | Install the external<br>encoder in the opposite<br>direction, or change the<br>setting of Pn002 =<br>n.X□□□ (External<br>Encoder Usage) to<br>reverse the direction. | page 10-6    |
| Overflow                                                                           | There is an error in the connection between the load (e.g., stage) and external encoder coupling.                                                                                                                                                                                                                                                         | Check the coupling of the external encoder.                                               | Check the mechanical coupling.                                                                                                                                       | -            |
| A.d30:<br>Position Data<br>Overflow                                                | The position data<br>exceeded<br>±1,879,048,192.                                                                                                                                                                                                                                                                                                          | Check the input refer-<br>ence pulse counter.                                             | Reconsider the operating specifications.                                                                                                                             | -            |
| <b>A.E00:</b><br>Command Option<br>Module IF Initial-<br>ization Timeout<br>Error  | There is a faulty con-<br>nection between the<br>SERVOPACK and the<br>Command Option<br>Module.                                                                                                                                                                                                                                                           | Check the connection<br>between the SERVO-<br>PACK and the Com-<br>mand Option Module.    | Correctly connect the<br>Command Option Mod-<br>ule.                                                                                                                 | -            |
|                                                                                    | A failure occurred in the Command Option Module.                                                                                                                                                                                                                                                                                                          | -                                                                                         | Replace the Command Option Module.                                                                                                                                   | -            |
|                                                                                    | A failure occurred in the SERVOPACK.                                                                                                                                                                                                                                                                                                                      | -                                                                                         | Replace the SERVO-<br>PACK.                                                                                                                                          | -            |

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| Alarm Number:<br>Alarm Name                                             | Possible Cause                                                                                                                                                                                                                               | Confirmation                                                                           | Correction                                                                                                                                 | Reference |
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| A.E02:<br>Command Option<br>Module IF Syn-                              | Fluctuations in the<br>communications sys-<br>tem of the host con-<br>troller that is<br>connected to the<br>Command Option<br>Module changed the<br>synchronization tim-<br>ing between the SER-<br>VOPACK and<br>Command Option<br>Module. | _                                                                                      | Turn the power supply<br>OFF and ON again. If the<br>alarm still occurs, restart<br>communications process-<br>ing at the host controller. | _         |
| chronization Error<br>1                                                 | There is a faulty con-<br>nection between the<br>SERVOPACK and the<br>Command Option<br>Module.                                                                                                                                              | Check the connection<br>between the SERVO-<br>PACK and the Com-<br>mand Option Module. | Correctly connect the<br>Command Option Mod-<br>ule.                                                                                       | -         |
|                                                                         | A failure occurred in the Command Option Module.                                                                                                                                                                                             | -                                                                                      | Replace the Command Option Module.                                                                                                         | -         |
|                                                                         | A failure occurred in the SERVOPACK.                                                                                                                                                                                                         | _                                                                                      | Replace the SERVO-<br>PACK.                                                                                                                | -         |
|                                                                         | Noise caused a com-<br>munications error<br>between the SERVO-<br>PACK and the Com-<br>mand Option Module.                                                                                                                                   | _                                                                                      | Implement countermea-<br>sures against noise.                                                                                              | -         |
| A.E03:<br>Command Option<br>Module IF Com-<br>munications Data<br>Error | There is a faulty con-<br>nection between the<br>SERVOPACK and the<br>Command Option<br>Module.                                                                                                                                              | Check the connection<br>between the SERVO-<br>PACK and the Com-<br>mand Option Module. | Correctly connect the<br>Command Option Mod-<br>ule.                                                                                       | -         |
|                                                                         | A failure occurred in the Command Option Module.                                                                                                                                                                                             | -                                                                                      | Replace the Command Option Module.                                                                                                         | -         |
|                                                                         | A failure occurred in the SERVOPACK.                                                                                                                                                                                                         | _                                                                                      | Replace the SERVO-<br>PACK.                                                                                                                | -         |
| <b>A.E70:</b><br>Command Option<br>Module Detec-<br>tion Failure        | There is a faulty con-<br>nection between the<br>SERVOPACK and the<br>Command Option<br>Module.                                                                                                                                              | Check the connection<br>between the SERVO-<br>PACK and the Com-<br>mand Option Module. | Correctly connect the<br>Command Option Mod-<br>ule.                                                                                       | -         |
|                                                                         | A Command Option<br>Module is not con-<br>nected.                                                                                                                                                                                            | -                                                                                      | Correctly connect the Command Option Mod-<br>ule.                                                                                          | -         |
|                                                                         | A failure occurred in the Command Option Module.                                                                                                                                                                                             | _                                                                                      | Replace the Command Option Module.                                                                                                         | -         |
|                                                                         | A failure occurred in the SERVOPACK.                                                                                                                                                                                                         | -                                                                                      | Replace the SERVO-<br>PACK.                                                                                                                | -         |

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| Continued from previous p                                       |                                                                                                  |                                                                                                        |                                                                                                                      | evious page. |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|--------------|
| Alarm Number:<br>Alarm Name                                     | Possible Cause                                                                                   | Confirmation                                                                                           | Correction                                                                                                           | Reference    |
|                                                                 | There is a faulty con-<br>nection between the<br>SERVOPACK and the<br>Safety Option Module.      | Check the connection<br>between the SERVO-<br>PACK and the Safety<br>Option Module.                    | Correctly connect the Safety Option Module.                                                                          | -            |
| A.E71:<br>Safety Option<br>Module Detec-<br>tion Failure        | The Safety Option<br>Module was discon-<br>nected.                                               | _                                                                                                      | Reset the Option Module<br>configuration error and<br>turn the power supply to<br>the SERVOPACK OFF and<br>ON again. | page 14-46   |
|                                                                 | A failure occurred in<br>the Command Option<br>Module.                                           | -                                                                                                      | Replace the Safety Option Module.                                                                                    | -            |
|                                                                 | A failure occurred in the SERVOPACK.                                                             | _                                                                                                      | Replace the SERVO-<br>PACK.                                                                                          | -            |
|                                                                 | There is a faulty con-<br>nection between the<br>SERVOPACK and the<br>Feedback Option<br>Module. | Check the connection<br>between the SERVO-<br>PACK and the Feed-<br>back Option Module.                | Correctly connect the<br>Feedback Option Module.                                                                     | -            |
| A.E72:<br>Feedback Option<br>Module Detec-<br>tion Failure      | The Feedback Option<br>Module was discon-<br>nected.                                             | -                                                                                                      | Reset the Option Module<br>configuration error and<br>turn the power supply to<br>the SERVOPACK OFF and<br>ON again. | page 14-46   |
|                                                                 | A failure occurred in<br>the Feedback Option<br>Module.                                          | -                                                                                                      | Replace the Feedback<br>Option Module.                                                                               | -            |
|                                                                 | A failure occurred in the SERVOPACK.                                                             | -                                                                                                      | Replace the SERVO-<br>PACK.                                                                                          | -            |
| A.E73:<br>Unsupported                                           | A failure occurred in the Command Option Module.                                                 | _                                                                                                      | Replace the Command Option Module.                                                                                   | _            |
| Command Option<br>Module                                        | An unsupported Com-<br>mand Option Module<br>was connected.                                      | -                                                                                                      | Connect a supported<br>Command Option Mod-<br>ule.                                                                   | _            |
| A.E74:<br>Unsupported                                           | A failure occurred in the Safety Option Module.                                                  | -                                                                                                      | Replace the Safety Option Module.                                                                                    | _            |
| Safety Option<br>Module                                         | An unsupported<br>Safety Option Module<br>was connected.                                         | -                                                                                                      | Connect a supported<br>Safety Option Module.                                                                         | -            |
| A.E75 <sup>*2</sup> :                                           | A failure occurred in<br>the Feedback Option<br>Module.                                          | _                                                                                                      | Replace the Feedback<br>Option Module.                                                                               | -            |
| Unsupported<br>Feedback Option<br>Module                        | An unsupported<br>Feedback Option<br>Module was con-<br>nected.                                  | Refer to the catalog for<br>the connected Feed-<br>back Option Module or<br>the SERVOPACK man-<br>ual. | Connect a supported<br>Feedback Option Module.                                                                       | -            |
| A.E80:<br>Command Option<br>Module Detec-<br>tion Inconsistency | The Command Option<br>Module was replaced<br>with a different model.                             | -                                                                                                      | Reset the Option Module<br>configuration error and<br>turn the power supply to<br>the SERVOPACK OFF and<br>ON again. | -            |

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| Alarm Number:                                                                                                                                                                        | Descible Course                                                                                                                | Confirmation                                                        |                                                                                                                                                                                                                                                                                                |           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Alarm Name                                                                                                                                                                           | Possible Cause                                                                                                                 | Confirmation                                                        | Correction                                                                                                                                                                                                                                                                                     | Reference |
| A.EA0:<br>Initialization Error<br>(Communica-<br>tions initialization<br>failed between<br>the SERVOPACK<br>and the Com-<br>mand Option<br>Module.)                                  | A failure occurred in<br>the DeviceNet Mod-<br>ule.                                                                            | _                                                                   | Replace the DeviceNet<br>Module.                                                                                                                                                                                                                                                               | -         |
| A.EA2:<br>Alarm in Current<br>Communications<br>between the<br>DeviceNet Mod-<br>ule and SERVO-<br>PACK 1                                                                            | An error occurred in<br>communications<br>between the Devi-<br>ceNet Module and<br>SERVOPACK during<br>operation.              | _                                                                   | Implement noise counter-<br>measures, such as<br>improving the frame<br>ground.                                                                                                                                                                                                                | -         |
| A.EA3:<br>Alarm in Current<br>Communications<br>between the<br>DeviceNet Mod-<br>ule and SERVO-<br>PACK 2                                                                            | An error occurred in<br>communications<br>between the Devi-<br>ceNet Module and<br>SERVOPACK during<br>operation.              | _                                                                   | Implement noise counter-<br>measures, such as<br>improving the frame<br>ground.                                                                                                                                                                                                                | _         |
| A.Eb1:<br>Safety Function<br>Signal Input Tim-<br>ing Error                                                                                                                          | The delay between<br>activation of the<br>/HWBB1 and<br>/HWBB2 input sig-<br>nals for the HWBB<br>was ten second or<br>longer. | Measure the time delay<br>between the /HWBB1<br>and /HWBB2 signals. | The output signal circuits<br>or devices for /HWBB1<br>and /HWBB2 or the SER-<br>VOPACK input signal cir-<br>cuits may be faulty.<br>Alternatively, the input sig-<br>nal cables may be discon-<br>nected. Check to see if<br>any of these items are<br>faulty or have been dis-<br>connected. | _         |
|                                                                                                                                                                                      | A failure occurred in the SERVOPACK.                                                                                           | -                                                                   | Replace the SERVO-<br>PACK.                                                                                                                                                                                                                                                                    | _         |
| A.EC8:<br>Gate Drive Error 1<br>(An error<br>occurred in the<br>gate drive circuit.)<br>A.EC9:<br>Gate Drive Error<br>2<br>(An error<br>occurred in the<br>gate drive cir-<br>cuit.) | A failure occurred in the SERVOPACK.                                                                                           | _                                                                   | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                                                                                                                                         | -         |
| A.Ed1:<br>Command Option<br>Module IF Com-                                                                                                                                           | Processing of a Servo<br>ON command from<br>the Command Option<br>Module was not com-<br>pleted.                               | _                                                                   | Input the Servo ON com-<br>mand when the motor is<br>stopped.                                                                                                                                                                                                                                  | -         |
| munications<br>Command Time-<br>out Error                                                                                                                                            | Processing of a Sen-<br>sor ON command<br>from the Command<br>Option Module was<br>not completed.                              | -                                                                   | Check to confirm that the encoder is connected properly.                                                                                                                                                                                                                                       | -         |

| Continued  | from | previous | page  |
|------------|------|----------|-------|
| 0011111000 |      | proviouo | page. |

| Alarm Number:                                                                                                | Possible Cause                                                                                                                                   | Confirmation                                                                   | Correction                                                                                                                                                                    | Reference  |
|--------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Alarm Name                                                                                                   |                                                                                                                                                  | Committation                                                                   | Conection                                                                                                                                                                     | helefelice |
|                                                                                                              | The three-phase<br>power supply wiring is<br>not correct.                                                                                        | Check the power sup-<br>ply wiring.                                            | Make sure that the power supply is correctly wired.                                                                                                                           | page 4-11  |
| <b>A.F10:</b><br>Power Supply<br>Line Open Phase                                                             | The three-phase power supply is unbalanced.                                                                                                      | Measure the voltage for<br>each phase of the<br>three-phase power sup-<br>ply. | Balance the power sup-<br>ply by changing phases.                                                                                                                             | -          |
| (The voltage was<br>low for more than<br>one second for<br>phase R, S, or T<br>when the main<br>power supply | A single-phase power<br>supply was input with-<br>out specifying a sin-<br>gle-phase AC power<br>supply input (Pn00B =<br>$n.\Box 1\Box \Box$ ). | Check the power sup-<br>ply and the parameter<br>setting.                      | Match the parameter set-<br>ting to the power supply.                                                                                                                         | page 4-11  |
| was ON.)                                                                                                     | A failure occurred in the SERVOPACK.                                                                                                             | _                                                                              | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                        | _          |
| FL-1 <sup>*5</sup> :<br>System Alarm                                                                         |                                                                                                                                                  |                                                                                |                                                                                                                                                                               |            |
| FL-2 <sup>*5</sup> :<br>System Alarm                                                                         |                                                                                                                                                  |                                                                                |                                                                                                                                                                               |            |
| FL-3 <sup>*5</sup> :<br>System Alarm<br>FL-4 <sup>*5</sup> :<br>System Alarm                                 | A failure occurred in the SERVOPACK.                                                                                                             | _                                                                              | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK                                                                    | -          |
| FL-5 <sup>*5</sup> :<br>System Alarm<br>FL-6 <sup>*5</sup> :<br>System Alarm                                 | -                                                                                                                                                | may be faulty. Repl<br>SERVOPACK.                                              | may be faulty. Replace the SERVOPACK.                                                                                                                                         |            |
| FL-7 <sup>*5</sup> :<br>System Alarm                                                                         |                                                                                                                                                  |                                                                                |                                                                                                                                                                               |            |
| CPF00:<br>Digital Operator                                                                                   | There is a faulty con-<br>nection between the<br>Digital Operator and<br>the SERVOPACK.                                                          | Check the connector contact.                                                   | Disconnect the connec-<br>tor and insert it again. Or,<br>replace the cable.                                                                                                  | -          |
| Communications<br>Error 1                                                                                    | A malfunction was caused by noise.                                                                                                               | _                                                                              | Keep the Digital Operator<br>or the cable away from<br>sources of noise.                                                                                                      | _          |
| <b>CPF01:</b><br>Digital Operator                                                                            | A failure occurred in the Digital Operator.                                                                                                      | _                                                                              | Disconnect the Digital<br>Operator and then con-<br>nect it again. If the alarm<br>still occurs, the Digital<br>Operator may be faulty.<br>Replace the Digital Oper-<br>ator. | -          |
| Communications<br>Error 2                                                                                    | A failure occurred in the SERVOPACK.                                                                                                             | _                                                                              | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.                        | -          |
| <ol> <li>Detection Condition</li> <li>Rotary Servomo</li> </ol>                                              | tor                                                                                                                                              |                                                                                |                                                                                                                                                                               |            |
|                                                                                                              | $\frac{\text{Encoder resolution}}{1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 +$                                                                       | 120E                                                                           |                                                                                                                                                                               |            |
|                                                                                                              |                                                                                                                                                  | n210                                                                           |                                                                                                                                                                               |            |
| <ul> <li>Maximum motor sp</li> </ul>                                                                         | peed [min <sup>-1</sup> ] × Encoder resolu<br>Approx. 3.66 ×                                                                                     | >                                                                              |                                                                                                                                                                               |            |

#### Linear Servomotor

If either of the following conditions is detected, an alarm will occur.

| Pn585 [mm/s]              |   | Resolution of Serial Converter Unit | 2 | Pn20E |  |
|---------------------------|---|-------------------------------------|---|-------|--|
| Linear encoder pitch [µm] | × | 10                                  | - | Pn210 |  |
| <br>Pn385 [100 mm/s]      | ~ | Resolution of Serial Converter Unit | > | Pn20E |  |
| Linear encoder pitch [µm] | ~ | Approx. 6.10 ×10 <sup>5</sup>       | ~ | Pn210 |  |

\*2. Detection Conditions • Rotary Servomotor

If either of the following conditions is detected, an alarm will occur.

| <ul> <li>Rated motor speed [min<sup>-1</sup>] × 1/3 ×</li> </ul> | Encoder resolution   | Pn20E              |
|------------------------------------------------------------------|----------------------|--------------------|
| · · · · · · · · · · · · · · · · · · ·                            | 6×10 <sup>5</sup>    | <sup>≥</sup> Pn210 |
| • Maximum motor speed [min <sup>-1</sup> ] $\times$              | Encoder resolution > | Pn20E              |
|                                                                  | Approx. 3.66 × 1012  | Pn210              |

#### Linear Servomotor

If either of the following conditions is detected, an alarm will occur.

|    | Rated motor speed [mm/s] $\times$ 1/3         |   | Resolution of Serial Converter Unit                                  | < | Pn20E          |
|----|-----------------------------------------------|---|----------------------------------------------------------------------|---|----------------|
|    | Linear encoder pitch [µm]                     | ~ | 10                                                                   | - | Pn210          |
| •_ | Pn385 [100 mm/s]<br>Linear encoder pitch [μm] | × | Resolution of Serial Converter Unit<br>Approx. 6.10 ×10 <sup>5</sup> | ≥ | Pn20E<br>Pn210 |

\*3. Refer to the following manual for details.

Ω Σ-7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)

\*4. The SERVOPACK will fail if the External Regenerative Resistor or Regenerative Resistor Unit is connected while the jumper is connected between the B2 and B3 terminals.

\*5. These alarms are not stored in the alarm history. They are only displayed on the panel display.

14.2.3 Resetting Alarms

# 14.2.3 Resetting Alarms

If there is an ALM (Servo Alarm) signal, use one of the following methods to reset the alarm after eliminating the cause of the alarm.

| ٦)<br>۲  |
|----------|
| Importar |

Be sure to eliminate the cause of an alarm before you reset the alarm. If you reset the alarm and continue operation without eliminating the cause of the alarm, it may result in damage to the equipment or fire.

# Resetting Alarms with the SigmaWin+

Use the following procedure to reset alarms with the SigmaWin+.

- 1. Click the <u>I</u> Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Display Alarm in the Menu Dialog Box. The Alarm Display Dialog Box will be displayed.
- 3. Click the Reset axes Button.

| Cause 1                                                                                                                                                     | Alar                     |  |  |  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--|--|--|--|
| rm diagnosis   Alarm History  <br>Cause 1                                                                                                                   |                          |  |  |  |  |
| Cause 1                                                                                                                                                     |                          |  |  |  |  |
| Cause 1                                                                                                                                                     |                          |  |  |  |  |
| Cause 1                                                                                                                                                     |                          |  |  |  |  |
| Cause 1                                                                                                                                                     |                          |  |  |  |  |
|                                                                                                                                                             |                          |  |  |  |  |
|                                                                                                                                                             | /5 <b>4</b> [ <b>b</b> ] |  |  |  |  |
| Cause                                                                                                                                                       |                          |  |  |  |  |
| Contact fault of encoder connector or incorrect encoder wiring.                                                                                             | *                        |  |  |  |  |
|                                                                                                                                                             |                          |  |  |  |  |
| ]                                                                                                                                                           | Ŧ                        |  |  |  |  |
| Investigated actions                                                                                                                                        |                          |  |  |  |  |
| Check the encoder connector contact status.                                                                                                                 | ~                        |  |  |  |  |
|                                                                                                                                                             |                          |  |  |  |  |
| Ŧ                                                                                                                                                           |                          |  |  |  |  |
|                                                                                                                                                             |                          |  |  |  |  |
| Corrective actions                                                                                                                                          |                          |  |  |  |  |
| Corrective actions<br>Re-insert the encoder connector and confirm that the encoder is correctly wired.                                                      | ~                        |  |  |  |  |
|                                                                                                                                                             | ^<br>                    |  |  |  |  |
| Re-insert the encoder connector and confirm that the encoder is correctly wired.                                                                            | *                        |  |  |  |  |
| Re-insert the encoder connector and confirm that the encoder is correctly wired.<br>Monitor at occurrence of alarm                                          | A<br>V                   |  |  |  |  |
| Re-insert the encoder connector and confirm that the encoder is correctly wired.  Monitor at occurrence of alarm Name Value Unit                            | *<br>*                   |  |  |  |  |
| Re-insert the encoder connector and confirm that the encoder is correctly wired. Montor at occurrence of alarm Name Value Unit Motor rotating speed 0 min-1 | *<br>*                   |  |  |  |  |
| Re-Insert the encoder connector and confirm that the encoder is correctly wired.  Montor at occurrence of alarm Name Value Unit                             | *                        |  |  |  |  |

The alarm will be reset, and the alarm display will be cleared. This concludes the procedure to reset alarms.

## **Resetting Alarms with I/O Communications**

Refer to the following section for details on resetting alarms with I/O communications.  $\square$  13.2.1 I/O Communications on page 13-5

## **Resetting Alarms Using the Digital Operator**

Press the **ALARM RESET** Key on the Digital Operator. Refer to the following manual for details on resetting alarms.

 $\square$   $\Sigma$ -7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)

14.2.4 Displaying the Alarm History

# 14.2.4 Displaying the Alarm History

The alarm history displays up to the last ten alarms that have occurred in the SERVOPACK. Note: FL-1 to FL-7 are not displayed in the alarm history.

### Preparations

No preparations are required.

## **Applicable Tools**

The following table lists the tools that you can use to display the alarm history.

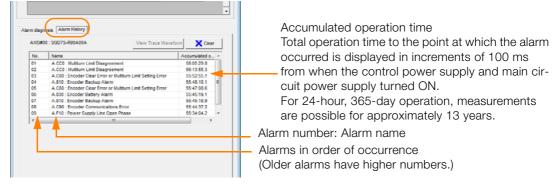
| Tool             | Fn No./Function Name            | Reference                                                                     |
|------------------|---------------------------------|-------------------------------------------------------------------------------|
| Digital Operator | Fn000                           | Ω-7-Series Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+        | Troubleshooting – Display Alarm | Operating Procedure on page 14-44                                             |

## **Operating Procedure**

Use the following procedure to display the alarm history.

- 1. Click the <u>I</u> Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Display Alarm in the Menu Dialog Box. The Alarm Display Dialog Box will be displayed.
- 3. Click the Alarm History Tab.

The following display will appear and you can check the alarms that occurred in the past.



- **Information** 1. If the same alarm occurs consecutively within one hour, it is not saved in the alarm history. If it occurs after an hour or more, it is saved.
  - 2. You can clear the alarm history by clicking the **Clear** Button. The alarm history is not cleared when alarms are reset or when the SERVOPACK main circuit power is turned OFF.

This concludes the procedure to display the alarm history.

# 14.2.5 Clearing the Alarm History

You can clear the alarm history that is recorded in the SERVOPACK.

The alarm history is not cleared when alarms are reset or when the SERVOPACK main circuit power is turned OFF. You must perform the following procedure.

### Preparations

Always check the following before you clear the alarm history.

• The parameters must not be write prohibited.

## **Applicable Tools**

The following table lists the tools that you can use to clear the alarm history.

| Tool             | Fn No./Function Name            | Reference                                                                         |
|------------------|---------------------------------|-----------------------------------------------------------------------------------|
| Digital Operator | Fn006                           | Chanal Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33) |
| SigmaWin+        | Troubleshooting – Display Alarm | Gerating Procedure on page 14-45                                                  |

## **Operating Procedure**

Use the following procedure to reset the alarm history.

- 1. Click the <u>Servo</u> Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Display Alarm in the Menu Dialog Box. The Alarm Display Dialog Box will be displayed.
- 3. Click the Alarm History Tab.
- 4. Click the Clear Button.

The alarm history will be cleared.

|          |                                                               |                          | -   |
|----------|---------------------------------------------------------------|--------------------------|-----|
| No.      | Name                                                          | Accumulated o            | - 1 |
| 01       | A.CC0 : Multiturn Limit Disagreement                          | 58:05:29.8               | -11 |
| 02       | A.CC0 : Multiturn Limit Disagreement                          | 56:13:55.3               | -11 |
| 03       | A.C80 : Encoder Clear Error or Multiturn Limit Setting Error  | 55:52:55.1               |     |
| 04       | A.810 : Encoder Backup Alarm                                  | 55:48:10.1               | E   |
| 05<br>06 | A.C80 : Encoder Clear Error or Multiturn Limit Setting Error  | 55:47:08.6<br>55:45:19.1 | -11 |
| 05       | A.830 : Encoder Battery Alarm<br>A.810 : Encoder Backup Alarm | 55:45:19.1               | -11 |
| 08       | A.C90 : Encoder Communications Error                          | 55:44:37.2               | -   |
| 09       | A.F10 : Power Supply Line Open Phase                          | 55:34:04.2               | ۰.  |
| 4        |                                                               | 33.34.04.2               |     |
|          |                                                               |                          |     |

This concludes the procedure to reset the alarm history.

14.2.6 Resetting Alarms Detected in Option Modules

## 14.2.6 Resetting Alarms Detected in Option Modules

If any Option Modules are attached to the SERVOPACK, the SERVOPACK detects the presence and models of the connected Option Modules. If it finds any errors, it outputs alarms.

You can delete those alarms with this operation.

- **Information** This operation is the only way to reset alarms for Option Modules. The alarms are not reset when you reset other alarms or when you turn OFF the power supply to the SERVOPACK.
  - Always remove the cause of an alarm before you reset the alarm.

## Preparations

Always check the following before you clear an alarm detected in an Option Module. • The parameters must not be write prohibited.

## **Applicable Tools**

The following table lists the tools that you can use to reset Option Module configuration errors.

| Tool             | Fn No./Function Name            | Reference                                                                     |
|------------------|---------------------------------|-------------------------------------------------------------------------------|
| Digital Operator | Fn014                           | Σ-7-Series Digital Operator Operating Manual<br>(Manual No.: SIEP S800001 33) |
| SigmaWin+        | Troubleshooting – Display Alarm | Coperating Procedure on page 14-46                                            |

### **Operating Procedure**

Use the following procedure to reset alarms detected in Option Modules.

- 1. Click the *P* Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Display Alarm in the Menu Dialog Box. The Display Alarm Dialog Box will be displayed.
- 3. Click the Reset axes Button.

| Alarm Display                                         |                                     |                 |                   |                  |
|-------------------------------------------------------|-------------------------------------|-----------------|-------------------|------------------|
| Alarm                                                 |                                     |                 | Reset axes. Vie   | w Trace Waveform |
| Axis                                                  |                                     |                 | <u></u>           | <b>^</b>         |
| AXIS#0001A : SGD7S-2                                  | R8A2UA                              | A.E./1 : Safet  | y Option Module D | etection Failure |
|                                                       |                                     |                 |                   | •                |
| Alarm diagnosis Alarm History                         |                                     |                 |                   | Cause 1/4 	)     |
| Cause                                                 |                                     |                 |                   |                  |
| Faulty connection between the                         | SERVOPA                             | CK and Safety C | ption Module.     | *                |
|                                                       |                                     |                 |                   | -                |
| Investigated actions                                  |                                     |                 |                   |                  |
| Check the connection between                          | the SERV                            | OPACK and Safe  | ty Option Module  | <b>A</b>         |
|                                                       |                                     |                 | ., .,             |                  |
|                                                       |                                     |                 |                   | Ŧ                |
| Corrective actions                                    |                                     |                 |                   |                  |
| Reconnect the Safety Option Mo                        | Reconnect the Safety Option Module. |                 |                   |                  |
|                                                       | *                                   |                 |                   |                  |
| ,<br>Monitor at occurrence of alarm                   |                                     |                 |                   |                  |
| Name                                                  | Val                                 | Unit            |                   | *                |
| Motor rotating speed                                  | -                                   | min-1           |                   |                  |
| Speed reference                                       | -                                   | min-1           |                   |                  |
| Internal torque reference                             | -                                   | %               |                   |                  |
| Input reference pulse speed                           | -                                   | min-1           |                   | *                |
| The diagonosis results su<br>The real cause may not b |                                     |                 | the alarm.        |                  |
|                                                       |                                     |                 |                   |                  |

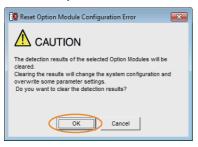
The Reset Option Module Configuration Error Dialog Box will be displayed.

14.2.6 Resetting Alarms Detected in Option Modules

4. Select the Clear Check Box for the Option Module for which to reset the alarm and then click the Execute Button.

| 👰 Reset Op | tion Module Configuration Error AXIS#0001A                                                                                                                |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
|            | Option Module error was detected.<br>Select the Clear check box of the Option Module and then<br>click the Execute button to clear the detection results. |
|            | Safety Option<br>Failed to detect Clear<br>Feedback Option<br>Normally detected Clear                                                                     |
|            | Execute                                                                                                                                                   |

5. Read the precaution and then click the OK Button.



6. Read the precaution and then click the OK Button.



7. Turn the power supply to the SERVOPACK OFF and ON again.

This concludes the procedure to reset alarms detected in Option Modules.

14.2.7 Resetting Motor Type Alarms

# 14.2.7 Resetting Motor Type Alarms

The SERVOPACK automatically determines the type of Servomotor that is connected to it. If the type of Servomotor that is connected is changed, an A.070 alarm (Motor Type Change Detected) will occur the next time the SERVOPACK is started. If an A.070 alarm occurs, you must set the parameters to match the new type of Servomotor.

An A.070 alarm is reset by executing the Reset Motor Type Alarm utility function.

- Information 1. This utility function is the only way to reset an A.070 alarm (Motor Type Change Detected). The errors are not reset when you reset alarms or turn OFF the power supply to the SER-VOPACK.
  - 2. If an A.070 alarm occurs, first set the parameters according to the newly connected Servomotor type and then execute the Reset Motor Type Alarm utility function.

### Preparations

Always check the following before you reset a motor type alarm.

• The parameters must not be write prohibited.

## **Applicable Tools**

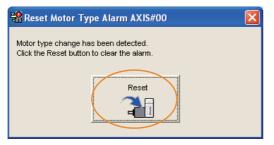
The following table lists the tools that you can use to clear the motor type alarm.

| Tool             | Fn No./Function Name                        | Reference                                                                                 |  |
|------------------|---------------------------------------------|-------------------------------------------------------------------------------------------|--|
| Digital Operator | Fn021                                       | $\bigcap \Sigma-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)$ |  |
| SigmaWin+        | Troubleshooting – Reset Motor<br>Type Alarm | G Operating Procedure on page 14-48                                                       |  |

## **Operating Procedure**

Use the following procedure to reset Motor Type alarm.

- 1. Click the <u>I</u> Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Reset Motor Type Alarm in the Menu Dialog Box. The Reset Motor Type Alarm Dialog Box will be displayed.
- 3. Click the Reset Button.



4. Read the precaution and then click the OK Button.



14.2.7 Resetting Motor Type Alarms

5. Read the precaution and then click the OK Button.



**6.** Turn the power supply to the SERVOPACK OFF and ON again.

This concludes the procedure to reset Motor Type alarms.

14.3.1 List of Warnings

# 14.3 Warning Displays

If a warning occurs in the SERVOPACK, a warning number will be displayed on the panel display. Warnings are displayed to warn you before an alarm occurs.

This section provides a list of warnings and the causes of and corrections for warnings.

# 14.3.1 List of Warnings

The list of warnings gives the warning name, warning meaning in order of the warning numbers.

| Warning<br>Number | Warning Name                                                           | Meaning                                                                                                                                                                                              |  |
|-------------------|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| A.900             | Position Deviation Over-<br>flow                                       | The position deviation exceeded the percentage set with the following formula:<br>(Pn520 × Pn51E/100)                                                                                                |  |
| A.901             | Position Deviation Over-<br>flow Alarm at Servo ON                     | The position deviation when the servo was turned ON exceeded the percentage set with the following formula: (Pn526 $\times$ Pn528/100)                                                               |  |
| A.910             | Overload                                                               | This warning occurs before an overload alarm (A.710 or A.720) occurs.<br>If the warning is ignored and operation is continued, an alarm may<br>occur.                                                |  |
| A.911             | Vibration                                                              | Abnormal vibration was detected during motor operation. The detec-<br>tion level is the same as A.520. Set whether to output an alarm or a<br>warning by setting Pn310 (Vibration Detection Switch). |  |
| A.912             | Internal Temperature<br>Warning 1 (Control Board<br>Temperature Error) | The surrounding temperature of the control PCB is abnormal.                                                                                                                                          |  |
| A.913             | Internal Temperature<br>Warning 2 (Power Board<br>Temperature Error)   | The surrounding temperature of the power PCB is abnormal.                                                                                                                                            |  |
| A.920             | Regenerative Overload                                                  | This warning occurs before an A.320 alarm (Regenerative Overload) occurs. If the warning is ignored and operation is continued, an alarm may occur.                                                  |  |
| A.921             | Dynamic Brake Overload                                                 | This warning occurs before an A.731 alarm (Dynamic Brake Overload) occurs. If the warning is ignored and operation is continued, an alarm may occur.                                                 |  |
| A.923             | SERVOPACK Built-in Fan<br>Stopped                                      | The fan inside the SERVOPACK stopped.                                                                                                                                                                |  |
| A.930             | Absolute Encoder Bat-<br>tery Error                                    | This warning occurs when the voltage of absolute encoder's battery is low.                                                                                                                           |  |
| A.93B             | Overheat Warning                                                       | The input voltage (temperature) of the overheat protection input (TH) signal exceeded the setting of Pn61C (Overheat Warning Level).                                                                 |  |
| A.942             | Speed Ripple Compen-<br>sation Information Dis-<br>agreement           | The speed ripple compensation information stored in the encoder does not agree with the speed ripple compensation information stored in the SERVOPACK.                                               |  |
| A.971             | Undervoltage                                                           | This warning occurs before an A.410 alarm (Undervoltage) occurs. If the warning is ignored and operation is continued, an alarm may occur.                                                           |  |
| A.9b0             | Preventative Mainte-<br>nance Warning                                  | One of the consumable parts has reached the end of its service life.                                                                                                                                 |  |
| A.A90             | Positioning Timeout                                                    | A positioning completion timeout occurred during a positioning opera-<br>tion.                                                                                                                       |  |
| A.A94             | Data Setting Warning                                                   | A parameter was set outside of the setting range.                                                                                                                                                    |  |
| A.A95             | Command Error                                                          | There was an error in a command message.                                                                                                                                                             |  |
| A.A96             | DeviceNet Communica-<br>tions Error                                    | DeviceNet communications have timed out.                                                                                                                                                             |  |
| A.A97             | Control Power Error                                                    | The control power supply is not ON.                                                                                                                                                                  |  |

Continued from previous page.

| Warning<br>Number | Warning Name                    | Meaning                                                                            |
|-------------------|---------------------------------|------------------------------------------------------------------------------------|
| A.A98             | Main Circuit Power Error        | The main circuit power supply is not ON.                                           |
| A.A99             | Rotary Switch Change<br>Warning | A rotary switch setting was changed after the power supply was turned ON or reset. |

Note: Use Pn008 = n.□X□□ (Warning Detection Selection) to select warning detection. However, the following warnings are not affected by the setting of Pn008 = n.□X□□ and other parameter settings are required in addition to Pn008 = n.□X□□.

| Warning | Parameters That Must Be Set to Select Warning Detection                                                                           | Reference |
|---------|-----------------------------------------------------------------------------------------------------------------------------------|-----------|
| A.911   | Pn310 = n. DDX (Vibration Detection Setting)                                                                                      | page 6-26 |
| A.930   | Pn008 = n.DDDX (Low Battery Voltage Alarm/Warning Selection)                                                                      | page 14-2 |
| A.942   | Pn423 = n. DIX (Speed Ripple Compensation Information Dis-<br>agreement Warning Detection Selection)                              | page 8-60 |
| A.971   | $Pn008 = n.\Box\Box X\Box$ (Function Selection for Undervoltage)<br>(Not affected by the setting of $Pn008 = n.\Box X\Box\Box$ .) | page 6-5  |
| A.9b0   | Pn00F = n.DDDX (Preventative Maintenance Selection)                                                                               | page 9-14 |

### 14.3.2 Troubleshooting Warnings

The causes of and corrections for the warnings are given in the following table. Contact your Yaskawa representative if you cannot solve a problem with the correction given in the table.

| Warning Number:<br>Warning Name                                      | Possible Cause                                                                                                                                             | Confirmation                                                                                                                   | Correction                                                                                                                                                    | Reference |
|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|                                                                      | The Servomotor<br>U, V, and W wiring<br>is not correct.                                                                                                    | Check the wiring of the<br>Servomotor's Main Cir-<br>cuit Cables.                                                              | Make sure that there are no faulty connections in the wiring for the Servomotor and encoder.                                                                  | -         |
|                                                                      | A SERVOPACK gain is too low.                                                                                                                               | Check the SERVO-<br>PACK gains.                                                                                                | Increase the servo gain,<br>e.g., by using autotuning<br>without a host reference.                                                                            | page 8-23 |
| <b>A.900:</b><br>Position Deviation                                  | The acceleration<br>of the position ref-<br>erence is too high.                                                                                            | Reduce the reference<br>acceleration and try<br>operating the SERVO-<br>PACK.                                                  | Reduce the settings of<br>PnB2A (Acceleration Rate)<br>and PnB2B (Deceleration<br>Rate) to reduce the acceler-<br>ation rate of the positioning<br>reference. | -         |
| Overflow                                                             | The excessive<br>position deviation<br>alarm level (Pn520<br>$\times$ Pn51E/100) is<br>too low for the<br>operating condi-<br>tions.                       | Check excessive posi-<br>tion deviation alarm<br>level (Pn520 × Pn51E/<br>100) to see if it is set to<br>an appropriate value. | Optimize the settings of<br>Pn520 and Pn51E.                                                                                                                  | page 8-7  |
|                                                                      | A failure occurred<br>in the SERVO-<br>PACK.                                                                                                               | _                                                                                                                              | Turn the power supply to<br>the SERVOPACK OFF and<br>ON again. If the alarm still<br>occurs, the SERVOPACK<br>may be faulty. Replace the<br>SERVOPACK.        | -         |
| <b>A.901:</b><br>Position Deviation<br>Overflow Alarm at<br>Servo ON | The position devi-<br>ation when the<br>servo was turned<br>ON exceeded the<br>percentage set<br>with the following<br>formula:<br>(Pn526 × Pn528/<br>100) | _                                                                                                                              | Optimize the setting of<br>Pn528 (Excessive Position<br>Error Warning Level at<br>Servo ON).                                                                  | -         |

Continued on next page.

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Continued from previous page.

| Warning Number:<br>Warning Name                                          | Possible Cause                                                                                                                        | Confirmation                                                                                             | Correction                                                                     | Reference |
|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-----------|
|                                                                          | The wiring is not<br>correct or there is<br>a faulty connec-<br>tion in the motor<br>or encoder wiring.                               | Check the wiring.                                                                                        | Make sure that the Servo-<br>motor and encoder are cor-<br>rectly wired.       | _         |
| A.910:<br>Overload (warning<br>before an A.710 or<br>A.720 alarm occurs) | Operation was<br>performed that<br>exceeded the<br>overload protec-<br>tion characteris-<br>tics.                                     | Check the motor over-<br>load characteristics and<br>Run command.                                        | Reconsider the load and operating conditions. Or, increase the motor capacity. | _         |
|                                                                          | The overload<br>warning level<br>(Pn52B) is not<br>suitable.                                                                          | Check that the overload<br>warning level (Pn52B) is<br>suitable.                                         | Set a suitable overload warning level (Pn52B).                                 | page 5-38 |
|                                                                          | A failure occurred<br>in the SERVO-<br>PACK.                                                                                          | _                                                                                                        | The SERVOPACK may be faulty. Replace the SERVO-<br>PACK.                       | _         |
|                                                                          | Abnormal vibra-<br>tion was detected<br>during motor<br>operation.                                                                    | Check for abnormal<br>motor noise, and check<br>the speed and torque<br>waveforms during oper-<br>ation. | Reduce the motor speed.<br>Or, reduce the servo gain<br>with custom tuning.    | page 8-42 |
| <b>A.911:</b><br>Vibration                                               | The setting of<br>Pn103 (Moment of<br>Inertia Ratio) is<br>greater than the<br>actual moment of<br>inertia or was<br>greatly changed. | Check the moment of inertia ratio or mass ratio.                                                         | Set Pn103 (Moment of Iner-<br>tia Ratio) to an appropriate<br>value.           | page 8-15 |
|                                                                          | The vibration<br>detection level<br>(Pn312 or Pn384)<br>is not suitable.                                                              | Check that the vibration detection level (Pn312 or Pn384) is suitable.                                   | Set a suitable vibration<br>detection level (Pn312 or<br>Pn384).               | page 6-26 |

Continued from previous page.

| Warning Number:<br>Warning Name                                                         | Possible Cause                                                                                                                     | Confirmation                                                                                                                                                                | Correction                                                                                          | Reference             |
|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----------------------|
|                                                                                         | The surrounding<br>temperature is too<br>high.                                                                                     | Check the surrounding<br>temperature using a<br>thermometer. Or, check<br>the operating status<br>with the SERVOPACK<br>installation environ-<br>ment monitor.              | Decrease the surrounding<br>temperature by improving<br>the SERVOPACK installa-<br>tion conditions. | page 3-6              |
|                                                                                         | An overload alarm<br>was reset by turn-<br>ing OFF the power<br>supply too many<br>times.                                          | Check the alarm display<br>to see if there is an<br>overload alarm.                                                                                                         | Change the method for resetting the alarm.                                                          | _                     |
| A.912:<br>Internal Tempera-<br>ture Warning 1<br>(Control Board Tem-<br>perature Error) | There was an<br>excessive load or<br>operation was<br>performed that<br>exceeded the<br>regenerative pro-<br>cessing capacity.     | Use the accumulated<br>load ratio to check the<br>load during operation,<br>and use the regenera-<br>tive load ratio to check<br>the regenerative pro-<br>cessing capacity. | Reconsider the load and operating conditions.                                                       | -                     |
|                                                                                         | The SERVOPACK<br>installation orien-<br>tation is not cor-<br>rect or there is<br>insufficient space<br>around the SER-<br>VOPACK. | Check the SERVO-<br>PACK installation con-<br>ditions.                                                                                                                      | Install the SERVOPACK according to specifications.                                                  | page 3-3,<br>page 3-6 |
|                                                                                         | A failure occurred<br>in the SERVO-<br>PACK.                                                                                       | -                                                                                                                                                                           | The SERVOPACK may be faulty. Replace the SERVO-<br>PACK.                                            | _                     |
|                                                                                         | The surrounding<br>temperature is too<br>high.                                                                                     | Check the surrounding<br>temperature using a<br>thermometer. Or, check<br>the operating status<br>with the SERVOPACK<br>installation environ-<br>ment monitor.              | Decrease the surrounding<br>temperature by improving<br>the SERVOPACK installa-<br>tion conditions. | page 3-6              |
|                                                                                         | An overload alarm<br>was reset by turn-<br>ing OFF the power<br>supply too many<br>times.                                          | Check the alarm display<br>to see if there is an<br>overload alarm.                                                                                                         | Change the method for resetting the alarm.                                                          | -                     |
| A.913:<br>Internal Tempera-<br>ture Warning 2<br>(Power Board Tem-<br>perature Error)   | There was an<br>excessive load or<br>operation was<br>performed that<br>exceeded the<br>regenerative pro-<br>cessing capacity.     | Use the accumulated<br>load ratio to check the<br>load during operation,<br>and use the regenera-<br>tive load ratio to check<br>the regenerative pro-<br>cessing capacity. | Reconsider the load and operating conditions.                                                       | _                     |
|                                                                                         | The SERVOPACK<br>installation orien-<br>tation is not cor-<br>rect or there is<br>insufficient space<br>around the SER-<br>VOPACK. | Check the SERVO-<br>PACK installation con-<br>ditions.                                                                                                                      | Install the SERVOPACK according to specifications.                                                  | page 3-3,<br>page 3-6 |
|                                                                                         | A failure occurred<br>in the SERVO-<br>PACK.                                                                                       | -                                                                                                                                                                           | The SERVOPACK may be<br>faulty. Replace the SERVO-<br>PACK.                                         | -                     |

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| Warning Number:<br>Warning Name                                                                                  | Possible Cause                                                                                                                                                                                            | Confirmation                                                                                                                              | Correction                                                                                                                                                                                                                               | Reference |
|------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|                                                                                                                  | The power supply voltage exceeded the specified range.                                                                                                                                                    | Measure the power supply voltage.                                                                                                         | Set the power supply volt-<br>age within the specified range.                                                                                                                                                                            | -         |
| <b>A.920:</b><br>Regenerative Over-<br>load (warning before<br>an A.320 alarm<br>occurs)                         | There is insuffi-<br>cient external<br>regenerative resis-<br>tance, regenera-<br>tive resistor<br>capacity, or SER-<br>VOPACK capac-<br>ity, or there has<br>been a continuous<br>regeneration<br>state. | Check the operating<br>conditions or the<br>capacity using the Sig-<br>maJunmaSize+ Capac-<br>ity Selection Software<br>or another means. | Change the regenerative<br>resistance value, regenera-<br>tive resistance capacity, or<br>SERVOPACK capacity.<br>Reconsider the operating<br>conditions using the Sigma-<br>JunmaSize+ Capacity<br>Selection Software or other<br>means. | -         |
|                                                                                                                  | There was a con-<br>tinuous regenera-<br>tion state because<br>a negative load<br>was continuously<br>applied.                                                                                            | Check the load applied<br>to the Servomotor<br>during operation.                                                                          | Reconsider the system<br>including the servo,<br>machine, and operating<br>conditions.                                                                                                                                                   | _         |
|                                                                                                                  | The Servomotor was rotated by an external force.                                                                                                                                                          | Check the operation status.                                                                                                               | Implement measures to<br>ensure that the motor will<br>not be rotated by an exter-<br>nal force.                                                                                                                                         | -         |
| A.921:<br>Dynamic Brake<br>Overload (warning<br>before an A.731<br>alarm occurs)                                 | When the Servo-<br>motor was<br>stopped with the<br>dynamic brake,<br>the rotational or<br>linear kinetic<br>energy exceeded<br>the capacity of the<br>dynamic brake<br>resistor.                         | Check the power con-<br>sumed by the DB resis-<br>tor to see how<br>frequently the DB is<br>being used.                                   | <ul> <li>Reconsider the following:</li> <li>Reduce the Servomotor command speed.</li> <li>Decrease the moment of inertia or mass.</li> <li>Reduce the frequency of stopping with the dynamic brake.</li> </ul>                           |           |
|                                                                                                                  | A failure occurred<br>in the SERVO-<br>PACK.                                                                                                                                                              | _                                                                                                                                         | The SERVOPACK may be faulty. Replace the SERVO-<br>PACK.                                                                                                                                                                                 | _         |
| A.923:<br>SERVOPACK Built-<br>in Fan Stopped                                                                     | The fan inside the<br>SERVOPACK<br>stopped.                                                                                                                                                               | Check for foreign mat-<br>ter inside the SERVO-<br>PACK.                                                                                  | Remove foreign matter from<br>the SERVOPACK. If the<br>alarm still occurs, the SER-<br>VOPACK may be faulty.<br>Replace the SERVOPACK.                                                                                                   | -         |
| A.930:<br>Absolute Encoder<br>Battery Error (The                                                                 | The battery con-<br>nection is faulty or<br>a battery is not<br>connected.                                                                                                                                | Check the battery con-<br>nection.                                                                                                        | Correct the battery connec-<br>tion.                                                                                                                                                                                                     | page 4-27 |
| absolute encoder<br>battery voltage was<br>lower than the spec-<br>ified level.) (Detected<br>only when an abso- | The battery volt-<br>age is lower than<br>the specified value<br>(2.7 V).                                                                                                                                 | Measure the battery voltage.                                                                                                              | Replace the battery.                                                                                                                                                                                                                     | page 14-3 |
| lute encoder is con-<br>nected.)                                                                                 | A failure occurred<br>in the SERVO-<br>PACK.                                                                                                                                                              | -                                                                                                                                         | The SERVOPACK may be faulty. Replace the SERVO-<br>PACK.                                                                                                                                                                                 | _         |

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|------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Warning Number:<br>Warning Name                                        | Possible Cause                                                                                                                                                    | Confirmation                                                       | Correction                                                                                                                                                                                                                         | Reference   |
|                                                                        | The surrounding<br>temperature is too<br>high.                                                                                                                    | Check the surrounding temperature using a thermometer.             | Lower the surrounding tem-<br>perature by improving the<br>installation conditions of the<br>Linear Servomotor or the<br>machine.                                                                                                  | -           |
|                                                                        | Operation was<br>performed under<br>an excessive load.                                                                                                            | Use the accumulated load ratio to check the load during operation. | Reconsider the load and operating conditions.                                                                                                                                                                                      | -           |
| A.93B:<br>Overheat Warning                                             | A failure occurred<br>in the SERVO-<br>PACK.                                                                                                                      | -                                                                  | The SERVOPACK may be faulty. Replace the SERVO-<br>PACK.                                                                                                                                                                           | _           |
|                                                                        | The temperature<br>detection circuit in<br>the Linear Servo-<br>motor is faulty or<br>the sensor<br>attached to the<br>machine is faulty.                         | _                                                                  | The temperature detection<br>circuit in the Linear Servo-<br>motor may be faulty or the<br>sensor attached to the<br>machine may be faulty.<br>Replace the Linear Servo-<br>motor or repair the sensor<br>attached to the machine. | _           |
|                                                                        | The speed ripple                                                                                                                                                  | -                                                                  | Reset the speed ripple<br>compensation value on the<br>SigmaWin+.                                                                                                                                                                  | page 8-60   |
| A.942:<br>Speed Ripple Com-<br>pensation Informa-<br>tion Disagreement | compensation<br>information stored<br>in the encoder<br>does not agree<br>with the speed<br>ripple compensa-<br>tion information<br>stored in the SER-<br>VOPACK. | _                                                                  | Set Pn423 to n. <b>D</b> 1 <b>D</b> (Do<br>not detect A.942 alarms).<br>However, changing the set-<br>ting may increase the speed<br>ripple.                                                                                       | page 8-60   |
|                                                                        |                                                                                                                                                                   | _                                                                  | Set Pn423 to n. DDD<br>(Disable torque ripple com-<br>pensation). However,<br>changing the setting may<br>increase the speed ripple.                                                                                               | page 8-60   |
|                                                                        | For a 200-V SER-<br>VOPACK, the AC<br>power supply volt-<br>age dropped<br>below 140 V.                                                                           | Measure the power supply voltage.                                  | Set the power supply volt-<br>age within the specified range.                                                                                                                                                                      | _           |
| A.971:                                                                 | For a 100-V SER-<br>VOPACK, the AC<br>power supply volt-<br>age dropped<br>below 60 V.                                                                            | Measure the power supply voltage.                                  | Set the power supply volt-<br>age within the specified range.                                                                                                                                                                      | _           |
| A.971:<br>Undervoltage                                                 | A momentary<br>power interrup-<br>tion occurred.                                                                                                                  | Measure the power supply voltage.                                  | If you have changed the<br>setting of Pn509 (Momen-<br>tary Power Interruption Hold<br>Time), decrease the setting.                                                                                                                | page 6-5    |
|                                                                        | The SERVOPACK fuse is blown out.                                                                                                                                  | -                                                                  | Replace the SERVOPACK and connect a reactor.                                                                                                                                                                                       | page 4-25   |
|                                                                        | A failure occurred<br>in the SERVO-<br>PACK.                                                                                                                      | _                                                                  | The SERVOPACK may be faulty. Replace the SERVO-<br>PACK.                                                                                                                                                                           | _           |
| A.9b0:<br>Preventative Mainte-<br>nance Warning                        | One of the con-<br>sumable parts has<br>reached the end<br>of its service life.                                                                                   | _                                                                  | Replace the part. Contact<br>your Yaskawa representa-<br>tive for replacement.                                                                                                                                                     | page 9-15   |

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Maintenance

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| Continued from previous p                                                                                                                     |                                                                                                   |                                                |                                                                                                                                                                                                                      | mous page. |
|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------|
| Warning Number:<br>Warning Name                                                                                                               | Possible Cause                                                                                    | Confirmation                                   | Correction                                                                                                                                                                                                           | Reference  |
| A.A90:<br>Positioning Timeout<br>(A positioning com-                                                                                          | The SERVOPACK gain is not adjusted.                                                               | Check the SERVO-<br>PACK gain.                 | Adjust the gain.                                                                                                                                                                                                     | page 8-79  |
| pletion timeout<br>occurred during a<br>positioning opera-<br>tion.)                                                                          | The positioning<br>completion time-<br>out error check<br>time (PnB51) is<br>too short.           | Check the timeout error check time.            | Set the positioning comple-<br>tion timeout error check<br>time to a suitable value.                                                                                                                                 | page 12-12 |
| A.A94:<br>Data Setting Warn-<br>ing (A parameter<br>was set to an out-<br>of-range value via<br>DeviceNet.)                                   | A parameter was set outside of the setting range.                                                 | -                                              | Correct the set value.                                                                                                                                                                                               | _          |
| A.A95:<br>Command Error                                                                                                                       | There was an<br>error in a com-<br>mand message.                                                  | Check the command.                             | Check the command data<br>and then change the value<br>of the Data Enable bit.                                                                                                                                       | page 13-5  |
| A.A96:<br>DeviceNet Commu-<br>nications Error (A<br>timeout or other<br>error occurred in<br>DeviceNet commu-<br>nications.)                  | DeviceNet com-<br>munications have<br>timed out.                                                  | Check the connections of the DeviceNet cables. | Restart DeviceNet commu-<br>nications from the host con-<br>troller.                                                                                                                                                 | _          |
| A.A97:<br>Control Power Error<br>(The control power<br>supply is not ON.)<br>(SGDV-OCA05A<br>only)                                            | The control power supply is not ON.                                                               | _                                              | Turn ON the control power supply.                                                                                                                                                                                    | -          |
| A.A98:<br>Main Circuit Power<br>Error (The main cir-<br>cuit power supply is<br>not ON.)                                                      | The main circuit<br>power supply is<br>not ON.                                                    | -                                              | Turn ON the main circuit power supply.                                                                                                                                                                               | -          |
| A.A99:<br>Rotary Switch<br>Change Warning (A<br>rotary switch setting<br>was changed after<br>the power supply<br>was turned ON or<br>reset.) | A rotary switch<br>setting was<br>changed after the<br>power supply was<br>turned ON or<br>reset. | Check the rotary switch settings.              | Clear the alarm. With the<br>SGDV-OCA04A, you can<br>also turn the control power<br>supply OFF and ON again.<br>With the SGDV-OCA05A,<br>you can also turn the com-<br>munications power supply<br>OFF and ON again. | -          |

## **14.4** Troubleshooting Based on the Operation and Conditions of the Servomotor

This section provides troubleshooting based on the operation and conditions of the Servomotor, including causes and corrections.

| Problem                         | Possible Cause                                                                                                          | Confirmation                                                                                                                        | Correction                                                                                                                                                                               | Reference              |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
|                                 | The control power supply is not turned ON.                                                                              | Measure the voltage<br>between control power<br>supply terminals.                                                                   | Turn OFF the power<br>supply to the servo<br>system.<br>Correct the wiring so<br>that the control power<br>supply is turned ON.                                                          | _                      |
|                                 | The main circuit power sup-<br>ply is not turned ON.                                                                    | Measure the voltage<br>across the main circuit<br>power input terminals.                                                            | Turn OFF the power<br>supply to the servo<br>system.<br>Correct the wiring so<br>that the main circuit<br>power supply is turned<br>ON.                                                  | _                      |
|                                 | The I/O signal connector<br>(CN1) pins are not wired cor-<br>rectly or are disconnected.                                | Turn OFF the power sup-<br>ply to the servo system.<br>Check the wiring condi-<br>tion of the I/O signal con-<br>nector (CN1) pins. | Correct the wiring of<br>the I/O signal connec-<br>tor (CN1) pins.                                                                                                                       | page 4-36,<br>page 9-5 |
|                                 | The wiring for the Servomo-<br>tor Main Circuit Cables or<br>Encoder Cable is discon-<br>nected.                        | Check the wiring condi-<br>tions.                                                                                                   | Turn OFF the power<br>supply to the servo<br>system.<br>Wire the cable cor-<br>rectly.                                                                                                   | -                      |
| Servomotor<br>Does Not<br>Start | There is an overload on the Servomotor.                                                                                 | Operate the Servomotor<br>with no load and check<br>the load status.                                                                | Turn OFF the power<br>supply to the servo<br>system.<br>Reduce the load or<br>replace the Servomo-<br>tor with a Servomotor<br>with a larger capacity.                                   | -                      |
|                                 | The type of encoder that is being used does not agree with the setting of $Pn002 = n.\Box X \Box \Box$ (Encoder Usage). | Check the type of the encoder that is being used and the setting of Pn002 = $n.\Box X \Box \Box$ .                                  | Set Pn002 = $n.\Box X \Box \Box$<br>according to the type of<br>the encoder that is<br>being used.                                                                                       | page 6-18              |
|                                 | The Servo ON command has not been input.                                                                                | Check the commands sent from the host con-<br>troller.                                                                              | Input the Servo ON<br>command from the<br>host controller.                                                                                                                               | _                      |
|                                 | The CCW-OT (CCW Drive<br>Prohibit) or CW-OT (CW<br>Drive Prohibit) signal is still<br>OFF.                              | Check the CCW-OT and CW-OT signals.                                                                                                 | Turn ON the CCW-OT or CW-OT signal.                                                                                                                                                      | page 9-5               |
|                                 | The safety input signals<br>(/HWBB1 or /HWBB2) were<br>not turned ON.                                                   | Check the /HWBB1 and<br>/HWBB2 input signals.                                                                                       | Turn ON the /HWBB1<br>and /HWBB2 input sig-<br>nals. If you are not<br>using the safety func-<br>tion, connect the Safety<br>Jumper Connector<br>(provided as an acces-<br>sory) to CN8. | page 9-5               |
|                                 | A failure occurred in the SER-<br>VOPACK.                                                                               | -                                                                                                                                   | Turn OFF the power<br>supply to the servo<br>system.<br>Replace the SERVO-<br>PACK.                                                                                                      | -                      |

Continued on next page.

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|                                                         |                                                                                                                    |                                                                                                                                                                                                                          | Continued from pre                                                                                                                                                                                        | vious page. |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|
| Problem                                                 | Possible Cause                                                                                                     | Confirmation                                                                                                                                                                                                             | Correction                                                                                                                                                                                                | Reference   |
|                                                         |                                                                                                                    | Check the setting of<br>Pn080 =n.□□□X (Polar-<br>ity Sensor Selection).                                                                                                                                                  | Correct the parameter setting.                                                                                                                                                                            | page 5-24   |
| Servomotor<br>Does Not<br>Start                         | The polarity detection was not executed.                                                                           | Check the Servo ON command input.                                                                                                                                                                                        | <ul> <li>If you are using an incremental linear encoder, send the Servo ON command from the host controller.</li> <li>If you are using an absolute linear encoder, execute polarity detection.</li> </ul> | page 5-25   |
|                                                         | There is a mistake in the Ser-<br>vomotor wiring.                                                                  | Turn OFF the power sup-<br>ply to the servo system.<br>Check the wiring.                                                                                                                                                 | Wire the Servomotor correctly.                                                                                                                                                                            | -           |
|                                                         | There is a mistake in the wir-<br>ing of the encoder or Serial<br>Converter Unit.                                  | Turn OFF the power sup-<br>ply to the servo system.<br>Check the wiring.                                                                                                                                                 | Wire the Serial Con-<br>verter Unit correctly.                                                                                                                                                            | -           |
| Servomotor<br>Moves                                     | There is a mistake in the lin-<br>ear encoder wiring.                                                              | Turn OFF the power sup-<br>ply to the servo system.<br>Check the wiring.                                                                                                                                                 | Wire the cable cor-<br>rectly.                                                                                                                                                                            | _           |
| Instanta-<br>neously,                                   | The setting of Pn282 (Linear Encoder Pitch) is not correct.                                                        | Check the setting of Pn282.                                                                                                                                                                                              | Correct the setting of Pn282.                                                                                                                                                                             | page 5-17   |
| and Then<br>Stops                                       | The count-up direction of the linear encoder does not match the forward direction of the Moving Coil in the motor. | Check the directions.                                                                                                                                                                                                    | Change the setting of<br>Pn080 = $n.\Box\Box X\Box$<br>(Motor Phase Selec-<br>tion). Place the linear<br>encoder and motor in<br>the same direction.                                                      | page 5-22   |
|                                                         | Polarity detection was not performed correctly.                                                                    | Check to see if electrical<br>angle 2 (electrical angle<br>from polarity origin) at any<br>position is between ±10°.                                                                                                     | Correct the settings for<br>the polarity detection-<br>related parameters.                                                                                                                                | _           |
| Servomotor<br>Speed Is<br>Unstable                      | There is a faulty connection in the Servomotor wiring.                                                             | The connector connec-<br>tions for the power line<br>(U, V, and W phases) and<br>the encoder or Serial<br>Converter Unit may be<br>unstable.<br>Turn OFF the power sup-<br>ply to the servo system.<br>Check the wiring. | Tighten any loose ter-<br>minals or connectors<br>and correct the wiring.                                                                                                                                 | -           |
|                                                         | A failure occurred in the SER-<br>VOPACK.                                                                          | -                                                                                                                                                                                                                        | Turn OFF the power<br>supply to the servo<br>system.<br>Replace the SERVO-<br>PACK.                                                                                                                       | _           |
| Servomotor<br>Moves with-<br>out a Refer-<br>ence Input | The count-up direction of the linear encoder does not match the forward direction of the Moving Coil in the motor. | Check the directions.                                                                                                                                                                                                    | Change the setting of<br>Pn080 = n.<br>(Motor Phase Selec-<br>tion).<br>Match the linear<br>encoder direction and<br>Servomotor direction.                                                                | page 5-22   |
|                                                         | Polarity detection was not performed correctly.                                                                    | Check to see if electrical<br>angle 2 (electrical angle<br>from polarity origin) at any<br>position is between ±10°.                                                                                                     | Correct the settings for<br>the polarity detection-<br>related parameters.                                                                                                                                | _           |

| Problem                              | Possible Cause                                                                                                 | Confirmation                                                                                                                                                                                                                                          | Correction                                                                                                                                                                                                                                                                                                                                                                                                       | Referenc |
|--------------------------------------|----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
|                                      | The setting of Pn001 =<br>n.                                                                                   | Check the setting of Pn001 = $n.\Box\Box\BoxX$ .                                                                                                                                                                                                      | Set Pn001 = n.□□□X<br>correctly.                                                                                                                                                                                                                                                                                                                                                                                 | _        |
| Dynamic<br>Brake Does<br>Not Operate | The dynamic brake resistor is disconnected.                                                                    | Check the moment of<br>inertia, motor speed, and<br>dynamic brake frequency<br>of use. If the moment of<br>inertia, motor speed, or<br>dynamic brake frequency<br>of use is excessive, the<br>dynamic brake resis-<br>tance may be discon-<br>nected. | Turn OFF the power<br>supply to the servo<br>system.<br>Replace the SERVO-<br>PACK. To prevent dis-<br>connection, reduce the<br>load.                                                                                                                                                                                                                                                                           | _        |
|                                      | There was a failure in the dynamic brake drive circuit.                                                        | _                                                                                                                                                                                                                                                     | There is a defective<br>component in the<br>dynamic brake circuit.<br>Turn OFF the power<br>supply to the servo<br>system.<br>Replace the SERVO-<br>PACK.                                                                                                                                                                                                                                                        | -        |
|                                      | The Servomotor vibrated considerably while perform-<br>ing the tuning-less function with the default settings. | Check the waveform of the motor speed.                                                                                                                                                                                                                | Reduce the load so<br>that the moment of<br>inertia ratio or mass<br>ratio is within the allow-<br>able value, or increase<br>the load level or reduce<br>the rigidity level in the<br>tuning-less level set-<br>tings.<br>If the situation is not<br>improved, disable the<br>tuning-less function<br>(i.e., set Pn170 to<br>n.□□□0) and execute<br>autotuning either with<br>or without a host refer-<br>ence. | page 8-1 |
| Abnormal<br>Noise from               |                                                                                                                | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if there are<br>any loose mounting<br>screws.                                                                                                                                     | Tighten the mounting screws.                                                                                                                                                                                                                                                                                                                                                                                     | _        |
| Servomotor                           | The machine mounting is not secure.                                                                            | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if there is<br>misalignment in the cou-<br>pling.                                                                                                                                 | Align the coupling.                                                                                                                                                                                                                                                                                                                                                                                              | -        |
|                                      |                                                                                                                | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if the cou-<br>pling is balanced.                                                                                                                                                 | Balance the coupling.                                                                                                                                                                                                                                                                                                                                                                                            | -        |
|                                      | The bearings are defective.                                                                                    | Turn OFF the power sup-<br>ply to the servo system.<br>Check for noise and<br>vibration around the bear-<br>ings.                                                                                                                                     | Replace the Servomo-<br>tor.                                                                                                                                                                                                                                                                                                                                                                                     | -        |
|                                      | There is a vibration source at the driven machine.                                                             | Turn OFF the power sup-<br>ply to the servo system.<br>Check for any foreign<br>matter, damage, or defor-<br>mation in the machine's<br>moving parts.                                                                                                 | Consult with the machine manufacturer.<br>Continued or                                                                                                                                                                                                                                                                                                                                                           | _        |

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Maintenance

| Problem                              | Possible Cause                                                                                                                    | Confirmation                                                                                                                                                                                                                                                                    | Correction                                                                                                                                                                                                                                                                                                             | vious page.<br>Reference |  |
|--------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|--|
|                                      | Noise interference occurred<br>because of incorrect I/O sig-<br>nal cable specifications.                                         | Turn OFF the power sup-<br>ply to the servo system.<br>Check the I/O signal<br>cables to see if they sat-<br>isfy specifications. Use<br>shielded twisted-pair wire<br>cables or screened<br>twisted-pair cables with<br>conductors of at least<br>0.12 mm <sup>2</sup> .       | Use cables that satisfy the specifications.                                                                                                                                                                                                                                                                            | -                        |  |
| Abnormal<br>Noise from<br>Servomotor | Noise interference occurred<br>because an I/O signal cable<br>is too long.                                                        | Turn OFF the power sup-<br>ply to the servo system.<br>Check the lengths of the<br>I/O signal cables.                                                                                                                                                                           | The I/O signal cables<br>must be no longer than<br>3 m.                                                                                                                                                                                                                                                                | _                        |  |
|                                      | Noise interference occurred<br>because of incorrect Encoder<br>Cable specifications.                                              | Turn OFF the power sup-<br>ply to the servo system.<br>Check the Encoder Cable<br>to see if it satisfies speci-<br>fications. Use shielded<br>twisted-pair cables or<br>screened twisted-pair<br>cables with conductors of<br>at least 0.12 mm <sup>2</sup><br>(stranded wire). | Use cables that satisfy the specifications.                                                                                                                                                                                                                                                                            | -                        |  |
|                                      | Noise interference occurred<br>because the Encoder Cable<br>is too long.                                                          | Turn OFF the power sup-<br>ply to the servo system.<br>Check the length of the<br>Encoder Cable.                                                                                                                                                                                | <ul> <li>Rotary Servomotors:<br/>The Encoder Cable<br/>length must be 50 m<br/>max.</li> <li>Linear Servomotors:<br/>Make sure that the<br/>Serial Converter Unit<br/>cable is no longer<br/>than 20 m and that<br/>the Linear Encoder<br/>Cable and the Sensor<br/>Cable are no longer<br/>than 15 m each.</li> </ul> | _                        |  |
|                                      | Noise interference occurred because the Encoder Cable is damaged.                                                                 | Turn OFF the power sup-<br>ply to the servo system.<br>Check the Encoder Cable<br>to see if it is pinched or<br>the sheath is damaged.                                                                                                                                          | Replace the Encoder<br>Cable and correct the<br>cable installation envi-<br>ronment.                                                                                                                                                                                                                                   | _                        |  |
|                                      | The Encoder Cable was sub-<br>jected to excessive noise interference.                                                             | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if the<br>Encoder Cable is bundled<br>with a high-current line or<br>installed near a high-cur-<br>rent line.                                                                                               | Correct the cable lay-<br>out so that no surge is<br>applied by high-current<br>lines.                                                                                                                                                                                                                                 | _                        |  |
|                                      | There is variation in the FG<br>potential because of the<br>influence of machines on the<br>Servomotor side, such as a<br>welder. | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if the<br>machines are correctly<br>grounded.                                                                                                                                                               | Properly ground the machines to separate them from the FG of the encoder.                                                                                                                                                                                                                                              | _                        |  |
|                                      | There is a SERVOPACK pulse counting error due to noise.                                                                           | Check to see if there is<br>noise interference on the<br>signal line from the<br>encoder.                                                                                                                                                                                       | Turn OFF the power<br>supply to the servo<br>system.<br>Implement counter-<br>measures against noise<br>for the encoder wiring.                                                                                                                                                                                        | -                        |  |

| Problem                                                                   | Possible Cause Confirmation<br>Turn OFF the power sup-                                      |                                                                                                                                                                                                                                                                                                                                          | Correction                                                                                              | Reference |
|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|-----------|
|                                                                           | The encoder was subjected to excessive vibration or shock.                                  | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if vibration<br>from the machine<br>occurred. Check the Ser-<br>vomotor installation<br>(mounting surface preci-<br>sion, securing state, and<br>alignment).<br>Check the linear encoder<br>installation (mounting sur-<br>face precision and secur-<br>ing method). | Reduce machine vibra-<br>tion. Improve the<br>mounting state of the<br>Servomotor or linear<br>encoder. | _         |
| Abnormal<br>Noise from<br>Servomotor                                      | A failure occurred in the encoder.                                                          | _                                                                                                                                                                                                                                                                                                                                        | Turn OFF the power<br>supply to the servo<br>system.<br>Replace the Servomo-<br>tor.                    | _         |
|                                                                           | A failure occurred in the Serial Converter Unit.                                            | -                                                                                                                                                                                                                                                                                                                                        | Turn OFF the power<br>supply to the servo<br>system.<br>Replace the Serial Con-<br>verter Unit.         | -         |
|                                                                           | A failure occurred in the linear encoder.                                                   | _                                                                                                                                                                                                                                                                                                                                        | Turn OFF the power<br>supply to the servo<br>system.<br>Replace the linear<br>encoder.                  | _         |
|                                                                           | The servo gains are not bal-<br>anced.                                                      | Check to see if the servo gains have been cor-<br>rectly tuned.                                                                                                                                                                                                                                                                          | Perform autotuning without a host reference.                                                            | page 8-23 |
| Servomotor                                                                | The setting of Pn100 (Speed<br>Loop Gain) is too high.                                      | Check the setting of<br>Pn100.<br>The default setting is Kv =<br>40.0 Hz.                                                                                                                                                                                                                                                                | Set Pn100 to an appro-<br>priate value.                                                                 | _         |
| Servomotor<br>Vibrates at<br>Frequency<br>of Approx.<br>200 to 400<br>Hz. | The setting of Pn102 (Posi-<br>tion Loop Gain) is too high.                                 | Check the setting of<br>Pn102.<br>The default setting is Kp<br>= 40.0/s.                                                                                                                                                                                                                                                                 | Set Pn102 to an appro-<br>priate value.                                                                 | -         |
|                                                                           | The setting of Pn101 (Speed<br>Loop Integral Time Con-<br>stant) is not appropriate.        | Check the setting of<br>Pn101.<br>The default setting is Ti =<br>20.0 ms.                                                                                                                                                                                                                                                                | Set Pn101 to an appro-<br>priate value.                                                                 | _         |
|                                                                           | The setting of Pn103<br>(Moment of Inertia Ratio or<br>Mass Ratio) is not appropri-<br>ate. | Check the setting of Pn103.                                                                                                                                                                                                                                                                                                              | Set Pn103 to an appro-<br>priate value.                                                                 | _         |

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| Problem                                                                                                                                                                       | Possible Cause                                                                              | Confirmation                                                                                                                                                                                                                                                             | Correction                                                                                                                                                                                                                                                                                                             | Reference |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|                                                                                                                                                                               | The servo gains are not bal-<br>anced.                                                      | Check to see if the servo gains have been cor-<br>rectly tuned.                                                                                                                                                                                                          | Perform autotuning without a host reference.                                                                                                                                                                                                                                                                           | page 8-23 |
| Large Motor<br>Speed<br>Overshoot<br>on Starting<br>and Stop-<br>ping                                                                                                         | The setting of Pn100 (Speed<br>Loop Gain) is too high.                                      | Check the setting of<br>Pn100.<br>The default setting is Kv =<br>40.0 Hz.                                                                                                                                                                                                | Set Pn100 to an appropriate value.                                                                                                                                                                                                                                                                                     | _         |
|                                                                                                                                                                               | The setting of Pn102 (Posi-<br>tion Loop Gain) is too high.                                 | Check the setting of<br>Pn102.<br>The default setting is Kp<br>= 40.0/s.                                                                                                                                                                                                 | Set Pn102 to an appropriate value.                                                                                                                                                                                                                                                                                     | _         |
|                                                                                                                                                                               | The setting of Pn101 (Speed<br>Loop Integral Time Con-<br>stant) is not appropriate.        | Check the setting of<br>Pn101.<br>The default setting is Ti =<br>20.0 ms.                                                                                                                                                                                                | Set Pn101 to an appropriate value.                                                                                                                                                                                                                                                                                     | _         |
|                                                                                                                                                                               | The setting of Pn103<br>(Moment of Inertia Ratio or<br>Mass Ratio) is not appropri-<br>ate. | Check the setting of Pn103.                                                                                                                                                                                                                                              | Set Pn103 to an appro-<br>priate value.                                                                                                                                                                                                                                                                                | _         |
|                                                                                                                                                                               | The torque reference is satu-<br>rated.                                                     | Check the waveform of the torque reference.                                                                                                                                                                                                                              | Use the mode switch.                                                                                                                                                                                                                                                                                                   | -         |
|                                                                                                                                                                               | The force limits (Pn483 and Pn484) are set to the default values.                           | The default values of the force limits and Pn483 = 30% and Pn484 = 30%.                                                                                                                                                                                                  | Set Pn483 and Pn484 to appropriate values.                                                                                                                                                                                                                                                                             | page 6-17 |
| Absolute<br>Encoder<br>Position<br>Deviation<br>Error (The                                                                                                                    | Noise interference occurred<br>because of incorrect Encoder<br>Cable specifications.        | Turn OFF the power sup-<br>ply to the servo system.<br>Check the Encoder Cable<br>to see if it satisfies speci-<br>fications.<br>Use a shielded twisted-<br>pair wire cable or a<br>screened twisted-pair<br>cable with conductors of<br>at least 0.12 mm <sup>2</sup> . | Use cables that satisfy the specifications.                                                                                                                                                                                                                                                                            | -         |
| position<br>that was<br>saved in the<br>host con-<br>troller when<br>the power<br>was turned<br>OFF is dif-<br>ferent from<br>the posi-<br>tion when<br>the power<br>was next | Noise interference occurred<br>because the Encoder Cable<br>is too long.                    | Turn OFF the power sup-<br>ply to the servo system.<br>Check the length of the<br>Encoder Cable.                                                                                                                                                                         | <ul> <li>Rotary Servomotors:<br/>The Encoder Cable<br/>length must be 50 m<br/>max.</li> <li>Linear Servomotors:<br/>Make sure that the<br/>Serial Converter Unit<br/>cable is no longer<br/>than 20 m and that<br/>the Linear Encoder<br/>Cable and the Sensor<br/>Cable are no longer<br/>than 15 m each.</li> </ul> | -         |
| turned ON.)                                                                                                                                                                   | Noise interference occurred because the Encoder Cable is damaged.                           | Turn OFF the power sup-<br>ply to the servo system.<br>Check the Encoder Cable<br>to see if it is pinched or<br>the sheath is damaged.                                                                                                                                   | Replace the Encoder<br>Cable and correct the<br>cable installation envi-<br>ronment.                                                                                                                                                                                                                                   | _         |

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| Problem                                                                                                                                                                                                                                                    | Possible Cause                                                                                                                    | Confirmation                                                                                                                                                                                                                                                                                                                           | Continued from pre                                                                                      | Reference |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|-----------|
| Absolute<br>Encoder<br>Position<br>Deviation<br>Error (The<br>position<br>that was<br>saved in the<br>host con-<br>troller when<br>the power<br>was turned<br>OFF is dif-<br>ferent from<br>the posi-<br>tion when<br>the power<br>was next<br>turned ON.) | The Encoder Cable was sub-<br>jected to excessive noise interference.                                                             | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if the<br>Encoder Cable is bundled<br>with a high-current line or<br>installed near a high-cur-<br>rent line.                                                                                                                                                      | Correct the cable lay-<br>out so that no surge is<br>applied by high-current<br>lines.                  | _         |
|                                                                                                                                                                                                                                                            | There is variation in the FG<br>potential because of the<br>influence of machines on the<br>Servomotor side, such as a<br>welder. | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if the<br>machines are correctly<br>grounded.                                                                                                                                                                                                                      | Properly ground the machines to separate them from the FG of the encoder.                               | -         |
|                                                                                                                                                                                                                                                            | There is a SERVOPACK pulse counting error due to noise.                                                                           | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if there is<br>noise interference on the<br>I/O signal line from the<br>encoder or Serial Con-<br>verter Unit.                                                                                                                                                     | Implement counter-<br>measures against noise<br>for the encoder or<br>Serial Converter Unit<br>wiring.  | _         |
|                                                                                                                                                                                                                                                            | The encoder was subjected to excessive vibration or shock.                                                                        | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if vibration<br>from the machine<br>occurred.<br>Check the Servomotor<br>installation (mounting sur-<br>face precision, securing<br>state, and alignment).<br>Check the linear encoder<br>installation (mounting sur-<br>face precision and secur-<br>ing method). | Reduce machine vibra-<br>tion. Improve the<br>mounting state of the<br>Servomotor or linear<br>encoder. | _         |
|                                                                                                                                                                                                                                                            | A failure occurred in the encoder.                                                                                                | _                                                                                                                                                                                                                                                                                                                                      | Turn OFF the power<br>supply to the servo<br>system.<br>Replace the Servomo-<br>tor or linear encoder.  | -         |
|                                                                                                                                                                                                                                                            | A failure occurred in the SER-<br>VOPACK.                                                                                         | _                                                                                                                                                                                                                                                                                                                                      | Turn OFF the power<br>supply to the servo<br>system.<br>Replace the SERVO-<br>PACK.                     | -         |

|                                       |                                                                                             |                                                                                                                | Continued from pre                                                                                   | vious page. |
|---------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------|
| Problem                               | Possible Cause                                                                              | Confirmation                                                                                                   | Correction                                                                                           | Reference   |
|                                       |                                                                                             | Check the external power supply (+24 V) voltage for the input signals.                                         | Correct the external<br>power supply (+24 V)<br>voltage for the input<br>signals.                    | _           |
| Overtravel<br>Occurred                | The CCW-OT/CW-OT (CCW<br>Drive Prohibit or CW Drive<br>Prohibit) signal was input.          | Check the operating con-<br>dition of the overtravel<br>limit switches.                                        | Make sure that the overtravel limit switches operate correctly.                                      | _           |
|                                       |                                                                                             | Check the wiring of the overtravel limit switches.                                                             | Correct the wiring of the overtravel limit switches.                                                 | page 5-28   |
|                                       |                                                                                             | Check for fluctuation in<br>the external power supply<br>(+24 V) voltage for the<br>input signals.             | Eliminate fluctuation<br>from the external power<br>supply (+24 V) voltage<br>for the input signals. | _           |
|                                       | The CCW-OT/CW-OT (CCW<br>Drive Prohibit or CW Drive<br>Prohibit) signal malfunc-<br>tioned. | Check to see if the opera-<br>tion of the overtravel limit switches is unstable.                               | Stabilize the operating condition of the over-<br>travel limit switches.                             | _           |
|                                       |                                                                                             | Check the wiring of the<br>overtravel limit switches<br>(e.g., check for cable<br>damage and loose<br>screws). | Correct the wiring of the overtravel limit switches.                                                 | -           |
|                                       | The selection of the Servo-<br>motor stopping method is<br>not correct.                     | Check the servo OFF<br>stopping method set in<br>Pn001 = $n.\Box\BoxX$ or<br>Pn001 = $n.\Box\BoxX\Box$ .       | Select a Servomotor stopping method other than coasting to a stop.                                   | page 5-29   |
| Improper<br>Stop Posi-                | The limit switch position and dog length are not appropriate.                               | -                                                                                                              | Install the limit switch at the appropriate position.                                                | _           |
| tion for<br>Overtravel<br>(OT) Signal | The overtravel limit switch position is too close for the coasting distance.                | _                                                                                                              | Install the overtravel limit switch at the appropriate position.                                     | _           |

|                                             |                                                                                                                                   | <b>a</b> <i>u u</i>                                                                                                                                                                                                                                                  | Continued from pre                                                                                                                                                                                                                                                                                                     |           |
|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Problem                                     | Possible Cause                                                                                                                    | Confirmation                                                                                                                                                                                                                                                         | Correction                                                                                                                                                                                                                                                                                                             | Reference |
|                                             | Noise interference occurred<br>because of incorrect Encoder<br>Cable specifications.                                              | Turn OFF the power sup-<br>ply to the servo system.<br>Check the Encoder Cable<br>to see if it satisfies speci-<br>fications. Use a shielded<br>twisted-pair wire cable or<br>a screened twisted-pair<br>cable with conductors of<br>at least 0.12 mm <sup>2</sup> . | Use cables that satisfy the specifications.                                                                                                                                                                                                                                                                            | -         |
| Position<br>Deviation<br>(without<br>Alarm) | Noise interference occurred<br>because the Encoder Cable<br>is too long.                                                          | Turn OFF the power sup-<br>ply to the servo system.<br>Check the length of the<br>Encoder Cable.                                                                                                                                                                     | <ul> <li>Rotary Servomotors:<br/>The Encoder Cable<br/>length must be 50 m<br/>max.</li> <li>Linear Servomotors:<br/>Make sure that the<br/>Serial Converter Unit<br/>cable is no longer<br/>than 20 m and that<br/>the Linear Encoder<br/>Cable and the Sensor<br/>Cable are no longer<br/>than 15 m each.</li> </ul> | _         |
|                                             | Noise interference occurred because the Encoder Cable is damaged.                                                                 | Turn OFF the power sup-<br>ply to the servo system.<br>Check the Encoder Cable<br>to see if it is pinched or<br>the sheath is damaged.                                                                                                                               | Replace the Encoder<br>Cable and correct the<br>cable installation envi-<br>ronment.                                                                                                                                                                                                                                   | _         |
|                                             | The Encoder Cable was sub-<br>jected to excessive noise<br>interference.                                                          | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if the<br>Encoder Cable is bundled<br>with a high-current line or<br>installed near a high-cur-<br>rent line.                                                                                    | Correct the cable lay-<br>out so that no surge is<br>applied by high-current<br>lines.                                                                                                                                                                                                                                 | _         |
|                                             | There is variation in the FG<br>potential because of the<br>influence of machines on the<br>Servomotor side, such as a<br>welder. | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if the<br>machines are correctly<br>grounded.                                                                                                                                                    | Properly ground the machines to separate them from the FG of the encoder.                                                                                                                                                                                                                                              | -         |
|                                             | There is a SERVOPACK pulse counting error due to noise.                                                                           | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if there is<br>noise interference on the<br>I/O signal line from the<br>encoder or Serial Con-<br>verter Unit.                                                                                   | Implement counter-<br>measures against noise<br>for the encoder wiring<br>or Serial Converter Unit<br>wiring.                                                                                                                                                                                                          | _         |

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| Problem                                     | Possible Cause                                                                            | Confirmation                                                                                                                                                                                                                                                                                                                           | Continued from pre                                                                                                                                      | Reference |  |
|---------------------------------------------|-------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|--|
|                                             | The encoder was subjected to excessive vibration or shock.                                | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if vibration<br>from the machine<br>occurred.<br>Check the Servomotor<br>installation (mounting sur-<br>face precision, securing<br>state, and alignment).<br>Check the linear encoder<br>installation (mounting sur-<br>face precision and secur-<br>ing method). | Reduce machine vibra-<br>tion. Improve the<br>mounting state of the<br>Servomotor or linear<br>encoder.                                                 | -         |  |
| Position<br>Deviation<br>(without<br>Alarm) | The coupling between the machine and Servomotor is not suitable.                          | Turn OFF the power sup-<br>ply to the servo system.<br>Check to see if position<br>offset occurs at the cou-<br>pling between machine<br>and Servomotor.                                                                                                                                                                               | Correctly secure the coupling between the machine and Servomotor.                                                                                       | _         |  |
|                                             | Noise interference occurred<br>because of incorrect I/O sig-<br>nal cable specifications. | Turn OFF the power sup-<br>ply to the servo system.<br>Check the I/O signal<br>cables to see if they sat-<br>isfy specifications. Use a<br>shielded twisted-pair wire<br>cable or a screened<br>twisted-pair cable with<br>conductors of at least<br>0.12 mm <sup>2</sup> .                                                            | Use cables that satisfy the specifications.                                                                                                             | _         |  |
|                                             | Noise interference occurred<br>because an I/O signal cable<br>is too long.                | Turn OFF the power sup-<br>ply to the servo system.<br>Check the lengths of the<br>I/O signal cables.                                                                                                                                                                                                                                  | The I/O signal cables<br>must be no longer than<br>3 m.                                                                                                 | _         |  |
|                                             | An encoder fault occurred.<br>(The pulse count does not<br>change.)                       | -                                                                                                                                                                                                                                                                                                                                      | Turn OFF the power<br>supply to the servo<br>system.<br>Replace the Servomo-<br>tor or linear encoder.                                                  | -         |  |
|                                             | A failure occurred in the SER-<br>VOPACK.                                                 | _                                                                                                                                                                                                                                                                                                                                      | Turn OFF the power<br>supply to the servo<br>system.<br>Replace the SERVO-<br>PACK.                                                                     | -         |  |
|                                             | The surrounding air tempera-<br>ture is too high.                                         | Measure the surrounding air temperature around the Servomotor.                                                                                                                                                                                                                                                                         | Reduce the surround-<br>ing air temperature to<br>40°C or less.                                                                                         | -         |  |
|                                             | The surface of the Servomo-<br>tor is dirty.                                              | Turn OFF the power sup-<br>ply to the servo system.<br>Visually check the surface<br>for dirt.                                                                                                                                                                                                                                         | Clean dirt, dust, and oil from the surface.                                                                                                             | _         |  |
| Servomotor<br>Overheated                    | There is an overload on the Servomotor.                                                   | Check the load status with a monitor.                                                                                                                                                                                                                                                                                                  | If the Servomotor is<br>overloaded, reduce the<br>load or replace the<br>Servo Drive with a<br>SERVOPACK and Ser-<br>vomotor with larger<br>capacities. | _         |  |
|                                             | Polarity detection was not performed correctly.                                           | Check to see if electrical angle 2 (electrical angle from polarity origin) at any position is between ±10°.                                                                                                                                                                                                                            | Correct the settings for<br>the polarity detection-<br>related parameters.                                                                              | _         |  |

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# **Parameter Lists**



This chapter provides information on the parameters.

15.1.1 Interpreting the Parameter Lists

# 15.1 List of Parameters

## 15.1.1 Interpreting the Parameter Lists

| <ul> <li>A</li> <li>F</li> <li>L</li> <li>Rot</li> <li>to a</li> <li>inte</li> <li>detail</li> </ul> | NII: The parame<br>Servomoto<br>Rotary: The pa<br>Linear: The part<br>tary Servomoto<br>Propert the term<br>alls.<br>P ◆ Differe | eter is used for t<br>rs.<br>arameter is used<br>rameter is used<br>or terms are use<br>rs. If you are usin<br>as accordingly. F<br>ences in Terms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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Rotary Serve                                                                                                                                                                                                                                                                                                                                                               | Servomotors and<br>Servomotors.<br>Is that are ap<br>pomotor, you<br>ving section                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| Se<br>pro                                                                                            |                                                                                                                                  | notor and Linea<br>ed for both.<br>o row: For Rotar<br>ttom row: For Linea<br>Rotation Dire<br>Movement D<br>Use<br>0<br>Use<br>war<br>1<br>Use                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              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                                                                                                                                                                                                                                     | 0 When an encoder is not connected, start as SERVOPACK for<br>Botany Servemetor                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                  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|                                                                                                      | • A<br>• F<br>• L<br>Rot<br>to z<br>inter<br>det<br>C<br>S<br>Z<br>2                                                             | <ul> <li>All: The parameter Servomoto</li> <li>Rotary: The parameter Rotary: The parameter Rotary Servomoto</li> <li>Rotary Servomotor to all Servomotor interpret the term details.</li> <li> <ul> <li>Differe Linear</li> <li>M</li> <li>2 Basic Function</li> <li>If there Servor provid To get and the server provid to the serve</li></ul></li></ul> | <ul> <li>All: The parameter is used for the Servomotors.</li> <li>Rotary: The parameter is used</li> <li>Linear: The parameter is used</li> <li>Rotary Servomotor terms are used to all Servomotors. If you are using interpret the terms accordingly. For details.</li> <li>Differences in Terms and Linear Servomotors of Servomotor and Linear Servomotor and Linear provided for both.</li> <li>Top row: For Rotart</li> <li>Bottom row: For Linear Servom Tom Tom Tom Tom Tom Tom Tom Tom Tom T</li></ul> | <ul> <li>All: The parameter is used for both Rotary Services S</li></ul> | Servomotors.  Rotary: The parameter is used for only Rotary Servomotors. Inear: The parameter is used for only Linear Servomotors. Rotary Servomotor terms are used for parameters that are ap to all Servomotors. If you are using a Linear Servomotor, you interpret the terms accordingly. Refer to the following section details. Image: Differences in Terms for Rotary Servomotors and Linear Servomotors on page xi Image: Differences in Terms for Rotary Servomotors and Linear Servomotors on page xi Image: Differences in Terms for Rotary Servomotors and Linear Servomotors on page xi If there are differences in the parameters for Rotary Servomotor and Linear Servomotor, information is provided for both. If there are differences in the parameters for Rotary Servomotor and Linear Servomotors. If there are differences in the parameters for Rotary Servomotor and Linear Servomotors. If there are differences in the parameters for Rotary Servomotor and Linear Servomotors. If there are differences in the parameters for Rotary Servomotors. If there are differences in the parameters for Rotary Servomotors. If there are differences in the parameters for Rotary Servomotors. If there are differences in the parameters for Rotary Servomotors. If there are differences in the parameters for Rotary Servomotors. If there are differences in the parameters for Rotary Servomotors. If there are differences in the parameters for Rotary Servomotors. If there are differences in the parameters for Rotary Servomotors. If there are differences in the parameters for Rotary Servomotors. If there are differences in the parameters for Rotary Servomotors. If there are differences in the parameters for Rotary Servomotors. Image: Difference in the parameter is a set in the paramete | <ul> <li>Al: The parameter is used for both Rotary Servomotors and Linear Servomotors.</li> <li>Rotary: The parameter is used for only Rotary Servomotors.</li> <li>Linear: The parameter is used for only Linear Servomotors.</li> <li>Rotary: Servomotor terms are used for parameters that are applicable to all Servomotors. If you are using a Linear Servomotor, you need to interpret the terms accordingly. Refer to the following section for details.</li> <li>Differences in Terms for Rotary Servomotors and Linear Servomotors on page xi</li> <li>Mame Setting Setting Default Setting</li> <li>Basic Function Selections 0 0000h to 10B1h - 0000h</li> <li>If there are differences in the parameters for Rotary Servomotors and Linear Servomotors.</li> <li>Botom row: For Linear Servomotors</li> <li>If the direction Movement Direction Selection</li> <li>Movement Direction Selection.</li> <li>Use CCW as the forward direction.</li> <li>Use the direction in which the linear end forward direction.</li> <li>Use the direction. (Reverse Movement Norward direction.)</li> <li>Ise the direction in which the linear end forward direction. (Reverse Movement Norward direction.)</li> <li>Ise the direction. (Reverse Movement Norward direction.)</li></ul> | <ul> <li>All: The parameter is used for both Rotary Servomotors and Linear Servomotors.</li> <li>Rotary: The parameter is used for only Rotary Servomotors.</li> <li>Linear: The parameter is used for only Linear Servomotors.</li> <li>Rotary: The parameter is used for only Linear Servomotors.</li> <li>Rotary Servomotor terms are used for parameters that are applicable to all Servomotors. If you are using a Linear Servomotor, you need to interpret the terms accordingly. Refer to the following section for details.</li> <li> <ul> <li></li></ul></li></ul> | <ul> <li>All: The parameter is used for both Rotary Servomotors and Linear Servomotors.</li> <li>Rotary: The parameter is used for only Rotary Servomotors.</li> <li>Linear: The parameter is used for only Linear Servomotors.</li> <li>Rotary: The parameter is used for parameters that are applicable to all Servomotors. If you are using a Linear Servomotor, you need to interpret the terms accordingly. Refer to the following section for details.</li> <li> <ul> <li></li></ul></li></ul> | <ul> <li>Ali: The parameter is used for both Rotary Servomotors and Linear Servomotors.</li> <li>Rotary: The parameter is used for only Rotary Servomotors.</li> <li>Linear: The parameter is used for only Linear Servomotors.</li> <li>Rotary: The parameter is used for only Linear Servomotors.</li> <li>Rotary: The parameter is used for only Linear Servomotors, you need to interpret the terms accordingly. Refer to the following section for details.</li> <li>Indicates when a change to interpret the terms accordingly. Refer to the following section for details.</li> <li>Indicates when a change to interpret the terms accordingly. Refer to the following section for details.</li> <li>Indicates Servomotors on page xi</li> <li>Indicates when a change to interpret the terms accordingly. Refer to the following section for details.</li> <li>Basic Function Selections 0 0000 hto 10B1h – 0000h All After restart Setup</li> <li>If there are differences in the parameters for Rotary Servomotors.</li> <li>If there are differences in the parameters for Rotary Servomotors.</li> <li>If there are differences in the parameters for Rotary Servomotors.</li> <li>If there are differences in the parameters for Rotary Servomotors.</li> <li>If there are differences in the parameters for Rotary Servomotors.</li> <li>If there are differences in the parameters for Rotary Servomotors.</li> <li>If there are differences in the parameters for Rotary Servomotors.</li> <li>If there are differences in the parameters for Rotary Servomotors.</li> <li>If there are differences in the parameters for Rotary Servomotors.</li> <li>If there are differences in the parameters for Rotary Servomotors.</li> <li>If there are differences in the parameters for Rotary Servomotor.</li> <li>If there are differences in the parameters for Rotary Servomotor.</li> <li>If there are differences in the parameters for Rotary Servomotor.</li> <li>If there are differences in the parameter</li></ul> |

### 15.1.2 List of Parameters

The following table lists the parameters.

- Note: Do not change the following parameters from their default settings.
  Reserved parameters
  Parameters not given in this manual
  Parameters that are not valid for the Servomotor that you are using, as given in the parameter table

| Parameter<br>No. | Size | N                         | ame                                                                                                                 | Setting<br>Range                         | Setting<br>Unit | Default<br>Setting | Applicable<br>Motors | When<br>Enabled  | Classi-<br>fication | Refer-<br>ence |
|------------------|------|---------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------|-----------------|--------------------|----------------------|------------------|---------------------|----------------|
|                  | 2    | Basic Fund<br>tions 0     | tion Selec-                                                                                                         | 0000h to<br>10B1h                        | -               | 0000h              | All                  | After<br>restart | Setup               | -              |
|                  |      |                           |                                                                                                                     |                                          |                 |                    |                      |                  |                     |                |
|                  |      |                           | Rotation Dire                                                                                                       | Rotation Direction                       |                 |                    |                      |                  |                     |                |
|                  |      |                           |                                                                                                                     | irection Select                          |                 |                    |                      |                  | - Refere            |                |
|                  |      |                           |                                                                                                                     | e CCW as the f                           |                 |                    | ander on unto        | up og the fe     | ~                   |                |
|                  |      | n.🗆 🗆 🗆 X                 | - 036                                                                                                               | e the direction i<br>rd direction.       | n which th      | e imear en         | coder counts         | up as the lo     | page 5              | 5-16           |
|                  |      |                           | . —                                                                                                                 | e CW as the for                          |                 | <b>`</b>           |                      | ,                |                     | , 10           |
| Pn000            |      |                           |                                                                                                                     | e the direction i<br>ward direction.     |                 |                    |                      | down as the      | Э                   |                |
|                  |      | n.DDXD                    | Reserved par                                                                                                        | rameter (Do no                           | ot change.      | )                  |                      |                  |                     |                |
|                  |      | n.¤X¤¤                    | Reserved par                                                                                                        | rameter (Do no                           | ot change.      | )                  |                      |                  |                     |                |
|                  |      |                           | Rotary/Linea<br>nected                                                                                              | r Servomotor S                           | Startup Se      | election W         | hen Encoder          | Is Not Con-      | Refere              | ence           |
|                  |      | n.XDDD                    |                                                                                                                     | en an encoder<br>ary Servomoto           |                 | nected, st         | art as SERVO         | PACK for         |                     | - 45           |
|                  |      |                           |                                                                                                                     | en an encoder<br>Servomotor.             | is not con      | nected, st         | art as SERVO         | PACK for Lir     | page 5              | 5-15           |
|                  |      | _                         |                                                                                                                     | 1                                        | 1               |                    |                      |                  | 1                   | T              |
|                  | 2    | Application<br>Selections |                                                                                                                     | 0000h to<br>1142h                        | -               | 0000h              | All                  | After<br>restart | Setup               | -              |
|                  |      |                           |                                                                                                                     |                                          |                 |                    |                      |                  |                     |                |
|                  |      |                           | Motor Stoppi                                                                                                        | ing Method for                           | Servo OF        | F and Gro          | oup 1 Alarms         |                  | Refere              | ence           |
|                  |      |                           | 0 Sto                                                                                                               | p the motor by                           | applying t      | the dynam          | ic brake.            |                  |                     |                |
|                  |      | n.□□□X                    |                                                                                                                     | p the motor by<br>dynamic brake          |                 | ing dynam          | ic brake and t       | hen release      | page 5              | 5-34           |
|                  |      |                           | 2 Coa                                                                                                               | ast the motor to                         | o a stop w      | ithout the         | dynamic brak         | e.               |                     |                |
| Pn001            |      | n.🗆 🗆 X 🗆                 | Reserved par                                                                                                        | rameter (Do no                           | t change.       | )                  |                      |                  |                     |                |
|                  |      |                           | Main Circuit I                                                                                                      | Power Supply                             | AC/DC In        | put Select         | ion                  |                  | Refere              | ence           |
|                  |      | n.¤X¤¤                    | 0 Input AC power as the main circuit power supply using the L1, L2, and L3 terminals (do not use shared converter). |                                          |                 |                    |                      | )<br>· ,         |                     |                |
|                  |      |                           |                                                                                                                     | ut DC power as                           |                 |                    |                      |                  |                     | 5-13           |
|                  |      |                           |                                                                                                                     | $I \ominus 2$ terminals werter or the sh |                 |                    | terminals (use       | e an external    |                     |                |
|                  |      | n.X000                    | Reserved par                                                                                                        | rameter (Do no                           | t change.       | )                  |                      |                  |                     |                |
|                  |      |                           |                                                                                                                     |                                          |                 |                    |                      |                  |                     |                |

| plication<br>ections |              | Function      | Setting<br>Range<br>0000h to<br>4213h                     | Setting<br>Unit<br>–                                                                                                                 | Default<br>Setting<br>0000h                                                                                                                             | Applicable<br>Motors<br>–                                                                                                                                                    | When<br>Enabled<br>After<br>restart                                                                                                                                                          | Classi-<br>fication                                                                                                                                                                  | Refer-<br>ence                                                                                                                                                                       |  |
|----------------------|--------------|---------------|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| ections :            | Selections 2 |               | 4213h                                                     | _                                                                                                                                    | 0000h                                                                                                                                                   | _                                                                                                                                                                            |                                                                                                                                                                                              | 0                                                                                                                                                                                    |                                                                                                                                                                                      |  |
|                      |              | Reserved para |                                                           |                                                                                                                                      |                                                                                                                                                         |                                                                                                                                                                              | restart                                                                                                                                                                                      | Setup                                                                                                                                                                                | -                                                                                                                                                                                    |  |
|                      |              | Reserved para |                                                           |                                                                                                                                      |                                                                                                                                                         |                                                                                                                                                                              |                                                                                                                                                                                              |                                                                                                                                                                                      |                                                                                                                                                                                      |  |
| םאנ                  | .00X0 R      |               | ameter (Do no                                             | t change.                                                                                                                            | )                                                                                                                                                       |                                                                                                                                                                              |                                                                                                                                                                                              |                                                                                                                                                                                      |                                                                                                                                                                                      |  |
|                      |              | Reserved para | ameter (Do no                                             | t change.                                                                                                                            | )                                                                                                                                                       |                                                                                                                                                                              |                                                                                                                                                                                              |                                                                                                                                                                                      |                                                                                                                                                                                      |  |
|                      | E            | Encoder Usag  | Usage                                                     |                                                                                                                                      |                                                                                                                                                         |                                                                                                                                                                              | Applicable<br>Motors                                                                                                                                                                         | Refere                                                                                                                                                                               | nce                                                                                                                                                                                  |  |
|                      | .0X00        |               | Use the encoder according to encoder specifica-<br>tions. |                                                                                                                                      |                                                                                                                                                         |                                                                                                                                                                              |                                                                                                                                                                                              | All page 6-18                                                                                                                                                                        |                                                                                                                                                                                      |  |
|                      |              | 1 Use         | Use the encoder as an incremental encoder.                |                                                                                                                                      |                                                                                                                                                         |                                                                                                                                                                              |                                                                                                                                                                                              |                                                                                                                                                                                      |                                                                                                                                                                                      |  |
|                      |              |               | Use the encoder as a single-turn absolute encoder.        |                                                                                                                                      |                                                                                                                                                         |                                                                                                                                                                              |                                                                                                                                                                                              |                                                                                                                                                                                      |                                                                                                                                                                                      |  |
|                      | E            | External Encc | oder Usage                                                |                                                                                                                                      |                                                                                                                                                         |                                                                                                                                                                              | Applicable<br>Motors                                                                                                                                                                         | Refere                                                                                                                                                                               | nce                                                                                                                                                                                  |  |
|                      |              | 0 Do r        | not use an exte                                           | ernal enco                                                                                                                           | der.                                                                                                                                                    |                                                                                                                                                                              |                                                                                                                                                                                              |                                                                                                                                                                                      |                                                                                                                                                                                      |  |
|                      | .xooo        |               |                                                           |                                                                                                                                      |                                                                                                                                                         |                                                                                                                                                                              |                                                                                                                                                                                              |                                                                                                                                                                                      |                                                                                                                                                                                      |  |
|                      |              | 2 Res         | erved paramet                                             | er (Do not                                                                                                                           | change.)                                                                                                                                                |                                                                                                                                                                              | Rotary                                                                                                                                                                                       | page 1                                                                                                                                                                               | 0-6                                                                                                                                                                                  |  |
|                      |              |               |                                                           |                                                                                                                                      |                                                                                                                                                         | erse direc-                                                                                                                                                                  |                                                                                                                                                                                              |                                                                                                                                                                                      |                                                                                                                                                                                      |  |
|                      |              | 4 Res         | erved paramet                                             | er (Do not                                                                                                                           | change.)                                                                                                                                                |                                                                                                                                                                              |                                                                                                                                                                                              |                                                                                                                                                                                      |                                                                                                                                                                                      |  |
| 1                    | .XDI         |               | 1 tion<br>2 Res<br>3 The<br>tion                          | 1     tion for CCW moto       2     Reserved paramet       3     The external encoor       tion for CCW moto     The external encoor | 1       tion for CCW motor rotation.         2       Reserved parameter (Do not         3       The external encoder moves tion for CCW motor rotation. | 1       tion for CCW motor rotation.         2       Reserved parameter (Do not change.)         3       The external encoder moves in the revention for CCW motor rotation. | Image: The second parameter (Do not change.)         2       Reserved parameter (Do not change.)         3       The external encoder moves in the reverse direction for CCW motor rotation. | 1       tion for CCW motor rotation.         2       Reserved parameter (Do not change.)         3       The external encoder moves in the reverse direction for CCW motor rotation. | 1       tion for CCW motor rotation.         2       Reserved parameter (Do not change.)         3       The external encoder moves in the reverse direction for CCW motor rotation. |  |

Continued from previous page.

|       |   |                           | ame           | Setting<br>Range                 | Setting<br>Unit | Default<br>Setting      | Applicable<br>Motors         | When<br>Enabled  | Classi-<br>fication | Refei<br>ence |
|-------|---|---------------------------|---------------|----------------------------------|-----------------|-------------------------|------------------------------|------------------|---------------------|---------------|
|       | 2 | Application<br>Selections | Function<br>6 | 0000h to<br>105Fh                | _               | 0002h                   | All                          | Immedi-<br>ately | Setup               | page<br>9-10  |
|       |   |                           |               |                                  |                 |                         |                              |                  |                     |               |
|       |   |                           | Analog Mo     | nitor 1 Signal Se                |                 |                         |                              |                  |                     |               |
|       |   |                           | 00            | Motor speed (1                   |                 | ,                       |                              |                  |                     |               |
|       |   |                           |               | Motor speed (1                   | V/1,000 m       | ım/s)                   |                              |                  |                     |               |
|       |   |                           | 01            | Speed reference                  | · · ·           | ,                       |                              |                  |                     |               |
|       |   |                           |               | Speed reference                  | (1 V/1,00       | 0 mm/s)                 |                              |                  |                     |               |
|       |   |                           | 02            | Torque reference                 | e (1 V/100      | % rated to              | rque)                        |                  |                     |               |
|       |   |                           |               | Force reference                  | (1 V/100%       | 5 rated for             | ce)                          |                  |                     |               |
|       |   |                           | 03            | Position deviatio                | n (0.05 V/      | reference               | unit)                        |                  |                     |               |
|       |   |                           |               | Position amplifie                |                 |                         | 0 / (                        |                  |                     | unit)         |
|       |   |                           | 04            | Position amplifie<br>pulse unit) | r deviatior     | n (after elec           | ctronic gear) (              | 0.05 V/linea     | r encoder           |               |
|       |   |                           | 05            | Position reference               | e speed (       | 1 V/1,000               | min <sup>-1</sup> )          |                  |                     |               |
|       |   |                           | 05            | Position reference               | e speed (       | 1 V/1,000               | mm/s)                        |                  |                     |               |
|       |   |                           | 06            | Reserved param                   | eter (Do n      | ot change               | .)                           |                  |                     |               |
| Pn006 |   | n.□□XX                    | 07            | Load-motor pos                   | ition devia     | tion (0.01              | V/reference u                | nit)             |                     |               |
|       |   |                           | 08            | Positioning com pleted: 0 V)     | pletion (po     | ositioning c            | completed: 5                 | V, positioning   | g not com           | -             |
|       |   |                           | 09            | Speed feedforwa                  | ard (1 V/1,     | 000 min <sup>-1</sup> ) | 1                            |                  |                     |               |
|       |   |                           | 03            | Speed feedforwa                  | ard (1 V/1,     | ,000 mm/s               | ;)                           |                  |                     |               |
|       |   |                           | 0A            | Torque feedforw                  | ard (1 V/1      | 00% rated               | torque)                      |                  |                     |               |
|       |   |                           | UA            | Force feedforwa                  | rd (1 V/10      | 0% rated f              | force)                       |                  |                     |               |
|       |   |                           | 0B            | Active gain (1st                 | gain: 1 V, 1    | 2nd gain: 2             | 2 V)                         |                  |                     |               |
|       |   |                           | 0C            | Completion of p<br>pleted: 0 V)  | osition refe    | erence dist             | tribution (com               | pleted: 5 V,     | not com-            |               |
|       |   |                           | 0D            | External encode                  | r speed (1      | V/1,000 r               | nin <sup>-1</sup> : value at | the motor s      | shaft)              |               |
|       |   |                           | 0E            | Reserved param                   | eter (Do n      | ot change               | .)                           |                  |                     |               |
|       |   |                           | 0F            | Reserved param                   | eter (Do n      | ot change               | .)                           |                  |                     |               |
|       |   |                           | 10            | Main circuit DC                  | voltage         |                         |                              |                  |                     |               |
|       |   |                           | 11 to 5F      | Reserved param                   | eters (Do       | not chang               | e.)                          |                  |                     |               |
|       |   | n.¤X¤¤                    | Reserved      | parameter (Do no                 | t change.       | )                       |                              |                  |                     |               |
|       |   | n.X000                    | Reserved I    | parameter (Do no                 | t change.       | )                       |                              |                  |                     |               |

|                  |      |                           |                 |                                  |                 |                          | Con                          | tinued from      | n previous          | s page.        |
|------------------|------|---------------------------|-----------------|----------------------------------|-----------------|--------------------------|------------------------------|------------------|---------------------|----------------|
| Parameter<br>No. | Size | N                         | lame            | Setting<br>Range                 | Setting<br>Unit | Default<br>Setting       | Applicable<br>Motors         | When<br>Enabled  | Classi-<br>fication | Refer-<br>ence |
|                  | 2    | Application<br>Selections | n Function<br>7 | 0000h to<br>105Fh                | -               | 0000h                    | All                          | Immedi-<br>ately | Setup               | page<br>9-10   |
|                  | -    |                           |                 |                                  |                 |                          |                              |                  |                     |                |
|                  |      |                           | Analog Mo       | onitor 2 Signal Se               | lection         |                          |                              |                  |                     |                |
|                  |      |                           | 00              | Motor speed (1                   | V/1,000 m       | nin <sup>-1</sup> )      |                              |                  |                     |                |
|                  |      |                           |                 | Motor speed (1                   | V/1,000 m       | ım/s)                    |                              |                  |                     |                |
|                  |      |                           | 01              | Speed reference                  | e (1 V/1,00     | 0 min⁻¹)                 |                              |                  |                     |                |
|                  |      |                           |                 | Speed reference                  | e (1 V/1,00     | 0 mm/s)                  |                              |                  |                     |                |
|                  |      |                           | 02              | Torque reference                 | e (1 V/100      | % rated to               | rque)                        |                  |                     |                |
|                  |      |                           | 02              | Force reference                  | (1 V/100%       | 6 rated for              | ce)                          |                  |                     |                |
|                  |      |                           | 03              | Position deviation               | n (0.05 V/      | reference                | unit)                        |                  |                     |                |
|                  |      |                           |                 | Position amplifie                | r deviatior     | n (after eleo            | ctronic gear) (              | 0.05 V/enco      | der pulse           | unit)          |
|                  |      |                           | 04              | Position amplifie<br>pulse unit) | r deviatior     | n (after elec            | ctronic gear) (              | 0.05 V/linear    | r encoder           |                |
|                  |      |                           | 05              | Position reference               | ce speed (      | 1 V/1,000                | min <sup>-1</sup> )          |                  |                     |                |
|                  |      |                           | 05              | Position reference               | ce speed (      | 1 V/1,000                | mm/s)                        |                  |                     |                |
|                  |      |                           | 06              | Reserved param                   | ieter (Do n     | ot change                | .)                           |                  |                     |                |
| Pn007            |      | n.🗆🗆 XX                   | 07              | Load-motor pos                   | ition devia     | tion (0.01               | V/reference u                | nit)             |                     |                |
|                  |      |                           | 08              | Positioning com<br>pleted: 0 V)  | pletion (po     | ositioning c             | ompleted: 5 \                | V, positioninę   | g not com           |                |
|                  |      |                           | 09              | Speed feedforwa                  | ard (1 V/1,     | ,000 min <sup>-1</sup> ) |                              |                  |                     |                |
|                  |      |                           | 09              | Speed feedforwa                  | ard (1 V/1,     | ,000 mm/s                | )                            |                  |                     |                |
|                  |      |                           | 0A              | Torque feedforw                  | ard (1 V/1      | 00% rated                | torque)                      |                  |                     |                |
|                  |      |                           | UA              | Force feedforwa                  | rd (1 V/10      | 0% rated f               | orce)                        |                  |                     |                |
|                  |      |                           | 0B              | Active gain (1st                 | gain: 1 V, 1    | 2nd gain: 2              | 2 V)                         |                  |                     |                |
|                  |      |                           | 0C              | Completion of p<br>pleted: 0 V)  | osition refe    | erence dist              | ribution (com                | pleted: 5 V,     | not com-            |                |
|                  |      |                           | 0D              | External encode                  | r speed (1      | V/1,000 r                | nin <sup>-1</sup> : value at | the motor s      | haft)               |                |
|                  |      |                           | 0E              | Reserved param                   | ieter (Do n     | ot change                | .)                           |                  |                     |                |
|                  |      |                           | 0F              | Reserved param                   | ieter (Do n     | ot change                | .)                           |                  |                     |                |
|                  |      |                           | 10              | Main circuit DC                  | voltage         |                          |                              |                  |                     |                |
|                  |      |                           | 11 to 5F        | Reserved param                   | eters (Do       | not chang                | e.)                          |                  |                     |                |
|                  |      | n.¤X¤¤                    | Reserved        | parameter (Do no                 | ot change.      | )                        |                              |                  |                     |                |
|                  |      | n.X000                    | Reserved        | parameter (Do no                 | t change.       | )                        |                              |                  |                     |                |
|                  | -    |                           |                 |                                  |                 |                          |                              |                  |                     |                |

Continued from previous page.

|                  |      |                           |                 |                                                                                       |                                                   |                            |                                | tinued from      | · ·                    |              |
|------------------|------|---------------------------|-----------------|---------------------------------------------------------------------------------------|---------------------------------------------------|----------------------------|--------------------------------|------------------|------------------------|--------------|
| Parameter<br>No. | Size | Ν                         | lame            | Setting<br>Range                                                                      | Setting<br>Unit                                   | Default<br>Setting         | Applicable<br>Motors           | When<br>Enabled  | Classi-<br>fication    | Refe<br>ence |
|                  | 2    | Application<br>Selections | n Function<br>8 | 0000h to<br>7121h                                                                     | _                                                 | 4000h                      | Rotary                         | After<br>restart | Setup                  | Ι            |
|                  |      | n.000X                    | 0 C<br>1 C      | y Voltage Alarm/<br>utput alarm (A.8:<br>utput warning (A<br>election for Unde        | 30) for low<br>930) for le                        | v battery vo               | ÷                              |                  | Refere<br>page 1       | 4-3          |
| Pn008            |      | n.□□X□                    | 1 D             | o not detect und<br>etect undervoltag<br>etect undervoltag<br>n425 (i.e., only in     | ge warning<br>ge warning                          | g and limit<br>g and limit | •                              |                  | page 6                 | 6-6          |
|                  |      | n.🗆X🗆 🗆                   | 0 D             | etection Selectio<br>etect warnings.<br>o not detect war                              |                                                   | ept for A.9                | 71.                            |                  | Refere<br>page 1<br>50 |              |
|                  | 2    | Selections                | -               | 0000h to<br>0121h                                                                     |                                                   | 0010h                      | All                            | After<br>restart | Tuning                 | -            |
|                  | -    | n.000X                    | Reserved pa     | arameter (Do not                                                                      | t change.)                                        |                            |                                |                  |                        |              |
|                  |      |                           | Current Cor     | trol Mode Selec                                                                       | tion                                              |                            |                                | -                | Referer                | nce          |
| Pn009            |      | n.OOXO                    | 1 • 5           | e current contro<br>ERVOPACK Mo<br>3R8A, -5R5A, ar<br>SERVOPACK Mo<br>470A, -550A, -5 | dels SGD7<br>nd -7R6A:<br>dels SGD7<br>90A, and - | Use currei<br>7S-120A, -   | nt control moo<br>180A, -200A, | de 1.<br>-330A,  | page 8-                | -73          |
|                  |      |                           | 2 Us            | e current contro                                                                      | l mode 2.                                         |                            |                                |                  |                        |              |
|                  |      |                           | Speed Dete      | ction Method Se                                                                       | election                                          |                            |                                |                  | Referer                | nce          |
|                  |      | n.¤X¤¤                    |                 | e speed detections<br>e speed detections                                              |                                                   |                            |                                |                  | page 8                 | -74          |
|                  |      | n.X000                    | Reserved pa     | arameter (Do not                                                                      | t change.)                                        |                            |                                |                  |                        |              |

Continued on next page.

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| No.   | Size | N                         | ame                                                                                 | Setting<br>Range                                                                                                                                                                                                                                               | Setting<br>Unit                                                                                                                                        | Default<br>Setting                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Applicable<br>Motors                                                                                            | When<br>Enabled                                                              | Classi-<br>fication                  | Refer<br>ence           |
|-------|------|---------------------------|-------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------------|-------------------------|
|       | 2    | Application<br>Selections |                                                                                     | 0000h to<br>1044h                                                                                                                                                                                                                                              | _                                                                                                                                                      | 0001h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | All                                                                                                             | After<br>restart                                                             | Setup                                | _                       |
| Pn00A |      | n.000X                    | 0<br>1<br>2<br>3<br>4                                                               | opping Method fo<br>Apply the dynami<br>stopping method<br>Decelerate the me<br>the maximum tore<br>status after stopp<br>Decelerate the me<br>the maximum tore<br>Decelerate the me<br>Pn30A. Use the s<br>stopping.<br>Decelerate the me<br>Pn30A and then I | c brake or<br>set in PnC<br>otor to a s<br>que. Use th<br>ing.<br>otor to a s<br>que and th<br>otor to a s<br>etting of F<br>otor to a s<br>et the mot | coast the<br>$001 = n.\square I$<br>top using the<br>top using top using the<br>top using the<br>top using the<br>top using the | □□X).<br>the torque set<br>of Pn001 = n.l<br>the torque set<br>motor coast.<br>the deceleration<br>□□□X for the | in Pn406 as<br>DDX for th<br>in Pn406 as<br>on time set ir<br>e status after | page                                 |                         |
|       |      | n.0X00                    |                                                                                     | • •                                                                                                                                                                                                                                                            |                                                                                                                                                        | ,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                 |                                                                              |                                      |                         |
|       |      |                           | 1                                                                                   | d parameter (Do n                                                                                                                                                                                                                                              | -                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                 |                                                                              |                                      |                         |
|       |      | n.XOOO                    | Reserved                                                                            | d parameter (Do n                                                                                                                                                                                                                                              | ot change                                                                                                                                              | .)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                 |                                                                              |                                      |                         |
|       |      |                           |                                                                                     |                                                                                                                                                                                                                                                                |                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                 |                                                                              |                                      |                         |
|       | 2    | Application<br>Selections |                                                                                     | 0000h to<br>1121h                                                                                                                                                                                                                                              | _                                                                                                                                                      | 0000h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | All                                                                                                             | After<br>restart                                                             | Setup                                | -                       |
|       | 2    |                           |                                                                                     |                                                                                                                                                                                                                                                                | _                                                                                                                                                      | 0000h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | All                                                                                                             |                                                                              | Setup                                | _                       |
|       | 2    | Selections                | В                                                                                   |                                                                                                                                                                                                                                                                | -<br>Selectior                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | All                                                                                                             |                                                                              | Setup                                | -<br>nce                |
|       |      | Selections                | B<br>Operator I<br>0 I                                                              | 1121h Parameter Display Display only setup                                                                                                                                                                                                                     | paramete                                                                                                                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | All                                                                                                             |                                                                              |                                      |                         |
|       |      | Selections                | B<br>Operator I<br>0 I                                                              | 1121h<br>Parameter Display                                                                                                                                                                                                                                     | paramete                                                                                                                                               | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | All                                                                                                             |                                                                              | Refere                               |                         |
|       |      | Selections                | B<br>Operator I<br>0 I<br>1 I                                                       | 1121h Parameter Display Display only setup                                                                                                                                                                                                                     | paramete<br>ters.                                                                                                                                      | n<br>rs.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | All                                                                                                             |                                                                              | Refere                               | -3                      |
|       |      | Selections                | B<br>Operator F<br>0 1<br>1 0<br>Motor Sto                                          | 1121h<br>Parameter Display<br>Display only setup<br>Display all parame                                                                                                                                                                                         | parameter<br>ters.<br>Group 2 /                                                                                                                        | rs.<br>Alarms                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                 |                                                                              | Refere<br>page 5                     | -3                      |
| Pn00B |      | Selections                | B<br>Operator I<br>0 1<br>1 1<br>Motor Sto<br>0                                     | 1121h<br>Parameter Display<br>Display only setup<br>Display all parame<br>pping Method for                                                                                                                                                                     | paramete<br>ters.<br>Group 2 /<br>setting th<br>brake or                                                                                               | n<br>rs.<br>Alarms<br>e speed re<br>coast the r                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | ference to 0.<br>notor to a sto                                                                                 | restart                                                                      | Refere<br>page 5                     | -3<br>nce               |
| Pn00B |      | Selections                | B<br>Operator I<br>0 1<br>1 1<br>Motor Sto<br>0<br>1                                | 1121h       Parameter Display       Display only setup       Display all parame       pping Method for       Stop the motor by       Apply the dynamic                                                                                                         | paramete<br>ters.<br>Group 2 /<br>setting th<br>brake or<br>set in Pn00                                                                                | Alarms<br>e speed re<br>coast the r<br>01 = n.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ference to 0.<br>notor to a stc<br>□X).                                                                         | restart                                                                      | Refere<br>page 5<br>Refere           | -3<br>nce               |
| Pn00B |      | n. DDDX                   | B<br>Operator H<br>0 1<br>1 1<br>Motor Sto<br>0<br>1<br>2                           | 1121h       Parameter Display       Display only setup       Display all parameter       pping Method for       Stop the motor by       Apply the dynamic       stopping method s                                                                              | parameter<br>ters.<br>Group 2 /<br>setting th<br>brake or<br>set in Pn00<br>nethod wit                                                                 | Alarms<br>e speed re<br>coast the r<br>D1 = n.<br>h Pn00A =                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ference to 0.<br>notor to a sto<br>IDX).                                                                        | restart                                                                      | Refere<br>page 5<br>Refere           | -3<br>nce<br>-35        |
| Pn00B | 1    | n. DDDX                   | B<br>Operator I<br>0 1<br>1 1<br>Motor Sto<br>0 1<br>1 2<br>Power Inp               | 1121h         Parameter Display         Display only setup         Display all parame         pping Method for         Stop the motor by         Apply the dynamic         stopping method s         Set the stopping nethod s                                 | parameter<br>ters.<br>Group 2 /<br>setting th<br>brake or<br>set in Pn00<br>nethod wit                                                                 | Alarms<br>e speed re<br>coast the r<br>D1 = n.<br>h Pn00A =                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ference to 0.<br>notor to a sto<br>IDX).                                                                        | restart                                                                      | Refere<br>page 5<br>Refere<br>page 5 | -3<br>nce<br>-35        |
| Pn00B | 1    | n. DDDX                   | B<br>Operator I<br>0 1<br>1 1<br>Motor Sto<br>0 1<br>1 2<br>Power Inp<br>0 1<br>1 1 | 1121h         Parameter Display         Display only setup         Display all parameter         pping Method for         Stop the motor by         Apply the dynamic         stopping method s         Set the stopping nethod s         wut Selection for T  | parameter<br>ters.<br>Group 2 /<br>setting th<br>brake or<br>set in Pn00<br>nethod wit<br>hree-phas<br>power su<br>power su                            | Alarms<br>e speed re<br>coast the r<br>D1 = n.□□<br>h Pn00A =<br>e SERVOF<br>pply input.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ference to 0.<br>motor to a stc<br>□X).<br>= n.□□□X.<br>PACK                                                    | restart                                                                      | Refere<br>page 5<br>Refere<br>page 5 | -3<br>nce<br>-35<br>nce |

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|                  |      |                                        |                      |            |                                                                    |                        |                    |                      | tinued from      | n previous          | s page        |
|------------------|------|----------------------------------------|----------------------|------------|--------------------------------------------------------------------|------------------------|--------------------|----------------------|------------------|---------------------|---------------|
| Parameter<br>No. | Size | N                                      | ame                  |            | Setting<br>Range                                                   | Setting<br>Unit        | Default<br>Setting | Applicable<br>Motors | When<br>Enabled  | Classi-<br>fication | Refer<br>ence |
|                  | 2    | Application<br>Selections              | r Function<br>C      |            | 0000h to<br>0131h                                                  | _                      | 0000h              | _                    | After<br>restart | Setup               | page<br>7-20  |
|                  |      |                                        | Function             | Sele       | ection for Test                                                    | without a              | Motor              |                      |                  | Applica<br>Motor    |               |
|                  |      | n.□□□X                                 | 0                    |            | able tests with                                                    |                        |                    |                      |                  | All                 |               |
|                  |      |                                        | 1                    | Ena        | ble tests withc                                                    | out a moto             | r.                 |                      |                  | Applica             | blo           |
|                  |      |                                        |                      |            | olution for Tes                                                    | ts without             | a Motor            |                      |                  | Motor               |               |
| Pn00C            |      | n.¤¤X¤                                 | 0                    |            | 20 bits.                                                           |                        |                    |                      |                  |                     |               |
|                  |      |                                        | 2                    |            | 22 bits.                                                           |                        |                    |                      |                  | Rotar               | У             |
|                  |      |                                        | 3                    | Use        | 24 bits.                                                           |                        |                    |                      |                  |                     |               |
|                  |      |                                        | Encoder <sup>-</sup> | Туре       | e Selection for                                                    | Tests wit              | nout a Mo          | tor                  |                  | Applica<br>Motor    |               |
|                  |      | n.¤X¤¤                                 | 0                    |            | an incrementa<br>an absolute e                                     |                        | •                  |                      |                  | All                 |               |
|                  |      |                                        |                      |            |                                                                    |                        | N                  |                      |                  |                     |               |
|                  |      | n.X000                                 | Reserved             | i par      | ameter (Do no                                                      | ot change.             | )                  |                      |                  |                     |               |
|                  | 2    | Application<br>Selections              | n Function<br>D      |            | 0000h to<br>2001h                                                  | -                      | 0000h              | All                  | Immedi-<br>ately | Setup               | _             |
| Pn00D            |      | n.00X0<br>n.0X00<br>n.X000             | Reserved<br>Reserved | par<br>par | able connection<br>ameter (Do no<br>ameter (Do no<br>ameter (Do no | t change.<br>t change. | )                  |                      |                  |                     |               |
|                  |      | Reserved                               | parameter            |            |                                                                    |                        |                    |                      |                  |                     |               |
| Pn00E            | 2    | (Do not ch<br>Application              | ange.)               |            | –<br>0000h to                                                      | -                      | 0000h              | All                  | –<br>After       | -                   | -             |
|                  | 2    | Selections                             | F                    |            | 2011h                                                              | -                      | 0000h              | All                  | restart          | Setup               | -             |
|                  | -    |                                        | Preventat            | tive       | Maintenance \                                                      | Warning S              | election           |                      |                  | Referer             | nce           |
|                  |      | n.🗆 🗆 🗆 X                              |                      |            | ot detect prev                                                     |                        |                    | 9                    |                  | page 9-             | -15           |
| Pn00F            |      |                                        |                      |            | ct preventative                                                    |                        |                    | ngs.                 |                  |                     |               |
|                  |      | n.□□X□                                 | Reserved             | l par      | ameter (Do no                                                      | ot change.             | )                  |                      |                  |                     |               |
|                  |      | n.¤X¤¤                                 | Reserved             | l par      | ameter (Do no                                                      | ot change.             | )                  |                      |                  |                     |               |
|                  |      | n.XDDD                                 | Reserved             | l par      | ameter (Do no                                                      | ot change.             | )                  |                      |                  |                     |               |
| Pn010            | 2    | Axis Addre<br>(For UART,<br>munication | /USB Com             |            | 0000h to<br>007Fh                                                  | _                      | 0001h              | All                  | After<br>restart | Setup               | _             |
| Pn021            | 2    | Reserved p<br>(Do not ch               | oarameter            |            | -                                                                  | _                      | 0000h              | All                  | _                | _                   | -             |
| Pn022            | 2    | Reserved p<br>(Do not ch               | oarameter            |            | _                                                                  | _                      | 0000h              | All                  | _                | _                   | -             |
|                  |      | - 1                                    |                      |            | ł                                                                  | +                      | 1                  |                      | 1                | +                   |               |

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|                                        |                       |                                              |                                                                       |                |                                                                                |                                             |                              | Con                  | tinued from                                              | n previous          | s page                                       |
|----------------------------------------|-----------------------|----------------------------------------------|-----------------------------------------------------------------------|----------------|--------------------------------------------------------------------------------|---------------------------------------------|------------------------------|----------------------|----------------------------------------------------------|---------------------|----------------------------------------------|
| Parameter<br>No.                       | Size                  |                                              | Name                                                                  |                | Setting<br>Range                                                               | Setting<br>Unit                             | Default<br>Setting           | Applicable<br>Motors | When<br>Enabled                                          | Classi-<br>fication | Refer<br>ence                                |
|                                        | 2                     | Σ-V Com<br>tion Swit                         | patible Fun<br>ch                                                     | 1C-            | 0000h to<br>2111h                                                              | _                                           | 0000h                        | _                    | After<br>restart                                         | Setup               | -                                            |
|                                        |                       | I                                            |                                                                       |                |                                                                                |                                             |                              |                      |                                                          | I                   | I                                            |
|                                        | n.[                   | XDDC                                         | Reserved                                                              | parar          | neter (Do not (                                                                | change.)                                    |                              |                      |                                                          |                     |                                              |
| Pn040                                  |                       |                                              | Encoder F                                                             | Resolu         | ution Compatil                                                                 | bility Sele                                 | ction                        |                      |                                                          | Applica<br>Motor    |                                              |
| 211040                                 | n.[                   | םאםכ                                         | - 1                                                                   | Use a          | ne encoder res<br>resolution of 2<br>7A, SGM7P, SC                             | 20 bits whe                                 | en connec                    | ted to an SGI        |                                                          | Rotar               | У                                            |
|                                        | n.[                   |                                              | Reserved                                                              | parar          | meter (Do not                                                                  | change.)                                    |                              |                      |                                                          |                     |                                              |
|                                        | n.)                   | Kooo                                         | Reserved                                                              | parar          | meter (Do not                                                                  | change.)                                    |                              |                      |                                                          |                     |                                              |
|                                        | 2                     | Applicati<br>Selection                       | on Functior<br>Is 80                                                  | ١              | 0000h to<br>1111h                                                              | -                                           | 0000h                        | Linear               | After<br>restart                                         | Setup               | _                                            |
|                                        |                       |                                              | Delevity                                                              | <b>.</b>       | Oala atian                                                                     |                                             |                              |                      |                                                          | Defens              |                                              |
|                                        | n                     | .000X                                        | 0                                                                     |                | or Selection<br>polarity sensor                                                | :                                           |                              |                      |                                                          | Refere              |                                              |
|                                        |                       |                                              | 1                                                                     | Do r           | ot use polarity                                                                | sensor.                                     |                              |                      |                                                          | page 5              | -24                                          |
|                                        |                       |                                              | Motor Ph                                                              | nase S         | Sequence Sele                                                                  | ection                                      |                              |                      |                                                          | Refere              | nce                                          |
| Pn080                                  | n                     | .00X0                                        | 0                                                                     |                | a phase-A lead<br>a phase-B lead                                               |                                             |                              |                      |                                                          | page 5              | -22                                          |
|                                        | 5                     |                                              |                                                                       |                | •                                                                              |                                             |                              |                      | J VV.                                                    |                     |                                              |
|                                        | n                     |                                              |                                                                       |                | ameter (Do not                                                                 | 0,                                          |                              |                      |                                                          |                     |                                              |
|                                        |                       |                                              |                                                                       |                | ethod for Max                                                                  | •                                           |                              | •                    |                                                          | Refere              | ence                                         |
|                                        | n                     | .X000                                        | 0                                                                     | spee           |                                                                                |                                             | •                            | 0                    |                                                          | page 1              | 6-4                                          |
|                                        |                       |                                              | 1                                                                     | setti          |                                                                                | num spee                                    |                              |                      | itput puise                                              |                     |                                              |
|                                        | 2                     | Applicati<br>Selection                       | on Function                                                           | l              | 0000h to<br>1111h                                                              | _                                           | 0000h                        | All                  | After<br>restart                                         | Setup               | page<br>6-11                                 |
|                                        |                       | Gelection                                    | 13 01                                                                 |                |                                                                                |                                             |                              |                      | Testart                                                  |                     | 0-11                                         |
|                                        |                       |                                              | Phase-C                                                               | Puls           | e Output Sele                                                                  | ction                                       |                              |                      |                                                          |                     |                                              |
|                                        | r                     | 1.000X                                       | 0                                                                     |                | put phase-C p<br>put phase-C p                                                 | ,                                           |                              |                      |                                                          |                     |                                              |
| Pn081                                  |                       |                                              |                                                                       | 1              | put priase-o p                                                                 |                                             |                              | walu allu leve       |                                                          | 15.                 |                                              |
| 11001                                  | r                     |                                              | Reserve                                                               | d nar          | ameter (Do no                                                                  | t change                                    | )                            |                      |                                                          |                     |                                              |
| 1001                                   |                       |                                              |                                                                       | · ·            | ameter (Do no                                                                  | <b>.</b>                                    |                              |                      |                                                          |                     |                                              |
|                                        | r                     | n.0X00                                       | Reserve                                                               | d par          | ameter (Do no                                                                  | ot change.                                  | )                            |                      |                                                          |                     |                                              |
|                                        | r                     |                                              | Reserve                                                               | d par          | ζ.                                                                             | ot change.                                  | )                            |                      |                                                          |                     |                                              |
|                                        | r                     | n.0X00                                       | Reserve                                                               | d par          | ameter (Do no                                                                  | ot change.                                  | )                            | All                  | Immedi-<br>ately                                         | Tuning              | page<br>8-79                                 |
| Pn100                                  | r                     | n.DXDD                                       | Reserve                                                               | d par          | ameter (Do no<br>ameter (Do no                                                 | t change.<br>t change.<br>0.1 Hz            | )                            | All                  |                                                          | Tuning              |                                              |
| <sup>2</sup> n100<br><sup>2</sup> n101 | r<br>r<br>2           | Speed Lo<br>Time Co                          | Reserve                                                               | d par          | ameter (Do no<br>ameter (Do no<br>10 to 20,000                                 | t change.<br>t change.<br>0.1 Hz            | ) 400                        |                      | ately<br>Immedi-                                         |                     | 8-79<br>page<br>8-79                         |
| Pn100<br>Pn101<br>Pn102<br>Pn103       | r<br>2<br>2           | Speed La<br>Speed La<br>Time Con<br>Position | Reserve<br>Reserve                                                    | d par<br>d par | ameter (Do no<br>ameter (Do no<br>10 to 20,000<br>15 to 51,200                 | t change.<br>t change.<br>0.1 Hz<br>0.01 ms | )<br>)<br>400<br>2000        | All                  | ately<br>Immedi-<br>ately<br>Immedi-                     | Tuning              | 8-79<br>page                                 |
| Pn100<br>Pn101<br>Pn102                | r<br>r<br>2<br>2<br>2 | A. D.    | Reserve<br>Reserve<br>Dop Gain<br>Dop Integra<br>Instant<br>Loop Gain | d par<br>d par | ameter (Do no<br>ameter (Do no<br>10 to 20,000<br>15 to 51,200<br>10 to 20,000 | 0.1 Hz<br>0.01 ms<br>0.1/s                  | )<br>)<br>400<br>2000<br>400 | All                  | ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi- | Tuning<br>Tuning    | 8-79<br>page<br>8-79<br>page<br>8-79<br>page |

|                  |      |                            |                             |                                            |                            |                    |                      | inued from       |                     |                               |
|------------------|------|----------------------------|-----------------------------|--------------------------------------------|----------------------------|--------------------|----------------------|------------------|---------------------|-------------------------------|
| Parameter<br>No. | Size | N                          | lame                        | Setting<br>Range                           | Setting<br>Unit            | Default<br>Setting | Applicable<br>Motors | When<br>Enabled  | Classi-<br>fication | Refer-<br>ence                |
| Pn106            | 2    | Second Po<br>Gain          | osition Loop                | 10 to 20,000                               | 0.1/s                      | 400                | All                  | Immedi-<br>ately | Tuning              | page<br>8-66                  |
| Pn109            | 2    | Feedforwa                  | ırd                         | 0 to 100                                   | 1%                         | 0                  | All                  | Immedi-<br>ately | Tuning              | page<br>8-89                  |
| Pn10A            | 2    | Feedforwa<br>Constant      | rd Filter Tim               | e 0 to 6,400                               | 0.01 ms                    | 0                  | All                  | Immedi-<br>ately | Tuning              | page<br>8-89                  |
|                  | 2    | Gain Appli<br>tions        | cation Selec                | e- 0000h to<br>5334h                       | -                          | 0000h              | All                  | -                | Setup               | -                             |
|                  | Ι.   |                            | 1                           |                                            |                            |                    |                      |                  |                     |                               |
|                  |      |                            | Mode Swit                   | ching Selection                            |                            |                    |                      | When<br>Enabled  | Refere              | ence                          |
|                  |      |                            |                             | Use the internal to<br>level setting: Pn10 |                            | ence as th         | e condition          |                  |                     |                               |
|                  |      |                            | 1 L                         | Jse the speed refeing: Pn10D).             | erence as                  | the condit         | ion (level set-      |                  |                     |                               |
|                  |      | 1.000X                     | l                           | Jse the speed refing: Pn181).              | erence as                  | the condit         | ion (level set-      |                  |                     |                               |
|                  |      |                            |                             | Use the accelerati setting: Pn10E).        | on referen                 | ce as the o        | condition (level     | Immedi-<br>ately | page 8              | 3-90                          |
| Pn10B            |      |                            | l                           | Jse the accelerati<br>setting: Pn182).     | on referen                 | ce as the o        | condition (level     | l                |                     |                               |
|                  |      |                            |                             | Jse the position d<br>ing: Pn10F).         | leviation as               | s the cond         | ition (level set-    |                  |                     |                               |
|                  |      |                            | 4 [                         | Do not use mode                            | switching.                 |                    |                      |                  |                     |                               |
|                  |      |                            | Speed Loo                   | op Control Metho                           | d                          |                    |                      | When<br>Enabled  | Refere              | ence                          |
|                  | 1    | n.00X0                     |                             | PI control<br>-P control                   |                            |                    |                      | After            |                     |                               |
|                  |      |                            |                             | Reserved paramet                           | ters (Do no                | ot change.)        | )                    | restart          | page 8              | 5-00                          |
|                  |      | n.OXOO                     | Reserved                    | parameter (Do no                           | ot change.                 | )                  |                      |                  |                     |                               |
|                  |      | n.XDDD                     | Reserved                    | parameter (Do no                           | ot change.                 | )                  |                      |                  |                     |                               |
|                  |      | 1                          |                             |                                            |                            |                    | 1                    |                  | 1                   |                               |
| Pn10C            | 2    | for Torque                 | tching Level<br>Reference   | 0 to 800                                   | 1%                         | 200                | All                  | Immedi-<br>ately | Tuning              | page<br>8-90                  |
| Pn10D            | 2    | Mode Swit<br>for Speed     | tching Level<br>Reference   | 0 to 10,000                                | 1 min <sup>-1</sup>        | 0                  | Rotary               | Immedi-<br>ately | Tuning              | page<br>8-90                  |
| Pn10E            | 2    | Mode Swit<br>for Acceler   | tching Level<br>ration      | 0 to 30,000                                | 1 min <sup>-1</sup> /<br>s | 0                  | Rotary               | Immedi-<br>ately | Tuning              | page<br>8-90                  |
| Pn10F            | 2    | Mode Swit<br>for Position  | tching Level<br>n Deviation | 0 to 10,000                                | 1 refer-<br>ence<br>unit   | 0                  | All                  | Immedi-<br>ately | Tuning              | page<br>8-90                  |
| Pn11F            | 2    | Position In<br>Constant    | tegral Time                 | 0 to 50,000                                | 0.1 ms                     | 0                  | All                  | Immedi-<br>ately | Tuning              | page<br>8-92                  |
| Pn121            | 2    | Friction Co<br>Gain        | ompensatior                 | 10 to 1,000                                | 1%                         | 100                | All                  | Immedi-<br>ately | Tuning              | page<br>8-66,<br>page<br>8-69 |
| Pn122            | 2    | Second Fr<br>pensation     | iction Com-<br>Gain         | 10 to 1,000                                | 1%                         | 100                | All                  | Immedi-<br>ately | Tuning              | page<br>8-66,<br>page<br>8-69 |
|                  | 2    | Friction Co<br>Coefficient | ompensatior                 | 0 to 100                                   | 1%                         | 0                  | All                  | Immedi-<br>ately | Tuning              | page<br>8-69                  |
| Pn123            |      |                            |                             | -10,000 to                                 | 0.1 Hz                     | 0                  | All                  | Immedi-          | Tuning              | page<br>8-69                  |
| Pn123<br>Pn124   | 2    | Friction Co<br>Frequency   | Correction                  | 10,000                                     | 0.1 HZ                     | 0                  |                      | ately            | Ŭ                   | 8-69                          |
|                  | 2    | Frequency                  | Correction                  | 10,000                                     | 1%                         | 100                | All                  | Immedi-<br>ately | Tuning              | 8-69<br>page<br>8-69          |

Parameter Lists

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|                  |      | - <b>T</b>               |            |        |                                                        | <b>i</b>        |                    | Con                  | tinued from      | n previous          | s page.        |
|------------------|------|--------------------------|------------|--------|--------------------------------------------------------|-----------------|--------------------|----------------------|------------------|---------------------|----------------|
| Parameter<br>No. | Size | Ν                        | lame       |        | Setting<br>Range                                       | Setting<br>Unit | Default<br>Setting | Applicable<br>Motors | When<br>Enabled  | Classi-<br>fication | Refer-<br>ence |
| Pn132            | 2    | Gain Swite               | ching Time | 2      | 0 to 65,535                                            | 1 ms            | 0                  | All                  | Immedi-<br>ately | Tuning              | page<br>8-66   |
| Pn135            | 2    | Gain Swite<br>Time 1     | ching Wait | ing    | 0 to 65,535                                            | 1 ms            | 0                  | All                  | Immedi-<br>ately | Tuning              | page<br>8-66   |
| Pn136            | 2    | Gain Swite<br>Time 2     | ching Wait | ing    | 0 to 65,535                                            | 1 ms            | 0                  | All                  | Immedi-<br>ately | Tuning              | page<br>8-66   |
|                  | 2    | Automatic<br>ing Select  |            | ch-    | 0000h to<br>0052h                                      | _               | 0000h              | All                  | Immedi-<br>ately | Tuning              | page<br>8-66   |
|                  |      |                          | Coin Sw    | itchi  | ng Selection                                           |                 |                    |                      |                  |                     |                |
|                  |      |                          | 0          | 1      | able automatic                                         | goin ouite      | hing               |                      |                  |                     |                |
|                  |      | n.🗆 🗆 🗆 X                | 1          |        | served paramet                                         | -               | -                  |                      |                  |                     |                |
|                  |      |                          | 2          |        | •                                                      |                 | 0 /                |                      |                  |                     |                |
|                  |      |                          | 2          | EUS    | ble automatic                                          | gain switc      | ning.              |                      |                  |                     |                |
|                  |      |                          | Gain Sw    | itchiı | ng Condition A                                         | •               |                    |                      |                  |                     |                |
| Pn139            |      |                          | 0          | /CC    | DIN (Positioning                                       | Completi        | on Output)         | ) signal turns       | ON.              |                     |                |
|                  |      |                          | 1          | /CC    | DIN (Positioning                                       | Completi        | on Output)         | ) signal turns       | OFF.             |                     |                |
|                  |      | n.DDXD                   | 2          | /NE    | AR (Near Outp                                          | ut) signal      | turns ON.          |                      |                  |                     |                |
|                  |      |                          | 3          |        | AR (Near Outp                                          |                 |                    |                      |                  |                     |                |
|                  |      |                          | 4          | Pos    | sition reference                                       | filter outp     | ut is 0 and        | position refe        | rence input i    | s OFF.              |                |
|                  |      |                          | 5          |        | sition reference                                       |                 |                    |                      | ·                |                     |                |
|                  |      |                          | -          |        |                                                        |                 |                    |                      |                  |                     |                |
|                  |      | n.¤X¤¤                   | Reserve    | d pai  | rameter (Do no                                         | ot change.      | )                  |                      |                  |                     |                |
|                  |      | n.XDDD                   | Reserve    | d pai  | rameter (Do no                                         | t change.       | )                  |                      |                  |                     |                |
| Pn13D            | 2    | Current G                | ain Level  |        | 100 to 2,000                                           | 1%              | 2000               | All                  | Immedi-<br>ately | Tuning              | page<br>8-73   |
|                  | 2    | Model Fol<br>trol-Relate |            |        | 0000h to<br>1121h                                      | _               | 0100h              | All                  | Immedi-<br>ately | Tuning              | _              |
|                  |      | 1                        |            |        | 1                                                      | 1               | <u> </u>           | 1                    | ļ <u> </u>       | 1                   | 4              |
|                  |      |                          | Model Fo   | ollow  | ing Control Se                                         | lection         |                    |                      |                  |                     |                |
|                  | r    | n.000X                   | 0          | Do r   | not use model                                          | following       | control.           |                      |                  |                     | 00             |
|                  |      |                          | 1          | Use    | model following                                        | ng control      |                    |                      |                  | page 8              | -80            |
|                  | Ī    |                          | Vibration  | Sup    | pression Selec                                         | tion            |                    |                      |                  | Refere              | nce            |
|                  |      |                          | 0          | Do r   | not perform vib                                        | ration sup      | pression.          |                      |                  |                     |                |
| Pn140            | ſ    | 1.00X0                   | 1          | Perf   | orm vibration s                                        | uppressio       | n for a spe        | ecific frequenc      | cy.              | page 8              | -86            |
| FIII40           |      |                          | 2          | Perf   | orm vibration s                                        | uppressio       | n for two s        | specific freque      | encies.          |                     |                |
|                  | - 7  |                          | \/ibyer    | 0      |                                                        | traced 0        | la ati - r         |                      |                  | Def                 | 200            |
|                  |      |                          | vibration  |        | pression Adjus                                         |                 |                    | omotion" -           |                  | Refere              | nce            |
|                  | r    | 1.0X00                   | 0          | tion   | not adjust vibra<br>of autotuning v<br>rence, and cust | vithout a h     | ost referer        |                      |                  |                     |                |
|                  |      |                          | 1          | auto   | ist vibration sup<br>otuning without<br>e, and custom  | a host ref      |                    |                      |                  | — page 8            | -32            |
|                  | r    | n.X000                   | Reserved   |        | ameter (Do not                                         | 0               |                    |                      |                  |                     |                |
|                  |      |                          |            |        |                                                        |                 |                    |                      |                  |                     |                |
| Pn141            | 2    | Model Fol<br>trol Gain   | lowing Co  | ז-     | 10 to 20,000                                           | 0.1/s           | 500                | All                  | Immedi-<br>ately | Tuning              | page<br>8-86   |
|                  | 2    | Model Fol<br>trol Gain ( |            | า-     | 500 to 2,000                                           | 0.1%            | 1000               | All                  | Immedi-<br>ately | Tuning              | _              |
| Pn142            |      | tior dain c              |            |        |                                                        |                 |                    |                      | ,                |                     |                |

|                  |      |                           |                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                        |                    |                      | tinued from      |                     | s page.        |
|------------------|------|---------------------------|---------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|--------------------|----------------------|------------------|---------------------|----------------|
| Parameter<br>No. | Size | ٩                         | lame                                  | Setting<br>Range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Setting<br>Unit                        | Default<br>Setting | Applicable<br>Motors | When<br>Enabled  | Classi-<br>fication | Refer-<br>ence |
| Pn144            | 2    |                           | lowing Con-<br>a the Reverse          | 0 to 10,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.1%                                   | 1000               | All                  | Immedi-<br>ately | Tuning              | page<br>8-86   |
| Pn145            | 2    | Vibration S<br>Frequency  | Suppression 1                         | 10 to 2,500                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.1 Hz                                 | 500                | All                  | Immedi-<br>ately | Tuning              | page<br>8-59   |
| Pn146            | 2    | Vibration S<br>Frequency  | Suppression 1                         | 10 to 2,500                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.1 Hz                                 | 700                | All                  | Immedi-<br>ately | Tuning              | page<br>8-59   |
| Pn147            | 2    |                           | lowing Con-<br>I Feedforward<br>ation | 0 to 10,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.1%                                   | 1000               | All                  | Immedi-<br>ately | Tuning              | page<br>8-86   |
| Pn148            | 2    | Second M<br>ing Contro    | odel Follow-<br>I Gain                | 10 to 20,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.1/s                                  | 500                | All                  | Immedi-<br>ately | Tuning              | -              |
| Pn149            | 2    |                           | odel Follow-<br>I Gain Correc-        | 500 to 2,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.1%                                   | 1000               | All                  | Immedi-<br>ately | Tuning              | _              |
| Pn14A            | 2    | Vibration S<br>Frequency  | Suppression 2                         | 10 to 2,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0.1 Hz                                 | 800                | All                  | Immedi-<br>ately | Tuning              | page<br>8-59   |
| Pn14B            | 2    | Vibration S<br>Correction | Suppression 2                         | 10 to 1,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1%                                     | 100                | All                  | Immedi-<br>ately | Tuning              | page<br>8-59   |
|                  | 2    | Control-Re<br>tions       | elated Selec-                         | 0000h to<br>0021h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -                                      | 0021h              | All                  | After<br>restart | Tuning              | _              |
|                  | r    | n.000X                    | 0 Use<br>1 Use                        | ving Control Ty<br>e model followir<br>e model followir                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ng control                             | type 1.            |                      |                  | Refere              | 3-89           |
| Pn14F            | r    | n.00X0                    | 0 Use<br>1 Use                        | ype Selection<br>tuning-less type<br>tuning-less type | pe 2.                                  |                    |                      |                  | Page 8              |                |
|                  | r    | n.0X00                    | Reserved par                          | rameter (Do no                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | t change.                              | )                  |                      |                  |                     |                |
|                  | r    | n.X000                    | Reserved par                          | rameter (Do no                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | t change.                              | )                  |                      |                  |                     |                |
|                  | 2    |                           | nance Con-<br>d Selections            | 0000h to<br>0011h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | _                                      | 0010h              | All                  | Immedi-<br>ately | Tuning              | _              |
|                  |      |                           | Anti-Resonan                          | ce Control Sel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ection                                 |                    |                      |                  | Refere              | ence           |
|                  | n    | X                         |                                       | not use anti-res<br>anti-resonance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                        | ontrol.            |                      |                  | page 8              | 3-51           |
|                  | -    |                           |                                       | ce Control Ad                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                        | Selection          |                      |                  | Refere              | nce            |
| Pn160            |      |                           | Do                                    | not adjust anti-<br>of autotuning v                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | resonance                              | e control a        |                      |                  |                     |                |
|                  | n    | I.OOXO                    | refe<br>Adju<br>1 auto                | rence, and cus<br>ust anti-resonal<br>otuning without<br>e, and custom                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | tom tuning<br>nce contro<br>a host ref | g.<br>I automati   | cally during e       | xecution of      | page 8              | 8-31           |
|                  | n    |                           | Reserved par                          | ameter (Do no                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | t change.)                             |                    |                      |                  |                     |                |
|                  | n    | .X000                     | Reserved par                          | ameter (Do no                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | t change.)                             |                    |                      |                  |                     |                |
| Pn161            | 2    | Anti-Reso<br>quency       | nance Fre-                            | 10 to 20,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0.1 Hz                                 | 1000               | All                  | Immedi-<br>ately | Tuning              | page<br>8-51   |
| Pn162            | 2    |                           | nance Gain                            | 1 to 1,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1%                                     | 100                | All                  | Immedi-<br>ately | Tuning              | page<br>8-51   |
| Pn163            | 2    |                           | nance Damp-                           | 0 to 300                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1%                                     | 0                  | All                  | Immedi-<br>ately | Tuning              | page<br>8-51   |
|                  |      | ing Gain                  |                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                        |                    |                      | Continue         |                     |                |

Parameter Lists

15

|                  |      |                          |                              |                    |                                                    |                                      |                            |                                | tinued from                   |                     | <u> </u>      |
|------------------|------|--------------------------|------------------------------|--------------------|----------------------------------------------------|--------------------------------------|----------------------------|--------------------------------|-------------------------------|---------------------|---------------|
| Parameter<br>No. | Size |                          | Name                         |                    | Setting<br>Range                                   | Setting<br>Unit                      | Default<br>Setting         | Applicable<br>Motors           | When<br>Enabled               | Classi-<br>fication | Refer<br>ence |
| Pn164            | 2    |                          | onance Filte<br>Istant 1 Cor |                    | -1,000 to<br>1,000                                 | 0.01 ms                              | 0                          | All                            | Immedi-<br>ately              | Tuning              | page<br>8-51  |
| Pn165            | 2    |                          | onance Filte<br>Istant 2 Cor |                    | -1,000 to<br>1,000                                 | 0.01 ms                              | 0                          | All                            | Immedi-<br>ately              | Tuning              | page<br>8-51  |
| Pn166            | 2    | Anti-Reso<br>ing Gain 2  | onance Dan<br>2              | np-                | 0 to 1,000                                         | 1%                                   | 0                          | All                            | Immedi-<br>ately              | Tuning              | page<br>8-54  |
|                  | 2    | Tuning-le<br>Related S   | ss Function<br>Selections    | -                  | 0000h to<br>2711h                                  | -                                    | 1401h                      | All                            | _                             | Setup               | page<br>8-11  |
|                  |      |                          | Tuning-les                   | ss Se              | lection                                            |                                      |                            |                                |                               | When<br>Enable      |               |
|                  | n    | .000X                    | 0                            | Disab              | ole tuning-less                                    | function.                            |                            |                                |                               | After               |               |
|                  |      |                          | 1                            | Enab               | le tuning-less                                     | function.                            |                            |                                |                               | resta               | π             |
| - 170            | n    | .00X0                    | Reserved                     | para               | meter (Do not                                      | change.)                             |                            |                                |                               |                     |               |
| Pn170            | n    | .0X00                    | Rigidity Le                  | evel               |                                                    |                                      |                            |                                |                               | When<br>Enable      |               |
|                  |      |                          | 0 to 7                       | Set tl             | he rigidity leve                                   | l.                                   |                            |                                |                               | Immeo<br>ately      |               |
|                  |      | .X000                    | Tuning-les                   | ss Lo              | ad Level                                           |                                      |                            |                                |                               | When<br>Enable      |               |
|                  |      |                          | 0 to 2                       | Set tl             | he load level fo                                   | or the tunir                         | ng-less fun                | ction.                         |                               | Immed<br>ately      |               |
| Pn181            | 2    |                          | vitching Leve<br>d Reference |                    | 0 to 10,000                                        | 1 mm/s                               | 0                          | Linear                         | Immedi-<br>ately              | Tuning              | page<br>8-90  |
| Pn182            | 2    | Mode Sw<br>for Accele    | vitching Leve<br>eration     | el                 | 0 to 30,000                                        | 1 mm/<br>s <sup>2</sup>              | 0                          | Linear                         | Immedi-<br>ately              | Tuning              | page<br>8-90  |
| Pn205            | 2    | Multiturn                | Limit                        |                    | 0 to 65,535                                        | 1 rev                                | 65535                      | Rotary                         | After<br>restart              | Setup               | page<br>6-19  |
|                  | 2    | Position (<br>tion Selec | Control Fund                 | C-                 | 0000h to<br>2210h                                  | -                                    | 0010h                      | All                            | After<br>restart              | Setup               | _             |
|                  |      |                          |                              |                    |                                                    |                                      |                            |                                |                               |                     |               |
|                  | 1    | n.000X                   | Reserved                     | d par              | ameter (Do no                                      | ot change.                           | )                          |                                |                               |                     |               |
|                  |      | n.00X0                   | Reserved                     | d para             | ameter (Do no                                      | ot change.                           | )                          |                                |                               |                     |               |
|                  | 1    | n.OXOO                   | Reserved                     | d para             | ameter (Do no                                      | ot change.                           | )                          |                                |                               |                     |               |
| Pn207            |      |                          | /COIN (P                     | ositio             | oning Comple                                       | tion Outpu                           | ut) Signal (               | Output Timin                   | g                             | Refe                |               |
|                  |      |                          | 0                            | Outr<br>sam<br>Wid | out when the a<br>le or less than<br>th).          | absolute va<br>the setting           | alue of the<br>g of Pn522  | position devia<br>(Positioning | ation is the<br>Completed     |                     |               |
|                  | 1    | n.X000                   | 1                            | or le              | out when the a<br>ess than the se<br>the reference | etting of Pr                         | 1522 (Posit                | ioning Comp                    | leted Width)                  |                     | 8-66          |
|                  |      |                          | 2                            | or le              | out when the a<br>ess than the se<br>the reference | etting of Pr                         | alue of the<br>1522 (Posit | position error<br>ioning Comp  | r is the same<br>leted Width) | )                   |               |
| Pn20A            | 4    |                          | of External<br>Scale Pitche  | es                 | 4 to<br>1,048,576                                  | 1 scale<br>pitch/<br>revolu-<br>tion | 32768                      | Rotary                         | After<br>restart              | Setup               | page<br>10-7  |
|                  |      |                          |                              | <u>,</u>           | 1 to                                               |                                      |                            |                                | After                         |                     | page          |
| Pn20E            | 4    | (Numerat                 | c Gear Ratio<br>or)          |                    | 1,073,741,824                                      | 1                                    | 64                         | All                            | restart                       | Setup               | 5-41          |

|  | Continued | from | previous | page. |
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                   | Classi-<br>fication                                         | Refer-<br>ence                                                                                                    |
| Pn212                                                       | 4                                    | Number of<br>Output Pu                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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                   | Setup                                                       | page<br>6-14                                                                                                      |
| Pn217                                                       | 2                                    | Reserved<br>(Do not ch                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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                   | Setup                                                       | page<br>10-9                                                                                                      |
|                                                             | I                                    | n.DDDX                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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| Pn230                                                       |                                      | n.000X<br>n.00X0<br>n.0X00<br>n.X000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              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                   | - page 8-                                                   | /5<br>                                                                                                            |
| Pn230<br>Pn231                                              |                                      | n. D X D<br>n. D X D D<br>n. X D D D                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| Pn231                                                       |                                      | n. 🗆 🗆 X 🗆<br>n. 🗆 X 🗆 🗆<br>n. X 🗆 🗆<br>Backlash (<br>tion Value)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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| Pn231<br>Pn233                                              | 4                                    | n. □ □ X □<br>n. □ X □ □<br>n. X □ □<br>Backlash (<br>tion Value<br>Backlash (<br>tion Time (                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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|                                                             | 4                                    | n. □ □ X □<br>n. □ X □ □<br>n. X □ □<br>N. X □ □ □<br>Backlash (<br>tion Value<br>Backlash (<br>tion Time (<br>Encoder C<br>tion                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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                                                                                                                                                                                                                                                                                                                                                            | acklash fo<br>t change.)<br>t change.)<br>t change.)<br>0.1 ref-<br>erence<br>units<br>0.01 ms<br>1 edge/                                                                                                                                                                                              | 0                                            | All                                                 | ately<br>Immedi-<br>ately<br>After                                                                                            | Setup                                                       | page<br>8-75<br>page<br>8-76<br>page                                                                              |
| Pn231<br>Pn233<br>Pn281                                     | 4                                    | n. □ □ X □<br>n. □ X □ □<br>n. X □ □<br>Backlash (<br>tion Value<br>Backlash (<br>tion Time (<br>Encoder C<br>tion<br>Linear Enc                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1     Con       Reserved par       Reserved par       Reserved par       Compensa-       Constant       Dutput Resolu-       oder Scale                                                                                       | npensate for ba<br>ameter (Do no<br>ameter (Do no<br>ameter (Do no<br>-500,000 to<br>500,000<br>0 to 65,535<br>1 to 4,096<br>0 to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | acklash fo<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>0.1 ref-<br>erence<br>units<br>0.01 ms<br>1 edge/<br>pitch<br>0.01                                                                                                                                                               | 0 0 20                                       | All<br>All<br>All                                   | ately<br>Immedi-<br>ately<br>After<br>restart<br>After                                                                        | Setup<br>Setup<br>Setup                                     | page<br>8-75<br>page<br>8-76<br>page<br>6-15<br>page                                                              |
| Pn231<br>Pn233<br>Pn281<br>Pn282                            | 4 2 4                                | n. DXD<br>n. DXDD<br>n. XDDD<br>N. XDDD<br>Backlash (<br>tion Value<br>Backlash (<br>tion Time (<br>Encoder C<br>tion<br>Linear Enc<br>Pitch<br>Jogging S                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1     Con       Reserved par       Reserved par       Reserved par       Compensa-       Constant       Dutput Resolu-       oder Scale                                                                                       | npensate for ba<br>ameter (Do no<br>ameter (Do no<br>ameter (Do no<br>ameter (Do no<br>-500,000 to<br>500,000<br>0 to 65,535<br>1 to 4,096<br>0 to<br>6,553,600                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | acklash fo<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>0.1 ref-<br>erence<br>units<br>0.01 ms<br>1 edge/<br>pitch<br>0.01<br>μm<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Drive:<br>0.1                                                  | 0 0 20 0                                     | All<br>All<br>All<br>Linear                         | ately<br>Immedi-<br>ately<br>After<br>restart<br>After<br>restart                                                             | Setup<br>Setup<br>Setup<br>Setup                            | page<br>8-75<br>page<br>8-76<br>page<br>6-15<br>page<br>5-17                                                      |
| Pn231<br>Pn233<br>Pn281<br>Pn282<br>Pn304<br>Pn305          | 4 2 4 2 2 4                          | n. DXD<br>n. DXDD<br>n. XDDD<br>n. XDDD<br>Backlash (<br>tion Value<br>Backlash (<br>tion Time (<br>Encoder C<br>tion<br>Linear Enc<br>Pitch<br>Jogging S<br>Jogging S                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1     Con       Reserved par       Reserved par       Reserved par       Compensa-       Compensa-       Constant       Dutput Resolu-       coder Scale                                                                      | npensate for ba<br>ameter (Do no<br>ameter (Do no<br>ameter (Do no<br>ameter (Do no<br>-500,000 to<br>500,000<br>0 to 65,535<br>1 to 4,096<br>0 to<br>6,553,600<br>0 to 10,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | acklash fo<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>0.1 ref-<br>erence<br>units<br>0.01 ms<br>1 edge/<br>pitch<br>0.01<br>μm<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Drive:<br>0.1<br>min <sup>-1</sup> | 000000000000000000000000000000000000000      | All<br>All<br>All<br>Linear<br>Rotary               | ately<br>Immedi-<br>ately<br>After<br>restart<br>After<br>restart<br>Immedi-<br>ately                                         | Setup<br>Setup<br>Setup<br>Setup<br>Setup                   | page<br>8-75<br>page<br>8-76<br>page<br>6-15<br>page<br>5-17<br>page<br>7-6                                       |
| Pn231<br>Pn233<br>Pn281<br>Pn282<br>Pn304                   | 4 2 4 2 2 2 2 2                      | n. DXD<br>n. DXDD<br>n. XDDD<br>n. XDDD<br>Backlash (<br>tion Value<br>Backlash (<br>tion Time (<br>Encoder C<br>tion<br>Linear Enc<br>Pitch<br>Jogging S<br>Jogging S<br>Soft Start<br>Time                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1     Con       Reserved par       Reserved par       Reserved par       Compensa-       Compensa-       Constant       Dutput Resolu-       coder Scale       peed       Acceleration       Deceleration       adback Filter | npensate for ba<br>ameter (Do no<br>ameter (Do no<br>ameter (Do no<br>ameter (Do no<br>ameter (Do no<br>constant<br>-500,000 to<br>500,000<br>0 to 65,535<br>1 to 4,096<br>0 to<br>6,553,600<br>0 to 10,000<br>0 to 10,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | acklash fo<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>0.1 ref-<br>erence<br>units<br>0.01 ms<br>1 edge/<br>pitch<br>0.01<br>μm<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Drive:<br>0.1<br>min <sup>-1</sup>                                           | 000000000000000000000000000000000000000      | All<br>All<br>All<br>Linear<br>Rotary<br>All        | ately<br>Immedi-<br>ately<br>After<br>restart<br>After<br>restart<br>Immedi-<br>ately<br>Immedi-<br>ately                     | Setup<br>Setup<br>Setup<br>Setup<br>Setup<br>Setup          | page<br>8-75<br>page<br>8-76<br>page<br>6-15<br>page<br>5-17<br>page<br>7-6<br>page<br>7-6<br>page                |
| Pn231<br>Pn233<br>Pn281<br>Pn282<br>Pn304<br>Pn305<br>Pn306 | 4<br>2<br>2<br>4<br>2<br>2<br>2<br>2 | n. D X D<br>n. D X D<br>n. D X D<br>n. X D D D<br>N. X | 1     Con       Reserved par       Reserved par       Reserved par       Compensa-       Compensa-       Constant       Dutput Resolu-       coder Scale       peed       Acceleration       Deceleration       adback Filter | ameter (Do no<br>ameter (Do no<br>ameter (Do no<br>ameter (Do no<br>ameter (Do no<br>ameter (Do no<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant<br>constant | acklash fo<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>t change.)<br>0.1 ref-<br>erence<br>units<br>0.01 ms<br>1 edge/<br>pitch<br>0.01<br>μm<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Drive:<br>0.1<br>min <sup>-1</sup><br>1 ms<br>1 ms                                         | 0<br>0<br>0<br>20<br>0<br>500<br>0<br>0<br>0 | All<br>All<br>All<br>Linear<br>Rotary<br>All<br>All | ately<br>Immedi-<br>ately<br>After<br>restart<br>After<br>restart<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately | Setup<br>Setup<br>Setup<br>Setup<br>Setup<br>Setup<br>Setup | page<br>8-75<br>page<br>8-76<br>page<br>6-15<br>page<br>5-17<br>page<br>7-6<br>page<br>7-6<br>page<br>7-6<br>page |

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|                  |      |                                                   |                             |                                                   |                     |                    | Con                  | tinued from      | n previous          | s page.        |  |  |
|------------------|------|---------------------------------------------------|-----------------------------|---------------------------------------------------|---------------------|--------------------|----------------------|------------------|---------------------|----------------|--|--|
| Parameter<br>No. | Size | Na                                                | ame                         | Setting<br>Range                                  | Setting<br>Unit     | Default<br>Setting | Applicable<br>Motors | When<br>Enabled  | Classi-<br>fication | Refer-<br>ence |  |  |
|                  | 2    | Vibration Detection<br>Selections                 |                             | 0000h to<br>0002h                                 | _                   | 0000h              | All                  | Immedi-<br>ately | Setup               | page<br>6-26   |  |  |
|                  |      |                                                   |                             |                                                   |                     |                    |                      |                  |                     |                |  |  |
|                  |      |                                                   | Vibration Det               | on Detection Selection                            |                     |                    |                      |                  |                     |                |  |  |
|                  |      |                                                   | 0 Do not detect vibration.  |                                                   |                     |                    |                      |                  |                     |                |  |  |
|                  | ſ    | n.000X                                            | 1 Out                       | put a warning                                     | (A.911) if v        | vibration is       | detected.            |                  |                     |                |  |  |
| Pn310            |      |                                                   | 2 Out                       | Output an alarm (A.520) if vibration is detected. |                     |                    |                      |                  |                     |                |  |  |
|                  | r    | n.00X0                                            | Reserved par                | ameter (Do no                                     | ot change.          | )                  |                      |                  |                     |                |  |  |
|                  | r    | n.0X00                                            | Reserved par                | rameter (Do no                                    | ot change.          | )                  |                      |                  |                     |                |  |  |
|                  | r    | n.X000                                            | Reserved par                | ameter (Do no                                     | ot change.          | )                  |                      |                  |                     |                |  |  |
|                  | _    |                                                   |                             |                                                   |                     |                    |                      |                  |                     |                |  |  |
| Pn311            | 2    | Vibration D sitivity                              | etection Sen-               | 50 to 500                                         | 1%                  | 100                | All                  | Immedi-<br>ately | Tuning              | page<br>6-26   |  |  |
| Pn312            | 2    | Vibration Detection<br>Level                      |                             | 0 to 5,000                                        | 1 min <sup>-1</sup> | 50                 | Rotary               | Immedi-<br>ately | Tuning              | page<br>6-26   |  |  |
| Pn316            | 2    | Maximum Motor Speed                               |                             | 0 to 65,535                                       | 1 min <sup>-1</sup> | 10000              | Rotary               | After<br>restart | Setup               | page<br>6-8    |  |  |
| Pn324            | 2    | Moment of Inertia Cal-<br>culation Starting Level |                             | 0 to 20,000                                       | 1%                  | 300                | All                  | Immedi-<br>ately | Setup               | page<br>8-30   |  |  |
| Pn383            | 2    | Jogging Sp                                        | beed                        | 0 to 10,000                                       | 1 mm/s              | 50                 | Linear               | Immedi-<br>ately | Setup               | page<br>7-6    |  |  |
| Pn384            | 2    | Vibration D<br>Level                              | etection                    | 0 to 5,000                                        | 1 mm/s              | 10                 | Linear               | Immedi-<br>ately | Tuning              | page<br>6-26   |  |  |
| Pn385            | 2    | Maximum N                                         | Notor Speed                 | 1 to 100                                          | 100<br>mm/s         | 50                 | Linear               | After<br>restart | Setup               | page<br>6-8    |  |  |
| Pn401            | 2    | First Stage<br>Reference<br>Constant              | First Torque<br>Filter Time | 0 to 65,535                                       | 0.01 ms             | 100                | All                  | Immedi-<br>ately | Tuning              | page<br>8-82   |  |  |
| Pn402            | 2    | Forward To                                        | orque Limit                 | 0 to 800                                          | 1% <sup>*1</sup>    | 800                | Rotary               | Immedi-<br>ately | Setup               | page<br>6-17   |  |  |
| Pn403            | 2    | Reverse To                                        | rque Limit                  | 0 to 800                                          | 1% <sup>*1</sup>    | 800                | Rotary               | Immedi-<br>ately | Setup               | page<br>6-17   |  |  |
| Pn404            | 2    | Reserved p<br>(Do not cha                         |                             | _                                                 | _                   | 100                | All                  | _                | _                   | -              |  |  |
| Pn405            | 2    | Reserved p<br>(Do not cha                         |                             | -                                                 | _                   | 100                | All                  | _                | -                   | -              |  |  |
| Pn406            | 2    | Emergency                                         | Stop Torque                 | 0 to 800                                          | 1% <sup>*1</sup>    | 800                | All                  | Immedi-<br>ately | Setup               | page<br>5-36   |  |  |
| Pn407            | 2    | Reserved p<br>(Do not cha                         |                             | _                                                 | -                   | 10000              | Rotary               | -                | -                   | -              |  |  |

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|   | 0011111000 |      | proviouo | page. |

| Parameter | Size                            |                                    | Name                                                                                             |                | Setting           | Setting      | Default | Applicable | When                    | Classi-   | Refer        |  |
|-----------|---------------------------------|------------------------------------|--------------------------------------------------------------------------------------------------|----------------|-------------------|--------------|---------|------------|-------------------------|-----------|--------------|--|
| No.       |                                 | Torque-B                           | elated Func-                                                                                     |                | Range<br>0000h to | Unit         | Setting | Motors     | Enabled                 | fication  | ence         |  |
|           | 2 tion Selections 1111h - 0000h |                                    |                                                                                                  |                |                   |              | All     | _          | Setup                   | _         |              |  |
|           |                                 |                                    |                                                                                                  |                |                   |              |         |            |                         |           |              |  |
|           |                                 |                                    | Notch Filter                                                                                     | er Selection 1 |                   |              |         |            | When<br>Enabled Referen |           | ice          |  |
|           | n.DDDX                          |                                    | 0 Disable first stage notch filter.                                                              |                |                   |              |         |            | Immedi-                 |           |              |  |
|           |                                 |                                    | 1 E                                                                                              | nabl           | e first stage n   | otch filter. |         |            | ately                   |           |              |  |
| D. 100    | n                               | .00X0                              | Reserved p                                                                                       | barar          | neter (Do not     | change.)     |         |            |                         |           |              |  |
| Pn408     |                                 |                                    | Notch Filter                                                                                     | r Sel          | lection 2         |              |         |            | When<br>Enabled         | Reference |              |  |
|           | n                               |                                    |                                                                                                  |                | le second sta     | <b>,</b>     |         |            | Immedi-                 | page 8-   | .82          |  |
|           |                                 |                                    | 1 E                                                                                              | nabl           | e second stag     | je notch fil | ter.    |            | ately                   | 19        |              |  |
|           |                                 |                                    | Friction Co                                                                                      | mpe            | ensation Func     | tion Selec   | tion    |            | When<br>Enabled         | Reference |              |  |
|           | n                               | .X000                              |                                                                                                  |                | le friction com   |              |         |            | Immedi-                 | page 8-   | 69           |  |
|           | -                               |                                    | 1 E                                                                                              | nabl           | e friction com    | pensation.   |         |            | ately                   |           |              |  |
| Pn409     | 2                               | First Stag                         | ge Notch Filte                                                                                   | er             | 50 to 5,000       | 1 Hz         | 5000    | All        | Immedi-<br>ately        | Tuning    | page<br>8-82 |  |
| Pn40A     | 2                               |                                    | ge Notch Filte                                                                                   | ər             | 50 to 1,000       | 0.01         | 70      | All        | Immedi-<br>ately        | Tuning    | page<br>8-82 |  |
| Pn40B     | 2                               | First Stag<br>Depth                | ge Notch Filte                                                                                   | ər             | 0 to 1,000        | 0.001        | 0       | All        | Immedi-<br>ately        | Tuning    | page<br>8-82 |  |
| Pn40C     | 2                               | Second S<br>ter Frequ              | Stage Notch I<br>ency                                                                            | Fil-           | 50 to 5,000       | 1 Hz         | 5000    | All        | Immedi-<br>ately        | Tuning    | page<br>8-82 |  |
| Pn40D     | 2                               | Second S<br>ter Q Valu             | Stage Notch I<br>Je                                                                              | Fil-           | 50 to 1,000       | 0.01         | 70      | All        | Immedi-<br>ately        | Tuning    | page<br>8-82 |  |
| Pn40E     | 2                               | Second S<br>ter Depth              | Stage Notch I                                                                                    | Fil-           | 0 to 1,000        | 0.001        | 0       | All        | Immedi-<br>ately        | Tuning    | page<br>8-82 |  |
| Pn40F     | 2                               | Second S<br>Torque R<br>Frequenc   | Stage Second<br>eference Filte<br>sy                                                             |                | 100 to 5,000      | 1 Hz         | 5000    | All        | Immedi-<br>ately        | Tuning    | page<br>8-82 |  |
| Pn410     | 2                               | Second S<br>Torque R<br>Q Value    | Stage Second<br>eference Filte                                                                   | d<br>ər        | 50 to 100         | 0.01         | 50      | All        | Immedi-<br>ately        | Tuning    | page<br>8-82 |  |
| Pn412     | 2                               | First Stag<br>Torque R<br>Time Cor | ge Second<br>eference Filte<br>Instant                                                           | ∋r             | 0 to 65,535       | 0.01 ms      | 100     | All        | Immedi-<br>ately        | Tuning    | page<br>8-66 |  |
|           | 2                               | Torque-R<br>tion Selec             | elated Func-<br>ctions 2                                                                         |                | 0000h to<br>1111h | -            | 0000h   | All        | Immedi-<br>ately        | Setup     | page<br>8-84 |  |
|           |                                 |                                    |                                                                                                  |                |                   |              |         |            |                         |           |              |  |
|           | Notch Filter Selection 3        |                                    |                                                                                                  |                |                   |              |         |            |                         |           |              |  |
|           |                                 | n.□□□X                             | O         Disable third stage notch filter.           1         Enable third stage notch filter. |                |                   |              |         |            |                         |           |              |  |
|           | i i                             | Notch Filter Selection 4           |                                                                                                  |                |                   |              |         |            |                         |           |              |  |
| Pn416     |                                 | n.DDXD                             |                                                                                                  |                | ble fourth stag   | ge notch fi  | ter.    |            |                         |           |              |  |
|           |                                 |                                    | 1     Enable fourth stage notch filter.                                                          |                |                   |              |         |            |                         |           |              |  |
|           |                                 |                                    | Notch Filte                                                                                      | er S           | election 5        |              |         |            |                         |           |              |  |
|           |                                 | n.¤X¤¤                             | 0 Disable fifth stage notch filter.                                                              |                |                   |              |         |            |                         |           |              |  |
|           |                                 |                                    | 1                                                                                                | Enak           | ble fifth stage i | notch filter |         |            |                         |           |              |  |
|           |                                 | n.X000                             | Reserved                                                                                         | para           | ameter (Do no     | t change.    | )       |            |                         |           |              |  |
|           |                                 | <b>T</b>                           | <b></b>                                                                                          |                |                   |              |         | <u> </u>   |                         |           |              |  |
| Pn417     | 2                               | I hird Sta                         | ge Notch Filt                                                                                    | er             | 50 to 5,000       | 1 Hz         | 5000    | All        | Immedi-<br>ately        | Tuning    | page         |  |

|                  |      |                                          |                                                                                    |                                                                                                                                                                                                   |                                                                        |                                     | Con                    | tinued from      | n previou           | s page.                                                        |
|------------------|------|------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|-------------------------------------|------------------------|------------------|---------------------|----------------------------------------------------------------|
| Parameter<br>No. | Size | N                                        | ame                                                                                | Setting<br>Range                                                                                                                                                                                  | Setting<br>Unit                                                        | Default<br>Setting                  | Applicable<br>Motors   | When<br>Enabled  | Classi-<br>fication | Refer-<br>ence                                                 |
| Pn418            | 2    | Third Stage<br>Q Value                   | e Notch Filte                                                                      | r 50 to 1,000                                                                                                                                                                                     | 0.01                                                                   | 70                                  | All                    | Immedi-<br>ately | Tuning              | page<br>8-84                                                   |
| Pn419            | 2    | Third Stage<br>Depth                     | e Notch Filte                                                                      | r 0 to 1,000                                                                                                                                                                                      | 0.001                                                                  | 0                                   | All                    | Immedi-<br>ately | Tuning              | page<br>8-84                                                   |
| Pn41A            | 2    | Fourth Sta<br>ter Freque                 | ge Notch Fil-<br>ncy                                                               | 50 to 5,000                                                                                                                                                                                       | 1 Hz                                                                   | 5000                                | All                    | Immedi-<br>ately | Tuning              | page<br>8-84                                                   |
| Pn41B            | 2    | Fourth Sta<br>ter Q Value                | ge Notch Fil·<br>e                                                                 | 50 to 1,000                                                                                                                                                                                       | 0.01                                                                   | 70                                  | All                    | Immedi-<br>ately | Tuning              | page<br>8-84                                                   |
| Pn41C            | 2    | ter Depth                                | ge Notch Fil-                                                                      | 0 10 1,000                                                                                                                                                                                        | 0.001                                                                  | 0                                   | All                    | Immedi-<br>ately | Tuning              | page<br>8-84                                                   |
| Pn41D            | 2    | Fifth Stage<br>Frequency                 | Notch Filter                                                                       | 50 to 5,000                                                                                                                                                                                       | 1 Hz                                                                   | 5000                                | All                    | Immedi-<br>ately | Tuning              | page<br>8-84                                                   |
| Pn41E            | 2    | Fifth Stage<br>Q Value                   | Notch Filter                                                                       | 50 to 1,000                                                                                                                                                                                       | 0.01                                                                   | 70                                  | All                    | Immedi-<br>ately | Tuning              | page<br>8-84                                                   |
| Pn41F            | 2    | Fifth Stage<br>Depth                     | Notch Filter                                                                       | 0 to 1,000                                                                                                                                                                                        | 0.001                                                                  | 0                                   | All                    | Immedi-<br>ately | Tuning              | page<br>8-83                                                   |
|                  | 2    | Speed Rip sation Sele                    | ple Compenections                                                                  | - 0000h to<br>1111h                                                                                                                                                                               | -                                                                      | 0000h                               | Rotary                 | _                | Setup               | page<br>8-64                                                   |
| Pn423            | r    |                                          | 0 D<br>1 E<br>Speed Ripp<br>tion Selecti<br>0 D<br>1 D<br>Speed Ripp<br>0 S<br>1 M | ble Compensation<br>isable speed ripp<br>nable speed ripp<br>ble Compensation<br>etect A.942 alarri<br>o not detect A.9<br>ble Compensation<br>peed reference<br>lotor speed<br>marameter (Do not | ole compe<br>le comper<br>on Informa<br>ms.<br>42 alarms.<br>on Enable | nsation.<br>Insation<br>Ition Disag | greement War           | ning Detec-      | Who<br>Enab         | edi-<br>edi-<br>ly<br>en<br>en<br>er<br>art<br>en<br>led<br>er |
| Pn424            | 2    | Torque Lim<br>cuit Voltag                | nit at Main Ci<br>e Drop                                                           | r- 0 to 100                                                                                                                                                                                       | 1%*1                                                                   | 50                                  | All                    | Immedi-<br>ately | Setup               | page<br>6-7                                                    |
| Pn425            | 2    | Release Tin<br>Limit at Ma<br>Voltage Dr |                                                                                    | e 0 to 1,000                                                                                                                                                                                      | 1 ms                                                                   | 100                                 | All                    | Immedi-<br>ately | Setup               | page<br>6-7                                                    |
| Pn426            | 2    | Reserved p<br>(Do not ch                 |                                                                                    | _                                                                                                                                                                                                 | -                                                                      | 0                                   | All                    | _                | _                   | _                                                              |
| Pn427            | 2    | Speed Rip<br>sation Ena                  | ple Compen<br>ble Speed                                                            | - 0 to 10,000                                                                                                                                                                                     | 1 min <sup>-1</sup>                                                    | 0                                   | Rotary Ser-<br>vomotor | Immedi-<br>ately | Tuning              | page<br>8-64                                                   |
| Pn456            | 2    | Sweep Tor<br>ence Ampl                   | que Refer-<br>itude                                                                | 1 to 800                                                                                                                                                                                          | 1%                                                                     | 15                                  | All                    | Immedi-<br>ately | Tuning              | page<br>8-98                                                   |
|                  |      | -                                        |                                                                                    |                                                                                                                                                                                                   | -                                                                      | -                                   |                        |                  | -                   | -                                                              |

Continued from previous page.

| Parameter                                                            | Ð                                                                        |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                  | Setting                                                                                                                                                                                                                                                                   | Setting                                                                                                                                      | Default                                                | Con<br>Applicable                                                            | When                                                                                                                                                   | Classi-                                                               | Refer                                  |  |  |  |
|----------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|----------------------------------------|--|--|--|
| No.                                                                  | Name                                                                     |                                                                                                                                                                                                                                                                                                               | Range                                                                                                                                                                                                                                                            | Unit                                                                                                                                                                                                                                                                      | Setting                                                                                                                                      | Motors                                                 | Enabled                                                                      | fication                                                                                                                                               | ence                                                                  |                                        |  |  |  |
|                                                                      | 2                                                                        | Notch Filte<br>Selections                                                                                                                                                                                                                                                                                     | er Adjustment<br>; 1                                                                                                                                                                                                                                             | 0000h to<br>0101h                                                                                                                                                                                                                                                         | _                                                                                                                                            | 0101h                                                  | All                                                                          | Immedi-<br>ately                                                                                                                                       | Tuning                                                                | page<br>8-14,<br>page<br>8-31          |  |  |  |
|                                                                      |                                                                          |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                           |                                                                                                                                              |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
| Pn460                                                                |                                                                          |                                                                                                                                                                                                                                                                                                               | Notch Filter                                                                                                                                                                                                                                                     | Adjustment Sel                                                                                                                                                                                                                                                            | ection 1                                                                                                                                     |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      |                                                                          | n.000X                                                                                                                                                                                                                                                                                                        | 0 tun                                                                                                                                                                                                                                                            | Do not adjust the first stage notch filter automatically during execution of auto-<br>tuning without a host reference, autotuning with a host reference, and custom tuning.                                                                                               |                                                                                                                                              |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      |                                                                          |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                  | Adjust the first stage notch filter automatically during execution of autotuning                                                                                                                                                                                          |                                                                                                                                              |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
| 1 11400                                                              |                                                                          | n.🗆 🗆 X 🗆                                                                                                                                                                                                                                                                                                     | Reserved pa                                                                                                                                                                                                                                                      | rameter (Do no                                                                                                                                                                                                                                                            | t change.                                                                                                                                    | )                                                      |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      | Ī                                                                        |                                                                                                                                                                                                                                                                                                               | Notch Filter                                                                                                                                                                                                                                                     | Adjustment Sel                                                                                                                                                                                                                                                            | ection 2                                                                                                                                     |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      |                                                                          | n.¤X¤¤                                                                                                                                                                                                                                                                                                        | 0 fun                                                                                                                                                                                                                                                            | not adjust the s<br>ction is enablec<br>otuning with a l                                                                                                                                                                                                                  | l or during                                                                                                                                  | execution                                              | of autotuning                                                                | y without a he                                                                                                                                         |                                                                       |                                        |  |  |  |
|                                                                      |                                                                          |                                                                                                                                                                                                                                                                                                               | 1 tion                                                                                                                                                                                                                                                           | autotuning with a host reference, and custom tuning.         Adjust the second stage notch filter automatically when the tuning-less function is enabled or during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning. |                                                                                                                                              |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      |                                                                          | n.XDDD                                                                                                                                                                                                                                                                                                        | Reserved pa                                                                                                                                                                                                                                                      | rameter (Do no                                                                                                                                                                                                                                                            | t change.                                                                                                                                    | )                                                      |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      | -                                                                        |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                           |                                                                                                                                              |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      | 2                                                                        | Gravity Co<br>Related Se                                                                                                                                                                                                                                                                                      | ompensation-<br>elections                                                                                                                                                                                                                                        | 0000h to<br>0001h                                                                                                                                                                                                                                                         | _                                                                                                                                            | 0000h                                                  | All                                                                          | After<br>restart                                                                                                                                       | Setup                                                                 | page<br>8-71                           |  |  |  |
|                                                                      | i                                                                        | n.□□□X Gravity Compensation Selection                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                           |                                                                                                                                              |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      | n.□□□X Gravity Compensation Selection<br>0 Disable gravity compensation. |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                           |                                                                                                                                              |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
| Pn475                                                                | 1 Enable gravity compensation.                                           |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                           |                                                                                                                                              |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      |                                                                          |                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                  | abio gravity con                                                                                                                                                                                                                                                          | iponoation                                                                                                                                   |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      | ]                                                                        | n.00X0                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                  | ameter (Do not                                                                                                                                                                                                                                                            | ·                                                                                                                                            |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      | ]                                                                        | n.00X0                                                                                                                                                                                                                                                                                                        | Reserved par                                                                                                                                                                                                                                                     | <u> </u>                                                                                                                                                                                                                                                                  | change.)                                                                                                                                     |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      |                                                                          |                                                                                                                                                                                                                                                                                                               | Reserved par                                                                                                                                                                                                                                                     | ameter (Do not                                                                                                                                                                                                                                                            | change.)<br>change.)                                                                                                                         |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
|                                                                      | ]                                                                        | n.0X00                                                                                                                                                                                                                                                                                                        | Reserved par<br>Reserved par<br>Reserved par                                                                                                                                                                                                                     | ameter (Do not<br>ameter (Do not<br>ameter (Do not                                                                                                                                                                                                                        | change.)<br>change.)                                                                                                                         |                                                        |                                                                              |                                                                                                                                                        |                                                                       |                                        |  |  |  |
| Pn476                                                                | 2                                                                        | n.0X00                                                                                                                                                                                                                                                                                                        | Reserved par                                                                                                                                                                                                                                                     | ameter (Do not<br>ameter (Do not                                                                                                                                                                                                                                          | change.)<br>change.)                                                                                                                         | 0                                                      | All                                                                          | Immedi-<br>ately                                                                                                                                       | Tuning                                                                | page<br>8-71                           |  |  |  |
| -                                                                    | 2                                                                        | n.□X□□<br>n.X□□□<br>Gravity Cc<br>Torque                                                                                                                                                                                                                                                                      | Reserved par<br>Reserved par<br>Reserved par<br>ompensation<br>parameter                                                                                                                                                                                         | ameter (Do not<br>ameter (Do not<br>ameter (Do not                                                                                                                                                                                                                        | change.)<br>change.)<br>change.)                                                                                                             |                                                        | All<br>Linear                                                                |                                                                                                                                                        | Tuning<br>–                                                           |                                        |  |  |  |
| Pn476<br>Pn480<br>Pn481                                              |                                                                          | n. DXDD<br>n. XDDD<br>Gravity Co<br>Torque<br>Reserved                                                                                                                                                                                                                                                        | Reserved par<br>Reserved par<br>Reserved par<br>ompensation<br>parameter<br>ange.)                                                                                                                                                                               | ameter (Do not<br>ameter (Do not<br>ameter (Do not                                                                                                                                                                                                                        | change.)<br>change.)<br>change.)                                                                                                             | 0                                                      |                                                                              |                                                                                                                                                        | Tuning<br>–<br>Tuning                                                 |                                        |  |  |  |
| Pn480                                                                | 2                                                                        | n. □X□□<br>n. X□□□<br>Gravity Co<br>Torque<br>Reserved<br>(Do not ch<br>Polarity De<br>Speed Loo                                                                                                                                                                                                              | Reserved par<br>Reserved par<br>Reserved par<br>mpensation<br>parameter<br>tange.)<br>stection<br>op Gain<br>stection<br>op Integral                                                                                                                             | ameter (Do not<br>ameter (Do not<br>ameter (Do not<br>-1,000 to<br>1,000                                                                                                                                                                                                  | change.)<br>change.)<br>change.)<br>0.1%                                                                                                     | 0 10000                                                | Linear                                                                       | ately<br>-<br>Immedi-                                                                                                                                  | -                                                                     |                                        |  |  |  |
| Pn480<br>Pn481                                                       | 2                                                                        | n. DXDD<br>n. XDDD<br>Gravity Cc<br>Torque<br>Reserved<br>(Do not ch<br>Polarity De<br>Speed Loo<br>Speed Loo                                                                                                                                                                                                 | Reserved par<br>Reserved par<br>Reserved par<br>ompensation<br>parameter<br>nange.)<br>etection<br>op Gain<br>etection<br>op Integral<br>stant                                                                                                                   | ameter (Do not<br>ameter (Do not<br>ameter (Do not<br>-1,000 to<br>1,000<br>-<br>10 to 20,000                                                                                                                                                                             | change.)<br>change.)<br>change.)<br>0.1%<br>-<br>0.1 Hz                                                                                      | 0<br>10000<br>400                                      | Linear<br>Linear                                                             | ately<br>–<br>Immedi-<br>ately<br>Immedi-                                                                                                              | –<br>Tuning                                                           | 8-71                                   |  |  |  |
| Pn480<br>Pn481<br>Pn482                                              | 2<br>2<br>2                                                              | n. DXDD<br>n. XDDD<br>Gravity Co<br>Torque<br>Reserved<br>(Do not ch<br>Polarity De<br>Speed Loo<br>Speed Loo<br>Time Cons                                                                                                                                                                                    | Reserved par<br>Reserved par<br>Reserved par<br>ompensation<br>parameter<br>nange.)<br>etection<br>op Gain<br>etection<br>op Integral<br>stant<br>orce Limit                                                                                                     | ameter (Do not<br>ameter (Do not<br>ameter (Do not<br>-1,000 to<br>1,000<br>-<br>10 to 20,000<br>15 to 51,200                                                                                                                                                             | change.)<br>change.)<br>change.)<br>0.1%<br>-<br>0.1 Hz<br>0.01 ms                                                                           | 0<br>10000<br>400<br>3000                              | Linear<br>Linear<br>Linear                                                   | ately<br>–<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-                                                                                          | -<br>Tuning<br>Tuning                                                 | 8-71<br>-<br>-<br>page<br>6-17         |  |  |  |
| Pn480<br>Pn481<br>Pn482<br>Pn483                                     | 2<br>2<br>2<br>2                                                         | n. □X□□<br>n. X□□□<br>Gravity Co<br>Torque<br>Reserved<br>(Do not ch<br>Polarity De<br>Speed Loo<br>Time Cons<br>Forward F<br>Reverse F<br>Polarity De<br>ence Spee                                                                                                                                           | Reserved par<br>Reserved par<br>Reserved par<br>mpensation<br>parameter<br>nange.)<br>etection<br>op Gain<br>etection<br>op Integral<br>stant<br>orce Limit<br>orce Limit<br>etection Refer-<br>ed                                                               | ameter (Do not<br>ameter (Do not<br>ameter (Do not<br>-1,000 to<br>1,000<br>-<br>10 to 20,000<br>15 to 51,200<br>0 to 800                                                                                                                                                 | change.)<br>change.)<br>change.)<br>0.1%<br>-<br>0.1 Hz<br>0.01 ms<br>1%* <sup>1</sup>                                                       | 0<br>10000<br>400<br>3000<br>30                        | Linear<br>Linear<br>Linear<br>Linear                                         | ately<br>-<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-                                                                      | -<br>Tuning<br>Tuning<br>Setup                                        | 8-71<br>-<br>-<br>page<br>6-17<br>page |  |  |  |
| Pn480<br>Pn481<br>Pn482<br>Pn483<br>Pn484                            | 2<br>2<br>2<br>2<br>2                                                    | n. □X□□<br>n. X□□□<br>Gravity Co<br>Torque<br>Reserved<br>(Do not ch<br>Polarity De<br>Speed Loo<br>Time Cons<br>Forward F<br>Reverse F<br>Polarity De<br>ence Spee                                                                                                                                           | Reserved par<br>Reserved par<br>Reserved par<br>ompensation<br>parameter<br>nange.)<br>etection<br>op Gain<br>etection<br>op Integral<br>stant<br>orce Limit<br>orce Limit<br>etection Refer-<br>ed<br>etection Refer-<br>ed                                     | ameter (Do not<br>ameter (Do not<br>ameter (Do not<br>-1,000 to<br>1,000<br>-<br>10 to 20,000<br>15 to 51,200<br>0 to 800<br>0 to 800                                                                                                                                     | change.)<br>change.)<br>change.)<br>0.1%<br>-<br>0.1 Hz<br>0.01 ms<br>1%* <sup>1</sup><br>1%* <sup>1</sup>                                   | 0<br>10000<br>400<br>3000<br>30<br>30                  | Linear<br>Linear<br>Linear<br>Linear<br>Linear                               | ately<br>–<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately                                         | -<br>Tuning<br>Tuning<br>Setup<br>Setup                               | 8-71<br>-<br>-<br>page<br>6-17<br>page |  |  |  |
| Pn480<br>Pn481<br>Pn482<br>Pn483<br>Pn483<br>Pn484<br>Pn485          | 2<br>2<br>2<br>2<br>2<br>2                                               | n. DXDD<br>n. XDDD<br>Gravity Cc<br>Torque<br>Reserved<br>(Do not ch<br>Polarity De<br>Speed Loo<br>Time Cons<br>Forward F<br>Reverse F<br>Polarity De<br>ence Spee<br>Polarity De<br>ence Spee<br>Polarity De<br>ence Acce<br>Decelerati<br>Polarity De<br>stant Spee                                        | Reserved par<br>Reserved par<br>Reserved par<br>mpensation<br>parameter<br>lange.)<br>etection<br>op Gain<br>etection<br>orce Limit<br>orce Limit<br>orce Limit<br>etection Refer-<br>etection Refer-<br>etection Con-<br>etection Con-<br>ed Time               | ameter (Do not<br>ameter (Do not<br>ameter (Do not<br>-1,000 to<br>1,000<br>-<br>10 to 20,000<br>15 to 51,200<br>0 to 800<br>0 to 800<br>0 to 100                                                                                                                         | change.)<br>change.)<br>change.)<br>0.1%<br>-<br>0.1 Hz<br>0.01 ms<br>1% <sup>*1</sup><br>1% <sup>*1</sup><br>1 mm/s                         | 0<br>10000<br>400<br>3000<br>30<br>30<br>30<br>20      | Linear<br>Linear<br>Linear<br>Linear<br>Linear<br>Linear                     | ately<br>-<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately                     | -<br>Tuning<br>Tuning<br>Setup<br>Setup<br>Tuning                     | 8-71<br>-<br>-<br>page<br>6-17<br>page |  |  |  |
| Pn480<br>Pn481<br>Pn482<br>Pn483<br>Pn484<br>Pn485<br>Pn486          | 2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2                                | n. DXDD<br>n. XDDD<br>Gravity Cc<br>Torque<br>Reserved<br>(Do not ch<br>Polarity De<br>Speed Loo<br>Time Cons<br>Forward F<br>Reverse F<br>Polarity De<br>ence Spee<br>Polarity De<br>ence Spee<br>Polarity De<br>ence Acce<br>Decelerati<br>Polarity De<br>stant Spee                                        | Reserved par<br>Reserved par<br>Reserved par<br>mpensation<br>parameter<br>nange.)<br>etection<br>op Gain<br>etection<br>op Integral<br>stant<br>orce Limit<br>orce Limit<br>etection Refer-<br>eleration/<br>on Time<br>etection Con-<br>ed Time                | ameter (Do not<br>ameter (Do not<br>ameter (Do not<br>-1,000 to<br>1,000<br>-<br>10 to 20,000<br>15 to 51,200<br>0 to 800<br>0 to 800<br>0 to 100<br>0 to 100                                                                                                             | change.)<br>change.)<br>change.)<br>0.1%<br>-<br>0.1 Hz<br>0.01 ms<br>1% <sup>*1</sup><br>1% <sup>*1</sup><br>1 mm/s<br>1 ms                 | 0<br>10000<br>400<br>3000<br>30<br>30<br>20<br>25      | Linear<br>Linear<br>Linear<br>Linear<br>Linear<br>Linear<br>Linear           | ately<br>–<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately                     | -<br>Tuning<br>Tuning<br>Setup<br>Setup<br>Tuning<br>Tuning           | 8-71<br>-<br>-<br>page<br>6-17<br>page |  |  |  |
| Pn480<br>Pn481<br>Pn482<br>Pn483<br>Pn484<br>Pn485<br>Pn486<br>Pn487 | 2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2                      | n. DXDD<br>n.XDDD<br>n.XDDD<br>Gravity Cc<br>Torque<br>Reserved<br>(Do not ch<br>Polarity De<br>Speed Loo<br>Time Cons<br>Polarity De<br>Speed Loo<br>Time Cons<br>Polarity De<br>ence Spee<br>Polarity De<br>ence Spee<br>Polarity De<br>ence Acce<br>Decelerati<br>Polarity De<br>stant Spee<br>Polarity De | Reserved par<br>Reserved par<br>Reserved par<br>mpensation<br>parameter<br>lange.)<br>etection<br>op Gain<br>etection<br>orce Limit<br>orce Limit<br>orce Limit<br>etection Refer-<br>etection Refer-<br>etection Con-<br>ed Time<br>etection Refer-<br>ing Time | ameter (Do not<br>ameter (Do not<br>ameter (Do not<br>ameter (Do not<br>-1,000 to<br>1,000<br>-<br>10 to 20,000<br>15 to 51,200<br>0 to 800<br>0 to 800<br>0 to 800<br>0 to 100<br>0 to 100<br>0 to 300                                                                   | change.)<br>change.)<br>change.)<br>0.1%<br>-<br>0.1 Hz<br>0.01 ms<br>1%* <sup>1</sup><br>1%* <sup>1</sup><br>1 mm/s<br>1 ms<br>1 ms<br>1 ms | 0<br>10000<br>400<br>3000<br>30<br>30<br>20<br>25<br>0 | Linear<br>Linear<br>Linear<br>Linear<br>Linear<br>Linear<br>Linear<br>Linear | ately<br>-<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately | -<br>Tuning<br>Tuning<br>Setup<br>Setup<br>Tuning<br>Tuning<br>Tuning | 8-71<br>-<br>-<br>page<br>6-17<br>page |  |  |  |

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| Continued from previous page. |      |                                                               |                       |                          |                    |                      |                  |                     |                              |  |
|-------------------------------|------|---------------------------------------------------------------|-----------------------|--------------------------|--------------------|----------------------|------------------|---------------------|------------------------------|--|
| Parameter<br>No.              | Size | Name                                                          | Setting<br>Range      | Setting<br>Unit          | Default<br>Setting | Applicable<br>Motors | When<br>Enabled  | Classi-<br>fication | Refer-<br>ence               |  |
| Pn495                         | 2    | Polarity Detection Con-<br>firmation Force Refer-<br>ence     | 0 to 200              | 1%                       | 100                | Linear               | Immedi-<br>ately | Tuning              | _                            |  |
| Pn498                         | 2    | Polarity Detection Allow-<br>able Error Range                 | 0 to 30               | 1 deg                    | 10                 | Linear               | Immedi-<br>ately | Tuning              | _                            |  |
| Pn49F                         | 2    | Speed Ripple Compen-<br>sation Enable Speed                   | 0 to 10,000           | 1 mm/s                   | 0                  | Linear               | Immedi-<br>ately | Tuning              | page<br>8-64                 |  |
| Pn502                         | 2    | Rotation Detection Level                                      | 1 to 10,000           | 1 min <sup>-1</sup>      | 20                 | Rotary               | Immedi-<br>ately | Setup               | page<br>1-8                  |  |
| Pn503                         | 2    | Reserved parameter<br>(Do not change.)                        | -                     | _                        | 10                 | Rotary               | -                | -                   | _                            |  |
| Pn506                         | 2    | Brake Reference-Servo<br>OFF Delay Time                       | 0 to 50               | 10 ms                    | 0                  | All                  | Immedi-<br>ately | Setup               | page<br>5-30                 |  |
| Pn507                         | 2    | Brake Reference Out-<br>put Speed Level                       | 0 to 10,000           | 1 min <sup>-1</sup>      | 100                | Rotary               | Immedi-<br>ately | Setup               | page<br>5-30                 |  |
| Pn508                         | 2    | Servo OFF-Brake Com-<br>mand Waiting Time                     | 10 to 100             | 10 ms                    | 50                 | All                  | Immedi-<br>ately | Setup               | page<br>5-30                 |  |
| Pn509                         | 2    | Momentary Power Inter-<br>ruption Hold Time                   | 20 to 50,000          | 1 ms                     | 20                 | All                  | Immedi-<br>ately | Setup               | page<br>6-5                  |  |
| Pn50A                         | 2    | Reserved parameter (Do not change.)                           | _                     | -                        | 1881h              | All                  | _                | _                   | -                            |  |
| Pn50B                         | 2    | Reserved parameter (Do not change.)                           | _                     | 1                        | 8882h              | All                  | _                | _                   | _                            |  |
| Pn50E                         | 2    | Reserved parameter (Do not change.)                           | _                     | 1                        | 0000h              | All                  | _                | _                   | _                            |  |
| Pn50F                         | 2    | Reserved parameter<br>(Do not change.)                        | _                     | _                        | 0100h              | All                  | _                | _                   | _                            |  |
| Pn510                         | 2    | Reserved parameter<br>(Do not change.)                        | _                     | -                        | 0000h              | All                  | _                | -                   | _                            |  |
| Pn511                         | 2    | Reserved parameter<br>(Do not change.)                        | _                     | _                        | 6543h              | All                  | _                | _                   | _                            |  |
| Pn512                         | 2    | Reserved parameter<br>(Do not change.)                        | _                     | _                        | 0000h              | All                  | _                | _                   | _                            |  |
| Pn514                         | 2    | Reserved parameter<br>(Do not change.)                        | _                     | _                        | 0000h              | All                  | _                | _                   | _                            |  |
| Pn516                         | 2    | Reserved parameter<br>(Do not change.)                        | _                     | _                        | 8888h              | All                  | _                | _                   | _                            |  |
| Pn517                         | 2    | Reserved parameter<br>(Do not change.)                        | _                     | _                        | 0000h              | All                  | _                | _                   | _                            |  |
| Pn518                         | _    | Safety Module-Related<br>Parameters                           | _                     | -                        | _                  | All                  | _                | _                   | _                            |  |
| Pn51B                         | 4    | Motor-Load Position<br>Deviation Overflow<br>Detection Level  | 0 to<br>1,073,741,824 | 1 refer-<br>ence<br>unit | 1000               | Rotary               | Immedi-<br>ately | Setup               | page<br>10-8                 |  |
| Pn51E                         | 2    | Position Deviation Over-<br>flow Warning Level                | 10 to 100             | 1%                       | 100                | All                  | Immedi-<br>ately | Setup               | page<br>8-8                  |  |
| Pn520                         | 4    | Position Deviation Over-<br>flow Alarm Level                  | 1 to<br>1,073,741,823 | 1 refer-<br>ence<br>unit | 524288<br>0        | All                  | Immedi-<br>ately | Setup               | page<br>8-7,<br>page<br>8-88 |  |
| Pn522                         | 4    | Positioning Completed<br>Width                                | 0 to<br>1,073,741,824 | 1 refer-<br>ence<br>unit | 7                  | All                  | Immedi-<br>ately | Setup               | page<br>8-66                 |  |
| Pn524                         | 4    | Near Signal Width                                             | 1 to<br>1,073,741,824 | 1 refer-<br>ence<br>unit | 107374<br>1824     | All                  | Immedi-<br>ately | Setup               | page<br>8-66                 |  |
| Pn526                         | 4    | Position Deviation Over-<br>flow Alarm Level at<br>Servo ON   | 1 to<br>1,073,741,823 | 1 refer-<br>ence<br>unit | 524288<br>0        | All                  | Immedi-<br>ately | Setup               | page<br>8-9                  |  |
| Pn528                         | 2    | Position Deviation Over-<br>flow Warning Level at<br>Servo ON | 10 to 100             | 1%                       | 100                | All                  | Immedi-<br>ately | Setup               | page<br>8-9                  |  |
| Pn529                         | 2    | Speed Limit Level at<br>Servo ON                              | 0 to 10,000           | 1 min <sup>-1</sup>      | 10000              | Rotary               | Immedi-<br>ately | Setup               | page<br>8-9                  |  |
| Pn52A                         | 2    | Multiplier per Fully-<br>closed Rotation                      | 0 to 100              | 1%                       | 20                 | Rotary               | Immedi-<br>ately | Tuning              | page<br>10-8                 |  |

Continued from previous page.

| Parameter<br>No.                                            | Size                                                          | N                                                                                                                                                                                                                             | ame                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Setting<br>Range                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Setting<br>Unit                                                                                                                                                                    | Default<br>Setting                                      | Applicable<br>Motors                             | When<br>Enabled                                                                                                                                   | Classi-<br>fication                                | Refer-<br>ence                                                                                                               |  |
|-------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|--|
| Pn52B                                                       | 2                                                             | Overload V                                                                                                                                                                                                                    | Varning Level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 to 100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1%                                                                                                                                                                                 | 20                                                      | All                                              | Immedi-<br>ately                                                                                                                                  | Setup                                              | page<br>5-38                                                                                                                 |  |
| Pn52C                                                       | 2                                                             | Base Curre<br>at Motor C<br>Detection                                                                                                                                                                                         | ent Derating<br>Verload                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 10 to 100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1%                                                                                                                                                                                 | 100                                                     | All                                              | After<br>restart                                                                                                                                  | Setup                                              | page<br>5-39                                                                                                                 |  |
|                                                             | 2                                                             | Program J<br>Related Se                                                                                                                                                                                                       | ogging-<br>elections                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0000h to<br>0005h                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | _                                                                                                                                                                                  | 0000h                                                   | All                                              | Immedi-<br>ately                                                                                                                                  | Setup                                              | page<br>7-12                                                                                                                 |  |
| Pn530                                                       |                                                               | 0<br>1<br>2<br>n.□□□X<br>3<br>4<br>5<br>n.□□X□ Reserved                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Jogging Operation Pattern<br>(Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of<br>movements in Pn535 → Reverse by travel distance in Pn531) × Number of<br>(Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of<br>movements in Pn535 → Forward by travel distance in Pn531) × Number of<br>(Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of<br>movements in Pn536<br>(Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of<br>movements in Pn536<br>(Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of<br>movements in Pn536<br>(Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of<br>movements in Pn536<br>(Waiting time in Pn535 → Forward by travel distance in Pn531) → Waiting time<br>in Pn535 → Reverse by travel distance in Pn531 → Waiting time<br>in Pn535 → Forward by travel distance in Pn531 → Waiting time<br>in Pn535 → Forward by travel distance in Pn531 → Waiting time<br>in Pn535 → Forward by travel distance in Pn531 → Waiting time<br>in Pn535 → Forward by travel distance in Pn531 → Waiting time<br>in Pn536<br>(Waiting time in Pn535 → Reverse by travel distance in Pn531 → Waiting time<br>in Pn535 → Forward by travel distance in Pn531 → Waiting time<br>in Pn536<br>(Maiting time in Pn535 → Reverse by travel distance in Pn531 → Waiting time<br>in Pn536<br>(Parameter (Do not change.) |                                                                                                                                                                                    |                                                         |                                                  |                                                                                                                                                   |                                                    |                                                                                                                              |  |
|                                                             |                                                               | n.00X0<br>n.0X00<br>n.X000                                                                                                                                                                                                    | Reserved pa                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | t change.                                                                                                                                                                          | )                                                       |                                                  |                                                                                                                                                   |                                                    |                                                                                                                              |  |
|                                                             |                                                               | n.¤X¤¤                                                                                                                                                                                                                        | Reserved pa                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | rameter (Do no                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | t change.                                                                                                                                                                          | )                                                       |                                                  |                                                                                                                                                   |                                                    |                                                                                                                              |  |
| Pn531                                                       |                                                               | n.0X00                                                                                                                                                                                                                        | Reserved pa                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | rameter (Do no                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | t change.                                                                                                                                                                          | )                                                       | All                                              | Immedi-<br>ately                                                                                                                                  | Setup                                              | page<br>7-12                                                                                                                 |  |
| Pn531<br>Pn533                                              |                                                               | n. DXDD<br>n. XDDD<br>Program J<br>Distance                                                                                                                                                                                   | Reserved participation of the second participation of the | rameter (Do no<br>rameter (Do no<br>1 to<br>1,073,741,824                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | t change.<br>t change.<br>t change.<br>1 refer-<br>ence<br>unit<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Drive:<br>0.1                                                       | )                                                       | All                                              |                                                                                                                                                   | Setup                                              |                                                                                                                              |  |
|                                                             | 4                                                             | n. DXDD<br>n. XDDD<br>Program J<br>Distance<br>Program J<br>ment Spee                                                                                                                                                         | Reserved par<br>Reserved par<br>ogging Travel<br>ogging Move-<br>ad                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | rameter (Do no<br>rameter (Do no<br>1,073,741,824                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | t change.<br>t change.<br>1 refer-<br>ence<br>unit<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Drive:                                                                           | ) 32768                                                 |                                                  | ately<br>Immedi-                                                                                                                                  |                                                    | 7-12<br>page                                                                                                                 |  |
| Pn533                                                       | 4                                                             | n. DXDD<br>n. XDDD<br>Program J<br>Distance<br>Program J<br>ment Spee<br>Program J<br>eration/De<br>Time                                                                                                                      | Reserved par<br>Reserved par<br>ogging Travel<br>ogging Move-<br>ad                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | rameter (Do no<br>rameter (Do no<br>1 to<br>1,073,741,824<br>1 to 10,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | t change.<br>t change.<br>t change.<br>1 refer-<br>ence<br>unit<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Drive:<br>0.1<br>min <sup>-1</sup>                                  | )<br>32768<br>500                                       | Rotary                                           | ately<br>Immedi-<br>ately<br>Immedi-                                                                                                              | Setup                                              | 7-12<br>page<br>7-12<br>page                                                                                                 |  |
| Pn533<br>Pn534                                              | 4                                                             | n. DXDD<br>n. XDDD<br>Program J<br>Distance<br>Program J<br>eration/De<br>Time<br>Program J<br>ing Time                                                                                                                       | Reserved par<br>Reserved par<br>ogging Travel<br>ogging Move-<br>ed<br>ogging Accel-<br>celeration<br>ogging Wait-<br>ogging Num-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | rameter (Do no<br>rameter (Do no<br>1,073,741,824<br>1 to 10,000<br>2 to 10,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | t change.<br>t change.<br>t change.<br>t change.<br>1 refer-<br>ence<br>unit<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Drive:<br>0.1<br>min <sup>-1</sup><br>1 ms             | )<br>32768<br>500<br>100                                | Rotary<br>All                                    | ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-                                                                                          | Setup                                              | 7-12<br>page<br>7-12<br>page<br>7-12<br>page                                                                                 |  |
| Pn533<br>Pn534<br>Pn535                                     | 4<br>2<br>2<br>2                                              | n. DXDD<br>n. XDDD<br>Program J<br>Distance<br>Program J<br>eration/De<br>Time<br>Program J<br>ing Time<br>Program J<br>ber of Mov                                                                                            | Reserved par<br>Reserved par<br>ogging Travel<br>ogging Move-<br>ed<br>ogging Accel-<br>celeration<br>ogging Wait-<br>ogging Num-                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | rameter (Do no<br>rameter (Do no<br>1,073,741,824<br>1 to 10,000<br>2 to 10,000<br>0 to 10,000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | t change.<br>t change.<br>t change.<br>1 refer-<br>ence<br>unit<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Drive:<br>0.1<br>min <sup>-1</sup><br>1 ms<br>1 ms                  | )<br>)<br>32768<br>500<br>100<br>100                    | Rotary<br>All<br>All                             | ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-                                                                                          | Setup<br>Setup<br>Setup                            | 7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>7-12<br>page                                                                 |  |
| Pn533<br>Pn534<br>Pn535<br>Pn536                            | 4<br>2<br>2<br>2<br>2                                         | n. DXDD<br>n. XDDD<br>Program J<br>Distance<br>Program J<br>eration/De<br>Time<br>Program J<br>ing Time<br>Program J<br>ber of Mov<br>Analog Mov<br>Voltage                                                                   | Reserved par<br>Reserved par<br>ogging Travel<br>ogging Move-<br>ad<br>ogging Accel-<br>celeration<br>ogging Wait-<br>ogging Num-<br>rements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | rameter (Do no<br>rameter (Do no<br>1 to<br>1,073,741,824<br>1 to 10,000<br>2 to 10,000<br>0 to 10,000<br>0 to 1,000<br>-10,000 to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | t change.<br>t change.<br>t change.<br>1 refer-<br>ence<br>unit<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Drive:<br>0.1<br>min <sup>-1</sup><br>1 ms<br>1 ms<br>1 ms<br>Times | )<br>)<br>32768<br>500<br>100<br>100<br>1               | Rotary<br>All<br>All<br>All                      | ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-                                                                      | Setup<br>Setup<br>Setup<br>Setup                   | 7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>7-12<br>page                                 |  |
| Pn533<br>Pn534<br>Pn535<br>Pn536<br>Pn550                   | 4<br>2<br>2<br>2<br>2<br>2<br>2<br>2                          | n. DXDD<br>n. XDDD<br>Program J<br>Distance<br>Program J<br>ment Spee<br>Program J<br>eration/De<br>Time<br>Program J<br>ber of Mov<br>Analog Mov<br>Voltage<br>Analog Mov                                                    | Reserved par<br>Reserved par<br>ogging Travel<br>ogging Move-<br>ad<br>ogging Accel-<br>celeration<br>ogging Wait-<br>ogging Num-<br>rements<br>unitor 1 Offset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | rameter (Do no<br>rameter (Do no<br>1 to<br>1,073,741,824<br>1 to 10,000<br>2 to 10,000<br>0 to 10,000<br>0 to 1,000<br>-10,000 to<br>10,000 to<br>-10,000 to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | t change.<br>t change.<br>t change.<br>1 refer-<br>ence<br>unit<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Direct<br>0.1<br>1 ms<br>1 ms<br>1 ms<br>0.1 V                      | )<br>)<br>32768<br>500<br>100<br>100<br>1<br>0          | Rotary<br>All<br>All<br>All<br>All               | ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-                                                  | Setup<br>Setup<br>Setup<br>Setup<br>Setup          | 7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>9-11<br>page                                 |  |
| Pn533<br>Pn534<br>Pn535<br>Pn536<br>Pn550<br>Pn551          | 4<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2                | n. DXDD<br>n. XDDD<br>Program J<br>Distance<br>Program J<br>ment Spee<br>Program J<br>eration/De<br>Time<br>Program J<br>ber of Mov<br>Analog Mov<br>Voltage<br>Analog Mov<br>Analog Mov<br>Notage                            | Reserved par<br>Reserved par<br>ogging Travel<br>ogging Move-<br>ad<br>ogging Accel-<br>celeration<br>ogging Wait-<br>ogging Num-<br>rements<br>initor 1 Offset<br>initor 2 Offset                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | rameter (Do no<br>rameter (Do no<br>rameter (Do no<br>1 to<br>1,073,741,824<br>1 to 10,000<br>2 to 10,000<br>0 to 10,000<br>0 to 1,000<br>-10,000 to<br>10,000<br>-10,000 to<br>10,000 to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | t change.<br>t change.<br>t change.<br>1 refer-<br>ence<br>unit<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Drive:<br>0.1<br>1 ms<br>1 ms<br>1 ms<br>0.1 V<br>0.1 V             | )<br>)<br>32768<br>500<br>100<br>100<br>1<br>0<br>0     | Rotary<br>All<br>All<br>All<br>All<br>All        | ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately                     | Setup<br>Setup<br>Setup<br>Setup<br>Setup<br>Setup | 7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>9-11<br>page<br>9-11<br>page                 |  |
| Pn533<br>Pn534<br>Pn535<br>Pn536<br>Pn550<br>Pn551<br>Pn552 | 4<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2<br>2 | n. DXDD<br>n. XDDD<br>Program J<br>Distance<br>Program J<br>eration/De<br>Time<br>Program J<br>eration/De<br>Time<br>Program J<br>ber of Mov<br>Analog Mov<br>Voltage<br>Analog Mov<br>Analog Mov<br>Analog Mov<br>Analog Mov | Reserved par<br>Reserved par<br>ogging Travel<br>ogging Move-<br>ad<br>ogging Accel-<br>celeration<br>ogging Wait-<br>ogging Wait-<br>ogging Num-<br>rements<br>unitor 1 Offset<br>unitor 2 Offset<br>unitor 1 Mag-<br>unitor 2 Mag-<br>nsumption                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | rameter (Do no<br>rameter (Do no<br>rameter (Do no<br>1,073,741,824<br>1 to 10,000<br>2 to 10,000<br>0 to 10,000<br>0 to 1,000<br>-10,000 to<br>10,000<br>-10,000 to<br>10,000<br>-10,000 to<br>10,000<br>-10,000 to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | t change.<br>t change.<br>t change.<br>1 refer-<br>ence<br>unit<br>Rotary:<br>1 min <sup>-1</sup><br>Direct<br>Drive:<br>0.1<br>1 ms<br>1 ms<br>1 ms<br>0.1 V<br>0.1 V<br>× 0.01   | )<br>32768<br>500<br>100<br>100<br>1<br>0<br>100<br>100 | Rotary<br>All<br>All<br>All<br>All<br>All<br>All | ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately<br>Immedi-<br>ately | Setup<br>Setup<br>Setup<br>Setup<br>Setup<br>Setup | 7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>7-12<br>page<br>9-11<br>page<br>9-11<br>page<br>9-11<br>page |  |

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| Parameter<br>No.  | Size                                       | N                                          | lame                 | Setting<br>Range                                                                                                                                                                                                                                                                             | Setting<br>Unit      | Default<br>Setting | Applicable<br>Motors | When<br>Enabled  | Classi-<br>fication | Refer-<br>ence                |
| Pn561             | 2                                          | Overshoot<br>Level                         | Detection            | 0 to 100                                                                                                                                                                                                                                                                                     | 1%                   | 100                | All                  | Immedi-<br>ately | Setup               | page<br>8-30,<br>page<br>8-40 |
| Pn581             | 2                                          | Zero Spee                                  | d Level              | 1 to 10,000                                                                                                                                                                                                                                                                                  | 1 mm/s               | 20                 | Linear               | Immedi-<br>ately | Setup               | page<br>1-8                   |
| Pn582             | 2                                          | Reserved (<br>Do not ch                    |                      | -                                                                                                                                                                                                                                                                                            | -                    | 10                 | Linear               | _                | -                   | -                             |
| Pn583             | 2                                          | Brake Refe<br>put Speed                    | erence Out-<br>Level | 0 to 10,000                                                                                                                                                                                                                                                                                  | 1 mm/s               | 10                 | Linear               | Immedi-<br>ately | Setup               | page<br>5-30                  |
| Pn584             | 2                                          | Speed Lim<br>Servo ON                      | nit Level at         | 0 to 10,000                                                                                                                                                                                                                                                                                  | 1 mm/s               | 10000              | Linear               | Immedi-<br>ately | Setup               | page<br>8-9                   |
| Pn585             | 2                                          | Program J<br>ment Spee                     | ogging Mov<br>ed     | e- 1 to 10,000                                                                                                                                                                                                                                                                               | 1 mm/s               | 50                 | Linear               | Immedi-<br>ately | Setup               | page<br>7-12                  |
| Pn586             | 2                                          | Motor Run<br>Ratio                         | ining Coolin         | 9 0 to 100                                                                                                                                                                                                                                                                                   | 1%/<br>Max.<br>speed | 0                  | Linear               | Immedi-<br>ately | Setup               | _                             |
| Pn587             | 2                                          | Reserved (<br>Do not ch                    |                      | _                                                                                                                                                                                                                                                                                            | _                    | 0000h              | Linear               | -                | _                   | _                             |
| Pn600             | 2                                          | Regenerat<br>Capacity <sup>*2</sup>        | ive Resistor         | Depends on model.*3                                                                                                                                                                                                                                                                          | 10 W                 | 0                  | All                  | Immedi-<br>ately | Setup               | page<br>5-53                  |
| Pn601             | 2                                          | Dynamic E<br>tor Allowat<br>Consumpt       |                      | 0 to 65,535                                                                                                                                                                                                                                                                                  | 10 J                 | 0                  | All                  | After<br>restart | Setup               | *4                            |
| Pn603             | 2                                          | Regenerat tance                            | ive Resis-           | 0 to 65,535                                                                                                                                                                                                                                                                                  | 10 m $\Omega$        | 0                  | All                  | Immedi-<br>ately | Setup               | page<br>5-53                  |
| Pn604             | 2                                          | Dynamic E<br>tance                         | Brake Resis-         | 0 to 65,535                                                                                                                                                                                                                                                                                  | 10 m $\Omega$        | 0                  | All                  | After<br>restart | Setup               | *4                            |
|                   | 2                                          | Overheat F<br>Selections                   |                      | 0000h to<br>0003h                                                                                                                                                                                                                                                                            | _                    | 0000h              | All                  | After<br>restart | Setup               | page<br>6-36                  |
| Pn61A             | r                                          | 0 Disa<br>1 Use<br>2 Mon<br>use<br>3 Mon   |                      | Protection Selection Disable overheat protection. Use overheat protection in the Yaskawa Linear Servomotor.*5 Monitor a negative voltage input from a sensor attached to the machine and use overheat protection. Monitor a positive voltage input from a sensor attached to the machine and |                      |                    |                      |                  |                     |                               |
|                   | n.□□X□ Reserved parameter (Do not change.) |                                            |                      |                                                                                                                                                                                                                                                                                              |                      |                    |                      |                  |                     |                               |
|                   | r                                          | n.□X□□ Reserved parameter (Do not change.) |                      |                                                                                                                                                                                                                                                                                              |                      |                    |                      |                  |                     |                               |
|                   | r                                          | n.XDDD Reserved parameter (Do not change.) |                      |                                                                                                                                                                                                                                                                                              |                      |                    |                      |                  |                     |                               |
| Pn61B<br>*6       | 2                                          | Overheat A                                 | Alarm Level          | 0 to 500                                                                                                                                                                                                                                                                                     | 0.01 V               | 250                | All                  | Immedi-<br>ately | Setup               | page<br>6-37                  |
| Pn61C<br>*6       | 2                                          | Overheat V                                 | Narning Lev          | el 0 to 100                                                                                                                                                                                                                                                                                  | 1%                   | 100                | All                  | Immedi-<br>ately | Setup               | page<br>6-37                  |
| Pn61D<br>*6       | 2                                          | Overheat A<br>Time                         | Alarm Filter         | 0 to 65,535                                                                                                                                                                                                                                                                                  | 1 s                  | 0                  | All                  | Immedi-<br>ately | Setup               | page<br>6-37                  |
| Pn621 to<br>Pn628 | -                                          | Reserved (<br>Do not ch                    | parameters<br>ange.) | _                                                                                                                                                                                                                                                                                            | _                    | _                  | All                  | _                | _                   | -                             |
|                   | 2                                          |                                            | urn Directior        | 0000h and<br>0001h                                                                                                                                                                                                                                                                           | _                    | 0001h              | All                  | Immedi-<br>ately | Setup               | page<br>12-4                  |
| PnB01             |                                            | 0000                                       |                      | ward<br>verse                                                                                                                                                                                                                                                                                |                      |                    |                      |                  |                     |                               |

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| Size                    | Name                                                               | •                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Setting<br>Range                                                                                                                                                                                                                            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| 4                       | Origin Approac                                                     | h Speed                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1 to<br>115,343,500                                                                                                                                                                                                                         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|                         | 0001h<br>0003h                                                     | ,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | ical linear acce<br>trical linear acc                                                                                                                                                                                                       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|                         | 4<br>4<br>4<br>2<br>4<br>4<br>4<br>4<br>4<br>2<br>2<br>2<br>2<br>4 | 4       Origin Approace         4       Origin Return O         4       Final Travel Dis         4       Origin Offset         2       Coordinate Type         4       Origin Offset         2       Coordinate Type         4       Reference Unit         4       Reference Unit         4       Forward Softw         4       Reverse Softw         2       Software Limit         8       Bit 0         Bit 1       Bit 2         Bit 3 to 15       Selection         2       Hardware Limit         2       Hardware Limit         2       External Stop /         2       External Stop /         2       External Stop /         3       Feed Speed         2       Acceleration/D | 4       Origin Approach Speed         4       Origin Return Creep         4       Final Travel Distance for         4       Origin Offset         2       Coordinate Type Selection         2       Coordinate Type Selection         4       Reference Units per<br>Machine Revolution         4       Reference Units per<br>Machine Revolution         4       Forward Software Limit         2       Software Limit Action<br>Selection         2       Software Limit Action<br>Selection         2       Hardware Limit Action<br>Selection         2       Hardware Limit Action<br>Selection         2       Hardware Limit Action<br>Selection         2       External Stop Action<br>Selection         2       External Stop Action<br>Selection         4       Feed Speed         2       Acceleration/Decelera-<br>tion Type | Name     Range       4     Origin Approach Speed     115,343,500       4     Origin Return Creep     1 to       4     Origin Return Creep     1 to       4     Final Travel Distance for Origin Return     0 to       2     Coordinate Type Selec-     0000h and       2     Coordinate Type Selec-     0000h and       0001h     Rotary     2.147,483,647       2     Coordinate Type Selec-     0000h and       0001h     Rotary     2.147,483,647       4     Reference Units per Machine Revolution     1,500,000       4     Forward Software Limit     -2,147,483,647       4     Reverse Software Limit     -2,147,483,647       2     Software Software Limit     -2,147,483,647       2     Software Limit Action     0000h to       2     Software Limit Action     0000h to       0005h     Bit 1     Reserved.       Bit 2     Software Limit Action (OBits 3 to 15     Reserved.       2     Hardware Limit Action     0000h to       0000h     Servo OFF     0000h       0001h     Hard stop     0000h       2     External Stop Action     0000h       2     External Stop Action     0000h       3     Feed Speed     1 to </td <td>30     Name     Range     Unit       4     Origin Approach Speed     1 to<br/>115,343,500     1 refer-<br/>ence<br/>unit/s       4     Origin Return Creep<br/>Speed     1 to<br/>115,343,500     1 refer-<br/>ence<br/>unit/s       4     Final Travel Distance for<br/>Origin Return     0 to<br/>2,147,483,647     1 refer-<br/>ence<br/>unit       4     Origin Offset     -2,147,483,647     1 refer-<br/>ence<br/>unit       2     Coordinate Type Selec-<br/>0000h     0000h and<br/>0001h     -       0     0001h     Reference Units per<br/>Machine Revolution     1 to<br/>1,500,000     1 refer-<br/>ence<br/>unit       4     Reference Units per<br/>Machine Revolution     1 to<br/>1,500,000     1 refer-<br/>ence<br/>unit       4     Forward Software Limit     -2,147,483,647<br/>0,11 refer-<br/>ence<br/>unit     1 refer-<br/>ence<br/>unit       4     Reverse Software Limit     -2,147,483,647<br/>1 refer-<br/>ence<br/>unit     1 refer-<br/>ence<br/>unit       2     Software Limit Action<br/>Selection     0000h to<br/>0005h     -       2     Software Limit Action<br/>Selection     0000h to<br/>0002h     -       2     Hardware Limit Action<br/>Selection     0000h to<br/>0002h     -       2     External Stop Action<br/>Selection     0000h     -       2     External Stop Action<br/>Selection     0000h to<br/>0003h     1 refer-<br/>ence<br/>unit/s       2     Acceleration/Decelera-<br/>tion Type     00000h to<br/>0003h     -  &lt;</td> <td>ist of the second s</td> <td>B         Name         Setting<br/>Range         Setting<br/>Unit         Default<br/>merce<br/>prese         Applicable<br/>Motors           4         Origin Approach Speed         1 to<br/>115,343,500         1 refer-<br/>ence<br/>unit/s         20000         All           4         Origin Return Creep<br/>Speed         1 to<br/>115,343,500         1 refer-<br/>ence<br/>unit/s         10000         All           4         Final Travel Distance for<br/>Origin Return         0 to<br/>2,147,483,647         1 refer-<br/>ence<br/>unit         0         All           4         Origin Offset         -2,147,483,647         1 refer-<br/>ence<br/>unit         0         All           2         Coordinate Type Selec-         0000h and<br/>0001h         -         0000h         All           4         Forward Software Limit         1,500,000         unit         360000         All           4         Reference Units per<br/>Machine Revolution         1 to<br/>1,500,000         1 refer-<br/>ence<br/>unit         214748         All           4         Reverse Software Limit         -2,147,483,647         1 refer-<br/>unit         214748         All           2         Software Limit Action         0000h         -         0000h         All           2         Software Limit Action         0000h         -         0000h         All</td> <td>90         Name         Setting<br/>Range         Setting<br/>Unit         Default<br/>Setting         Applicable<br/>Motors         When<br/>Enabled           4         Origin Approach Speed         1 to<br/>115,343,500         1 refer-<br/>ence<br/>units         20000         All         Immedi-<br/>ately           4         Origin Return Creep         1 to<br/>115,343,500         1 refer-<br/>ence<br/>units         10000         All         Immedi-<br/>ately           4         Final Travel Distance for<br/>Origin Return         0 to<br/>2.147,483,647         1 refer-<br/>ence<br/>unit         0         All         Immedi-<br/>ately           2         Coordinate Type Selec-         0000h and<br/>0001h         -         0000h         All         Immedi-<br/>ately           4         Reference Units per<br/>Machine Revolution         1 to<br/>1,500,000         1 refer-<br/>ence<br/>unit         2147,483,647         All         Immedi-<br/>ately           4         Forward Software Limit         -2147,483,647         1 refer-<br/>ence<br/>unit         2147,483         All         Immedi-<br/>ately           2         Software Limit Action         0000h to<br/>0005h         -         0000h         All         Immedi-<br/>ately           2         Software Limit Action         0000h to<br/>0005h         -         0000h         All         Immedi-<br/>ately           2         Software Limit Action<td>Name         Setting<br/>Range         Default<br/>Unit         Applicable<br/>Betting         When<br/>Motors         Classi-<br/>Enabled           4         Origin Approach Speed         1 to<br/>115,343,500         i refer-<br/>ence         20000         All         Immedi-<br/>ately         Setup           4         Origin Return Creep<br/>Speed         1 to<br/>115,343,500         i refer-<br/>ence         10000         All         Immedi-<br/>ately         Setup           4         Origin Return         0 to<br/>0rigin Return         2147,483,647         i refer-<br/>ence         0         All         Immedi-<br/>ately         Setup           4         Origin Offset         -2,147,483,647         i refer-<br/>unit         0         All         Immedi-<br/>ately         Setup           2         Coordinate Type Selec-         0000h and<br/>0001h         -         0000h         All         Immedi-<br/>ately         Setup           4         Reference Units per<br/>Machine Revolution         1 to<br/>1,500,000         1 refer-<br/>unit         2147,483,647         and<br/>ately         Setup           4         Forward Software Limit         -2,147,483,647         i refer-<br/>unit         2147,483         All         Immedi-<br/>ately         Setup           2         Software Limit 4         -2,147,483,647         i refer-<br/>unit         2,147,483,647         <td< td=""></td<></td></td> | 30     Name     Range     Unit       4     Origin Approach Speed     1 to<br>115,343,500     1 refer-<br>ence<br>unit/s       4     Origin Return Creep<br>Speed     1 to<br>115,343,500     1 refer-<br>ence<br>unit/s       4     Final Travel Distance for<br>Origin Return     0 to<br>2,147,483,647     1 refer-<br>ence<br>unit       4     Origin Offset     -2,147,483,647     1 refer-<br>ence<br>unit       2     Coordinate Type Selec-<br>0000h     0000h and<br>0001h     -       0     0001h     Reference Units per<br>Machine Revolution     1 to<br>1,500,000     1 refer-<br>ence<br>unit       4     Reference Units per<br>Machine Revolution     1 to<br>1,500,000     1 refer-<br>ence<br>unit       4     Forward Software Limit     -2,147,483,647<br>0,11 refer-<br>ence<br>unit     1 refer-<br>ence<br>unit       4     Reverse Software Limit     -2,147,483,647<br>1 refer-<br>ence<br>unit     1 refer-<br>ence<br>unit       2     Software Limit Action<br>Selection     0000h to<br>0005h     -       2     Software Limit Action<br>Selection     0000h to<br>0002h     -       2     Hardware Limit Action<br>Selection     0000h to<br>0002h     -       2     External Stop Action<br>Selection     0000h     -       2     External Stop Action<br>Selection     0000h to<br>0003h     1 refer-<br>ence<br>unit/s       2     Acceleration/Decelera-<br>tion Type     00000h to<br>0003h     -  < | ist of the second s | B         Name         Setting<br>Range         Setting<br>Unit         Default<br>merce<br>prese         Applicable<br>Motors           4         Origin Approach Speed         1 to<br>115,343,500         1 refer-<br>ence<br>unit/s         20000         All           4         Origin Return Creep<br>Speed         1 to<br>115,343,500         1 refer-<br>ence<br>unit/s         10000         All           4         Final Travel Distance for<br>Origin Return         0 to<br>2,147,483,647         1 refer-<br>ence<br>unit         0         All           4         Origin Offset         -2,147,483,647         1 refer-<br>ence<br>unit         0         All           2         Coordinate Type Selec-         0000h and<br>0001h         -         0000h         All           4         Forward Software Limit         1,500,000         unit         360000         All           4         Reference Units per<br>Machine Revolution         1 to<br>1,500,000         1 refer-<br>ence<br>unit         214748         All           4         Reverse Software Limit         -2,147,483,647         1 refer-<br>unit         214748         All           2         Software Limit Action         0000h         -         0000h         All           2         Software Limit Action         0000h         -         0000h         All | 90         Name         Setting<br>Range         Setting<br>Unit         Default<br>Setting         Applicable<br>Motors         When<br>Enabled           4         Origin Approach Speed         1 to<br>115,343,500         1 refer-<br>ence<br>units         20000         All         Immedi-<br>ately           4         Origin Return Creep         1 to<br>115,343,500         1 refer-<br>ence<br>units         10000         All         Immedi-<br>ately           4         Final Travel Distance for<br>Origin Return         0 to<br>2.147,483,647         1 refer-<br>ence<br>unit         0         All         Immedi-<br>ately           2         Coordinate Type Selec-         0000h and<br>0001h         -         0000h         All         Immedi-<br>ately           4         Reference Units per<br>Machine Revolution         1 to<br>1,500,000         1 refer-<br>ence<br>unit         2147,483,647         All         Immedi-<br>ately           4         Forward Software Limit         -2147,483,647         1 refer-<br>ence<br>unit         2147,483         All         Immedi-<br>ately           2         Software Limit Action         0000h to<br>0005h         -         0000h         All         Immedi-<br>ately           2         Software Limit Action         0000h to<br>0005h         -         0000h         All         Immedi-<br>ately           2         Software Limit Action <td>Name         Setting<br/>Range         Default<br/>Unit         Applicable<br/>Betting         When<br/>Motors         Classi-<br/>Enabled           4         Origin Approach Speed         1 to<br/>115,343,500         i refer-<br/>ence         20000         All         Immedi-<br/>ately         Setup           4         Origin Return Creep<br/>Speed         1 to<br/>115,343,500         i refer-<br/>ence         10000         All         Immedi-<br/>ately         Setup           4         Origin Return         0 to<br/>0rigin Return         2147,483,647         i refer-<br/>ence         0         All         Immedi-<br/>ately         Setup           4         Origin Offset         -2,147,483,647         i refer-<br/>unit         0         All         Immedi-<br/>ately         Setup           2         Coordinate Type Selec-         0000h and<br/>0001h         -         0000h         All         Immedi-<br/>ately         Setup           4         Reference Units per<br/>Machine Revolution         1 to<br/>1,500,000         1 refer-<br/>unit         2147,483,647         and<br/>ately         Setup           4         Forward Software Limit         -2,147,483,647         i refer-<br/>unit         2147,483         All         Immedi-<br/>ately         Setup           2         Software Limit 4         -2,147,483,647         i refer-<br/>unit         2,147,483,647         <td< td=""></td<></td> | Name         Setting<br>Range         Default<br>Unit         Applicable<br>Betting         When<br>Motors         Classi-<br>Enabled           4         Origin Approach Speed         1 to<br>115,343,500         i refer-<br>ence         20000         All         Immedi-<br>ately         Setup           4         Origin Return Creep<br>Speed         1 to<br>115,343,500         i refer-<br>ence         10000         All         Immedi-<br>ately         Setup           4         Origin Return         0 to<br>0rigin Return         2147,483,647         i refer-<br>ence         0         All         Immedi-<br>ately         Setup           4         Origin Offset         -2,147,483,647         i refer-<br>unit         0         All         Immedi-<br>ately         Setup           2         Coordinate Type Selec-         0000h and<br>0001h         -         0000h         All         Immedi-<br>ately         Setup           4         Reference Units per<br>Machine Revolution         1 to<br>1,500,000         1 refer-<br>unit         2147,483,647         and<br>ately         Setup           4         Forward Software Limit         -2,147,483,647         i refer-<br>unit         2147,483         All         Immedi-<br>ately         Setup           2         Software Limit 4         -2,147,483,647         i refer-<br>unit         2,147,483,647 <td< td=""></td<> |

Parameter Lists

|                  |      |                                                  |                                                            |                                                 |                                         |                    | Con                  | tinued from      | n previou:          | s page.                                        |  |  |
|------------------|------|--------------------------------------------------|------------------------------------------------------------|-------------------------------------------------|-----------------------------------------|--------------------|----------------------|------------------|---------------------|------------------------------------------------|--|--|
| Parameter<br>No. | Size | Name                                             | Э                                                          | Setting<br>Range                                | Setting<br>Unit                         | Default<br>Setting | Applicable<br>Motors | When<br>Enabled  | Classi-<br>fication | Refer-<br>ence                                 |  |  |
|                  | 2    | Filter Selectior                                 | ۱                                                          | 0000h to<br>0003h                               | _                                       | 0000h              | All                  | Immedi-<br>ately | Setup               | page<br>12-6                                   |  |  |
|                  |      |                                                  |                                                            |                                                 |                                         |                    |                      |                  |                     |                                                |  |  |
|                  |      | 0000h No filter                                  |                                                            |                                                 |                                         |                    |                      |                  |                     |                                                |  |  |
| PnB29            |      | 0001h                                            | Filter for e                                               | ilter for exponential acceleration/deceleration |                                         |                    |                      |                  |                     |                                                |  |  |
|                  |      | 0002h                                            | Filter for exponential acceleration/deceleration with bias |                                                 |                                         |                    |                      |                  |                     |                                                |  |  |
|                  |      | 0003h Average movement time filter               |                                                            |                                                 |                                         |                    |                      |                  |                     |                                                |  |  |
|                  |      |                                                  |                                                            |                                                 |                                         |                    |                      |                  |                     |                                                |  |  |
| PnB2A            | 4    | Acceleration F                                   | late                                                       | 15,625 to<br>2,047,968,750                      | 1 refer-<br>ence<br>unit/s <sup>2</sup> | 4000000            | All                  | Immedi-<br>ately | Setup               | page                                           |  |  |
| PnB2B            | 4    | Deceleration F                                   | late                                                       | 15,625 to<br>2,047,968,750                      | 1 refer-<br>ence<br>unit/s <sup>2</sup> | 4000000            | All                  | lmmedi-<br>ately | Setup               | 12-11                                          |  |  |
| PnB40            | 2    | Time Constant<br>nential Acceler<br>Deceleration | t for Expo-<br>ration/                                     | 4 to 1,000                                      | 1 ms                                    | 4                  | All                  | Immedi-<br>ately | Setup               | page                                           |  |  |
| PnB41            | 4    | Exponential Action/Deceleration                  | ion Bias                                                   | 0 to<br>115,343,500                             | 1 refer-<br>ence<br>unit/s              | 0                  | All                  | Immedi-<br>ately | Setup               | 12-12                                          |  |  |
| PnB42            | 2    | Average Move<br>Time Filter Tim<br>stant         | ment<br>ne Con-                                            | 4 to 4,000                                      | 1 ms                                    | 25                 | All                  | Immedi-<br>ately | Setup               | page<br>12-12                                  |  |  |
| PnB50            | 2    | Positioning Co<br>Width                          | mpleted                                                    | 0 to 255                                        | 1 refer-<br>ence<br>unit                | 5                  | All                  | Immedi-<br>ately | Setup               | page<br>12-12                                  |  |  |
| PnB51            | 2    | Positioning Co<br>Timeout Time                   | mpletion                                                   | 0 to 65,535                                     | 1 ms                                    | 0                  | All                  | Immedi-<br>ately | Setup               | 12-12                                          |  |  |
| PnB54            | 4    | Positioning Ap<br>Speed                          | proach                                                     | 1 to<br>115,343,500                             | 1 refer-<br>ence<br>unit/s              | 400000             | All                  | Immedi-<br>ately | Setup               | page<br>12-14                                  |  |  |
| PnB55            | 4    | End Position                                     |                                                            | 0 to<br>2,147,483,647                           | 1 refer-<br>ence<br>unit                | 0                  | All                  | Immedi-<br>ately | Setup               | page<br>12-15                                  |  |  |
|                  | 2    | Approach Mod                                     | de                                                         | 0000h to<br>0002h                               | _                                       | 0000h              | All                  | Immedi-<br>ately | Setup               | page<br>12-15                                  |  |  |
|                  |      |                                                  |                                                            |                                                 |                                         |                    |                      |                  |                     |                                                |  |  |
| PnB59            |      | 0000h                                            | Direct po                                                  | sitioning                                       |                                         |                    |                      |                  |                     |                                                |  |  |
|                  |      | 0001h                                            | Positionir                                                 | ng in specified i                               | rotation d                              | rection            |                      |                  |                     |                                                |  |  |
|                  |      | 0002h                                            | Positionir                                                 | ng by the near o                                | course                                  |                    |                      |                  |                     |                                                |  |  |
|                  | 2    | Input Signal Lo<br>ting                          | ogic Set-                                                  | 0000h to<br>00A3h                               | _                                       | 0000h              | All                  | Immedi-<br>ately | Setup               | page<br>5-29,<br>page<br>6-34,<br>page<br>12-3 |  |  |
|                  |      | Bit 0                                            | CCW-OT                                                     | Signal (0 = Ac                                  | tive when                               | open, 1 =          | Active when          | closed)          |                     |                                                |  |  |
| PnBA3            |      | Bit 1                                            | CW-OT S                                                    | Signal (0 = Activ                               | ve when c                               | pen, 1 = A         | ctive when cl        | osed)            |                     |                                                |  |  |
|                  |      | Bits 2 to 4                                      | Reserved                                                   |                                                 |                                         |                    |                      |                  |                     |                                                |  |  |
|                  |      | Bit 5                                            |                                                            | Signal (0 = Act                                 | ive when                                | open, 1 = /        | Active when c        | closed)          |                     |                                                |  |  |
|                  |      | Bit 6                                            | Reserved                                                   |                                                 |                                         |                    |                      | e                |                     |                                                |  |  |
|                  |      | Bit 7                                            |                                                            | Signal (0 = Activ                               | ve when o                               | pen, 1 = A         | ctive when cl        | osed)            |                     |                                                |  |  |
|                  |      | Bits 8 to 15                                     | Reserved                                                   | l.                                              |                                         |                    |                      |                  |                     |                                                |  |  |
|                  |      |                                                  |                                                            |                                                 |                                         |                    |                      | Continue         |                     |                                                |  |  |

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|                  | Continued from previo |                                                                                                                                  |                                                                                                                                                                         |                                                                                                                                                                                                                                         |                                                                                                                                   |                                                                                                                                                   |                                                                                                                        |                                                                                                 |                                                             |                                                |
|------------------|-----------------------|----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------|------------------------------------------------|
| Parameter<br>No. | Size                  | Name                                                                                                                             | •                                                                                                                                                                       | Setting<br>Range                                                                                                                                                                                                                        | Setting<br>Unit                                                                                                                   | Default<br>Setting                                                                                                                                | Applicable<br>Motors                                                                                                   | When<br>Enabled                                                                                 | Classi-<br>fication                                         | Refer-<br>ence                                 |
|                  | 2                     | Input Signal Se                                                                                                                  | etting                                                                                                                                                                  | 0000h to<br>00A3h                                                                                                                                                                                                                       | _                                                                                                                                 | 00A3h                                                                                                                                             | All                                                                                                                    | Immedi-<br>ately                                                                                | Setup                                                       | page<br>5-29,<br>page<br>6-34,<br>page<br>12-3 |
|                  |                       |                                                                                                                                  |                                                                                                                                                                         |                                                                                                                                                                                                                                         |                                                                                                                                   |                                                                                                                                                   |                                                                                                                        |                                                                                                 |                                                             |                                                |
|                  |                       | Bit 0                                                                                                                            | CCW-OT Signal (0 = Disable, 1 = Enable)                                                                                                                                 |                                                                                                                                                                                                                                         |                                                                                                                                   |                                                                                                                                                   |                                                                                                                        |                                                                                                 |                                                             |                                                |
| PnBA4            |                       | Bit 1                                                                                                                            | CW-OT S                                                                                                                                                                 | ignal (0 = Disa                                                                                                                                                                                                                         | ble, 1 = E                                                                                                                        | nable)                                                                                                                                            |                                                                                                                        |                                                                                                 |                                                             |                                                |
|                  |                       | Bits 2 to 4                                                                                                                      | Reserved                                                                                                                                                                |                                                                                                                                                                                                                                         |                                                                                                                                   |                                                                                                                                                   |                                                                                                                        |                                                                                                 |                                                             |                                                |
|                  |                       | Bit 5                                                                                                                            |                                                                                                                                                                         | Signal (0 = Dis                                                                                                                                                                                                                         | able, 1 = E                                                                                                                       | Enable)                                                                                                                                           |                                                                                                                        |                                                                                                 |                                                             |                                                |
|                  |                       | Bit 6                                                                                                                            | Reserved                                                                                                                                                                |                                                                                                                                                                                                                                         |                                                                                                                                   | 1-1 - )                                                                                                                                           |                                                                                                                        |                                                                                                 |                                                             |                                                |
|                  |                       | Bit 7<br>Bits 8 to 15                                                                                                            | 7HOME S<br>Reserved                                                                                                                                                     | ignal (0 = Disa                                                                                                                                                                                                                         | DIE, I = EI                                                                                                                       | nable)                                                                                                                                            |                                                                                                                        |                                                                                                 |                                                             |                                                |
|                  |                       | BIIS 0 10 15                                                                                                                     | neserveu                                                                                                                                                                |                                                                                                                                                                                                                                         |                                                                                                                                   |                                                                                                                                                   |                                                                                                                        |                                                                                                 |                                                             |                                                |
|                  | 2                     | Action Definition                                                                                                                | on Setting                                                                                                                                                              | 0000h to<br>F800h                                                                                                                                                                                                                       | _                                                                                                                                 | 0040h                                                                                                                                             | All                                                                                                                    | After<br>restart                                                                                | Setup                                                       | page<br>12-16                                  |
| -                |                       |                                                                                                                                  |                                                                                                                                                                         |                                                                                                                                                                                                                                         |                                                                                                                                   |                                                                                                                                                   |                                                                                                                        |                                                                                                 |                                                             |                                                |
|                  |                       | Bits 0 to 10                                                                                                                     | Reserved                                                                                                                                                                | •                                                                                                                                                                                                                                       | a pot ovoo                                                                                                                        | uto 1 Es                                                                                                                                          | (00) (10)                                                                                                              |                                                                                                 |                                                             |                                                |
| PnBA5            |                       | Bits 0 to 10<br>Bit 11<br>Bit 12                                                                                                 | Automatic<br>Command<br>message                                                                                                                                         | c Reset (0 = Do<br>d Error Clearin<br>is 0, 1 = Autor                                                                                                                                                                                   | g Method                                                                                                                          | (0 = Clear)                                                                                                                                       | error when Va                                                                                                          |                                                                                                 |                                                             |                                                |
| PnBA5            |                       | Bit 11                                                                                                                           | Automatic<br>Comman<br>message<br>sage is no<br>Main Circ                                                                                                               | c Reset (0 = Do<br>d Error Clearin<br>is 0, 1 = Autor<br>ormal)<br>uit Power Supp                                                                                                                                                       | g Method<br>natically re<br>oly Error N                                                                                           | (0 = Clear<br>eset error v<br>lask (0 = D                                                                                                         | error when Va<br>vhen the data<br>etect main cir                                                                       | in the comr                                                                                     | mand mes                                                    | 5-                                             |
| PnBA5            |                       | Bit 11<br>Bit 12                                                                                                                 | Automatic<br>Commany<br>message<br>sage is no<br>Main Circ<br>0 = Do no<br>Main Circ                                                                                    | c Reset (0 = Do<br>d Error Clearing<br>is 0, 1 = Autor<br>prmal)                                                                                                                                                                        | g Method<br>natically re<br>oly Error M<br>circuit pow<br>wer Alarm                                                               | (0 = Clear<br>eset error v<br>lask (0 = D<br>ver supply<br>Clearing N                                                                             | error when Va<br>when the data<br>etect main cir<br>errors)<br>lethod (0 = U                                           | cuit power s                                                                                    | nand mes                                                    | ors,                                           |
| PnBA5            |                       | Bit 11<br>Bit 12<br>Bit 13                                                                                                       | Automatic<br>Commany<br>message<br>sage is no<br>Main Circ<br>0 = Do no<br>Main Circ<br>mand, 1 =<br>Positionin                                                         | c Reset (0 = Do<br>d Error Clearing<br>is 0, 1 = Autor<br>ormal)<br>uit Power Supp<br>ot detect main<br>uit/Control Pov                                                                                                                 | g Method<br>natically re<br>bly Error N<br>circuit pov<br>ver Alarm<br>v reset alar<br>flethod aft                                | (0 = Clear<br>eset error v<br>lask (0 = D<br>ver supply<br>Clearing N<br>rm when p<br>er Continu                                                  | error when Va<br>when the data<br>etect main cir<br>errors)<br>lethod (0 = U<br>ower is restor                         | cuit power s<br>se the alarm                                                                    | upply erro                                                  | ors,                                           |
| PnBA5            |                       | Bit 11<br>Bit 12<br>Bit 13<br>Bit 14                                                                                             | Automatic<br>Commany<br>message<br>sage is no<br>Main Circ<br>0 = Do no<br>Main Circ<br>mand, 1 =<br>Positionin                                                         | c Reset (0 = Do<br>d Error Clearing<br>is 0, 1 = Autor<br>ormal)<br>uit Power Supp<br>t detect main<br>uit/Control Pow<br>= Automatically<br>g Command N<br>d, 1 = Use swit                                                             | g Method<br>natically re<br>bly Error N<br>circuit pov<br>ver Alarm<br>v reset alar<br>flethod aft                                | (0 = Clear<br>eset error v<br>lask (0 = D<br>ver supply<br>Clearing N<br>rm when p<br>er Continu                                                  | error when Va<br>when the data<br>etect main cir<br>errors)<br>lethod (0 = U<br>ower is restor                         | in the comr<br>rouit power s<br>se the alarm<br>red)<br>n (0 = Use pr                           | upply erro                                                  |                                                |
| PnBA5            | 2                     | Bit 11<br>Bit 12<br>Bit 13<br>Bit 14                                                                                             | Automatic<br>Comman<br>message<br>sage is no<br>Main Circ<br>0 = Do no<br>Main Circ<br>mand, 1 =<br>Positionin<br>command                                               | c Reset (0 = Do<br>d Error Clearing<br>is 0, 1 = Autor<br>ormal)<br>uit Power Supp<br>t detect main<br>uit/Control Pow<br>= Automatically<br>g Command M                                                                                | g Method<br>natically re<br>bly Error N<br>circuit pov<br>ver Alarm<br>v reset alar<br>flethod aft                                | (0 = Clear<br>eset error v<br>lask (0 = D<br>ver supply<br>Clearing N<br>rm when p<br>er Continu                                                  | error when Va<br>when the data<br>etect main cir<br>errors)<br>lethod (0 = U<br>ower is restor                         | cuit power s<br>se the alarm                                                                    | upply erro                                                  | n-                                             |
| PnBA5            | 2                     | Bit 11<br>Bit 12<br>Bit 13<br>Bit 14<br>Bit 15<br>Initialization Se                                                              | Automatic<br>Comman<br>message<br>sage is no<br>Main Circ<br>0 = Do no<br>Main Circ<br>mand, 1 =<br>Positionin<br>command                                               | c Reset (0 = Do<br>d Error Clearin,<br>is 0, 1 = Autor<br>ormal)<br>uit Power Supp<br>ot detect main<br>uit/Control Pov<br>= Automatically<br>g Command N<br>d, 1 = Use swit<br>0000h to<br>0003h                                       | g Method<br>natically re<br>oly Error M<br>circuit pov<br>wer Alarm<br>reset alar<br>reset alar<br>dethod aft<br>ching com        | (0 = Clear<br>esset error v<br>lask (0 = D<br>ver supply<br>Clearing N<br>rm when p<br>er Continu-<br>mand)<br>0000h                              | error when Va<br>vhen the data<br>etect main cir<br>errors)<br>lethod (0 = U<br>ower is restor<br>ous Operation<br>All | in the comr<br>rouit power s<br>se the alarm<br>red)<br>n (0 = Use po<br>After<br>restart       | nand mes<br>upply erro<br>clear con<br>ositioning           | n-                                             |
| PnBA5            | 2                     | Bit 11<br>Bit 12<br>Bit 13<br>Bit 14<br>Bit 15<br>Initialization Se<br>Bit 0                                                     | Automatic<br>Comman<br>message<br>sage is no<br>Main Circ<br>0 = Do no<br>Main Circ<br>mand, 1 =<br>Positionin<br>command                                               | c Reset (0 = Do<br>d Error Clearing<br>is 0, 1 = Autor<br>ormal)<br>uit Power Supp<br>ot detect main<br>uit/Control Poo<br>= Automatically<br>g Command N<br>d, 1 = Use swit<br>0000h to<br>0003h<br>Encoder Rese                       | g Method<br>natically re<br>oly Error M<br>circuit pov<br>wer Alarm<br>reset alar<br>dethod aft<br>ching corr<br>–<br>t (0 = Do r | (0 = Clear<br>esset error v<br>lask (0 = D<br>ver supply<br>Clearing M<br>rm when p<br>er Continue<br>mand)<br>0000h                              | error when Va<br>vhen the data<br>etect main cir<br>errors)<br>lethod (0 = U<br>ower is restor<br>ous Operation<br>All | in the comr<br>rouit power s<br>se the alarm<br>red)<br>n (0 = Use po<br>After<br>restart       | nand mes<br>upply erro<br>clear con<br>ositioning           | n-                                             |
|                  | 2                     | Bit 11<br>Bit 12<br>Bit 13<br>Bit 14<br>Bit 15<br>Initialization Se<br>Bit 0<br>Bit 1                                            | Automatic<br>Comman<br>message<br>sage is no<br>Main Circ<br>0 = Do no<br>Main Circ<br>mand, 1 =<br>Positionin<br>command<br>tting<br>Absolute<br>Paramete              | c Reset (0 = Do<br>d Error Clearing<br>is 0, 1 = Autor<br>ormal)<br>uit Power Supp<br>ot detect main<br>uit/Control Poy<br>= Automatically<br>g Command N<br>d, 1 = Use swit<br>0000h to<br>0003h<br>Encoder Rese<br>r Initialization ( | g Method<br>natically re<br>oly Error M<br>circuit pov<br>wer Alarm<br>reset alar<br>dethod aft<br>ching corr<br>–<br>t (0 = Do r | (0 = Clear<br>esset error v<br>lask (0 = D<br>ver supply<br>Clearing M<br>rm when p<br>er Continue<br>mand)<br>0000h                              | error when Va<br>vhen the data<br>etect main cir<br>errors)<br>lethod (0 = U<br>ower is restor<br>ous Operation<br>All | in the comr<br>rouit power s<br>se the alarm<br>red)<br>n (0 = Use po<br>After<br>restart       | nand mes<br>upply erro<br>clear con<br>ositioning           | n-                                             |
|                  | 2                     | Bit 11<br>Bit 12<br>Bit 13<br>Bit 14<br>Bit 15<br>Initialization Se<br>Bit 0                                                     | Automatic<br>Comman<br>message<br>sage is no<br>Main Circ<br>0 = Do no<br>Main Circ<br>mand, 1 =<br>Positionin<br>command                                               | c Reset (0 = Do<br>d Error Clearing<br>is 0, 1 = Autor<br>ormal)<br>uit Power Supp<br>ot detect main<br>uit/Control Poy<br>= Automatically<br>g Command N<br>d, 1 = Use swit<br>0000h to<br>0003h<br>Encoder Rese<br>r Initialization ( | g Method<br>natically re<br>oly Error M<br>circuit pov<br>wer Alarm<br>reset alar<br>dethod aft<br>ching corr<br>–<br>t (0 = Do r | (0 = Clear<br>esset error v<br>lask (0 = D<br>ver supply<br>Clearing M<br>rm when p<br>er Continue<br>mand)<br>0000h                              | error when Va<br>vhen the data<br>etect main cir<br>errors)<br>lethod (0 = U<br>ower is restor<br>ous Operation<br>All | in the comr<br>rouit power s<br>se the alarm<br>red)<br>n (0 = Use po<br>After<br>restart       | nand mes<br>upply erro<br>clear con<br>ositioning           | n-                                             |
|                  | 2                     | Bit 11<br>Bit 12<br>Bit 13<br>Bit 14<br>Bit 15<br>Initialization Se<br>Bit 0<br>Bit 1                                            | Automatic<br>Commany<br>message<br>sage is no<br>Main Circ<br>0 = Do no<br>Main Circ<br>mand, 1 =<br>Positionin<br>command<br>tting<br>Absolute<br>Paramete<br>Reserved | c Reset (0 = Do<br>d Error Clearing<br>is 0, 1 = Autor<br>ormal)<br>uit Power Supp<br>ot detect main<br>uit/Control Poy<br>= Automatically<br>g Command N<br>d, 1 = Use swit<br>0000h to<br>0003h<br>Encoder Rese<br>r Initialization ( | g Method<br>natically re<br>oly Error M<br>circuit pov<br>wer Alarm<br>reset alar<br>dethod aft<br>ching corr<br>–<br>t (0 = Do r | (0 = Clear<br>esset error v<br>lask (0 = D<br>ver supply<br>Clearing M<br>rm when p<br>er Continue<br>mand)<br>0000h                              | error when Va<br>vhen the data<br>etect main cir<br>errors)<br>lethod (0 = U<br>ower is restor<br>ous Operation<br>All | in the comr<br>rouit power s<br>se the alarm<br>red)<br>n (0 = Use po<br>After<br>restart       | nand mes<br>upply erro<br>clear con<br>ositioning           | n-                                             |
| PnBA7            |                       | Bit 11<br>Bit 12<br>Bit 13<br>Bit 14<br>Bit 14<br>Bit 15<br>Initialization Se<br>Bit 0<br>Bit 1<br>Bits 2 to 15<br>Reserved para | Automatic<br>Commany<br>message<br>sage is no<br>Main Circ<br>0 = Do no<br>Main Circ<br>mand, 1 =<br>Positionin<br>command<br>tting<br>Absolute<br>Paramete<br>Reserved | c Reset (0 = Do<br>d Error Clearing<br>is 0, 1 = Autor<br>ormal)<br>uit Power Supp<br>ot detect main<br>uit/Control Poy<br>= Automatically<br>g Command N<br>d, 1 = Use swit<br>0000h to<br>0003h<br>Encoder Rese<br>r Initialization ( | g Method<br>natically re<br>oly Error M<br>circuit pov<br>wer Alarm<br>reset alar<br>dethod aft<br>ching corr<br>–<br>t (0 = Do r | (0 = Clear<br>esset error v<br>lask (0 = D<br>ver supply<br>Clearing M<br>rm when p<br>er Continu-<br>mand)<br>0000h<br>not execute<br>t execute, | error when Va<br>vhen the data<br>etect main cir<br>errors)<br>lethod (0 = U<br>ower is restor<br>ous Operation<br>All | a in the comr<br>recuit power s<br>se the alarm<br>red)<br>n (0 = Use power<br>After<br>restart | nand mes<br>upply error<br>clear con<br>ositioning<br>Setup | ors,<br>n-                                     |

\*2. Normally set this parameter to 0. If you use an External Regenerative Resistor, set the capacity (W) of the External Regenerative Resistor.

\*3. The upper limit is the maximum output capacity (W) of the SERVOPACK.

\*4. These parameters are for SERVOPACKs with the Dynamic Brake Hardware Option. Refer to the following manual for details.

 <sup>(1)</sup> Σ-7-Series Σ-7S/Σ-7W SERVOPACK with Dynamic Brake Hardware Option Specifications Product Manual (Manual No.: SIEP S800001 73)

\*5. The SGLFW2 is the only Yaskawa Linear Servomotor that supports this function.

\*6. Enabled only when Pn61A is set to  $n.\square\square\square2$  or  $n.\square\square\square3$ .

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# 15.2 Parameter Recording Table

Use the following table to record the settings of the parameters.

| Parameter<br>No. | Default<br>Setting | Name                                                       | When<br>Enabled |
|------------------|--------------------|------------------------------------------------------------|-----------------|
| Pn000            | 0000h              | Basic Function Selections 0                                | After restart   |
| Pn001            | 0000h              | Application Function Selec-<br>tions 1                     | After restart   |
| Pn002            | 0000h              | Application Function Selec-<br>tions 2                     | After restart   |
| Pn006            | 0002h              | Application Function Selec-<br>tions 6                     | Immediately     |
| Pn007            | 0000h              | Application Function Selec-<br>tions 7                     | Immediately     |
| Pn008            | 4000h              | Application Function Selec-<br>tions 8                     | After restart   |
| Pn009            | 0010h              | Application Function Selec-<br>tions 9                     | After restart   |
| Pn00A            | 0001h              | Application Function Selec-<br>tions A                     | After restart   |
| Pn00B            | 0000h              | Application Function Selec-<br>tions B                     | After restart   |
| Pn00C            | 0000h              | Application Function Selec-<br>tions C                     | After restart   |
| Pn00D            | 0000h              | Application Function Selec-<br>tions D                     | Immediately     |
| Pn00F            | 0000h              | Application Function Selec-<br>tions F                     | After restart   |
| Pn010            | 0001h              | Axis Address Selection for<br>UART/USB Communica-<br>tions | After restart   |
| Pn021            | 0000               | Reserved parameter                                         | _               |
| Pn022            | 0000h              | Reserved parameter                                         | _               |
| Pn040            | 0000h              | Σ-V Compatible Function<br>Switch                          | After restart   |
| Pn080            | 0000h              | Application Function Selec-<br>tions 80                    | After restart   |
| Pn081            | 0000h              | Application Function Selec-<br>tions 81                    | After restart   |
| Pn100            | 400                | Speed Loop Gain                                            | Immediately     |
| Pn101            | 2000               | Speed Loop Integral Time<br>Constant                       | Immediately     |
| Pn102            | 400                | Position Loop Gain                                         | Immediately     |
| Pn103            | 100                | Moment of Inertia Ratio                                    | Immediately     |
| Pn104            | 400                | Second Speed Loop Gain                                     | Immediately     |
| Pn105            | 2000               | Second Speed Loop Inte-<br>gral Time Constant              | Immediately     |
| Pn106            | 400                | Second Position Loop Gain                                  | Immediately     |
| Pn109            | 0                  | Feedforward                                                | Immediately     |
| Pn10A            | 0                  | Feedforward Filter Time<br>Constant                        | Immediately     |
| Pn10B            | 0000h              | Gain Application Selections                                | *               |
| Pn10C            | 200                | Mode Switching Level for<br>Torque Reference               | Immediately     |
| Pn10D            | 0                  | Mode Switching Level for<br>Speed Reference                | Immediately     |

| _                | _                  | Continued from p                                               |                 |
|------------------|--------------------|----------------------------------------------------------------|-----------------|
| Parameter<br>No. | Default<br>Setting | Name                                                           | When<br>Enabled |
| Pn10E            | 0                  | Mode Switching Level for<br>Acceleration                       | Immediately     |
| Pn10F            | 0                  | Mode Switching Level for<br>Position Deviation                 | Immediately     |
| Pn11F            | 0                  | Position Integral Time Con-<br>stant                           | Immediately     |
| Pn121            | 100                | Friction Compensation Gain                                     | Immediately     |
| Pn122            | 100                | Second Friction Compen-<br>sation Gain                         | Immediately     |
| Pn123            | 0                  | Friction Compensation<br>Coefficient                           | Immediately     |
| Pn124            | 0                  | Friction Compensation Fre-<br>quency Correction                | Immediately     |
| Pn125            | 100                | Friction Compensation Gain<br>Correction                       | Immediately     |
| Pn131            | 0                  | Gain Switching Time 1                                          | Immediately     |
| Pn132            | 0                  | Gain Switching Time 2                                          | Immediately     |
| Pn135            | 0                  | Gain Switching Waiting<br>Time 1                               | Immediately     |
| Pn136            | 0                  | Gain Switching Waiting<br>Time 2                               | Immediately     |
| Pn139            | 0000h              | Automatic Gain Switching<br>Selections 1                       | Immediately     |
| Pn13D            | 2000               | Current Gain Level                                             | Immediately     |
| Pn140            | 0100h              | Model Following Control-<br>Related Selections                 | Immediately     |
| Pn141            | 500                | Model Following Control<br>Gain                                | Immediately     |
| Pn142            | 1000               | Model Following Control<br>Gain Correction                     | Immediately     |
| Pn143            | 1000               | Model Following Control<br>Bias in the Forward Direc-<br>tion  | Immediately     |
| Pn144            | 1000               | Model Following Control<br>Bias in the Reverse Direc-<br>tion  | Immediately     |
| Pn145            | 500                | Vibration Suppression 1<br>Frequency A                         | Immediately     |
| Pn146            | 700                | Vibration Suppression 1<br>Frequency B                         | Immediately     |
| Pn147            | 1000               | Model Following Control<br>Speed Feedforward Com-<br>pensation | Immediately     |
| Pn148            | 500                | Second Model Following<br>Control Gain                         | Immediately     |
| Pn149            | 1000               | Second Model Following<br>Gain Control Correction              | Immediately     |
| Pn14A            | 800                | Vibration Suppression 2<br>Frequency                           | Immediately     |
| Pn14B            | 100                | Vibration Suppression 2<br>Correction                          | Immediately     |
| Pn14F            | 0011h              | Control-Related Selections                                     | After restart   |
| Pn160            | 0010h              | Anti-Resonance Control-<br>Related Selections                  | Immediately     |
| Pn161            | 1000               | Anti-Resonance Frequency                                       | Immediately     |

Parameter Lists

| Parameter<br>No. | Default<br>Setting | Name                                                | When<br>Enabled |
|------------------|--------------------|-----------------------------------------------------|-----------------|
| Pn162            | 100                | Anti-Resonance Gain Cor-<br>rection                 | Immediately     |
| Pn163            | 0                  | Anti-Resonance Damping<br>Gain                      | Immediately     |
| Pn164            | 0                  | Anti-Resonance Filter Time<br>Constant 1 Correction | Immediately     |
| Pn165            | 0                  | Anti-Resonance Filter Time<br>Constant 2 Correction | Immediately     |
| Pn166            | 0                  | Anti-Resonance Damping<br>Gain 2                    | Immediately     |
| Pn170            | 1401h              | Tuning-less Function-<br>Related Selections         | *               |
| Pn181            | 0                  | Mode Switching Level for<br>Speed Reference         | Immediately     |
| Pn182            | 0                  | Mode Switching Level for<br>Acceleration            | Immediately     |
| Pn205            | 65535              | Multiturn Limit                                     | After restart   |
| Pn207            | 0010h              | Position Control Function<br>Selections             | After restart   |
| Pn20A            | 32768              | Number of External Scale<br>Pitches                 | After restart   |
| Pn20E            | 64                 | Electronic Gear Ratio<br>(Numerator)                | After restart   |
| Pn210            | 1                  | Electronic Gear Ratio<br>(Denominator)              | After restart   |
| Pn212            | 2048               | Number of Encoder Output<br>Pulses                  | After restart   |
| Pn216            | 0                  | Reserved parameter                                  | -               |
| Pn217            | 0                  | Reserved parameter                                  | _               |
| Pn22A            | 0000h              | Fully-closed Control Selec-<br>tions                | After restart   |
| Pn230            | 0000h              | Position Control Expansion<br>Function Selection    | After restart   |
| Pn231            | 0                  | Backlash Compensation<br>Value                      | Immediately     |
| Pn233            | 0                  | Backlash Compensation<br>Time Constant              | Immediately     |
| Pn281            | 20                 | Encoder Output Resolution                           | After restart   |
| Pn282            | 0                  | Linear Encoder Pitch                                | After restart   |
| Pn304            | 500                | Jogging Speed                                       | Immediately     |
| Pn305            | 0                  | Soft Start Acceleration<br>Time                     | Immediately     |
| Pn306            | 0                  | Soft Start Deceleration<br>Time                     | Immediately     |
| Pn308            | 0                  | Speed Feedback Filter<br>Time Constant              | Immediately     |
| Pn30A            | 0                  | Deceleration Time for Servo<br>OFF and Forced Stops | Immediately     |
| Pn30C            | 0                  | Reserved parameter                                  | _               |
| Pn310            | 0000h              | Vibration Detection Selec-<br>tions                 | Immediately     |
| Pn311            | 100                | Vibration Detection Sensi-<br>tivity                | Immediately     |
| Pn312            | 50                 | Vibration Detection Level                           | Immediately     |
| Pn316            | 10000              | Maximum Motor Speed                                 | After restart   |

|           |         | Continued from p                                                 |               |
|-----------|---------|------------------------------------------------------------------|---------------|
| Parameter | Default | Name                                                             | When          |
| No.       | Setting |                                                                  | Enabled       |
| Pn324     | 300     | Moment of Inertia Calcula-<br>tion Starting Level                | Immediately   |
| Pn383     | 50      | Jogging Speed                                                    | Immediately   |
| Pn384     | 10      | Vibration Detection Level                                        | Immediately   |
| Pn385     | 50      | Maximum Motor Speed                                              | After restart |
| Pn401     | 100     | First Stage First Torque<br>Reference Filter Time Con-<br>stant  | Immediately   |
| Pn402     | 800     | Forward Torque Limit                                             | Immediately   |
| Pn403     | 800     | Reverse Torque Limit                                             | Immediately   |
| Pn404     | 100     | Reserved parameter                                               | -             |
| Pn405     | 100     | Reserved parameter                                               | _             |
| Pn406     | 800     | Emergency Stop Torque                                            | Immediately   |
| Pn407     | 10000   | Reserved parameter                                               | _             |
| Pn408     | 0000h   | Torque-Related Function<br>Selections                            | *             |
| Pn409     | 5000    | First Stage Notch Filter Fre-<br>quency                          | Immediately   |
| Pn40A     | 70      | First Stage Notch Filter Q<br>Value                              | Immediately   |
| Pn40B     | 0       | First Stage Notch Filter<br>Depth                                | Immediately   |
| Pn40C     | 5000    | Second Stage Notch Filter<br>Frequency                           | Immediately   |
| Pn40D     | 70      | Second Stage Notch Filter<br>Q Value                             | Immediately   |
| Pn40E     | 0       | Second Stage Notch Filter<br>Depth                               | Immediately   |
| Pn40F     | 5000    | Second Stage Second<br>Torque Reference Filter Fre-<br>quency    | Immediately   |
| Pn410     | 50      | Second Stage Second<br>Torque Reference Filter Q<br>Value        | Immediately   |
| Pn412     | 100     | First Stage Second Torque<br>Reference Filter Time Con-<br>stant | Immediately   |
| Pn416     | 0000h   | Torque-Related Function<br>Selections 2                          | Immediately   |
| Pn417     | 5000    | Third Stage Notch Filter<br>Frequency                            | Immediately   |
| Pn418     | 70      | Third Stage Notch Filter Q<br>Value                              | Immediately   |
| Pn419     | 0       | Third Stage Notch Filter<br>Depth                                | Immediately   |
| Pn41A     | 5000    | Fourth Stage Notch Filter<br>Frequency                           | Immediately   |
| Pn41B     | 70      | Fourth Stage Notch Filter Q<br>Value                             | Immediately   |
| Pn41C     | 0       | Fourth Stage Notch Filter<br>Depth                               | Immediately   |
| Pn41D     | 5000    | Fifth Stage Notch Filter Fre-<br>quency                          | Immediately   |
| Pn41E     | 70      | Fifth Stage Notch Filter Q<br>Value                              | Immediately   |

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| Parameter<br>No. | Default<br>Setting | Name                                                                  | When<br>Enabled |
|------------------|--------------------|-----------------------------------------------------------------------|-----------------|
| Pn41F            | 0                  | Fifth Stage Notch Filter<br>Depth                                     | Immediately     |
| Pn423            | 0000h              | Speed Ripple Compensa-<br>tion Selections                             | *               |
| Pn424            | 50                 | Torque Limit at Main Circuit<br>Voltage Drop                          | Immediately     |
| Pn425            | 100                | Release Time for Torque<br>Limit at Main Circuit Voltage<br>Drop      | Immediately     |
| Pn426            | 0                  | Reserved parameter                                                    | _               |
| Pn427            | 0                  | Speed Ripple Compensa-<br>tion Enable Speed                           | Immediately     |
| Pn456            | 15                 | Sweep Torque Reference<br>Amplitude                                   | Immediately     |
| Pn460            | 0101h              | Notch Filter Adjustment<br>Selections 1                               | Immediately     |
| Pn475            | 0000h              | Gravity Compensation-<br>Related Selections                           | After restart   |
| Pn476            | 0                  | Gravity Compensation<br>Torque                                        | Immediately     |
| Pn480            | 10000              | Reserved parameter                                                    | _               |
| Pn481            | 400                | Polarity Detection Speed<br>Loop Gain                                 | Immediately     |
| Pn482            | 3000               | Polarity Detection Speed<br>Loop Integral Time Con-<br>stant          | Immediately     |
| Pn483            | 30                 | Forward Force Limit                                                   | Immediately     |
| Pn484            | 30                 | Reverse Force Limit                                                   | Immediately     |
| Pn485            | 20                 | Polarity Detection Refer-<br>ence Speed                               | Immediately     |
| Pn486            | 25                 | Polarity Detection Refer-<br>ence Acceleration/Deceler-<br>ation Time | Immediately     |
| Pn487            | 0                  | Polarity Detection Con-<br>stant Speed Time                           | Immediately     |
| Pn488            | 100                | Polarity Detection Refer-<br>ence Waiting Time                        | Immediately     |
| Pn48E            | 10                 | Polarity Detection Range                                              | Immediately     |
| Pn490            | 100                | Polarity Detection Load<br>Level                                      | Immediately     |
| Pn495            | 100                | Polarity Detection Confir-<br>mation Force Reference                  | Immediately     |
| Pn498            | 10                 | Polarity Detection Allowable<br>Error Range                           | Immediately     |
| Pn49F            | 0                  | Speed Ripple Compensa-<br>tion Enable Speed                           | Immediately     |
| Pn502            | 20                 | Rotation Detection Level                                              | Immediately     |
| Pn503            | 10                 | Reserved parameter                                                    | _               |
| Pn506            | 0                  | Brake Reference-Servo<br>OFF Delay Time                               | Immediately     |
| Pn507            | 100                | Brake Reference Output<br>Speed Level                                 | Immediately     |
| Pn508            | 50                 | Servo OFF-Brake Com-<br>mand Waiting Time                             | Immediately     |
| Pn509            | 20                 | Momentary Power Interrup-<br>tion Hold Time                           | Immediately     |

| Parameter<br>No. | Default<br>Setting | Continued from p                                               | When<br>Enabled |
|------------------|--------------------|----------------------------------------------------------------|-----------------|
| Pn50A            | 1881h              | Reserved parameter                                             | _               |
| Pn50B            | 8882h              | Reserved parameter                                             | _               |
| Pn50E            | 0000h              | Reserved parameter                                             | _               |
| Pn50F            | 0100h              | Reserved parameter                                             | -               |
| Pn510            | 0000h              | Reserved parameter                                             | -               |
| Pn511            | 6543h              | Reserved parameter                                             | _               |
| Pn512            | 0000h              | Reserved parameter                                             | _               |
| Pn514            | 0000h              | Reserved parameter                                             | _               |
| Pn516            | 8888h              | Reserved parameter                                             | _               |
| Pn517            | 0000h              | Reserved parameter                                             | _               |
| Pn51B            | 1000               | Motor-Load Position Devia-<br>tion Overflow Detection<br>Level | Immediately     |
| Pn51E            | 100                | Position Deviation Over-<br>flow Warning Level                 | Immediately     |
| Pn520            | 5242880            | Position Deviation Over-<br>flow Alarm Level                   | Immediately     |
| Pn522            | 7                  | Positioning Completed<br>Width                                 | Immediately     |
| Pn524            | 1073741<br>824     | Near Signal Width                                              | Immediately     |
| Pn526            | 5242880            | Position Deviation Over-<br>flow Alarm Level at Servo<br>ON    | Immediately     |
| Pn528            | 100                | Position Deviation Over-<br>flow Warning Level at Servo<br>ON  | Immediately     |
| Pn529            | 10000              | Speed Limit Level at Servo<br>ON                               | Immediately     |
| Pn52A            | 20                 | Multiplier per Fully-closed<br>Rotation                        | Immediately     |
| Pn52B            | 20                 | Overload Warning Level                                         | Immediately     |
| Pn52C            | 100                | Base Current Derating at<br>Motor Overload Detection           | After restart   |
| Pn530            | 0000h              | Program Jogging-Related<br>Selections                          | Immediately     |
| Pn531            | 32768              | Program Jogging Travel<br>Distance                             | Immediately     |
| Pn533            | 500                | Program Jogging Move-<br>ment Speed                            | Immediately     |
| Pn534            | 100                | Program Jogging Accelera-<br>tion/Deceleration Time            | Immediately     |
| Pn535            | 100                | Program Jogging Waiting<br>Time                                | Immediately     |
| Pn536            | 1                  | Program Jogging Number<br>of Movements                         | Immediately     |
| Pn550            | 0                  | Analog Monitor 1 Offset<br>Voltage                             | Immediately     |
| Pn551            | 0                  | Analog Monitor 2 Offset<br>Voltage                             | Immediately     |
| Pn552            | 100                | Analog Monitor 1 Magnifi-<br>cation                            | Immediately     |
| Pn553            | 100                | Analog Monitor 2 Magnifi-<br>cation                            | Immediately     |

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| Parameter<br>No.  | Default<br>Setting | Name                                                   | When<br>Enabled      |
|-------------------|--------------------|--------------------------------------------------------|----------------------|
| Pn55A             | 1                  | Power Consumption<br>tor Unit Time                     | Moni- Immediately    |
| Pn560             | 400                | Residual Vibration De tion Width                       | etec- Immediately    |
| Pn561             | 100                | Overshoot Detection                                    | Level Immediately    |
| Pn581             | 20                 | Zero Speed Level                                       | Immediately          |
| Pn582             | 10                 | Reserved parameter                                     | -                    |
| Pn583             | 10                 | Brake Reference Out<br>Speed Level                     | Immediately          |
| Pn584             | 10000              | Speed Limit Level at ON                                | Immediately          |
| Pn585             | 50                 | Program Jogging Mo<br>ment Speed                       |                      |
| Pn586             | 0                  | Motor Running Cooli<br>Ratio                           | ng Immediately       |
| Pn587             | 0000h              | Reserved parameter                                     | -                    |
| Pn600             | 0                  | Regenerative Resisto<br>Capacity                       | Immediately          |
| Pn601             | 0                  | Dynamic Brake Resis<br>Allowable Energy Co<br>sumption |                      |
| Pn603             | 0                  | Regenerative Resista                                   | ance Immediately     |
| Pn604             | 0                  | Dynamic Brake Resis                                    | stance After restart |
| Pn61A             | 0000h              | Overheat Protection tions                              | Selec- After restart |
| Pn61B             | 250                | Overheat Alarm Leve                                    | Immediately          |
| Pn61C             | 100                | Overheat Warning Le                                    | evel Immediately     |
| Pn61D             | 0                  | Overheat Alarm Filter                                  | Time Immediately     |
| Pn621 to<br>Pn628 | -                  | Reserved parameter                                     | -                    |
| PnB01             | 0001h              | Origin Return Direction                                | on Immediately       |
| PnB03             | 20000              | Origin Approach Spe                                    | ed Immediately       |
| PnB04             | 10000              | Origin Return Creep                                    | Speed Immediately    |
| PnB05             | 0                  | Final Travel Distance<br>Origin Return                 | for Immediately      |
| PnB09             | 0                  | Origin Offset                                          | Immediately          |
| PnB12             | 0000h              | Coordinate Type Sele                                   | ection Immediately   |
| PnB13             | 360000             | Reference Units per<br>Machine Revolution              | After restart        |
| PnB16             | 2147483<br>647     | Forward Software Lir                                   | mit Immediately      |
| PnB17             | -214748<br>3647    | Reverse Software Lir                                   | nit Immediately      |
| PnB18             | 0000h              | Software Limit Action<br>Selection                     | Immediately          |
| PnB1A             | 0000h              | Hardware Limit Actio<br>Selection                      | Immediately          |
| PnB1C             | 0000h              | External Stop Action tion                              | Selec- Immediately   |
| PnB21             | 400000             | Feed Speed                                             | Immediately          |
| PnB26             | 0003h              | Acceleration/Deceler<br>Type                           | ation Immediately    |
| PnB29             | 0000h              | Filter Selection                                       | Immediately          |
| PnB2A             | 4000000            | Acceleration Rate                                      | Immediately          |

| Parameter<br>No. | Default<br>Setting | Name                                                              | When<br>Enabled |
|------------------|--------------------|-------------------------------------------------------------------|-----------------|
| PnB2B            | 4000000            | Deceleration Rate                                                 | Immediately     |
| PnB40            | 4                  | Time Constant for Expo-<br>nential Acceleration/Decel-<br>eration | Immediately     |
| PnB41            | 0                  | Exponential Acceleration/<br>Deceleration Bias Speed              | Immediately     |
| PnB42            | 25                 | Average Movement Time<br>Filter Time Constant                     | Immediately     |
| PnB50            | 5                  | Positioning Completed<br>Width                                    | Immediately     |
| PnB51            | 0                  | Positioning Completion<br>Timeout Time                            | Immediately     |
| PnB54            | 400000             | Positioning Approach<br>Speed                                     | Immediately     |
| PnB55            | 0                  | End Position                                                      | Immediately     |
| PnB59            | 0000h              | Approach Mode                                                     | Immediately     |
| PnBA3            | 0000h              | Input Signal Logic Setting                                        | Immediately     |
| PnBA4            | 00A3h              | Input Signal Setting                                              | Immediately     |
| PnBA5            | 0000h              | Action Definition Setting                                         | After restart   |
| PnBA7            | 0000h              | Initialization Setting                                            | After restart   |
| PnBA9            | 10000              | Reserved parameter                                                | -               |
| PnBAA            | 4000000            | Reserved parameter                                                | -               |
| PnBAB            | 4000000            | Reserved parameter                                                | -               |

\* The enable timing depends on the digit that is changed. Refer to the following section for details.

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# Appendices

The appendix provides corresponding SERVOPACK and SigmaWin+ function names.

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| 16.1 | Corresponding SERVOPACK and SigmaWin+ Function Names 16-2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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16.1.1 Corresponding SERVOPACK Utility Function Names

# 16.1 Corresponding SERVOPACK and SigmaWin+ Function Names

This section gives the names and numbers of the utility functions and monitor display functions used by the SERVOPACKs and the names used by the SigmaWin+.

# 16.1.1 Corresponding SERVOPACK Utility Function Names

|                                 | SigmaWin+                                                 | SERVOPACK |                                                                  |  |  |
|---------------------------------|-----------------------------------------------------------|-----------|------------------------------------------------------------------|--|--|
| Button in<br>Menu<br>Dialog Box | Function Name                                             | Fn No.    | Function Name                                                    |  |  |
|                                 | Initialize                                                | Fn005     | Initializing Parameters                                          |  |  |
|                                 | Software Reset                                            | Fn030     | Software Reset                                                   |  |  |
|                                 | Setup Wizard                                              | -         | -                                                                |  |  |
| Basic Func-                     | I/O Signal Allocation                                     | -         | -                                                                |  |  |
| tions                           |                                                           | Fn011     | Display Servomotor Model                                         |  |  |
| lions                           |                                                           | Fn012     | Display Software Version                                         |  |  |
|                                 | Product Information                                       | Fn01E     | Display SERVOPACK and Servomotor IDs                             |  |  |
|                                 |                                                           | Fn01F     | Display Servomotor ID from Feedback Option<br>Module             |  |  |
|                                 | Reset Absolute Encoder                                    | Fn008     | Reset Absolute Encoder                                           |  |  |
|                                 | Multi-turn Limit Setup                                    | Fn013     | Multiturn Limit Setting after Multiturn Limit Disagreement Alarm |  |  |
| Encoder                         | Search Origin                                             | Fn003     | Origin Search                                                    |  |  |
| Setting                         | Zero Point Position Setting                               | Fn020     | Set Absolute Linear Encoder Origin                               |  |  |
|                                 | Polarity Detection                                        | Fn080     | Polarity Detection                                               |  |  |
|                                 | Motor Parameter Scale Write                               | _         | -                                                                |  |  |
|                                 |                                                           | Fn000     | Display Alarm History                                            |  |  |
|                                 | Display Alarm                                             | Fn006     | Clear Alarm History                                              |  |  |
| Trouble-                        |                                                           | Fn014     | Reset Option Module Configuration Error                          |  |  |
| shooting                        | Alarm Trace                                               | -         | -                                                                |  |  |
|                                 | Reset Motor Type Alarm                                    | Fn021     | Reset Motor Type Alarm                                           |  |  |
| 0                               | Jog                                                       | Fn002     | Jog                                                              |  |  |
| Operation                       | Program JOG Operation                                     | Fn004     | Jog Program                                                      |  |  |
|                                 | Trace                                                     | _         | -                                                                |  |  |
| Acoitou                         | Real Time Trace                                           | _         | -                                                                |  |  |
| Monitor                         | Monitor                                                   | _         | -                                                                |  |  |
|                                 | Life Monitor                                              | _         | -                                                                |  |  |
|                                 | Tuning -<br>Autotuning without Host Refer-<br>ence        | Fn201     | Advanced Autotuning without Reference                            |  |  |
|                                 | Tuning -<br>Autotuning with Host Reference                | Fn202     | Advanced Autotuning with Reference                               |  |  |
|                                 | Tuning - Custom Tuning                                    | Fn203     | One-Parameter Tuning                                             |  |  |
| Tuning                          | Tuning - Custom Tuning -<br>Adjust Anti-resonance Control | Fn204     | Adjust Anti-resonance Control                                    |  |  |
|                                 | Tuning - Custom Tuning -<br>Vibration Suppression         | Fn205     | Vibration Suppression                                            |  |  |
|                                 | System Tuning                                             | -         | -                                                                |  |  |
|                                 | Response Level Setting                                    | Fn200     | Tuning-less Level Setting                                        |  |  |
|                                 | Edit Online Parameters                                    | _         | -                                                                |  |  |

#### 16.1.1 Corresponding SERVOPACK Utility Function Names

Continued from previous page.

|                                 | SigmaWin                                        |        | SERVOPACK                                                |
|---------------------------------|-------------------------------------------------|--------|----------------------------------------------------------|
|                                 | SigmaWin+                                       |        | SERVUPAUR                                                |
| Button in<br>Menu<br>Dialog Box | Function Name                                   | Fn No. | Function Name                                            |
|                                 | Mechanical Analysis                             | _      | -                                                        |
| Diagnostic                      | Easy FFT                                        | Fn206  | Easy FFT                                                 |
| Diagnostic                      | Ripple Compensation                             | -      | -                                                        |
|                                 | Online Vibration Monitor                        | -      | -                                                        |
|                                 | Adjust the Analog Monitor Output                | Fn00C  | Adjust Analog Monitor Output Offset                      |
|                                 | Adjust the Analog Monitor Output                | Fn00D  | Adjust Analog Monitor Output Gain                        |
|                                 | Adjust the Motor Current Detec-<br>tion Offsets | Fn00E  | Autotune Motor Current Detection Signal Offset           |
|                                 |                                                 | Fn00F  | Manually Adjust Motor Current Detection Signal<br>Offset |
| Others                          | Initialize Vibration Detection Level            | Fn01B  | Initialize Vibration Detection Level                     |
|                                 | Parameter Converter                             | _      | -                                                        |
|                                 | SERVOPACK Axis Name Setting                     | _      | -                                                        |
|                                 | Write Prohibited Setting                        | Fn010  | Write Prohibition Setting                                |
|                                 | Motor Parameter SERVOPACK<br>Write              | -      | -                                                        |

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16.1.2 Corresponding SERVOPACK Monitor Display Function Names

# 16.1.2 Corresponding SERVOPACK Monitor Display Function Names

|                                   | SigmaWin+                                                                                                                                                                                                                                                                                   | SERVOPACK |                                                                                                                                                                                                                                                                                                                                           |  |
|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Button in<br>Menu Dia-<br>log Box | Name [Unit]                                                                                                                                                                                                                                                                                 | Un No.    | Name [Unit]                                                                                                                                                                                                                                                                                                                               |  |
|                                   | Motor Speed [min <sup>-1</sup> ]                                                                                                                                                                                                                                                            | Un000     | Motor Speed [min <sup>-1</sup> ]                                                                                                                                                                                                                                                                                                          |  |
|                                   | Speed Reference [min <sup>-1</sup> ]                                                                                                                                                                                                                                                        | Un001     | Speed Reference [min <sup>-1</sup> ]                                                                                                                                                                                                                                                                                                      |  |
|                                   | Torque Reference [%]                                                                                                                                                                                                                                                                        | Un002     | Torque Reference [%]<br>(percentage of rated torque)                                                                                                                                                                                                                                                                                      |  |
|                                   | <ul> <li>Rotary Servomotors:<br/>Rotational Angle 1 [encoder pulses]<br/>(number of encoder pulses from origin within<br/>one encoder rotation)</li> <li>Linear Servomotors:<br/>Electrical Angle 1 [linear encoder pulses]<br/>(linear encoder pulses from the polarity origin)</li> </ul> |           | <ul> <li>Rotary Servomotors:<br/>Rotational Angle 1 [encoder pulses]<br/>(number of encoder pulses from origin within<br/>one encoder rotation displayed in decimal)</li> <li>Linear Servomotors:<br/>Electrical Angle 1 [linear encoder pulses]<br/>(linear encoder pulses from the polarity origin<br/>displayed in decimal)</li> </ul> |  |
|                                   | <ul> <li>Rotary Servomotors:<br/>Rotational Angle 2 [deg]<br/>(electrical angle from origin within one encoder<br/>rotation)</li> <li>Linear Servomotors:<br/>Electrical Angle 2 [deg]<br/>(electrical angle from polarity origin)</li> </ul>                                               | Un004     | <ul> <li>Rotary Servomotors:<br/>Rotational Angle 2 [deg]<br/>(electrical angle from polarity origin)</li> <li>Linear Servomotors:<br/>Electrical Angle 2 [deg]<br/>(electrical angle from polarity origin)</li> </ul>                                                                                                                    |  |
|                                   | Input Reference Pulse Speed [min-1]                                                                                                                                                                                                                                                         | Un007     | Input Reference Pulse Speed [min <sup>-1</sup> ]<br>(displayed only during position control)                                                                                                                                                                                                                                              |  |
|                                   | Position Deviation [reference units]                                                                                                                                                                                                                                                        | Un008     | Position Error Amount [reference units]<br>(displayed only during position control)                                                                                                                                                                                                                                                       |  |
| Motion                            | Accumulated Load Ratio [%]                                                                                                                                                                                                                                                                  | Un009     | Accumulated Load Ratio [%]<br>(percentage of rated torque: effective torque in<br>cycles of 10 seconds)                                                                                                                                                                                                                                   |  |
| Monitor                           | Regenerative Load Ratio [%]                                                                                                                                                                                                                                                                 | Un00A     | Regenerative Load Ratio [%]<br>(percentage of processable regenerative power:<br>regenerative power consumption in cycles of 10<br>seconds)                                                                                                                                                                                               |  |
|                                   | Dynamic Brake Resistor Power Consumption [%]                                                                                                                                                                                                                                                | Un00B     | Power Consumed by DB Resistance [%]<br>(percentage of processable power at DB activa-<br>tion: displayed in cycles of 10 seconds)                                                                                                                                                                                                         |  |
|                                   | Input Reference Pulse Counter [reference units]                                                                                                                                                                                                                                             | Un00C     | Input Reference Pulse Counter [reference units]                                                                                                                                                                                                                                                                                           |  |
|                                   | Feedback Pulse Counter [encoder pulses]                                                                                                                                                                                                                                                     | Un00D     | Feedback Pulse Counter [encoder pulses]                                                                                                                                                                                                                                                                                                   |  |
|                                   | Fully-closed Loop Feedback Pulse Counter<br>[external encoder resolution]                                                                                                                                                                                                                   | Un00E     | Fully-closed Loop Feedback Pulse Counter<br>[external encoder resolution]                                                                                                                                                                                                                                                                 |  |
|                                   | Upper Limit Setting of Motor Maximum Speed/<br>Upper Limit Setting of Encoder Output Resolu-<br>tion                                                                                                                                                                                        | Un010*1   | Upper Limit Setting of Motor Maximum Speed/<br>Upper Limit Setting of Encoder Output Resolu-<br>tion                                                                                                                                                                                                                                      |  |
|                                   | Total Operation Time [100 ms]                                                                                                                                                                                                                                                               | Un012     | Total Operation Time [100 ms]                                                                                                                                                                                                                                                                                                             |  |
|                                   | Feedback Pulse Counter [reference units]                                                                                                                                                                                                                                                    | Un013     | Feedback Pulse Counter [reference units]                                                                                                                                                                                                                                                                                                  |  |
|                                   | Overheat Protection Input [0.01 V]                                                                                                                                                                                                                                                          | Un02F     | Overheat Protection Input [0.01 V]                                                                                                                                                                                                                                                                                                        |  |
|                                   | Current Backlash Compensation Value [0.1 reference units]                                                                                                                                                                                                                                   | Un030     | Current Backlash Compensation Value [0.1 reference units]                                                                                                                                                                                                                                                                                 |  |
|                                   | Backlash Compensation Value Setting Limit [0.1 reference units]                                                                                                                                                                                                                             | Un031     | Backlash Compensation Value Setting Limit [0.1 reference units]                                                                                                                                                                                                                                                                           |  |
|                                   | Power Consumption [W]                                                                                                                                                                                                                                                                       | Un032     | Power Consumption [W]                                                                                                                                                                                                                                                                                                                     |  |
|                                   | Consumed Power [0.001 Wh]                                                                                                                                                                                                                                                                   | Un033     | Consumed Power [0.001 Wh]                                                                                                                                                                                                                                                                                                                 |  |
|                                   | Cumulative Power Consumption [Wh]                                                                                                                                                                                                                                                           | Un034     | Cumulative Power Consumption [Wh]                                                                                                                                                                                                                                                                                                         |  |
|                                   | Absolute Encoder Multiturn Data                                                                                                                                                                                                                                                             | Un040     | Absolute Encoder Multiturn Data                                                                                                                                                                                                                                                                                                           |  |

#### 16.1.2 Corresponding SERVOPACK Monitor Display Function Names

Continued from previous page.

|                                   | SigmoWin                                                             | SERVOPACK |                                                                                |  |
|-----------------------------------|----------------------------------------------------------------------|-----------|--------------------------------------------------------------------------------|--|
|                                   | SigmaWin+                                                            | SERVOPACK |                                                                                |  |
| Button in<br>Menu Dia-<br>log Box | Name [Unit]                                                          | Un No.    | Name [Unit]                                                                    |  |
|                                   | Position within One Rotation of Absolute<br>Encoder [encoder pulses] |           | Position within One Rotation of Absolute<br>Encoder [encoder pulses]           |  |
| Motion<br>Monitor                 | Lower Bits of Absolute Encoder Position<br>[encoder pulses]          | Un042     | Lower Bits of Absolute Encoder Position<br>[encoder pulses]                    |  |
|                                   | Upper Bits of Absolute Encoder Position<br>[encoder pulses]          | Un043     | Upper Bits of Absolute Encoder Position<br>[encoder pulses]                    |  |
|                                   | Polarity Sensor Signal Monitor                                       | Un011     | Polarity Sensor Signal Monitor                                                 |  |
| Status<br>Monitor                 | Active Gain Monitor                                                  | Un014     | Effective Gain Monitor (gain settings 1 = 1, gain settings 2 = 2)              |  |
|                                   | Safety I/O Signal Monitor                                            | Un015     | Safety I/O Signal Monitor                                                      |  |
| Input Sig-<br>nal Moni-<br>tor    | Input Signal Monitor                                                 | Un005     | Input Signal Monitor                                                           |  |
| Output<br>Signal<br>Monitor       | Output Signal Monitor                                                | Un006     | Output Signal Monitor                                                          |  |
|                                   | Installation Environment Monitor – SERVOPACK                         | Un025     | SERVOPACK Installation Environment Monitor [%]                                 |  |
|                                   | Installation Environment Monitor – Servomotor*2                      | Un026     | Servomotor Installation Environment Monitor [%]                                |  |
| Service<br>Life Moni-             | Service Life Prediction Monitor –<br>Built-in Fan                    | Un027     | Built-in Fan Remaining Life Ratio [%]                                          |  |
| tor                               | Service Life Prediction Monitor – Capacitor                          | Un028     | Capacitor Remaining Life Ratio [%]                                             |  |
|                                   | Service Life Prediction Monitor – Surge Preven-<br>tion Circuit      | Un029     | Surge Prevention Circuit Remaining Life Ratio [%]                              |  |
|                                   | Service Life Prediction Monitor – Dynamic Brake Circuit              | Un02A     | Dynamic Brake Circuit Remaining Life Ratio [%]                                 |  |
| Product<br>Informa-               | Motor – Resolution                                                   | Un084     | Linear Encoder Pitch (Scale pitch = Un084 $\times$ 10 <sup>Un085</sup> [pm])   |  |
| tion                              |                                                                      | Un085     | Linear Encoder Pitch Exponent (Scale pitch = Un084 × 10 <sup>Un085</sup> [pm]) |  |
|                                   | -                                                                    | Un020     | Rated Motor Speed [min <sup>-1</sup> ]                                         |  |
| _                                 | -                                                                    | Un021     | Maximum Motor Speed [min <sup>-1</sup> ]                                       |  |

\*1. You can use Un010 to monitor the upper limit setting for the maximum motor speed or the upper limit setting for the encoder output resolution.

You can monitor the upper limit of the encoder output resolution setting (Pn281) for the current maximum motor speed setting (Pn385), or you can monitor the upper limit of the maximum motor speed setting for the current encoder output resolution setting.

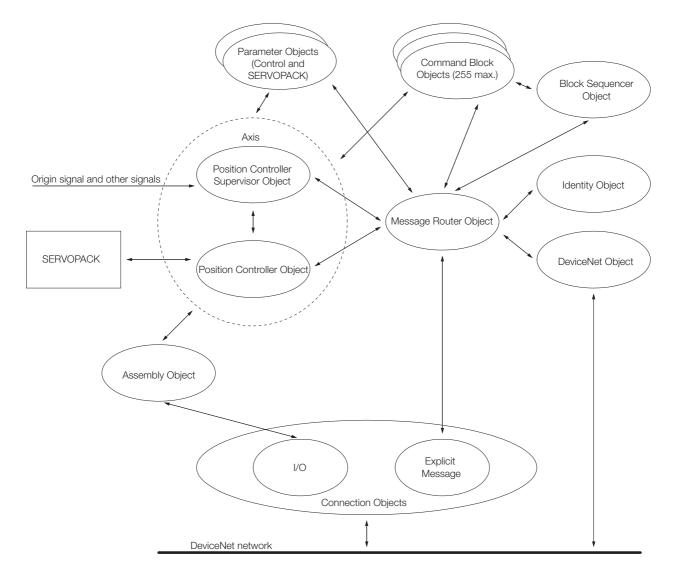
Select which signal to monitor with Pn080 = n.XDDD (Calculation Method for Maximum Speed or Divided Output Pulses).

• If  $Pn080 = n.0 \square \square \square$ , the encoder output resolution (Pn281) that can be set is displayed.

• If Pn080 =  $n.1\square\square\square$ , the maximum motor speed (Pn385) that can be set is displayed in mm/s.

\*2. This applies to the following motors. The display will show 0 for all other models. SGM7M, SGM7J, SGM7A, SGM7P, SGM7G, SGMMV, SGM7E, SGM7F, and SGMCV

# 16.2 DeviceNet Object Model



| Object Class                         | Class ID | Instance | Function                                                                                                              | Reference |
|--------------------------------------|----------|----------|-----------------------------------------------------------------------------------------------------------------------|-----------|
| Identity                             | 0x01     | 1        | Manages ID information, such as the device type, serial number, and vendor ID.                                        | 16.3.1    |
| Message Router                       | 0x02     | 1        | Routes explicit messages to the appropriate object.                                                                   | 16.3.2    |
| DeviceNet                            | 0x03     | 1        | Manages the physical connection to the DeviceNet. Also executes the Master/Slave Connection Set and Release requests. | 16.3.3    |
| Accomply                             | 0x04     | 1        | Manages I/O output messages from the slaves to the master.                                                            | 16.2.4    |
| Assembly                             |          | 2        | Manages I/O input messages from the mas-<br>ter to the slaves.                                                        | - 16.3.4  |
|                                      | 0x05     | 1        | Manages attributes for explicit messages.                                                                             |           |
| Connection                           |          | 2        | Manages attributes for I/O message (polled I/O).                                                                      | 16.3.5    |
| Position<br>Controller<br>Supervisor | 0x24     | 1        | Manages origin returns, positioning, com-<br>mand assembly codes, response assembly<br>codes, alarms, etc.            | 16.3.6    |
| Position<br>Controller               | 0x25     | 1        | Manages motion profiles, the SERVOPACK interface, limits, etc.                                                        | 16.3.7    |

| Object Class             | Class ID | Instance | Function                                            | Reference |
|--------------------------|----------|----------|-----------------------------------------------------|-----------|
| Block Sequencer          | 0x26     | 1        | Executes block commands and block sequences.        | 16.3.8    |
| Command Block            | 0x27     | 1 to 255 | Manages block commands.                             | 16.3.9    |
| Control<br>Parameter     | 0x64     | 1        | Manages position controller engine attri-<br>butes. | 16.3.10   |
| Servopack Param-<br>eter | 0x66     | 1        | Manages attributes within the SERVOPACK.            | 16.3.11   |

16.3.1 Identity Object

# 16.3 DeviceNet Attributes

# 16.3.1 Identity Object

#### Class: 0x01

Attributes: Not supported. Services: Not supported.

### Instance 1

#### Attributes

| No. | Access | Name               | Data Type | Description                                                         | Value                                      |
|-----|--------|--------------------|-----------|---------------------------------------------------------------------|--------------------------------------------|
| 1   | Get    | Vendor ID          | UINT      | Gives the identification number of the vendor.                      | 44                                         |
| 2   | Get    | Device Type        | UINT      | Gives the general type of the product.                              | 0x10                                       |
| 3   | Get    | Product Code       | USINT     | Gives the identification number of the product.                     | 0x270, 0x271 <sup>*1</sup>                 |
| 4   | Get    | Revision           | _         | Gives the revision of the item that the identity object represents. | 1.x                                        |
| 5   | Get    | Status             | WORD      | Gives the overall status of the SER-<br>VOPACK.                     | -                                          |
| 6   | Get    | Serial Num-<br>ber | UDINT     | Gives the serial number of the SER-<br>VOPACK.                      | Each SERVO-<br>PACK has its own<br>number. |
| 7   | Get    | Product<br>Name    | STRING    | Gives a name to identify the product.                               | SGDV-OCA04A,<br>SGDV-OCA05A <sup>*2</sup>  |

\*1. SGDV-OCA04A: 0x270

SGDV-OCA05A: 0x271

\*2. SGDV-OCA04A: SGDV-OCA04A SGDV-OCA05A: SGDV-OCA05A

#### Services

| Service Code | Service              | Description                                  |
|--------------|----------------------|----------------------------------------------|
| 0x05         | Reset                | Executes a software reset of the SERVOPACK.  |
| 0x0E         | Get_Attribute_Single | Returns the data of the specified attribute. |

# 16.3.2 Message Router Object

### Class: 0x02

Attributes: Not supported. Services: Not supported.

#### Instance 1

Attributes: Not supported. Services: Not supported.

16.3.3 DeviceNet Object

# 16.3.3 DeviceNet Object

# Class: 0x03

Attributes: Not supported. Services: Not supported.

### Instance 1

#### ♦ Attributes

| No. | Access | Name                           | Data Type                                                         | Description                                                                                                 | Value                                                              |
|-----|--------|--------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| 1   | Get    | MAC ID                         | USINT                                                             | Gives the node address.                                                                                     | 0 to 63                                                            |
| 2   | Get    | Baud Rate                      | USINT                                                             | Gives the baud rate.                                                                                        | 0 to 2                                                             |
| 3   | Get    | BOI                            | BOOL                                                              | Indicates a bus-OFF interrupt.                                                                              | 0x00                                                               |
| 4   | Get    | Bus-Off<br>Counter             | USINT Gives the number of times the CAN went to the bus-OFF state |                                                                                                             | 0 to 255                                                           |
|     |        | Allocation<br>Information      | A structure that                                                  | t includes the following members.                                                                           |                                                                    |
| 5   | Get    | Allocation<br>Choice Byte      | Byte                                                              | Gives the connection type of the master/<br>slave connection.                                               | 0x00 to 0x03<br>Bit 0: Explicit<br>message<br>Bit 1: Polled<br>I/O |
|     |        | Master's<br>MAC ID             | USINT                                                             | Gives the node address of the master device.                                                                | 0 to 63                                                            |
| 6   | Get    | MAC ID<br>Switch<br>Changed    | BOOL                                                              | Indicates a change in the node address (NA x10 and x1 rotary switches) after the power supply is turned ON. | 0: No change<br>1: Change                                          |
| 7   | Get    | Baud Rate<br>Switch<br>Changed | BOOL                                                              | Indicates a change in the baud rate<br>(rotary switch DR) after the power supply<br>is turned ON.           | 0: No change<br>1: Change                                          |
| 8   | Get    | MAC ID<br>Switch Value         | USINT                                                             | Gives the actual value of the node address (NA x10 and x1 rotary switches).                                 | 0 to 63                                                            |
| 9   | Get    | Baud Rate<br>Switch Value      | USINT                                                             | Gives the actual value of the baud rate (rotary switch DR).                                                 | 0 to 2                                                             |

#### ♦ Services

| Service Code | Service                                  | Description                                      |
|--------------|------------------------------------------|--------------------------------------------------|
| 0x0E         | Get_Attribute_Single                     | Returns the value of the specified attribute.    |
| 0x4B         | Allocate_Master/<br>Slave_Connection_Set | Requests the use of the master/slave connection. |
| 0x4C         | Release_Master/<br>Slave_Connection_Set  | Releases the master/slave connection.            |

16.3.4 Assembly Objects

# 16.3.4 Assembly Objects

#### Class: 0x04

Attributes: Not supported. Services: Not supported.

#### Instances 1 and 2

#### ◆ Attributes for Instance 1: Input

| No. | Access | Name | Data Type | Description                                 | Value |
|-----|--------|------|-----------|---------------------------------------------|-------|
| 3   | Get    | Data | Array     | Gives the input data to the SERVO-<br>PACK. | _     |

#### ◆ Attributes for Instance 2: Output

| No. | Access | Name | Data Type | Description                                    | Value |
|-----|--------|------|-----------|------------------------------------------------|-------|
| 3   | Get    | Data | Array     | Gives the output data from the SERVO-<br>PACK. | _     |

#### Services

| Service Code | Service              | Description                                   |
|--------------|----------------------|-----------------------------------------------|
| 0x0E         | Get_Attribute_Single | Returns the value of the specified attribute. |

# 16.3.5 Connection Objects

#### Class: 0x05

Attributes: Not supported. Services: Not supported.

#### Instances 1 and 2

#### ◆ Attributes for Instance 1: Explicit Messages

| No. | Access | Name                             | Data Type | Description                                                                                                        | Value  |
|-----|--------|----------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------|--------|
| 1   | Get    | State                            | USINT     | Gives the state of the object.                                                                                     | -      |
| 2   | Get    | Instance_Type                    | USINT     | Gives the message connection.                                                                                      | 0x00   |
| 3   | Get    | TransportClass<br>_Trigger       | Byte      | Defines the behavior of the connection.                                                                            | 0x83   |
| 4   | Get    | Produced_<br>Connection_ID       | UINT      | Placed in the CAN ID field when the con-<br>nection sends a message.                                               | _      |
| 5   | Get    | Consumed_<br>Connection_ID       | UINT      | Gives the value of the CAN ID field that indicates the message to receive.                                         | _      |
| 6   | Get    | Initial_Comm_<br>Characteristics | USINT     | Defines the message group where mes-<br>sage transmission and reception process-<br>ing for this connection occur. | 0x21   |
| 7   | Get    | Produced_<br>Connection_<br>Size | UINT      | Gives the maximum number of bytes sent through this connection.                                                    | 0x00FF |
| 8   | Get    | Consumed_<br>Connection_<br>Size | UINT      | Gives the maximum number of bytes received through this connection.                                                | 0x00FF |

16.3.5 Connection Objects

Continued from previous page.

| No. | Access  | Name                                    | Data Type      | Description                                                                                              | Value  |
|-----|---------|-----------------------------------------|----------------|----------------------------------------------------------------------------------------------------------|--------|
| 9   | Get/Set | Expected_<br>Packet_Rate                | UINT           | Defines the timing for this connection.                                                                  | _      |
| 12  | Get     | Watchdog_<br>Timeout_<br>Action         | USINT          | Defines how to handle timeouts.                                                                          | 0x03   |
| 13  | Get     | Produced_<br>Connection_<br>Path_Length | UINT           | Gives the number of bytes in the Produced Connection Path attribute.                                     | 0x0000 |
| 14  | Get     | Produced_<br>Connection_<br>Path        | USINT<br>Array | Specifies the application object where data will be sent by this connection object.                      | -      |
| 15  | Get     | Consumed_<br>Connection_<br>Path_Length | UINT           | Gives the number of bytes in the Con-<br>sumed Connection Path attribute.                                | 0x0000 |
| 16  | Get     | Consumed_<br>Connection_<br>Path        | USINT<br>Array | Specifies the application object that will receive the data that was received by this connection object. | -      |

#### ♦ Attributes for Instance 2: Polled I/O

| No. | Access  | Name                                    | Data Type      | Description                                                                                                        | Value                 |
|-----|---------|-----------------------------------------|----------------|--------------------------------------------------------------------------------------------------------------------|-----------------------|
| 1   | Get     | State                                   | USINT          | Gives the state of the object.                                                                                     | -                     |
| 2   | Get     | Instance_Type                           | USINT          | Gives the message connection.                                                                                      | 0x01                  |
| 3   | Get     | TransportClass<br>_Trigger              | Byte           | Defines the behavior of the connection.                                                                            | 0x83                  |
| 4   | Get     | Produced_<br>Connection_ID              | UINT           | Placed in the CAN ID field when the con-<br>nection sends a message.                                               | _                     |
| 5   | Get     | Consumed_<br>Connection_ID              | UINT           | Gives the value of the CAN ID field that indicates the message to receive.                                         | _                     |
| 6   | Get     | Initial_Comm_<br>Characteristics        | USINT          | Defines the message group where mes-<br>sage transmission and reception process-<br>ing for this connection occur. | 0x01                  |
| 7   | Get     | Produced_<br>Connection_<br>Size        | UINT           | Gives the maximum number of bytes sent through this connection.                                                    | 0x0008                |
| 8   | Get     | Consumed_<br>Connection_<br>Size        | UINT           | Gives the maximum number of bytes received through this connection.                                                | 0x0008                |
| 9   | Get/Set | Expected_<br>Packet_Rate                | UINT           | Defines the timing for this connection.                                                                            | _                     |
| 12  | Get     | Watchdog_<br>Timeout_<br>Action         | USINT          | Defines how to handle timeouts.                                                                                    | 0x01                  |
| 13  | Get     | Produced_<br>Connection_<br>Path_Length | UINT           | Gives the number of bytes in the Produced Connection Path attribute.                                               | 0x0006                |
| 14  | Get     | Produced_<br>Connection_<br>Path        | USINT<br>Array | Specifies the application object where data will be sent by this connection object.                                | 20_04_24_0<br>1_30_03 |
| 15  | Get     | Consumed_<br>Connection_<br>Path_Length | UINT           | Gives the number of bytes in the Con-<br>sumed Connection Path attribute.                                          | 0x0006                |
| 16  | Get     | Consumed_<br>Connection_<br>Path        | USINT<br>Array | Specifies the application object that will receive the data that was received by this connection object.           | 20_04_24_0<br>2_30_03 |

16.3.6 Position Controller Supervisor Object

#### Services

| Service Code | Service              | Description                                   |
|--------------|----------------------|-----------------------------------------------|
| 0x0E         | Get_Attribute_Single | Returns the value of the specified attribute. |
| 0x10         | Set_Attribute_Single | Changes the value of the specified attribute. |

# 16.3.6 Position Controller Supervisor Object

#### Class: 0x24

Attributes: Not supported. Services: Not supported.

#### Instance 1

#### Attributes

| No. | Access  | Name                         | Data Type         | Description                                                                       | Value                                          |
|-----|---------|------------------------------|-------------------|-----------------------------------------------------------------------------------|------------------------------------------------|
| 1   | Get     | Number of<br>Attributes      | USINT             | Gives the number of attributes contained in this object.                          | -                                              |
| 2   | Get     | Attribute List               | Array of<br>USINT | Gives the arrangement of the attribute numbers that are contained in this object. | -                                              |
| 3   | Get     | Axis Instance                | USINT             | Gives the axis number.                                                            | Always 1.                                      |
| 5   | Get     | General Fault                | BOOL              | Gives the status of the SERVOPACK.                                                | 1: Alarm                                       |
| 6   | Get/Set | Command<br>Assembly<br>Type  | USINT             | Specifies the command code.                                                       | -                                              |
| 7   | Get/Set | Response<br>Assembly<br>Type | USINT             | Specifies the response code.                                                      | -                                              |
| 10  | Get/Set | Home Action                  | USINT             | Specifies the origin return type.                                                 | -                                              |
| 11  | Set     | Home Active<br>Level         | BOOL              | Specifies the polarity of origin signal input.                                    | 0: Normally<br>closed.<br>1: Normally<br>open. |
| 12  | Get/Set | Home Arm                     | BOOL              | Specifies a origin return command.                                                | 1: Origin<br>return                            |
| 16  | Get     | Home Input<br>Level          | BOOL              | Gives the origin signal input status.                                             | 0: Open<br>1: Closed                           |
| 17  | Get/Set | Home Posi-<br>tion           | DINT              | Specifies the origin position offset.                                             | -                                              |

#### Services

| Service Code | Service              | Description                                   |
|--------------|----------------------|-----------------------------------------------|
| 0x0E         | Get_Attribute_Single | Returns the value of the specified attribute. |
| 0x10         | Set_Attribute_Single | Changes the value of the specified attribute. |

16.3.7 Position Controller Object

# 16.3.7 Position Controller Object

### Class: 0x25

Attributes: Not supported. Services: Not supported.

# Instance 1

#### ♦ Attributes

| No. | Access  | Name                              | Data Type         | Description                                                                       | Value                                                  |
|-----|---------|-----------------------------------|-------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------|
| 1   | Get     | Number of<br>Attributes           | USINT             | Gives the number of attributes contained in this object.                          | -                                                      |
| 2   | Get     | Attribute List                    | Array of<br>USINT | Gives the arrangement of the attribute numbers that are contained in this object. | -                                                      |
| 3   | Get/Set | Mode                              | USINT             | Specifies the operating mode.                                                     | 0: Positioning<br>1: Continuous<br>operation           |
| 6   | Get/Set | Target Posi-<br>tion              | DINT              | Specifies the target position.<br>Unit: Reference units                           | 0x80000001 to<br>0x7FFFFFF                             |
| 7   | Get/Set | Target Veloc-<br>ity              | DINT              | Specifies the target rate.<br>Unit: Reference units/s                             | 1 to<br>115,343,500                                    |
| 8   | Get/Set | Acceleration                      | DINT              | Specifies the acceleration rate.<br>Unit: Reference units/s <sup>2</sup>          | 15,625 to<br>2,047,968,750                             |
| 9   | Get/Set | Deceleration                      | DINT              | Specifies the deceleration rate.<br>Unit: Reference units/s2                      | 15,625 to<br>2,047,968,750                             |
| 10  | Get/Set | Incremental<br>Position           | BOOL              | Specifies either absolute or incremental positioning.                             | 0: Absolute<br>1: Incremental                          |
| 11  | Get/Set | Trajectory<br>Start/Com-<br>plete | BOOL              | Starts operation.                                                                 | 1: Start opera-<br>tion.<br>0: Operation<br>completed. |
| 12  | Get     | On Target<br>Position             | BOOL              | Indicates whether the current position is within the positioning completed width. | 1: Within posi-<br>tioning com-<br>pleted width.       |
| 13  | Get/Set | Actual Posi-<br>tion              | DINT              | Gives the current position.<br>Unit: Reference units                              | 0x80000001 to<br>0x7FFFFFF                             |
| 14  | Get     | Actual<br>Velocity                | DINT              | Gives the current speed.<br>Unit: Reference units/s                               | 0 to<br>115,343,500                                    |
| 15  | Get     | Commanded<br>Position             | DINT              | Gives the reference position.<br>Unit: Reference units                            | 0x80000001 to<br>0x7FFFFFF                             |
| 16  | Get     | Commanded<br>Velocity             | DINT              | Gives the command speed.<br>Unit: Reference units/s                               | 0 to<br>115,343,500                                    |
| 17  | Get/Set | Enable                            | BOOL              | Specifies a Servo ON command.                                                     | 0: Servo OFF<br>1: Servo ON                            |
| 18  | Get/Set | Profile Type                      | USINT             | Specifies the acceleration/deceleration type.                                     | -                                                      |
| 19  | Get/Set | Profile Gain                      | DINT              | Specifies the time constant for S-curve acceleration/deceleration.                | 4 to 4,000                                             |
| 20  | Get/Set | Smooth Stop                       | BOOL              | Specifies the command to decelerate to a stop.                                    | 1: Smooth Stop<br>command                              |
| 21  | Get/Set | Hard Stop                         | BOOL              | Specifies the Hard Stop command.                                                  | 1: Hard Stop<br>command                                |
| 22  | Get/Set | Jog Velocity                      | DINT              | Specifies the speed for continuous oper-<br>ation.<br>Unit: Reference units/s     | 1 to<br>115,343,500                                    |

16.3.7 Position Controller Object

Continued from previous page.

| No. | Access  | Name                                     | Data Type | Description                                                                                                  | Value                                                           |
|-----|---------|------------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|
| 23  | Get/Set | Direction                                | BOOL      | Specifies the direction.                                                                                     | 0: Reverse                                                      |
| 24  | Get/Set | Reference<br>Direction                   | BOOL      | Specifies the forward direction when the shaft is viewed from the back of the motor.                         | 1: Forward<br>0: CW is for-<br>ward.<br>1: CCW is for-<br>ward. |
| 25  | Get/Set | Torque                                   | DINT      | Specifies the Torque command for torque control. Also, returns the monitor value of the current torque.      | 0 to 800                                                        |
| 26  | Get/Set | Positive<br>Torque Limit                 | DINT      | Specifies the forward torque limit.<br>Unit: 1%                                                              | 0 to 800                                                        |
| 27  | Get/Set | Negative<br>Torque Limit                 | DINT      | Specifies the reverse torque limit.<br>Unit: 1%                                                              | -800 to 0                                                       |
| 30  | Get/Set | Кр                                       | UINT      | Specifies the proportional gain for the position loop.<br>Unit: 0.1/s                                        | 10 to 20,000                                                    |
| 31  | Get/Set | Ki                                       | UINT      | Specifies the integral time constant of the position loop.<br>Unit: 0.1 ms                                   | 0 to 50,000                                                     |
| 38  | Get/Set | Position<br>Deadband                     | USINT     | Specifies the positioning completed width.<br>Unit: Reference units.                                         | 0 to 255                                                        |
| 45  | Get/Set | Max Dynamic<br>Following<br>Error        | DINT      | Specifies the maximum allowable follow-<br>ing deviation.<br>Unit: Reference units                           | 1 to<br>1,073,741,823                                           |
| 48  | Get     | Actual Fol-<br>lowing Error              | DINT      | Gives the current position deviation.<br>Unit: Reference units                                               | 1 to<br>1,073,741,824                                           |
| 49  | Get/Set | Hard Limit<br>Action                     | USINT     | Specifies the response to overtravel.                                                                        | 0: Servo OFF<br>1: Smooth stop<br>2: Hard stop                  |
| 50  | Get     | CW<br>Hard Limit                         | BOOL      | Gives the status of the CW overtravel signal.                                                                | 0: Disabled<br>1: Enabled                                       |
| 51  | Get     | CCW<br>Hard Limit                        | BOOL      | Gives the status of the CCW overtravel signal.                                                               | 0: Disabled<br>1: Enabled                                       |
| 52  | Get/Set | Soft Limit<br>Enable                     | BOOL      | Enables the software limit.                                                                                  | 0: Disabled<br>1: Enabled                                       |
| 53  | Get/Set | Soft Limit<br>Action                     | USINT     | Specifies the response to a software limit.                                                                  | 1: Hard stop<br>2: Smooth stop                                  |
| 54  | Get/Set | Positive Soft-<br>ware Limit<br>Position | DINT      | Specifies the forward software limit posi-<br>tion.<br>Unit: Reference units                                 | 0x80000001 to<br>0x7FFFFFF                                      |
| 55  | Get/Set | Negative<br>Software<br>Limit Position   | DINT      | Specifies the reverse software limit posi-<br>tion.<br>Unit: Reference units                                 | 0x80000001 to<br>0x7FFFFFF                                      |
| 56  | Get     | Positive Limit<br>State                  | BOOL      | Gives the status of the forward software limit.                                                              | 0: Within limit<br>1: Outside limit                             |
| 57  | Get     | Negative<br>Limit State                  | BOOL      | Gives the status of the reverse software limit.                                                              | 0: Within limit<br>1: Outside limit                             |
| 200 | Get/Set | Approach<br>Velocity for<br>Positioning  | DINT      | Specifies the approach speed for posi-<br>tioning after switching to positioning.<br>Unit: Reference units/s | 1 to<br>115,343,500                                             |
| 201 | Get/Set | End Position                             | DINT      | Specifies the end position after switching<br>to positioning.<br>Unit: Reference units                       | 0 to<br>0x7FFFFFF                                               |
| 231 | Get/Set | Hard Limit<br>Enable                     | BOOL      | Specifies the overtravel settings.                                                                           | 0: Disabled<br>1: Enabled                                       |

16.3.8 Block Sequencer Object

Continued from previous page.

| No. | Access  | Name                      | Data Type | Description                                                         | Value                                          |
|-----|---------|---------------------------|-----------|---------------------------------------------------------------------|------------------------------------------------|
| 232 | Get/Set | Hard Limit<br>Input Logic | BOOL      | Specifies the polarity of the overtravel signal.                    | 0: Normally<br>closed.<br>1: Normally<br>open. |
| 241 | Get/Set | External Stop<br>Action   | USINT     | Specifies the external stop action.                                 | 0: Hard stop<br>and servo OFF                  |
| 242 | Get/Set | External Stop<br>Enable   | BOOL      | Specifies the external stop input signal.                           | 0: Disabled<br>1: Enabled                      |
| 243 | Get/Set | External Stop<br>Logic    | BOOL      | Specifies the polarity of the external stop input signal.           | 0: Normally<br>closed.<br>1: Normally<br>open. |
| 244 | Get     | External Stop<br>State    | BOOL      | Gives the status of the external stop input signal.                 | 0: Disabled<br>1: Enabled                      |
| 253 | Get/Set | Home<br>Direction         | BOOL      | Specifies the origin return direction.                              | 0: Reverse<br>1: Forward                       |
| 254 | Get/Set | Home Fast<br>Velocity     | DINT      | Specifies the origin approach speed.<br>Unit: Reference units/s     | 1 to<br>115,343,500                            |
| 255 | Get/Set | Home Slow<br>Velocity     | DINT      | Specifies the origin return creep speed.<br>Unit: Reference units/s | 1 to<br>115,343,500                            |

#### Services

| Service Code | Service              | Description                                   |
|--------------|----------------------|-----------------------------------------------|
| 0x0E         | Get_Attribute_Single | Returns the value of the specified attribute. |
| 0x10         | Set_Attribute_Single | Changes the value of the specified attribute. |

# 16.3.8 Block Sequencer Object

#### Class: 0x26

Attributes: Not supported. Services: Not supported.

### Instance 1

#### Attributes

| No. | Access  | Name                | Data Type | Description                                                   | Value                                                                          |
|-----|---------|---------------------|-----------|---------------------------------------------------------------|--------------------------------------------------------------------------------|
| 1   | Get/Set | Block               | USINT     | Specifies the block number of the start command.              | 1 to 255                                                                       |
| 2   | Get/Set | Block Exe-<br>cute  | BOOL      | Specifies the command to start program execution.             | 1: Starts execu-<br>tion.<br>0: Execution<br>completed.                        |
| 3   | Get     | Current Block       | USINT     | Gives the number of the command block that is being executed. | 1 to 255                                                                       |
| 4   | Get     | Block Fault         | BOOL      | Gives the program execution status.                           | 1: Alarm                                                                       |
| 5   | Get     | Block Fault<br>Code | USINT     | Gives the alarm code for program execu-<br>tion.              | 0: Normal<br>1: Invalid block<br>data<br>2: Timeout<br>3: Execution<br>failure |
| 6   | Set     | Counter             | DINT      | Specifies the sequence counter.                               | 0 to<br>0x7FFFFFF                                                              |

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16.3.9 Command Block Objects

#### ♦ Services

| Service Code | Service              | Description                                   |
|--------------|----------------------|-----------------------------------------------|
| 0x0E         | Get_Attribute_Single | Returns the value of the specified attribute. |
| 0x10         | Set_Attribute_Single | Changes the value of the specified attribute. |

# 16.3.9 Command Block Objects

#### Class: 0x27

Attributes: Not supported. Services: Not supported.

#### Instances 1 to 255

#### Attributes

| No. | Access  | Name                    | Data Type | Description                                                                                               | Value |
|-----|---------|-------------------------|-----------|-----------------------------------------------------------------------------------------------------------|-------|
| 1   | Get/Set | Block Com-<br>mand      | USINT     | Specifies the block command.                                                                              | -     |
| 2   | Get/Set | Block Link #            | USINT     | Specifies the number of the next com-<br>mand block to execute.<br>A value of 0 indicates the last block. | -     |
| 3   | Get/Set | Depends on<br>Command # | _         | Depends on the block command.                                                                             | _     |
| 4   | Get/Set | Depends on<br>Command # | _         | Depends on the block command.                                                                             | -     |
| 5   | Get/Set | Depends on<br>Command # | _         | Depends on the block command.                                                                             | -     |
| 6   | Get/Set | Depends on<br>Command # | _         | Depends on the block command.                                                                             | _     |
| 7   | Get/Set | Depends on<br>Command # | _         | Depends on the block command.                                                                             | -     |

#### ♦ Services

| Service Code | Service              | Description                                     |
|--------------|----------------------|-------------------------------------------------|
| 0x01         | Get_Attribute_All    | Returns all the data of the specified instance. |
| 0x02         | Set_Attribute_All    | Changes all the data of the specified instance. |
| 0x0E         | Get_Attribute_Single | Returns the value of the specified attribute.   |
| 0x10         | Set_Attribute_Single | Changes the value of the specified attribute.   |

16.3.10 Control Parameter Object

# 16.3.10 Control Parameter Object

# Class: 0x64

Attributes: Not supported. Services: Not supported.

### Instance 1

#### ♦ Attributes

| No. | Access  | Name                                                | Data Type | Description                                                                                    | Value                  |
|-----|---------|-----------------------------------------------------|-----------|------------------------------------------------------------------------------------------------|------------------------|
| 15  | Get/Set | Final Travel<br>Distance                            | DINT      | Specifies the final travel distance for origin returns.<br>Unit: Reference units               | 0 to<br>0x7FFFFFFF     |
| 32  | Get/Set | Coordinate<br>Type                                  | BOOL      | Specifies the coordinate type.                                                                 | 0: Linear<br>1: Rotary |
| 33  | Get/Set | Command<br>Value per<br>Machine<br>Rotation         | DINT      | Specifies the number of reference units per machine revolution.<br>Unit: Reference units       | 1 to<br>1,500,000      |
| 70  | Get/Set | Time Con-<br>stant<br>for Exponen-<br>tial<br>Curve | UINT      | Specifies the time constant for exponen-<br>tial acceleration/deceleration.<br>Unit: ms        | 4 to 1,000             |
| 71  | Get/Set | Bias Velocity                                       | DINT      | Specifies the bias speed for exponential acceleration/deceleration.<br>Unit: Reference units/s | 0 to<br>115,343,500    |
| 91  | Get/Set | Positioning<br>Timeout                              | UINT      | Specifies the positioning completion time-<br>out time.<br>Unit: ms                            | 0 to 65,535            |
| 99  | Get/Set | Switch Mode                                         | UINT      | Specifies the switching mode when changing to position control.                                | 0 to 2                 |
| 173 | Get/Set | Input Signal<br>Logic<br>Setting                    | UINT      | Specifies the polarity of the input signals.                                                   | -                      |
| 174 | Get/Set | Input Signal<br>Setting                             | UINT      | Enables the input signals.                                                                     | -                      |
| 253 | Get/Set | Initializing<br>Function                            | UINT      | Initializes the absolute encoder and parameters.                                               | -                      |
| 255 | Get/Set | Behavior<br>Definition                              | UINT      | Defines the action.                                                                            | -                      |

#### Services

| Service Code | Service              | Description                                   |
|--------------|----------------------|-----------------------------------------------|
| 0x0E         | Get_Attribute_Single | Returns the value of the specified attribute. |
| 0x10         | Set_Attribute_Single | Changes the value of the specified attribute. |

Appendices

# 16.3.11 SERVOPACK Parameter Object

# Class: 0x66

Attributes: Not supported. Services: Not supported.

# Instance 1

#### ♦ Attributes

| No. | Access  | Name                                        | Data Type | Description                                                        | Value               |
|-----|---------|---------------------------------------------|-----------|--------------------------------------------------------------------|---------------------|
| 10  | Get/Set | Basic Function<br>Select Switch 0           | UINT      | Sets the Basic Function Selections 0.                              | 0x0000 to<br>0x00B3 |
| 11  | Get/Set | Application<br>Function Select<br>Switch 1  | UINT      | Sets the Application Function Selections 1.                        | 0x0000 to<br>0x1122 |
| 12  | Get/Set | Application<br>Function Select<br>Switch 2  | UINT      | Sets the Application Function Selections 2.                        | 0x0000 to<br>0x4113 |
| 13  | Get/Set | Application<br>Function Select<br>Switch 6  | UINT      | Sets the Application Function Selections 6.                        | 0x0000 to<br>0x005F |
| 14  | Get/Set | Application<br>Function Select<br>Switch 7  | UINT      | Sets the Application Function Selections 7.                        | 0x0000 to<br>0x005F |
| 15  | Get/Set | Application<br>Function Select<br>Switch 8  | UINT      | Sets the Application Function Selections 8.                        | 0x0000 to<br>0x7121 |
| 16  | Get/Set | Application<br>Function Select<br>Switch 9  | UINT      | Sets the Application Function Selections<br>9.                     | 0x0000 to<br>0x0111 |
| 17  | Get/Set | Application<br>Function Select<br>Switch B  | UINT      | Sets the Application Function Selections<br>B.                     | 0x0000 to<br>0x1111 |
| 18  | Get/Set | Application<br>Function Select<br>Switch C  | UINT      | Sets the Application Function Selections<br>C.                     | 0x0000 to<br>0x0111 |
| 19  | Get/Set | Application<br>Function Select<br>Switch D  | UINT      | Sets the Application Function Selections D.                        | 0x0000 to<br>0x1001 |
| 21  | Get/Set | Application<br>Function Select<br>Switch 80 | UINT      | Sets the Application Function Selections 80.                       | 0x0000 to<br>0x1111 |
| 23  | Get/Set | Speed Loop<br>Gain                          | UINT      | Sets the speed loop gain.<br>Unit: 0.1 Hz                          | 10 to 20,000        |
| 24  | Get/Set | Speed Loop<br>Integral Time<br>Constant     | UINT      | Sets the speed loop integral time con-<br>stant.<br>Unit: 0.01 ms  | 15 to 51,200        |
| 25  | Get/Set | Position Loop<br>Gain                       | UINT      | Sets the position loop gain.<br>Unit: 0.1/s                        | 10 to 20,000        |
| 26  | Get/Set | Moment of Iner-<br>tia Ratio                | UINT      | Sets the moment of inertia ratio.<br>Unit: %                       | 15 to 51,200        |
| 27  | Get/Set | 2nd Speed<br>Loop Gain                      | UINT      | Sets the second speed loop gain.<br>Unit: 0.1 Hz                   | 10 to 20,000        |
| 28  | Get/Set | 2nd Speed<br>Loop Integral<br>Time Constant | UINT      | Sets the second speed loop integral time constant.<br>Unit: 0.1 Hz | 15 to 51,200        |

Continued from previous page.

|     |         |                                                         | _         |                                                                                         | previous page.       |
|-----|---------|---------------------------------------------------------|-----------|-----------------------------------------------------------------------------------------|----------------------|
| No. | Access  | Name                                                    | Data Type | Description                                                                             | Value                |
| 29  | Get/Set | 2nd Position<br>Loop Gain                               | UINT      | Sets the second position loop gain.<br>Unit: 0.1/s                                      | 10 to 20,000         |
| 30  | Get/Set | Feedforward<br>Gain                                     | UINT      | Sets the feedforward gain.<br>Unit: %                                                   | 0 to 100             |
| 31  | Get/Set | Feedforward<br>Filter Time Con-<br>stant                | UINT      | Sets the feedforward filter time constant.<br>Unit: 0.01 ms                             | 0 to 6,400           |
| 32  | Get/Set | Application<br>Function for<br>Gain Select<br>Switch    | UINT      | Sets the gain application selections.                                                   | 0x0000 to<br>0x5334  |
| 33  | Get/Set | Mode Switch<br>(torque refer-<br>ence)                  | UINT      | Sets the mode switching level for torque references.<br>Unit: %                         | 0 to 800             |
| 34  | Get/Set | Mode Switch<br>(speed refer-<br>ence)                   | UINT      | Sets the mode switching level for speed references.<br>Unit: min <sup>-1</sup>          | 0 to 10,000          |
| 35  | Get/Set | Mode Switch<br>(acceleration)                           | UINT      | Sets the mode switching level for acceler-<br>ation.<br>Unit: min <sup>-1</sup> /s      | 0 to 30,000          |
| 36  | Get/Set | Mode Switch<br>(position error)                         | UINT      | Sets the mode switching level for the posi-<br>tion deviation.<br>Unit: Reference units | 0 to 10,000          |
| 37  | Get/Set | Position Integral<br>Time Constant                      | UINT      | Sets the position integral time constant.<br>Unit: 0.1 ms                               | 0 to 50,000          |
| 38  | Get/Set | Friction Com-<br>pensation Gain                         | UINT      | Sets the friction compensation gain.<br>Unit: %                                         | 0 to 10,000          |
| 39  | Get/Set | 2nd Gain for<br>Friction Com-<br>pensation              | UINT      | Sets the second friction compensation<br>gain.<br>Unit: %                               | 10 to 1,000          |
| 40  | Get/Set | Friction Com-<br>pensation Coef-<br>ficient             | UINT      | Sets the friction compensation coefficient.<br>Unit: %                                  | 0 to 100             |
| 41  | Get/Set | Friction Com-<br>pensation Fre-<br>quency<br>Correction | INT       | Sets the friction compensation frequency<br>correction.<br>Unit: 0.1 Hz                 | -10,000 to<br>10,000 |
| 42  | Get/Set | Friction Com-<br>pensation Gain<br>Correction           | UINT      | Sets the friction compensation gain cor-<br>rection.<br>Unit: %                         | 1 to 1,000           |
| 43  | Get/Set | Gain Switching<br>Time 1                                | UINT      | Sets gain switching time 1.<br>Unit: ms                                                 | 0 to 65,535          |
| 44  | Get/Set | Gain Switching<br>Time 2                                | UINT      | Sets gain switching time 2.<br>Unit: ms                                                 | 0 to 65,535          |
| 45  | Get/Set | Gain Switching<br>Waiting Time 1                        | UINT      | Sets gain switching waiting time 1.<br>Unit: ms                                         | 0 to 65,535          |
| 46  | Get/Set | Gain Switching<br>Waiting Time 2                        | UINT      | Sets gain switching waiting time 2.<br>Unit: ms                                         | 0 to 65,535          |
| 47  | Get/Set | Automatic Gain<br>Changeover<br>Related Switch<br>1     | UINT      | Sets automatic gain switching selection 1.                                              | 0x0000 to<br>0x0052  |
| 48  | Get/Set | Auto Gain<br>Switching<br>Switches                      | UINT      | Sets the current gain level.<br>Unit: %                                                 | 100 to 2,000         |
| 49  | Get/Set | Model Follow-<br>ing Control<br>Related Switch          | UINT      | Sets the model following control-related selections.                                    | 0x0000 to<br>0x1121  |

Continued from previous page.

| No. | Access  | Name                                                                   | Data Type | Description                                                                      | Value               |
|-----|---------|------------------------------------------------------------------------|-----------|----------------------------------------------------------------------------------|---------------------|
| 50  | Get/Set | Model Follow-<br>ing Control<br>Gain                                   | UINT      | Sets the model following control gain.<br>Unit: 0.1/s                            | 10 to 20,000        |
| 51  | Get/Set | Model Follow-<br>ing Control<br>Gain Compen-<br>sation                 | UINT      | Sets the model following control gain cor-<br>rection.<br>Unit: 0.1%             | 500 to 2,000        |
| 52  | Get/Set | Model Follow-<br>ing Control Bias<br>(Forward Direc-<br>tion)          | UINT      | Sets the model following control bias in<br>the forward direction.<br>Unit: 0.1% | 0 to 10,000         |
| 53  | Get/Set | Model Follow-<br>ing Control Bias<br>(Reverse Direc-<br>tion)          | UINT      | Sets the model following control bias in<br>the reverse direction.<br>Unit: 0.1% | 0 to 10,000         |
| 54  | Get/Set | Vibration Sup-<br>pression 1 Fre-<br>quency A                          | UINT      | Sets vibration suppression 1 frequency A.<br>Unit: 0.1 Hz                        | 10 to 2,500         |
| 55  | Get/Set | Vibration Sup-<br>pression 1 Fre-<br>quency B                          | UINT      | Sets vibration suppression 1 frequency B.<br>Unit: 0.1 Hz                        | 10 to 2,500         |
| 56  | Get/Set | Model Follow-<br>ing Control<br>Speed Feedfor-<br>ward<br>Compensation | UINT      | Sets the model following control speed feedforward compensation.<br>Unit: 0.1%   | 0 to 10,000         |
| 57  | Get/Set | 2nd Model Fol-<br>lowing Control<br>Gain                               | UINT      | Sets the second model following control gain.<br>Unit: 0.1/s                     | 10 to 20,000        |
| 58  | Get/Set | 2nd Model Fol-<br>lowing Control<br>Gain Compen-<br>sation             | UINT      | Sets the second model following gain control correction.<br>Unit: 0.1%           | 500 to 2,000        |
| 59  | Get/Set | Vibration Sup-<br>pression 2 Fre-<br>quency                            | UINT      | Sets the vibration suppression 2 fre-<br>quency.<br>Unit: 0.1 Hz                 | 10 to 2,000         |
| 60  | Get/Set | Vibration Sup-<br>pression 2<br>Compensation                           | UINT      | Sets the vibration suppression 2 correc-<br>tion.<br>Unit: %                     | 10 to 1,000         |
| 62  | Get/Set | Anti-Reso-<br>nance Control<br>Related Switch                          | UINT      | Sets the anti-resonance control-related selections.                              | 0x0000 to<br>0x0011 |
| 63  | Get/Set | Anti-Reso-<br>nance Fre-<br>quency                                     | UINT      | Sets the anti-resonance frequency.<br>Unit: 0.1 Hz                               | 10 to 20,000        |
| 64  | Get/Set | Anti-Reso-<br>nance Gain<br>Compensation                               | UINT      | Sets the anti-resonance gain correction.<br>Unit: %                              | 1 to 1,000          |
| 65  | Get/Set | Anti-Reso-<br>nance Damp-<br>ing Gain                                  | UINT      | Sets the anti-resonance damping gain.<br>Unit: %                                 | 0 to 300            |
| 66  | Get/Set | Anti-Reso-<br>nance Filter<br>Time Constant<br>1 Compensa-<br>tion     | INT       | Sets the anti-resonance filter time con-<br>stant 1 correction.<br>Unit: 0.01 ms | -1,000 to<br>1,000  |
| 67  | Get/Set | Anti-Reso-<br>nance Filter<br>Time Constant<br>2 Compensa-<br>tion     | INT       | Sets the anti-resonance filter time con-<br>stant 2 correction.<br>Unit: 0.01 ms | -1,000 to<br>1,000  |

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| N.I. |         |                                                   |           |                                                                                       |                                    |
|------|---------|---------------------------------------------------|-----------|---------------------------------------------------------------------------------------|------------------------------------|
| No.  | Access  | Name                                              | Data Type | Description                                                                           | Value                              |
| 68   | Get/Set | Tuning-less<br>Function<br>Related Switch         | UINT      | Sets the tuning-less function-related selections.                                     | 0x0000 to<br>0x2411                |
| 71   | Get/Set | Multi-turn Limit<br>Setting                       | UINT      | Sets the multiturn limit setting.<br>Unit: rev                                        | 0 to 65,535                        |
| 73   | Get/Set | Number of<br>External Scale<br>Pitch              | UDINT     | Sets the number of external encoder pitches.                                          | 4 to<br>1,048,576                  |
| 74   | Get/Set | Electronic Gear<br>Ratio<br>(Numerator)           | UDINT     | Sets the electronic gear ratio numerator.                                             | 1 to<br>1,073,741,82<br>4          |
| 75   | Get/Set | Electronic Gear<br>Ratio<br>(Denominator)         | UDINT     | Sets the electronic gear ratio denominator.                                           | 1 to<br>1,073,741,82<br>4          |
| 76   | Get/Set | Encoder Out-<br>put Pulses                        | UDINT     | Sets number of encoder output pulses 1.<br>Unit: P/Rev                                | 16 to Upper<br>limit of<br>encoder |
| 79   | Get/Set | Fully-closed<br>Control Selec-<br>tion Switch     | UINT      | Sets the fully-closed control selections.                                             | 0x0000 to<br>0x1003                |
| 80   | Get/Set | Position Con-<br>trol Expanded<br>Function Switch | UINT      | Sets the position control expansion func-<br>tion selections.                         | 0 or 1                             |
| 81   | Get/Set | Backlash Com-<br>pensation Value                  | DINT      | Sets the backlash compensation.<br>Unit: 0.1 reference units                          | -500,000 to<br>500,000             |
| 82   | Get/Set | Backlash Com-<br>pensation Time<br>Constant       | UINT      | Sets the backlash compensation time constant.<br>Unit: 0.01 ms                        | 0 to 65,535                        |
| 83   | Get/Set | Encoder Out-<br>put Resolution                    | UINT      | Sets the encoder output resolution (edges/pitch).                                     | 1 to 4,096                         |
| 88   | Get/Set | JOG Speed                                         | UINT      | Sets the jogging speed.<br>Unit: min <sup>-1</sup>                                    | 0 to 10,000                        |
| 89   | Get/Set | Soft Start<br>Acceleration<br>Time                | UINT      | Sets the soft start acceleration time.<br>Unit: ms                                    | 0 to 10,000                        |
| 90   | Get/Set | Soft Start<br>Deceleration<br>Time                | UINT      | Sets the soft start deceleration time.<br>Unit: ms                                    | 0 to 10,000                        |
| 92   | Get/Set | Vibration<br>Detection<br>Switch                  | UINT      | Sets the vibration detection selections.                                              | 0x0000 to<br>0x0002                |
| 93   | Get/Set | Vibration<br>Detection<br>Sensibility             | UINT      | Sets the vibration detection sensitivity.<br>Unit: %                                  | 50 to 500                          |
| 94   | Get/Set | Vibration<br>Detection Level                      | UINT      | Sets the vibration detection level.<br>Unit: min <sup>-1</sup>                        | 0 to 5,000                         |
| 95   | Get/Set | Moment of Iner-<br>tia Calculating<br>Start Level | UINT      | Sets the moment of inertia calculation<br>start level.<br>Unit: %                     | 0 to 20,000                        |
| 97   | Get/Set | Torque Refer-<br>ence Filter Time<br>Constant     | UINT      | Sets the first stage first torque reference<br>filter time constant.<br>Unit: 0.01 ms | 0 to 65,535                        |
| 98   | Get/Set | Forward Torque<br>Limit                           | UINT      | Sets the forward torque limit.<br>Unit: %                                             | 0 to 800                           |
| 99   | Get/Set | Reverse Torque<br>Limit                           | UINT      | Sets the reverse torque limit.<br>Unit: %                                             | 0 to 800                           |
| 104  | Get/Set | Torque Related<br>Function<br>Switch              | UINT      | Sets the torque-related function selec-<br>tions.                                     | 0x0000 to<br>0x1111                |

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Continued from previous page.

|     |         |                                                                      | _         | Continued from                                                                                       |                       |
|-----|---------|----------------------------------------------------------------------|-----------|------------------------------------------------------------------------------------------------------|-----------------------|
| No. | Access  | Name                                                                 | Data Type | Description                                                                                          | Value                 |
| 105 | Get/Set | 1st Notch Filter<br>Frequency                                        | UINT      | Sets the first stage notch filter frequency.<br>Unit: Hz                                             | 50 to 5,000           |
| 106 | Get/Set | 1st Notch Filter<br>Q Value                                          | UINT      | Sets the first stage notch filter Q value.<br>Unit: 0.01                                             | 50 to 1,000           |
| 107 | Get/Set | 1st Notch Filter<br>Depth                                            | UINT      | Specifies the first stage notch filter depth.<br>Unit: 0.001                                         | 0 to 1,000            |
| 108 | Get/Set | 2nd Notch Filter<br>Frequency                                        | UINT      | Sets the second stage notch filter fre-<br>quency.<br>Unit: Hz                                       | 50 to 5,000           |
| 109 | Get/Set | 2nd Notch Filter<br>Q Value                                          | UINT      | Sets the second stage notch filter Q value.<br>Unit: 0.01                                            | 50 to 1,000           |
| 111 | Get/Set | 2nd Step 2nd<br>Torque Refer-<br>ence Filter Fre-<br>quency          | UINT      | Sets the second stage second torque ref-<br>erence filter frequency.<br>Unit: Hz                     | 100 to 5,000          |
| 112 | Get/Set | 2nd Step 2nd<br>Torque Refer-<br>ence Filter Q<br>Value              | UINT      | Sets the second stage second torque ref-<br>erence filter Q value.<br>Unit: 0.01                     | 50 to 100             |
| 113 | Get/Set | 1st Step 2nd<br>Torque Refer-<br>ence Filter Time<br>Constant        | UINT      | Sets the first stage second torque refer-<br>ence filter time constant.<br>Unit: 0.01 ms             | 0 to 65,535           |
| 115 | Get/Set | Torque Limit at<br>Main Circuit<br>Voltage Drop                      | UINT      | Sets the torque limit at main circuit voltage<br>drop.<br>Unit: %                                    | 0 to 100              |
| 116 | Get/Set | Release Time<br>for Torque Limit<br>at Main Circuit<br>Voltage Drop  | UINT      | Sets the release time for the torque limit at<br>main circuit voltage drop.<br>Unit: ms              | 0 to 1,000            |
| 117 | Get/Set | Sweep Torque<br>Reference<br>Amplitude                               | UINT      | Sets the sweep torque reference ampli-<br>tude.<br>Unit: %                                           | 1 to 800              |
| 118 | Get/Set | Notch Filter<br>Adjustment<br>Switch                                 | UINT      | Sets the notch filter adjustment selec-<br>tions.                                                    | 0x0000 to<br>0x0101   |
| 122 | Get/Set | Brake Refer-<br>ence - Servo<br>OFF Delay Time                       | UINT      | Sets the brake reference-servo OFF delay<br>time.<br>Unit: 10 ms                                     | 0 to 50               |
| 123 | Get/Set | Brake Refer-<br>ence Output<br>Speed 5.2.4<br>Level                  | UINT      | Sets the brake reference output speed<br>level.<br>Unit: min <sup>-1</sup>                           | 0 to 10,000           |
| 124 | Get/Set | Waiting Time<br>for Brake Sig-<br>nal When Motor<br>Running          | UINT      | Sets the servo OFF-brake command wait-<br>ing time.<br>Unit: 10 ms                                   | 10 to 100             |
| 125 | Get/Set | Instantaneous<br>Power Cut Hold<br>Time                              | UINT      | Sets the momentary power interruption<br>hold time.<br>Unit: ms                                      | 20 to 1,000           |
| 135 | Get/Set | Excessive Error<br>Level between<br>Servomotor and<br>Load Positions | DINT      | Sets the excessive following deviation<br>level between the motor and load.<br>Unit: Reference units | 0 to<br>1,073,741,824 |
| 136 | Get/Set | Excessive Posi-<br>tion Error Warn-<br>ing Level                     | UINT      | Sets the position deviation overflow warn-<br>ing level.<br>Unit: %                                  | 10 to 100             |
| 137 | Get/Set | Excessive Posi-<br>tion Error Alarm<br>Level                         | UDINT     | Sets the position deviation overflow alarm<br>level.<br>Unit: Reference units                        | 1 to<br>1,073,741,823 |
|     |         |                                                                      |           | Continues                                                                                            |                       |

#### 16.3.11 SERVOPACK Parameter Object

Continued from previous page.

| No.  | Access  | Name                                                               | Data Type | Continued from<br>Description                                                                             | Value                                          |
|------|---------|--------------------------------------------------------------------|-----------|-----------------------------------------------------------------------------------------------------------|------------------------------------------------|
| 110. | ALLESS  |                                                                    | Data Type | Description                                                                                               | value                                          |
| 140  | Get/Set | Excessive Posi-<br>tion Error Alarm<br>Level at Servo<br>ON        | UDINT     | Sets the position deviation overflow alarm<br>level when the servo is turned ON.<br>Unit: Reference units | 1 to<br>1,073,741,823                          |
| 141  | Get/Set | Excessive Posi-<br>tion Error Warn-<br>ing Level at<br>Servo ON    | UINT      | Sets the position deviation overflow warn-<br>ing level when the servo is turned ON.<br>Unit: %           | 10 to 100                                      |
| 142  | Get/Set | Speed Limit<br>Level at Servo<br>ON                                | UINT      | Sets the speed limit level when the servo<br>is turned ON.<br>Unit: min <sup>-1</sup>                     | 0 to 10,000                                    |
| 143  | Get/Set | Multiplier per<br>One Fully-<br>closed Rotation                    | UINT      | Sets the multiplier per fully-closed rota-<br>tion.<br>Unit: %                                            | 0 to 100                                       |
| 144  | Get/Set | Overload Warn-<br>ing Level                                        | UINT      | Sets the overload warning level.<br>Unit: %                                                               | 1 to 100                                       |
| 145  | Get/Set | Derating of<br>Base Current at<br>Detecting Over-<br>load of Motor | UINT      | Sets the base current derating at motor overload detection.<br>Unit: %                                    | 10 to 100                                      |
| 147  | Get/Set | Program JOG<br>Operation<br>Related Switch                         | UINT      | Sets the program jogging-related selec-<br>tions.                                                         | 0x0000 to<br>0x0005                            |
| 148  | Get/Set | Program JOG<br>Movement Dis-<br>tance                              | UINT      | Sets the program jogging travel distance.<br>Unit: Reference units                                        | 1 to<br>1,073,741,824                          |
| 149  | Get/Set | Program JOG<br>Movement<br>Speed                                   | UINT      | Sets the program jogging movement speed.<br>Unit: min <sup>-1</sup>                                       | 1 to 10,000                                    |
| 150  | Get/Set | Program JOG<br>Acceleration /<br>Deceleration<br>Time              | UINT      | Sets the program jogging acceleration/<br>deceleration time.<br>Unit: ms                                  | 2 to 10,000                                    |
| 151  | Get/Set | Program JOG<br>Waiting Time                                        | UINT      | Sets the program jogging waiting time.<br>Unit: ms                                                        | 0 to 10,000                                    |
| 152  | Get/Set | Number of<br>Times of Pro-<br>gram JOG<br>Movement                 | UINT      | Sets the number of program jogging<br>movements.<br>Unit: Number of movements                             | 0 to 1,000                                     |
| 153  | Get/Set | Analog Monitor<br>1 Offset Voltage                                 | INT       | Sets the analog monitor 1 offset voltage.<br>Unit: 0.1 V                                                  | -10,000 to<br>10,000                           |
| 154  | Get/Set | Analog Monitor<br>2 Offset Voltage                                 | INT       | Sets the analog monitor 2 offset voltage.<br>Unit: 0.1 V                                                  | -10,000 to<br>10,000                           |
| 155  | Get/Set | Analog Monitor<br>1 Magnification                                  | INT       | Sets the analog monitor 1 magnification.<br>Unit: 0.01x                                                   | -10,000 to<br>10,000                           |
| 156  | Get/Set | Analog Monitor<br>2 Magnification                                  | INT       | Sets the analog monitor 2 magnification.<br>Unit: 0.01x                                                   | -10,000 to<br>10,000                           |
| 157  | Get/Set | Remained<br>Vibration<br>Detection Width                           | UINT      | Sets the residual vibration detection width.<br>Unit: 0.1%                                                | 1 to 3,000                                     |
| 158  | Get/Set | Overshoot<br>Detection Level                                       | UINT      | Sets the overshoot detection level.<br>Unit: %                                                            | 0 to 100                                       |
| 159  | Get/Set | Regenerative<br>Resistor<br>Capacity                               | UINT      | Sets the regenerative resistor capacity.<br>Unit: 10 W                                                    | 0 to Upper limit<br>of SERVO-<br>PACK capacity |

#### ♦ Services

| Service Code | Service              | Description                                   |
|--------------|----------------------|-----------------------------------------------|
| 0x0E         | Get_Attribute_Single | Returns the value of the specified attribute. |
| 0x10         | Set_Attribute_Single | Changes the value of the specified attribute. |

## 16.4 Relationship between Parameters and Attributes

| Pn No. | Object No. | Attribute No. | Parameter Name                                                      | Attribute Name                                |
|--------|------------|---------------|---------------------------------------------------------------------|-----------------------------------------------|
| Pn000  | 0x66       | 10            | Basic Function Selections 0                                         | Basic Function Select Switch 0                |
| Pn001  | 0x66       | 11            | Application Function Selections 1 Application Function Selections 1 |                                               |
| Pn002  | 0x66       | 12            | Application Function Selections 2 Application Function Selectors 2  |                                               |
| Pn006  | 0x66       | 13            | Application Function Selections 6                                   | Application Function Select<br>Switch 6       |
| Pn007  | 0x66       | 14            | Application Function Selections 7                                   | Application Function Select<br>Switch 7       |
| Pn008  | 0x66       | 15            | Application Function Selections 8                                   | Application Function Select<br>Switch 8       |
| Pn009  | 0x66       | 16            | Application Function Selections 9                                   | Application Function Select<br>Switch 9       |
| Pn00B  | 0x66       | 17            | Application Function Selections B                                   | Application Function Select<br>Switch B       |
| Pn00C  | 0x66       | 18            | Application Function Selections C                                   | Application Function Select<br>Switch C       |
| Pn00D  | 0x66       | 19            | Application Function Selections D                                   | Application Function Select<br>Switch D       |
| Pn080  | 0x66       | 21            | Application Function Selections 80                                  | Application Function Select<br>Switch 80      |
| Pn100  | 0x66       | 23            | Speed Loop Gain                                                     | Speed Loop Gain                               |
| Pn101  | 0x66       | 24            | Speed Loop Integral Time Con-<br>stant                              | Speed Loop Integral Time Con-<br>stant        |
| Pn102  | 0x66       | 25            | Position Loop Gain                                                  | Position Loop Gain                            |
| Pn103  | 0x66       | 26            | Moment of Inertia Ratio                                             | Moment of Inertia Ratio                       |
| Pn104  | 0x66       | 27            | Second Speed Loop Gain                                              | 2nd Speed Loop Gain                           |
| Pn105  | 0x66       | 28            | Second Speed Loop Integral Time Constant                            | 2nd Speed Loop Integral Time<br>Constant      |
| Pn106  | 0x66       | 29            | Second Position Loop Gain                                           | 2nd Position Loop Gain                        |
| Pn109  | 0x66       | 30            | Feedforward                                                         | Feedforward Gain                              |
| Pn10A  | 0x66       | 31            | Feedforward Filter Time Constant                                    | Feedforward Filter Time Con-<br>stant         |
| Pn10B  | 0x66       | 32            | Gain Application Selections                                         | Application Function for Gain Select Switch   |
| Pn10C  | 0x66       | 33            | Mode Switching Level for Torque<br>Reference                        | Mode Switch (torque reference)                |
| Pn10D  | 0x66       | 34            | Mode Switching Level for Speed<br>Reference                         | Mode Switch (speed reference)                 |
| Pn10E  | 0x66       | 35            | Mode Switching Level for Acceler-<br>ation                          | Mode Switch (acceleration)                    |
| Pn10F  | 0x66       | 36            | Mode Switching Level for Position Deviation                         | Mode Switch (position error)                  |
| Pn11F  | 0x66       | 37            | Position Integral Time Constant                                     | Position Integral Time Constant               |
| Pn121  | 0x66       | 38            | Friction Compensation Gain                                          | Friction Compensation Gain                    |
| Pn122  | 0x66       | 39            | Second Friction Compensation Gain                                   | 2nd Gain for Friction Compen-<br>sation       |
| Pn123  | 0x66       | 40            | Friction Compensation Coefficient                                   | Friction Compensation Coefficient             |
| Pn124  | 0x66       | 41            | Friction Compensation Frequency<br>Correction                       | Friction Compensation<br>Frequency Correction |
| Pn125  | 0x66       | 42            | Friction Compensation Gain Cor-<br>rection                          | Friction Compensation Gain Correction         |

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| Pn No. | Object No. | Attribute No. | Parameter Name                                            | Attribute Name                                            |  |
|--------|------------|---------------|-----------------------------------------------------------|-----------------------------------------------------------|--|
| Pn131  | 0x66       | 43            | Gain Switching Time 1                                     | Gain Switching Time 1                                     |  |
| Pn132  | 0x66       | 44            | Gain Switching Time 2                                     | Gain Switching Time 2                                     |  |
| Pn135  | 0x66       | 45            | Gain Switching Waiting Time 1                             | Gain Switching Waiting Time 1                             |  |
| Pn136  | 0x66       | 46            | Gain Switching Waiting Time 2                             | Gain Switching Waiting Time 2                             |  |
| Pn139  | 0x66       | 47            | Automatic Gain Switching Selec-<br>tions 1                | Automatic Gain Changeover<br>Related Switch 1             |  |
| Pn13D  | 0x66       | 48            | Current Gain Level                                        | Auto Gain Switching Switches                              |  |
| Pn140  | 0x66       | 49            | Model Following Control-Related Selections                | Model Following Control Related Switch                    |  |
| Pn141  | 0x66       | 50            | Model Following Control Gain                              | Model Following Control Gain                              |  |
| Pn142  | 0x66       | 51            | Model Following Control Gain Cor-<br>rection              | Model Following Control Gain<br>Compensation              |  |
| Pn143  | 0x66       | 52            | Model Following Control Bias in the Forward Direction     | Model Following Control Bias<br>(Forward Direction)       |  |
| Pn144  | 0x66       | 53            | Model Following Control Bias in the Reverse Direction     | Model Following Control Bias (Reverse Direction)          |  |
| Pn145  | 0x66       | 54            | Vibration Suppression 1 Frequency A                       | Vibration Suppression 1 Fre-<br>quency A                  |  |
| Pn146  | 0x66       | 55            | Vibration Suppression 1 Frequency<br>B                    | Vibration Suppression 1 Fre-<br>quency B                  |  |
| Pn147  | 0x66       | 56            | Model Following Control Speed<br>Feedforward Compensation | Model Following Control Speed<br>Feedforward Compensation |  |
| Pn148  | 0x66       | 57            | Second Model Following Control Gain                       | 2nd Model Following Control Gain                          |  |
| Pn149  | 0x66       | 58            | Second Model Following Gain<br>Control Correction         | 2nd Model Following Control<br>Gain Compensation          |  |
| Pn14A  | 0x66       | 59            | Vibration Suppression 2 Frequency                         | Vibration Suppression 2 Fre-<br>quency                    |  |
| Pn14B  | 0x66       | 60            | Vibration Suppression 2 Correction                        | Vibration Suppression 2 Compensation                      |  |
| Pn160  | 0x66       | 62            | Anti-Resonance Control-Related Selections                 | Anti-Resonance Control Related Switch                     |  |
| Pn161  | 0x66       | 63            | Anti-Resonance Frequency                                  | Anti-Resonance Frequency                                  |  |
| Pn162  | 0x66       | 64            | Anti-Resonance Gain Correction                            | Anti-Resonance Gain Compen-<br>sation                     |  |
| Pn163  | 0x66       | 65            | Anti-Resonance Damping Gain                               | Anti-Resonance Damping Gain                               |  |
| Pn164  | 0x66       | 66            | Anti-Resonance Filter Time Con-<br>stant 1 Correction     | Anti-Resonance Filter Time<br>Constant 1 Compensation     |  |
| Pn165  | 0x66       | 67            | Anti-Resonance Filter Time Con-<br>stant 2 Correction     | Anti-Resonance Filter Time<br>Constant 2 Compensation     |  |
| Pn170  | 0x66       | 68            | Tuning-less Function-Related<br>Selections                | Tuning-less Function Related<br>Switch                    |  |
| Pn205  | 0x66       | 71            | Multiturn Limit                                           | Multi-turn Limit Setting                                  |  |
| Pn20A  | 0x66       | 73            | Number of External Encoder Scale<br>Pitches               | Number of External Scale Pitch                            |  |
| Pn20E  | 0x66       | 74            | Electronic Gear Ratio (Numerator)                         | Electronic Gear Ratio<br>(Numerator)                      |  |
| Pn210  | 0x66       | 75            | Electronic Gear Ratio (Denomina-<br>tor)                  | Electronic Gear Ratio<br>(Denominator)                    |  |
| Pn212  | 0x66       | 76            | Number of Encoder Output Pulses                           | Encoder Output Pulses                                     |  |
| Pn22A  | 0x66       | 79            | Fully-Closed Control Selections                           | Fully-closed Control Selection<br>Switch                  |  |
| Pn233  | 0x66       | 82            | Backlash Compensation Time<br>Constant                    | Backlash Compensation Time<br>Constant                    |  |
| Pn281  | 0x66       | 83            | Encoder Output Resolution                                 | Encoder Output Resolution                                 |  |

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|--------|------------|---------------|---------------------------------------------------------------|---------------------------------------------------------------|
| Pn No. | Object No. | Attribute No. | Parameter Name                                                | Attribute Name                                                |
| Pn304  | 0x66       | 88            | Jogging Speed                                                 | JOG Speed                                                     |
| Pn305  | 0x66       | 89            | Soft Start Acceleration Time                                  | Soft Start Acceleration Time                                  |
| Pn306  | 0x66       | 90            | Soft Start Deceleration Time                                  | Soft Start Deceleration Time                                  |
| Pn310  | 0x66       | 92            | Vibration Detection Selections                                | Vibration Detection Switch                                    |
| Pn311  | 0x66       | 93            | Vibration Detection Sensitivity                               | Vibration Detection<br>Sensibility                            |
| Pn312  | 0x66       | 94            | Vibration Detection Level                                     | Vibration Detection Level                                     |
| Pn324  | 0x66       | 95            | Moment of Inertia Calculation<br>Starting Level               | Moment of Inertia Calculating Start Level                     |
| Pn401  | 0x66       | 97            | First Stage First Torque Reference<br>Filter Time Constant    | Torque Reference Filter Time<br>Constant                      |
| Pn402  | 0x66       | 98            | Forward Torque Limit                                          | Forward Torque Limit                                          |
| Pn403  | 0x66       | 99            | Reverse Torque Limit                                          | Reverse Torque Limit                                          |
| Pn408  | 0x66       | 104           | Torque-Related Function Selec-<br>tions                       | Torque Related Function<br>Switch                             |
| Pn409  | 0x66       | 105           | First Stage Notch Filter Frequency                            | 1st Notch Filter Frequency                                    |
| Pn40A  | 0x66       | 106           | First Stage Notch Filter Q Value                              | 1st Notch Filter Q Value                                      |
| Pn40B  | 0x66       | 107           | First Stage Notch Filter Depth                                | 1st Notch Filter Depth                                        |
| Pn40C  | 0x66       | 108           | Second Stage Notch Filter Fre-<br>quency                      | 2nd Notch Filter Frequency                                    |
| Pn40D  | 0x66       | 109           | Second Stage Notch Filter Q Value                             | 2nd Notch Filter Q Value                                      |
| Pn40F  | 0x66       | 111           | Second Stage Second Torque Reference Filter Frequency         | 2nd Step 2nd Torque Reference<br>Filter Frequency             |
| Pn410  | 0x66       | 112           | Second Stage Second Torque Reference Filter Q Value           | 2nd Step 2nd Torque Reference<br>Filter Q Value               |
| Pn412  | 0x66       | 113           | First Stage Second Torque Refer-<br>ence Filter Time Constant | 1st Step 2nd Torque Reference<br>Filter Time Constant         |
| Pn424  | 0x66       | 115           | Torque Limit at Main Circuit Volt-<br>age Drop                | Torque Limit at Main Circuit Volt-<br>age Drop                |
| Pn425  | 0x66       | 116           | Release Time for Torque Limit at<br>Main Circuit Voltage Drop | Release Time for Torque Limit at<br>Main Circuit Voltage Drop |
| Pn456  | 0x66       | 117           | Sweep Torque Reference Ampli-<br>tude                         | Sweep Torque Reference Ampli-<br>tude                         |
| Pn460  | 0x66       | 118           | Notch Filter Adjustment Selections<br>1                       | Notch Filter Adjustment Switch                                |
| Pn506  | 0x66       | 122           | Brake Reference-Servo OFF Delay<br>Time                       | Brake Reference - Servo OFF<br>Delay Time                     |
| Pn507  | 0x66       | 123           | Brake Reference Output Speed<br>Level                         | Brake Reference Output Speed 5.2.4 Level                      |
| Pn508  | 0x66       | 124           | Servo OFF-Brake Command Wait-<br>ing Time                     | Waiting Time for Brake Signal When Motor Running              |
| Pn509  | 0x66       | 125           | Momentary Power Interruption<br>Hold Time                     | Instantaneous Power Cut Hold time                             |
| Pn51B  | 0x66       | 135           | Motor-Load Position Deviation<br>Overflow Detection Level     | Excessive Error Level between Servomotor and Load Positions   |
| Pn51E  | 0x66       | 136           | Position Deviation Overflow Warn-<br>ing Level                | Excessive Position Error Warn-<br>ing Level                   |
| Pn520  | 0x66       | 137           | Position Deviation Overflow Alarm Level                       | Excessive Position Error Alarm<br>Level                       |
| Pn526  | 0x66       | 140           | Position Deviation Overflow Alarm<br>Level at Servo ON        | Excessive Position Error Alarm<br>Level at Servo ON           |
| Pn528  | 0x66       | 141           | Position Deviation Overflow Warn-<br>ing Level at Servo ON    | Excessive Position Error Warn-<br>ing Level at Servo ON       |
| Pn529  | 0x66       | 142           | Speed Limit Level at Servo ON                                 | Speed Limit Level at Servo ON                                 |

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|----------------|----------------|
|----------------|----------------|

| Pn No. | Object No. | Attribute No. | Parameter Name                                          | Attribute Name                                             |  |
|--------|------------|---------------|---------------------------------------------------------|------------------------------------------------------------|--|
| THNO.  | -          |               |                                                         | Multiplier per One Fully-closed                            |  |
| Pn52A  | 0x66       | 143           | Multiplier per Fully-Closed Rotation                    | Rotation                                                   |  |
| Pn52B  | 0x66       | 144           | Overload Warning Level Overload Warning Level           |                                                            |  |
| Pn52C  | 0x66       | 145           | Base Current Derating at Motor<br>Overload Detection    | Derating of Base Current at<br>Detecting Overload of Motor |  |
| Pn530  | 0x66       | 147           | Program Jogging-Related Selec-<br>tions                 | Program JOG Operation<br>Related Switch                    |  |
| Pn531  | 0x66       | 148           | Program Jogging Travel Distance                         | Program JOG Movement Dis-<br>tance                         |  |
| Pn533  | 0x66       | 149           | Program Jogging Movement<br>Speed                       | Program JOG Movement Speed                                 |  |
| Pn534  | 0x66       | 150           | Program Jogging Acceleration/<br>Deceleration Time      | Program JOG Acceleration /<br>Deceleration Time            |  |
| Pn535  | 0x66       | 151           | Program Jogging Waiting Time                            | Program JOG Waiting Time                                   |  |
| Pn536  | 0x66       | 152           | Program Jogging Number of<br>Movements                  | Number of Times of Program<br>JOG Movement                 |  |
| Pn550  | 0x66       | 153           | Analog Monitor 1 Offset Voltage                         | Analog Monitor 1 Offset Voltage                            |  |
| Pn551  | 0x66       | 154           | Analog Monitor 2 Offset Voltage                         | Analog Monitor 2 Offset Voltage                            |  |
| Pn552  | 0x66       | 155           | Analog Monitor 1 Magnification                          | Analog Monitor 1 Magnification                             |  |
| Pn553  | 0x66       | 156           | Analog Monitor 2 Magnification                          | Analog Monitor 2 Magnification                             |  |
| Pn560  | 0x66       | 157           | Residual Vibration Detection Width                      | Remained Vibration Detection<br>Width                      |  |
| Pn561  | 0x66       | 158           | Overshoot Detection Level                               | Overshoot Detection Level                                  |  |
| Pn600  | 0x66       | 159           | Regenerative Resistor Capacity                          | Regenerative Resistor Capacity                             |  |
| PnB01  | 0x25       | 253           | Origin Return Direction                                 | Home Direction                                             |  |
| PnB03  | 0x25       | 254           | Origin Approach Speed                                   | Home Fast Velocity                                         |  |
| PnB04  | 0x25       | 255           | Origin Return Creep Speed                               | Home Slow Velocity                                         |  |
| PnB05  | 0x64       | 15            | Final Travel Distance for Origin Return                 | Final Travel Distance                                      |  |
| PnB09  | 0x24       | 17            | Origin Offset                                           | Home Position                                              |  |
| PnB12  | 0x64       | 32            | Coordinate Type Selection                               | Coordinate Type                                            |  |
| PnB13  | 0x64       | 33            | Reference Units per Machine Rev-<br>olution             | Command Value per Machine<br>Rotation                      |  |
| PnB16  | 0x25       | 54            | Forward Software Limit                                  | Positive Software Limit Position                           |  |
| PnB17  | 0x25       | 55            | Reverse Software Limit                                  | Negative Software Limit Position                           |  |
| PnB18  | 0x25       | 52            | Software Limit Action Selection                         | Software Limit Enable                                      |  |
| PnB1A  | 0x25       | 49            | Hardware Limit Action Selection                         | Hardware Limit Action                                      |  |
| PnB1C  | 0x25       | 241           | External Stop Action Selection                          | External Stop Action                                       |  |
| PnB21  | 0x25       | 7             | Feed Speed                                              | Target velocity                                            |  |
| PnB26  | 0x25       | 18            | Acceleration/Deceleration Type                          | Profile Type                                               |  |
| PnB29  | 0x25       | 18            | Filter Selection                                        | Profile Type                                               |  |
| PnB2A  | 0x25       | 8             | Acceleration Rate                                       | Acceleration                                               |  |
| PnB2B  | 0x25       | 9             | Deceleration Rate                                       |                                                            |  |
| PnB40  | 0x64       | 70            | Time Constant for Exponential Acceleration/Deceleration | Time Constant of Exponential<br>Curve                      |  |
| PnB41  | 0x64       | 71            | Exponential Acceleration/Deceler-<br>ation Bias Speed   | Bias Velocity                                              |  |
| PnB42  | 0x25       | 19            | Average Movement Time Filter<br>Time Constant           | Profile Gain                                               |  |
| PnB50  | 0x25       | 38            | Positioning Completed Width                             | Position Deadband                                          |  |
| PnB51  | 0x64       | 91            | Positioning Completion Timeout<br>Time                  | Positioning Timeout                                        |  |
| PnB54  | 0x25       | 200           | Positioning Approach Speed                              | Approach Speed for Positioning                             |  |
|        |            |               |                                                         | Continued on next page.                                    |  |

| Pn No. | Object No. | Attribute No. | Parameter Name             | Attribute Name             |
|--------|------------|---------------|----------------------------|----------------------------|
| PnB55  | 0x25       | 201           | End Position               | End Position               |
| PnB59  | 0x64       | 99            | Approach Mode              | Approach Mode              |
| PnBA3  | 0x64       | 173           | Input Signal Logic Setting | Input Signal Logic Setting |
| PnBA4  | 0x64       | 174           | Input Signal Setting       | Input Signal Setting       |
| PnBA5  | 0x64       | 255           | Action Definition Setting  | Behavior Definition        |
| PnBA7  | 0x64       | 253           | Initialization Setting     | Initializing Function      |

Continued from previous page.

## 16.5 Relation between Alarm Codes and Alarm Numbers

| Alarm<br>Code | MS Indi-<br>cator | NS Indi-<br>cator | Alarm Name                         | Alarm<br>Number | Description                                                     |
|---------------|-------------------|-------------------|------------------------------------|-----------------|-----------------------------------------------------------------|
| 0x01          | Lights            | _                 | Power Element Error                | A.030           | Main Circuit Encoder Error                                      |
| ono i         | red.              |                   |                                    | A.330           | Main Circuit Power Supply Wiring Error                          |
| 0x03          | Flashes red.      | _                 | External Overheat                  | A.7Ab           | SERVOPACK Built-in Fan Stopped                                  |
| 0x05          | Flashes           |                   | Overvoltage                        | A.400           | Overvoltage                                                     |
| 0,00          | red.              |                   | Overvoltage                        | A.410           | Undervoltage                                                    |
| 0x07          | Flashes red.      | -                 | Control Power Error                | A.A97           | Control Power Error                                             |
|               |                   |                   |                                    | A.810           | Encoder Backup Error                                            |
|               |                   |                   |                                    | A.820           | Encoder Checksum Error                                          |
|               |                   |                   |                                    | A.830           | Encoder Battery Alarm                                           |
|               |                   |                   |                                    | A.840           | Encoder Data Alarm                                              |
|               |                   |                   |                                    | A.850           | Encoder Overspeed                                               |
|               |                   |                   |                                    | A.860           | Encoder Overheated                                              |
|               |                   |                   |                                    | A.861           | Motor Overheated                                                |
| 0x08          | Lights            | _                 | Sensor Error                       | A.930           | Absolute Encoder Battery Error                                  |
| UNUU          | red.              |                   |                                    | A.C80           | Encoder Clear Error                                             |
|               |                   |                   |                                    | A.C90           | Encoder Communications Error                                    |
|               |                   |                   |                                    | A.C91           | Encoder Communications Position Data<br>Acceleration Rate Error |
|               |                   |                   |                                    | A.C92           | Encoder Communications Timer Error                              |
|               |                   |                   |                                    | A.CA0           | Encoder Parameter Error                                         |
|               |                   |                   |                                    | A.Cb0           | Encoder Echoback Error                                          |
|               |                   |                   |                                    | A.CC0           | Multiturn Limit Disagreement                                    |
|               |                   |                   |                                    | A.710           | Instantaneous Overload                                          |
|               |                   |                   |                                    | A.720           | Continuous Overload                                             |
| 0x0a          | Flashes red.      | -                 | Overload                           | A.730           | Dynamic Brake Overload                                          |
|               | Teu.              |                   |                                    | A.740           | Inrush Current Limiting Resistor Overload                       |
|               |                   |                   |                                    | A.910           | Overload                                                        |
| 0x0b          | Flashes red.      | -                 | Overspeed                          | A.510           | Overspeed                                                       |
|               |                   |                   |                                    | A.900           | Position Deviation Overflow Warning                             |
|               |                   |                   |                                    | A.901           | Position Deviation Overflow Warning at Servo ON                 |
|               | Flashes           |                   |                                    | A.d00           | Position Deviation Overflow Alarm                               |
| 0x0d          | red.              | 2S _              | Overflow                           | A.d01           | Position Deviation Overflow Alarm at Servo<br>ON                |
|               |                   |                   |                                    | A.d02           | Position Deviation Overflow Alarm for Speed Limit at Servo ON   |
|               |                   |                   |                                    | A.A90           | Excessive Positioning Time                                      |
| 0             | Flashes           | -                 | Main Circuit Power<br>Supply Error | A.A98           | Main Circuit Power Supply Error                                 |
| 0x10          | red.              |                   |                                    | A.F10           | Power Supply Line Open Phase                                    |
|               |                   |                   |                                    | A.300           | Regeneration Error                                              |
| 0x12          | Flashes           | ashes _<br>red    |                                    | A.320           | Regenerative Overload                                           |
|               | ieu.              |                   |                                    | A.920           | Regenerative Overload Warning                                   |

Appendices

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Alarm MS Indi-NS Indi-Alarm Alarm Name Description Code cator cator Number A.bC0 System Alarm 10 A.bF0 System Alarm 0 A.bF1 System Alarm 1 A.bF2 System Alarm 2 A.bF3 System Alarm 3 Lights 0x13 Servo CPU Error A.bF4 System Alarm 4 red. A.bF5 System Alarm 5 A.bF6 System Alarm 6 A.bF7 System Alarm 7 A.bF8 System Alarm 8 A.C10 Servomotor Out of Control Lights 0x14 **EEPROM Error** A.020 Parameter Checksum Error red. Flashes 0x18 Overcurrent A.100 Overcurrent \_ red. Lights A.AE6 0x20 Duplicate MAC ID Duplicated Address Error \_ red. Lights 0x21 **Bus-OFF Error** A.AE9 Bus-OFF Error red. Command Option Module Interface Initial-A.E00 ization Timeout Error Lights Command Option Module Interface Syn-0x22 Dual Port RAM Error A.E02 chronization Error 1 red. Command Option Module Detection Incon-A.E80 sistency Alarm A.040 Parameter Setting Error Flashes Parameter Setting 0xF0 red. Error A.A94 Data Setting Warning Flashes 0xF1 Command Error A.A95 Command Error red. Flashes A.050 0xF2 Combination Error Combination Error \_ red. Flashes Rotary Switch Set-0xF4 A.AE8 Rotary Switch Setting Error \_ red. ting Error A.520 Vibration Alarm Flashes 0xF5 Vibration Error red. A.911 Vibration Flashes 0xFF \_ Other Errors \_ red.

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# $\Sigma$ -7-Series AC Servo Drive $\Sigma$ -7S SERVOPACK Command Option Attachable Type with DeviceNet Module **Product Manual**

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In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply. Specifications are subject to change without notice for ongoing product modifications and improvements.

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