YASKAWA

Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with EtherCAT (CoE) Communications References Product Manual

Model: SGD7S-DDDDA0DDDD

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Basic	Information on
,	SERVOPACKs

Selecting a SERVOPACK

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the information contained in this publication.

About this Manual

This manual provides information required to select Σ -7S SERVOPACKs with EtherCAT Communications References 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 on SERVOPACKs	Provides information required to select SERVOPACKs, such as SER-VOPACK models and combinations with Servomotors.
2	Selecting a SERVOPACK	Provides information required to select SERVOPACKs, such as specifications, block diagrams, dimensional drawings, and connection examples.
3	SERVOPACK Installation	Provides information on installing SERVOPACKs in the required locations.
4	Wiring and Connecting SERVOPACKs	Provides information on wiring and connecting SERVOPACKs to power supplies and peripheral devices.
5	Basic Functions That Require Setting 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 Operation	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	EtherCAT Communications	Provides basic information on EtherCAT communications.
13	CiA402 Drive Profile	Provides detailed information on the CiA402 drive profile.
14	Object Dictionary	Provides an overview and details on the object dictionary.
15	Maintenance	Provides information on the meaning of, causes of, and corrections for alarms and warnings.
16	Parameter and Object Lists	Provides information on parameters and objects.
17	Appendices	Provides information on interpreting panel displays and tables of 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.

System Components Servo Drives Machine Controllers (I) Catalogs Machine Controller MP3300 Σ-7-Series and Servo Drive Catalog Catalog General Catalog Machine Controllers 4 (5) SERVOPACKs with Built-in Controllers: Σ -7C Built-in Option Function Module User's 7 8 Manuals Manuals Enclosed Σ -7-Series Built-in Σ -7-Series **Documents** Σ-7C Function Σ-7C SERVOPACK SERVOPACK Manuals SERVOPACKs: Σ -7S and Σ -7W Troubleshooting Product Manual Manual 12 Σ -7-Series Enclosed Σ -7-Series Σ-7-Series Option Documents Σ -7S/ Σ -7W Σ-7S/Σ-7W Σ-7S/Σ-7W Module SERVOPACK SERVOPACK SERVOPACK Product Hardware Option User's FT/EX Manuals Manual Manuals (such as this manual) Product Manuals Product Manuals Servomotors Enclosed Σ -7-Series Documents Servomotor Product Manuals Other Documents Σ -7-Series Programming Σ -7-Series Distributed Σ-7-Series MECHATROLINK Operation I/O Module Manuals Peripheral Interface Communications Device User's Command Operating Manual Selection Manuals Manuals Manual

Classification	Document Name	Document No.	Description
Machine Controller and Servo Drive General Catalog	Machine Controller and AC Servo Drive Solutions Catalog	KAEP S800001 22	Describes the features and application examples for combinations 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 specifications.
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.
	Σ-7-Series AC Servo Drive Σ-7C SERVOPACK Motion Control User's Manual	SIEP S800002 03	Provides detailed information on the specifications, system configuration, and application methods 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 configuration, and communications connection methods for the Ethernet communications that are used with MP3000-Series Machine Controllers and Σ -7-Series Σ -7C SERVO-PACKs.
	Machine Controller MP2000 Series Communication Module User's Manual	SIEP C880700 04	
	Machine Controller MP2000 Series 262IF-01 FL-net Communication Module User's Manual	SIEP C880700 36	Provide detailed information on the specifications and communications methods for the Communications Modules that can be mounted to MP3000-Series Machine Controllers and Σ-7-Series Σ-7C
⑤ Option Module	Machine Controller MP2000 Series 263IF-01 EtherNet/IP Communication Module User's Manual	SIEP C880700 39	SERVOPACKs.
Úser's Manuals	Machine Controller MP2000 Series I/O Module User's Manual	SIEP C880700 34	
	Machine Controller MP2000 Series Analog Input/Analog Output Module Al-01/AO-01 User's Manual	SIEP C880700 26	Provide detailed information on the specifications and communications methods for the I/O Modules that can be mounted to MP3000-Series Machine Controllers and Σ-7-Series Σ-7C SERVOPACKs.
	Machine Controller MP2000 Series Counter Module CNTR-01 User's Manual	SIEP C880700 27	

Classification	Document Name	Document No.	Description
	Σ-7-Series AC Servo Drive Σ-7S and Σ-7W SERVOPACK Safety Precautions	TOMP C710828 00	Provides detailed information for the safe usage of Σ-7-Series SERVOPACKs.
	Σ-V-Series/Σ-V-Series for Large-Capacity Models/ Σ-7-Series Safety Precautions Option Module	TOBP C720829 00	Provides detailed information for the safe usage of Option Modules.
	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	Σ-V-Series/Σ-V-Series for Large-Capacity Models/ Σ-7-Series Installation Guide Fully-closed Module	TOBP C720829 03	Provides detailed procedures for installing the Fully-closed Module 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.
	Σ-V-Series/Σ-V-Series for Large-Capacity Models/ Σ-7-Series Installation Guide INDEXER Module	TOBP C720829 02	Provides detailed procedures for installing the INDEXER Module in a SERVOPACK.
	Σ-V-Series/Σ-V-Series for Large-Capacity Models/ Σ-7-Series Installation Guide DeviceNet Module	TOBP C720829 07	Provides detailed procedures for installing the DeviceNet Module in a SERVOPACK.
⑦ 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 SERVO-PACKs; installing, connecting, setting, testing in trial operation, and tuning Servo Drives; writing, monitoring, and maintaining programs; and other information.
	Σ-7-Series AC Servo Drive Σ-7C SERVOPACK Troubleshooting Manual	SIEP S800002 07	Provides detailed troubleshooting information for Σ -7-Series Σ -7C SERVOPACKs.

Classification	Document Name	Document No.	Description
	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	
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with Analog Voltage/Pulse Train References Product Manual	SIEP S800001 26	Provide detailed information on selecting Σ -7-Series Σ -7S and Σ -7W SERVOPACKs; installing, connecting, setting, testing in trial operation,tuning, monitoring, and maintaining Servo Drives; and other information.
⑨Σ-7-SeriesΣ-7S/Σ-7WSERVOPACKProduct Manuals	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK Command Option Attachable Type with INDEXER Module Product Manual	SIEP S800001 64	
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK Command Option Attachable Type with DeviceNet Module Product Manual	SIEP S800001 70	
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with EtherCAT Communications References Product Manual	This manual (SIEP S800001 55)	
	Σ-7-Series AC Servo Drive Σ-7W SERVOPACK with MECHATROLINK-III Communications References Product Manual	SIEP S800001 29	
(ii) $\Sigma - 7 - \text{Series}$ $\Sigma - 7 \text{S} / \Sigma - 7 \text{W}$ $\Sigma - \frac{1}{2} \sum_{i=1}^{n} \frac{1}{2} \sum$	Σ-7-Series AC Servo Drive Σ-7S/Σ-7W SERVOPACK with Hardware Option Specifica- tions Dynamic Brake Product Manual	SIEP S800001 73	Provide detailed information on
SERVOPACK with Hardware Option Specifications Product Manuals	Σ-7-Series AC Servo Drive Σ-7W/Σ-7C SERVOPACK with Hardware Option Specifica- tions HWBB Function Product Manual	SIEP S800001 72	Hardware Options for Σ-7-Series SERVOPACKs.

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Classification	Document Name	Document No.	Description
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Index- ing Application Product Manual	SIEP S800001 84	Provide detailed information on the FT/EX Option for Σ-7-Series SERVOPACKs.
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Track- ing Application Product Manual	SIEP S800001 89	
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Application with Special Motor, SGM7D Motor Product Manual	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	
^Φ Σ-7-Series	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Transfer and Alignment Application Product Manual	SIEP S800001 95	
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	
	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	
® 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 Module. Continued on next page.

Classification	Document Name	Document No.	Description
Ciassification	AC Servo Drive	Document No.	Provides detailed information for
13	Rotary Servomotor Safety Precautions	TOBP C230260 00	the safe usage of Rotary Servomotors and Direct Drive Servomotors.
Enclosed Documents	AC Servomotor Linear Σ Series Safety Precautions	TOBP C230800 00	Provides detailed information for the safe usage of Linear Servomotors.
	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.
Troduct Maridas	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	Σ-7-Series AC Servo Drive MECHATROLINK-II Communications Command Manual	SIEP S800001 30	Provides detailed information on the MECHATROLINK-II communications commands that are used for a Σ -7-Series Servo System.
MECHATROLINK Communications Command Manuals	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.
0	Machine Controller MP3000 Series Ladder Programming Manual	SIEP C880725 13	Provides detailed information on the ladder programming specifications and instructions for MP3000-Series Machine Controllers and Σ -7-Series Σ -7C SERVOPACKs.
Programming Manuals	Machine Controller MP3000 Series Motion Programming Manual	SIEP C880725 14	Provides detailed information on the motion programming and sequence programming specifications and instructions for MP3000-Series Machine Controllers and Σ-7-Series Σ-7C SERVOPACKs.
(18)	Machine Controller MP2000/MP3000 Series Engineering Tool MPE720 Version 7 User's Manual	SIEP C880761 03	Describes in detail how to operate MPE720 version 7.
Σ-7-Series Operation Interface Operating Manuals	Σ-7-Series AC Servo Drive Digital Operator Operating Manual	SIEP S800001 33	Describes the operating procedures 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 procedures for the SigmaWin+ Engineering Tool for a Σ -7-Series Servo System.
® Distributed I/O Module User's Manual	MECHATROLINK-III Compatible I/O Module User's Manual	SIEP C880781 04	Describes the functions, specifications, operating methods, and MECHATROLINK-III communications for the Remote I/O Modules for MP2000/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 Servo Amplifier with EtherCAT Communications References.	
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.	
Servo ON command (Enable Operation command)	A command that is used to turn ON the servo (i.e., supply power to the motor) when bit 3 of controlword (6040h) is changed to 1 (ON) while the control power supply and main circuit power supply are ON. Refer to the following section for details. 3.1 Device Control (page 13-3)	
Servo OFF command (Disable Operation command)	A command that is used to turn OFF the servo (i.e., power not supplied to the motor) when bit 3 of controlword (6040h) is changed to 0 (OFF) while the control power supply and main circuit power supply are ON. Refer to the following section for details. 13.1 Device Control (page 13-3)	
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.

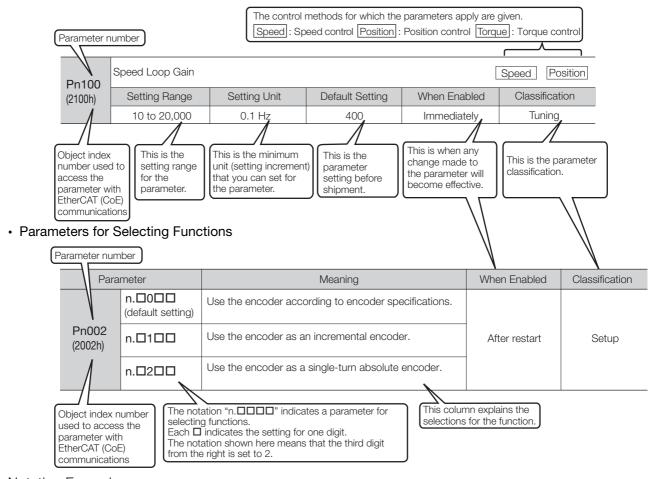
Notation Example

BK is written as /BK.

Notation for Parameters

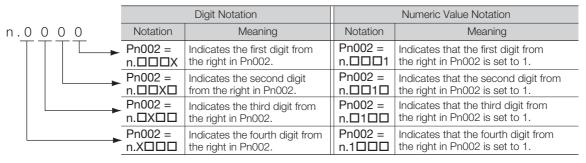
The notation depends on whether the parameter requires a numeric setting (parameter for numeric setting) or requires the selection of a function (parameter for selecting functions).

· Parameters for Numeric Settings



Notation Example

Notation Examples for Pn002



◆ Engineering Tools Used in This Manual

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

♦ Trademarks

- EtherCAT is a registered trademark of Beckhoff Automation GmbH, Germany.
- QR code is a trademark of Denso Wave 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.



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.

DANGER

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

MARNING

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

A CAUTION

• 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

DANGER

- 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.

MARNING

- 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.

⚠ CAUTION

• The SERVOPACK heat sinks, regenerative 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.

- 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

A CAUTION

 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

A CAUTION

- 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.

- 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

CAUTION

- Install the Servomotor or SERVOPACK in a way that will support the mass given in technical documents.
- Install SERVOPACKs, Servomotors, regenerative resistors, and External Dymamic 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.

- 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

DANGER

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

⚠ WARNING

- 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.

CAUTION

Wait for at least six minutes after turning OFF the power supply (with a SERVOPACK for a 100-VAC power supply 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 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 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

MARNING

- 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 motor will coast to a stop or stop with the dynamic brake according
 to a setting in the SERVOPACK. The coasting distance will change with the moment of inertia of
 the load. 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 P-OT and N-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 circuit 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.
 - 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.

- 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 quickly.
- 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.

⚠ WARNING

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

⚠ CAUTION

- Wait for at least six minutes after turning OFF the power supply (with a SERVOPACK for a 100-VAC power supply 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

DANGER

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.

MARNING

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.

CAUTION

- 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

When disposing of the product, treat it as ordinary industrial waste. However, local ordinances
and national laws must be observed. Implement all labeling and warnings as a final product as
required.

■ 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, 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.

North American Safety Standards (UL)



Product	Model	North American Safety Standards (UL File No.)
SERVOPACKs	SGD7S	UL 61800-5-1 (E147823) CSA C22.2 No.274
Rotary Servomotors	• SGM7M • SGM7A • SGM7J • SGM7P • SGM7G • SGMMV	UL 1004-1 UL 1004-6 (E165827)
Direct Drive Servomotors	SGM7E SGM7F-□□A, -□□B, -□□C, and -□□D (Small-Capacity Servomotors with Cores) SGMCV SGMCS-□□B, -□□C, -□□D, and -□□E (Small-Capacity, Coreless Servomotors)	UL 1004-1 UL 1004-6 (E165827)
Linear Servomotors	• SGLGW* • SGLFW* • SGLFW2 • SGLTW*	UL 1004-1 UL 1004-6 (E165827)

^{*} Only products with derating specifications are in compliance with the UL Standards. Estimates are available for those products. Contact your Yaskawa representative for details.

♦ EU Directives









Product	Model	EU Directive	Harmonized Standards
		Machinery Directive 2006/42/EC	EN ISO13849-1: 2015
SERVOPACKs	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 50178 EN 61800-5-1
		RoHS Directive 2011/65/EU	EN 50581
	COMM	EMC Directive 2004/108/EC	EN 55011 group 1, class A EN 61000-6-2 EN 61800-3 (Category C2, Second environment)
	SGMMV	Low Voltage Directive 2006/95/EC	EN 60034-1 EN 60034-5
Rotary		RoHS Directive 2011/65/EU	EN 50581
Servomotors	• SGM7M • SGM7J • SGM7A • SGM7P • SGM7G	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 60034-1 EN 60034-5
		RoHS Directive 2011/65/EU	EN 50581
Direct Drive	• SGM7E • SGM7F • SGMCV • SGMCS-□□B,	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)
Servomotors	-□□C, -□□D, and -□□E (Small-Capacity, Coreless Servomotors)	Low Voltage Directive 2014/35/EU	EN 60034-1 EN 60034-5
		RoHS Directive 2011/65/EU	EN 50581
Linear	• SGLG* • SGLF*	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)
Servomotors	• SGLF□2 • SGLT*	Low Voltage Directive 2014/35/EU	EN 60034-1
		RoHS Directive 2011/65/EU	EN 50581

^{*} For Moving Coils, only models with "-E" at the end of model numbers are certified.

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 interference and additional noise reduction measures may be necessary.

♦ Safety Standards



Product	Model	Safety Standards	Standards
		Safety of Machinery	EN ISO13849-1: 2015 IEC 60204-1
SERVOPACKs	SGD7S	Functional Safety	IEC 61508 series IEC 62061 IEC 61800-5-2
		EMC	IEC 61326-3-1

■ Safety Parameters

Item	Standards	Performa	nce Level
Safaty Integrity Layel	IEC 61508	SIL3	
Safety Integrity Level	IEC 62061	SILCL3	
Mission Time	IEC 61508	10 years	20 years
Probability of Dangerous Failure per Hour	IEC 61508 IEC 62061	PFH = 4.04×10^{-9} [1/h] (4.04% of SIL3)	PFH = 4.05×10^{-9} [1/h] (4.05% of SIL3)
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	IEC 60204-1	Stop category 0	
Safety Function	IEC 61800-5-2	STO	
Hardware Fault Tolerance	IEC 61508	HFT = 1	
Subsystem	IEC 61508	В	

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Revision History

Basic Information on SERVOPACKs

This chapter provides information required to select SERVOPACKs, such as SERVOPACK models 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 SERVOPACKs include Σ -7S SERVOPACKs for single-axis control and Σ -7W SERVOPACKs for two-axis control.

1.2.1 Introduction to CANopen

1.2 Introduction to EtherCAT

The CANopen over EtherCAT (CoE) Communications Reference SERVOPACKs implement the CiA 402 CANopen drive profile for EtherCAT communications (real-time Ethernet communications).

Basic position, speed, and torque control are supported along with synchronous position, speed, and torque control. You can select the type of control to match your system from basic positioning to high-speed, high-precision path control.

You can also use EtherCAT communications to control the high-level servo control performance, advanced turning functions, and many actuators of the Σ -7 Series.

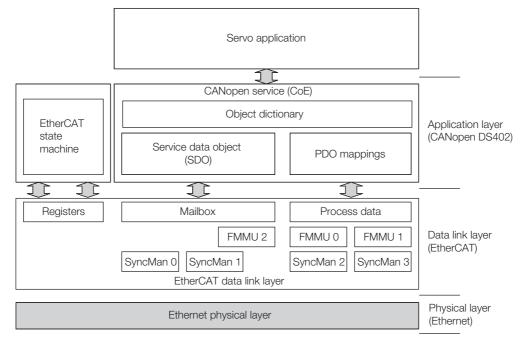
1.2.1 Introduction to CANopen

The CiA 402 CANopen profile is based on the IEC 61800-7-1, IEC61800-7-201, and IEC 61800-7-301 standards for international standardization of drive control and operation control.

1.2.2 CANopen over EtherCAT OSI Model

The OSI model implemented by the SERVOPACKs consists of three layers: the application layer (CANopen), the data link layer (EtherCAT), and the physical layer (Ethernet). The four layers other than the application layer, data link layer, and physical layer are not used. The data link layer is implemented with EtherCAT communications and the application layer is implemented with the DS402 CANopen drive profile.

This manual describes mainly the specifications of the application layer implemented in the SERVOPACKs. For detailed information on the data link layer (EtherCAT), refer to documentation provided by the EtherCAT Technology Group.



The object dictionary in the application layer includes parameters, application data, and PDO mapping information between the master and slaves.

The process data objects (PDOs) consist of the objects in the object dictionary that can be mapped to PDO mappings. The PDO mappings define the structure and contents of the process data.

1.2.3 Sending and Receiving Data in EtherCAT (CoE) Communications

Objects are used to send and receive data in EtherCAT (CoE) communications.

Reading and writing object data is performed in process data communications (PDO service), which transfers data cyclically, and in mailbox communications (SDO service), which transfers data non-cyclically.

Process data communications are used to read and write PDOs. Mailbox communications (SDO) are used to read and write object dictionary data entries.

1.2.4 CoE Terminology

The EtherCAT and CANopen terms that are used in this manual are described in the following table.

Term	Abbreviation	Description
CAN in Automation	CiA	A non-profit organization established in 1992 as a joint venture between companies to provide CAN technical information, product information, and marketing information.
Controller Area Network	CAN	Communications protocol for the physical layer and data link layer established for automotive LANs. It was established as an international standard as ISO 11898.
CANopen	CANopen	An upper-layer protocol based on the international CAN standard (EN 50325-4). It consists of profile specifications for the application layer, communications, applications, devices, and interfaces.
CANopen over EtherCAT	CoE	A network that uses Ethernet for the physical layer, EtherCAT for the data link layer, and CANopen for the application layer in a seven-layer OSI reference model.
Distributed Clocks	DC	A clock distribution mechanism that is used to synchronize the EtherCAT slaves with the EtherCAT master.
Electrically Erasable Programmable Read Only Memory	EEPROM	A ROM that can be electrically overwritten.
EtherCAT Slave Controller	ESC	A hardware chip that processes EtherCAT communications (such as loopbacks) and manages the distributed clock.
EtherCAT State Machine	ESM	A state machine in which the state of EtherCAT (the data link layer) changes according to transition conditions.
EtherCAT Technology Group	ETG	An international organization established in 2003 to provide support for developing EtherCAT technologies and to promote the spread of EtherCAT technologies.
Ethernet for Control Automation Technology	EtherCAT	An open network developed by Beckhoff Automation.
Fieldbus Memory Management Unit	FMMU	A unit that manages fieldbus memory.
INIT	INIT	The Init state in the EtherCAT state machine.
OPERATIONAL	OP	The Operational state in the EtherCAT state machine.
Object Dictionary	OD	A group of objects and structure supported by an EtherCAT SERVOPACK.
Process Data Object	PDO	Objects that are sent and received in cyclic communications.
Process Data Object Mapping	PDO mapping	Definitions of the applications objects that are sent with PDOs.
Service Data Object	SDO	Objects that are sent and received in mailbox communications.
PRE-OPERATIONAL	PREOP	The Pre-operational state in the EtherCAT state machine.

1.2.5 Data Types

Continued from previous page.

Term	Abbreviation	Description
Process data	_	The data contained in application objects that are periodically transferred for measurements or controls.
SyncManager	_	The ESC unit that coordinates data exchange between the master and slaves.
Receive Process Data Object	RXPDO	The process data received by the ESC.
Transmit Process Data Object	TXPDO	The process data sent by the ESC.

1.2.5 Data Types

The following table lists the data types and ranges that are used in this manual.

Code	Data Type	Range
SINT	Signed 8-bit integer	-128 to 127
INT	Signed 16-bit integer	-32,768 to 32,767
DINT	Signed 32-bit integer	-2,147,483,648 to 2,147,483,627
USINT	Unsigned 8-bit integer	0 to 255
UINT	Unsigned 16-bit integer	0 to 65,535
UDINT	Unsigned 32-bit integer	0 to 4,294,967,295
STRING	Character string	-

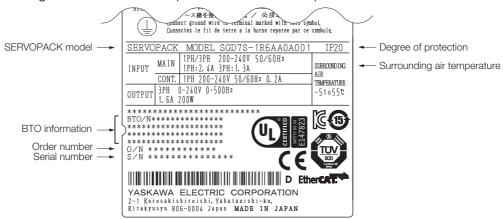
1.2.6 Data Units

The following table lists the data units and notations that are used in this manual.

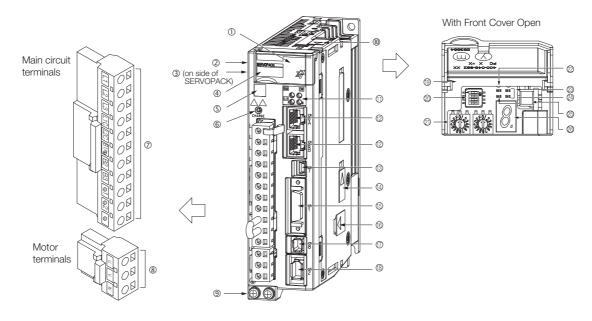
Notation	Description
Pos. unit	The user-defined position reference unit that is set in <i>position user unit</i> (2701h). 1 [Pos. unit] = 2701: 01h/2701: 02h [inc]
Vel. unit	The user-defined speed reference unit that is set in <i>velocity user unit</i> (2702h). 1 [Vel. unit] = 2702: 01h/2702: 02h [inc/s]
Acc. unit	The user-defined acceleration reference unit that is set in acceleration user unit (2703h). 1 [Acc. unit] = 2703 : $01h/2703$: $02h \times 10^4$ [inc/s ²]
Trq. unit	The user-defined torque reference unit that is set in <i>torque user unit</i> (2704h). 1 [Trq. unit] = 2704: 01h/2704: 02h [%]
inc	This is the encoder pulse unit. For a 24-bit encoder, the resolution is 16,777,216 [inc] per rotation.

1.3 Interpreting the Nameplate

The following basic information is provided on the nameplate.



1.4 Part Names



	Name	Description	Reference
①	Front Cover	-	_
2	Input Voltage	-	_
3	Nameplate	Indicates the SERVOPACK model and ratings.	page 1-7
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.	-
7	Main Circuit Terminals	The terminals depend on the main circuit power supply input specifications of the SERVOPACK.	page 4-12
8	Servomotor Terminals (U, V, and W)	The connection terminals for the Servomotor Main Circuit Cable (power line).	page 4-27
9	Ground Terminal ()	The ground terminals to prevent electric shock. Always connect this terminal.	-
10	Serial Communications Connector (CN502)	Connects to the Digital Operator. However, a Communications Unit (JUSP-JC001-1) is required to connect a Digital Operator.	page 4-46
11)	Communications Status Indicators	Indicate the status of EtherCAT communications.	page 1-19
12	EtherCAT Communications Connectors (Input: CN6A, Output: CN6B)	Connects to EtherCAT devices.	page 4-44
13	Computer Connector (CN7)	A USB connector to connect a computer.	page 4-46
14)	Safety Option Module Connector	Connects to a Safety Option Module.	_
15	I/O Signal Connector (CN1)	Connects to sequence I/O signals.	page 4-35
16	Feedback Option Module Connector	Connects to a Feedback Option Module.	_
17	Safety Connector (CN8)	Connects to a safety function device.	page 4-42
18	Encoder Connector (CN2)	 Rotary Servomotor: Connects to the encoder in the Servomotor. Linear Servomotor: Connects to a Serial Converter Unit or linear encoder. 	page 4-27
19	Serial Number	-	_

Continued from previous page.

No.	Name	Description	Reference
20	DIP Switch (S3)	Not used.	
21)	EtherCAT secondary address (S1 and S2)	Use these switches to set the device ID and address.	page 5-12
22	PWR	Lights when the control power is being supplied.	_
23)	CN	Not used.	_
24)	L1 and L2	Not used.	_
25)	Analog Monitor Connector (CN5)	You can use a special cable (peripheral device) to monitor the motor speed, torque reference, or other values.	page 4-47
26	Panel Display	Displays the servo status with a seven-segment display.	_

1.5.1 Interpreting SERVOPACK Model Numbers

1.5

Model Designations

1.5.1 Interpreting SERVOPACK Model Numbers

SGD7S

 \cdot H/0

A 4th

AU 5th+6th 7th digit

8th+9th+10th

11th+12th+13th digits

14th

 Σ -7-Series Σ -7S SERVOPACKs

1st+2nd+3rd digits

Maximum Applicable Motor Capacity

Voltage	Code	Specification
	R70*1	0.05 kW
	R90*1	0.1 kW
	1R6*1	0.2 kW
	2R8*1	0.4 kW
	3R8	0.5 kW
	5R5*1	0.75 kW
Three-	7R6	1.0 kW
Phase,	120*2	1.5 kW
200 VA	180	2.0 kW
	200	3.0 kW
	330	5.0 kW
	470	6.0 kW
	550	7.5 kW
	590	11 kW
	780	15 kW
	R70	0.05 kW
Single-	R90	0.1 kW
Phase, 100 VAC	2R1	0.2 kW
100 1/10	2R8	0.4 kW

4th digit Voltage

Code	Specification
Α	200 VAC
F	100 VAC

5th+6th digits Interface*3

Code	Specification	
A0	EtherCAT communications reference	



8th+9th+10th digits Hardware Options Specification

Code	Specification	Applicable Models	
None	Without options	All models	
001	Rack-mounted	SGD7S-R70A to -330A	
	Hack-Houlited	SGD7S-R70F to -2R8F	
	Duct-ventilated	SGD7S-470A to -780A	
002	Varnished	All models	
020*4	No di mancia buella	SGD7S-R70A to -2R8A	
	No dynamic brake	SGD7S-R70F to -2R8F	
	External dynamic brake resistor	SGD7S-3R8A to -780A	



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-120AA0A008).
- *3. The same SERVOPACKs are used for both Rotary Servomotors and Linear Servomotors.
- *4. Refer to the following manual for details.

Σ-7-Series Σ-7S/Σ-7W SERVOPACK with Dynamic Brake Hardware Option Specifications Product Manual (Manual No.: SIEP S800001 73)

*5. These models use the MechatroCloud BTO Service from e-mechatronics.com. A BTO number must be acquired separately.

Refer to the following catalog for details on the BTO specification.

 \square AC Servo Drives Σ-7 Series (Manual No.: KAEP S800001 23)

Interpreting Servomotor Model Numbers 1.5.2

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

- 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)
- Σ-7-Series Direct Drive Servomotor Product Manual (Manual No.: SIEP S800001 38)

Rotary Servomotors



Series	digits
Series	Σ-7 Series Servomotors

SGMMV













/ LI I
digit
digit

Code	Specification		
SGM7M	Low inertia , ultra-small capacity		
SGM7J	Medium inertia, high speed		
SGM7A	Low inertia, high speed		
SGM7P	Medium inertia, flat		
SGM7G	Medium inertia, low speed, high torque		
0014141	Low inertia, ultra-small		

capacity

- 1st+2nd digits Rated Output
- 3rd digit Power Supply Voltage
- 200 VAC
- 4th digit Serial Encoder Specification
- 17-bit absolute encoder
- 20-bit absolute encoder
- 24-bit batteryless absolute encoder
- 24-bit absolute encoder
- 24-bit incremental encoder

5th digit Design Revision Order



- Shaft End Specification
- Straight
- With key and tap
- With two flat seats



- With 24-V holding brake
- With oil seal

Direct Drive Servomotors



Series Σ -7 Series Servomotors

Code	Specification		
SGM7E	Small capacity, coreless, inner rotor		
SGM7F	Small capacity, with core, inner rotor		
SGM7F	Medium capacity, with core, inner rotor		
SGMCV	Small capacity, with core, inner rotor		
SGMCS	Small capacity, coreless, inner rotor		
SGIVICS	Medium capacity, with core, inner rotor		

1st+2nd digits Rated Torque



4th digit Serial Encoder Specification 5th digit Design Revision Order

6th digit Flange Specification

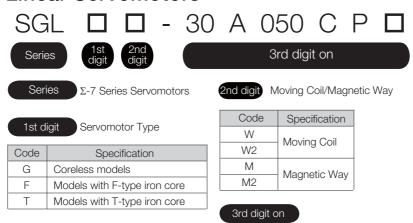
- Cable drawn to load side
- Cable drawn to non-load side

7th digit Option Specification

• High mechanical precision

1.5.2 Interpreting Servomotor Model Numbers

Linear Servomotors



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

1.6.1 Combinations of Rotary Servomotors and SERVOPACKs

1.6 Combinations of SERVOPACKs and Servomotors

1.6.1 Combinations of Rotary Servomotors and SERVOPACKs

Rotary Servomotor Model		Capacity	SERVOPACK Model	
		Capacity	SGD7S-	
SGM7M	SGM7M-A1A	11 W	R90A or R90F	
(Low Inertia, Ultrasmall Capacity),	SGM7M-A2A	22 W	1100/101/1001	
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 (Medium Inertia,	SGM7J-C2A	150 W	1R6A or 2R1F	
Small Capacity),	SGM7J-02A	200 W	THOA OF ZITTI	
3,000 min ⁻¹	SGM7J-04A	400 W	2R8A or 2R8F	
	SGM7J-06A	600 W	5R5A	
	SGM7J-08A	750 W		
	SGM7A-A5A	50 W	R70A or R70F	
	SGM7A-01A	100 W	R90A or R90F	
	SGM7A-C2A	150 W	1R6A or 2R1F	
	SGM7A-02A	200 W	0004 0005	
	SGM7A-04A	400 W	2R8A or 2R8F	
SGM7A	SGM7A-06A	600 W	5R5A	
(Low Inertia, Small	SGM7A-08A	750 W		
Capacity),	SGM7A-10A SGM7A-15A	1.0 kW 1.5 kW	120A	
3,000 min ⁻¹	SGM7A-13A	2.0 kW	180A	
	SGM7A-25A	2.5 kW	100A	
	SGM7A-30A	3.0 kW	200A	
	SGM7A-40A	4.0 kW		
	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		
	SGM7G-09A	850 W	7R6A	
001470	SGM7G-13A	1.3 kW	120A	
SGM7G (Medium Inertia,	SGM7G-20A	1.8 kW	180A	
Medium Capacity), 1,500 min ⁻¹	SGM7G-30A	2.9 kW*1	330A	
	SGM7G-44A	4.4 kW		
	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	R90A or R90F	
(Low Inertia, Ultrasmall Capacity),	SGMMV-A2A	20 W		
3,000 min ⁻¹	SGMMV-A3A	30 W	1R6A or 2R1F	

1.6.2 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.

1.6.2 Combinations of Direct Drive Servomotors and SERVOPACKs

		Rated Torque	Instantaneous	SERVOPACK Model
Direct Drive S	ervomotor Model	[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	EDE A
	SGM7E-35E	35	105	- 5R5A
	SGM7F-02A	2	6	2R8A or 2R1F
	SGM7F-05A	5	15	ZRBA OF ZRTF
	SGM7F-07A	7	21	
	SGM7F-04B	4	12	2R8A or 2R8F
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	120A
(Medium Capacity,	SGM7F-80N	80	240	120A
With Core, Inner	SGM7F-1AM	110	330	180A
Rotor)	SGM7F-1EN	150	450	200A
	SGM7F-2ZN	200	600	200A
	SGMCV-04B	4	12	2R8A or 2R8F
	SGMCV-10B	10	30	ZNOA UI ZNOI
SGMCV	SGMCV-14B	14	42	5R5A
(Small Capacity,	SGMCV-08C	8	24	2R8A or 2R8F
With Core, Inner Rotor)	SGMCV-17C	17	51	5R5A
	SGMCV-25C	25	75	7R6A
	SGMCV-16D	16	48	5R5A
	SGMCV-35D	35	105	7R6A* or 120A

Continued from previous page.

Direct Drive Servomotor Model		Rated Torque [N·m]	Instantaneous	SERVOPACK Model
			Maximum Torque [N·m]	SGD7S-
	SGMCS-02B	2	6	2R8A or 2R1F
	SGMCS-05B	5	15	
	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	SHOA
	SGMCS-45M	45	135	7R6A
SGMCS (Medium Capacity, With Core, Inner Rotor)	SGMCS-80M	80	240	120A
	SGMCS-80N	80	240	120A
	SGMCS-1AM	110	330	180A
	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 (Manual No.: KAEP S800001 23)

1.6.3 Combinations of Linear Servomotors and SERVOPACKs

Linear Servomotor Model		Rated Force [N]	Instantaneous Maxi- mum Force [N]	SERVOPACK Model
				SGD7S-
	SGLGW-30A050C	12.5	40	R70A, R70F
	SGLGW-30A080C	25	80	DOOA DOOF
	SGLGW-40A140C	47	140	R90A, R90F
2010	SGLGW-40A253C	93	280	1R6A, 2R1F
SGLG (Coreless Models),	SGLGW-40A365C	140	420	2R8A, 2R8F
Used with Stan-	SGLGW-60A140C	70	220	1R6A, 2R1F
dard-Force Mag-	SGLGW-60A253C	140	440	2R8A, 2R1F
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, 2R1F
SGLG	SGLGW-40A253C	114	460	2R8A, 2R8F
(Coreless Models), Used with High- Force Magnetic Way	SGLGW-40A365C	171	690	3R8A
	SGLGW-60A140C	85	360	1R6A, 2R1F
	SGLGW-60A253C	170	720	3R8A
	SGLGW-60A365C	255	1080	7R6A

1.6.3 Combinations of Linear Servomotors and SERVOPACKs

Continued from previous page.

		Rated Force	Instantaneous Maxi-	SERVOPACK Model	
Linear Serv	omotor Model	[N]	mum Force [N]	SGD7S-	
	SGLFW-20A090A	25	86		
	SGLFW-20A120A	40	125	1R6A, 2R1F	
	SGLFW-35A120A	80	220	-	
	SGLFW-35A230A	160	440	3R8A	
	SGLFW-50A200B	280	600	5R5A	
	SGLFW-50A380B	500	4000	1001	
	SGLFW-1ZA200B	560	1200	120A	
	SGLFW-1ZA380B	1120	2400	200A	
	SGLFW2-30A070A	45	135	1DCA 0D1E	
SGLF	SGLFW2-30A120A	90	270	- 1R6A, 2R1F	
(Models with F-type	COL EMO 0040004*	180	540	3R8A	
Iron Cores)	SGLFW2-30A230A*	170	500	2R8A	
	SGLFW2-45A200A	280	840	5R5A	
	COL EMO 45 4000 4*	F00	1680	180A	
	SGLFW2-45A380A*	560	1500	120A	
	SGLFW2-90A200A□1	560	1680	1004	
	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	
	SGLTW-20A170A	130	380	3R8A	
	SGLTW-20A320A	250	760	7R6A	
	SGLTW-20A460A	380	1140	120A	
	SGLTW-35A170A	220	660	5R5A	
	SGLTW-35A170H	300	600	JOSA	
	SGLTW-35A320A	440	1320	120A	
SGLT (Madala with T type	SGLTW-35A320H	600	1200	120A	
(Models with T-type Iron 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	

 $[\]ensuremath{^{*}}$ The force depends on the SERVOPACK that is used with the Servomotor.

1.7 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 5-12
Automatic Detection of Connected Motor	page 5-14
Motor Direction Setting	page 5-15
Linear Encoder Pitch Setting	page 5-16
Writing Linear Servomotor Parameters	page 5-17
Selecting the Phase Sequence for a Linear Servomotor	page 5-21
Polarity Sensor Setting	page 5-23
Polarity Detection	page 5-24
Overtravel Function and Settings	page 5-27
Holding Brake	page 5-33
Motor Stopping Methods for Servo OFF and Alarms	page 5-38
Resetting the Absolute Encoder	page 5-51
Setting the Origin of the Absolute Encoder	page 5-54
Setting the Regenerative Resistor Capacity	page 5-57
Operation for Momentary Power Interruptions	page 6-13
SEMI F47 Function	page 6-14
Setting the Motor Maximum Speed	page 6-16
Software Limits	page 6-24
Multiturn Limit Setting	page 6-35
Adjustment of Motor Current Detection Signal Offset	page 6-49
Forcing the Motor to Stop	page 6-53
Overheat Protection	page 6-56
Speed Ripple Compensation	page 8-59
Current Control Mode Selection	page 8-71
Current Gain Level Setting	page 8-71
Speed Detection Method Selection	page 8-72
Fully-Closed Loop Control	page 10-1
Safety Functions	page 11-1
Touch Probe	page 13-23
Sync Error Count Limit Setting	page 14-16

· Functions Related to the Host Controller

Function	Reference
Setting Unit Systems	page 5-43
I/O Signal Allocations	page 6-3
ALM (Servo Alarm) Signal	page 6-6
/WARN (Warning Output) Signal	page 6-6
/TGON (Rotation Detection) Signal	page 6-7
/S-RDY (Servo Ready) Signal	page 6-7
/V-CMP (Speed Coincidence Detection) Signal	page 6-8
/COIN (Positioning Completion) Signal	page 6-9

Continued from previous page.

Function	Reference
/NEAR (Near) Signal	page 6-10
Speed Limit during Torque Control	page 6-11
/VLT (Speed Limit Detection) Signal	page 6-11
Encoder Divided Pulse Output	page 6-17
Selecting Torque Limits	page 6-25
Vibration Detection Level Initialization	page 6-45
Alarm Reset	page 15-41
Replacing the Battery	page 15-3
Setting the Position Deviation Overflow Alarm Level	page 8-8

• Functions to Achieve Optimum Motions

Function	Reference
Tuning-less Function	page 8-12
Autotuning without a Host Reference	page 8-23
Autotuning with a Host Reference	page 8-34
Custom Tuning	page 8-41
Anti-Resonance Control Adjustment	page 8-50
Vibration Suppression	page 8-55
Gain Selection	page 8-65
Friction Compensation	page 8-68
Backlash Compensation	page 8-72
Model Following Control	page 8-85
Compatible Adjustment Functions	page 8-88
Mechanical Analysis	page 8-92
Easy FFT	page 8-94

• Functions for Trial Operation during Setup

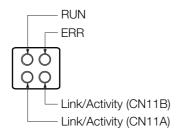
Function	Reference
Software Reset	page 6-43
Trial Operation for the Servomotor without a Load	page 7-7
Program Jogging	page 7-13
Origin Search	page 7-20
Test without a Motor	page 7-22
Monitoring Machine Operation Status and Signal Waveforms	page 9-6

• Functions for Inspection and Maintenance

Function	Reference
Write Prohibition Setting for Parameters	page 5-7
Initializing Parameter Settings	page 5-10
Automatic Detection of Connected Motor	page 5-14
Monitoring Product Information	page 9-2
Monitoring Product Life	page 9-2
Alarm History Display	page 15-41

1.8 EtherCAT Communications LED Indicators

This diagram shows details of the EtherCAT communications LED indicators.



1.8.1 RUN

The RUN indicator shows the status of EtherCAT communications.

	LED Indicator	Description			
Status	Pattern	Description			
Off	Constantly off.	EtherCAT communications are in INIT state.			
Blinking	On Off 200 ms 200 ms	EtherCAT communications are in PRE-OPERATIONAL state.			
Double flash	On	EtherCAT communications are in SAFE-OPERATIONAL state.			
On	Constantly on.	EtherCAT communications are in OPERATIONAL state.			
Flickering	On Off	EtherCAT communications have been started but are not yet in INIT state.			

1.8.2 ERR

1.8.2 ERR

The ERR indicator shows the error status of EtherCAT communications.

	LED Indicator	Description			
Status	Pattern	Description			
Off	Constantly off.	The EtherCAT communications is in working condition.			
Flickering	On Off	Booting Error was detected.			
Blinking	On Off 200 ms 200 ms	State change commanded by master is impossible due to register or object settings.			
Single flash	On 1000 ms 200 ms	Synchronization Error, the EtherCAT Network Module enters SAFE-OPERATIONAL state automatically.			
Double flash	On	An application (Sync Manager) watchdog timeout has occurred.			
On	Constantly on.	A PDI Watchdog timeout has occurred.			

1.8.3 Link/Activity

The Link/Activity indicators show whether Communications Cables are connected to the CN6A and CN6B connectors and whether communications are active.

	LED Indicator	Description				
Status	Pattern	Description				
Off	Constantly off.	A Communications Cable is not physically connected. A EtherCAT controller is not started up.				
Flickering	On Off	Data are being exchanged.				
On	Constantly on.	A Communications Cable is physically connected, but no data being exchanged.				

Selecting a SERVOPACK

2

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

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2.1	Rating	gs and Specifications2-2
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2.2	Block	Diagrams 2-10
	2.2.1 2.2.2 2.2.3 2.2.4 2.2.5 2.2.6 2.2.7 2.2.8 2.2.9 2.2.10	SGD7S-R70A, -R90A, and -1R6A 2-10 SGD7S-2R8A 2-10 SGD7S-3R8A, -5R5A, and -7R6A 2-11 SGD7S-120A 2-12 SGD7S-180A and -200A 2-13 SGD7S-330A 2-14 SGD7S-470A and -550A 2-15 SGD7S-590A and -780A 2-16 SGD7S-2R8F 2-17
2.3	Extern	nal Dimensions2-18
	2.3.1	Front Cover Dimensions and Connector Specifications
2.4	Examples of	of Standard Connections between SERVOPACKs and Peripheral Devices 2-24

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

Model SGD7S-		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	
	Continuous Output Current [Arms]		0.66	0.91	1.6	2.8	3.8	5.5	7.6	11.6	18.5	19.6	32.9
	Instantaneous Maximum Output Current [Arms]		2.1	3.2	5.9	9.3	11	16.9	17	28	42	56	84
Main	Power Supply		200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz										
Circuit	Input Cu [Arms]*	rrent	0.4	0.8	1.3	2.5	3.0	4.1	5.7	7.3	10	15	25
Con-	Power S	upply		•	200 VA	C to 24	0 VAC,	-15% t	o +10%	, 50 Hz	z/60 Hz		
trol	Input Cu [Arms]*	rrent	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.25	0.25	0.3
Power [kVA]*	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 Circuit Power Loss [W]		5.0	7.0	11.9	22.5	28.5	38.9	49.2	72.6	104.2	114.2	226.6
Power	Control Circuit Power Loss [W]		12	12	12	12	14	14	14	15	16	16	19
Loss*	Built-in Regenera- tive Resistor Power Loss [W]		-	-	_	_	8	8	8	12	12	12	36
	Total Power Loss [W]		17.0	19.0	23.9	34.5	50.5	60.9	71.2	97.6	136.2	146.2	281.6
Pogo	Built-In Regen- erative Resis- tor	Resistance $[\Omega]$	-	-	_	_	40	40	40	20	12	12	8
Rege nera- tive		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
Overvoltage Category		III											

^{*} This is the net value at the rated load.

	Model SGD7S-	470A	550A	590A	780A	
Maximum Appl	icable Motor Capacity [kW]	6.0	7.5	11	15	
Continuous Ou	tput Current [Arms]	46.9	54.7	58.6	78.0	
Instantaneous I	Maximum Output Current [Arms]	110	130	140	170	
Main	Power Supply	200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz				
Circuit	Input Current [Arms]*1	29	37	54	73	
Cantual	Power Supply	200 VAC to	240 VAC, -15	% to +10%, 5	0 Hz/60 Hz	
Control	Input Current [Arms]*1	0.3	0.3	0.4	0.4	
Power Supply (Capacity [kVA]*1	10.7	14.6	21.7	29.6	

Continued from previous page.

	Model SGD7S-	470A	550A	590A	780A	
	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 Regenerative 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	III				

^{*1.} This is the net value at the rated load.

Single-Phase, 200 VAC

	Model SGD7S	R70A	R90A	1R6A	2R8A	5R5A	120A	
Maximum Applicable Motor Capacity [kW]			0.05	0.1	0.2	0.4	0.75	1.5
Continuous Outp	out Current [Arms]		0.66	0.91	1.6	2.8	5.5	11.6
Instantaneous M	laximum Output Current	[Arms]	2.1	3.2	5.9	9.3	16.9	28
Main Circuit	Power Supply		200 V	AC to 240	VAC, -15	% to +10	%, 50 Hz/	60 Hz
Main Gircuit	Input Current [Arms]*		0.8	1.6	2.4	5.0	8.7	16
Control	Power Supply		200 V	AC to 240	VAC, -15	% to +10	%, 50 Hz/	60 Hz
Control	Input Current [Arms]*			0.2	0.2	0.2	0.2	0.25
Power Supply C	Power Supply Capacity [kVA]*			0.3	0.6	1.2	1.9	4.0
	Main Circuit Power Lo	ss [W]	5.0	7.1	12.1	23.7	39.2	71.8
	Control Circuit Power	Loss [W]	12	12	12	12	14	16
Power Loss*	Power Loss* Built-in Regenerative Re		_	-	-	-	8	12
Total Power Loss [W]			17.0	19.1	24.1	35.7	61.2	103.8
Regenerative Resistor Built-In Regenerative Resistor	Resistance $[\Omega]$	_	_	_	_	40	12	
	tive Resistor	Capacity [W]	_	_	_	_	40	60
110010101	Minimum Allowable Ex	40	40	40	40	40	12	
Overvoltage Category					I	II		

 $[\]boldsymbol{\ast}$ This is the net value at the rated load.

270 VDC

1.5						
11.6						
28.0						
270 VDC to 324 VDC, -15% to +10%						
11						
0.2*2						
3.2						
9						

^{*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.

2.1.1 Ratings

Continued from previous page.

								- 10 0.3 0 .	
Model SGD7S-			R90A	1R6A	2R8A	3R8A	5R5A	7R6A	120A
	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			*	•	II	Ī	•		-

^{*1.} This is the net value at the rated load.

^{*2.} The value is 0.25 Arms for the SGD7S-120AA0A008.

	Model SGD7S-	180A	200A	330A	470A	550A	590A	780A
Maximum Applicable Motor Capacity [kW]			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
Main Circuit	Power Supply		270 \	/DC to 32	24 VDC, -	-15% to -	+10%	
Main Circuit	Input Current [Arms]*	14	20	34	36	48	68	92
Control	Power Supply	270 VDC to 324 VDC, -15% to +10%						
Control	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 Category		III						<u> </u>

^{*} This is the net value at the rated load.

Single-Phase, 100 VAC

	Model SGD7S-	R70F	R90F	2R1F	2R8F		
Maximum App	licable Motor Capacity [kW]	0.05	0.1	0.2	0.4		
Continuous Or	utput Current [Arms]	0.66	0.91	2.1	2.8		
Instantaneous	Maximum Output Current [Arms]	2.1	3.2	6.5	9.3		
Main Circuit	Power Supply	100 VAC to	120 VAC, -15	% to +10%, 5	0 Hz/60 Hz		
Mairi Circuit	Input Current [Arms]*	1.5	2.5	5	10		
Power Supply		100 VAC to 120 VAC, -15% to +10%, 50 Hz/60 Hz					
Control	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 Resistor	Minimum Allowable Resistance $[\Omega]$	40	40	40	40		
Overvoltage C	ategory	III					

^{*} This is the net value at the rated load.

2.1.2 SERVOPACK Overload Protection Characteristics

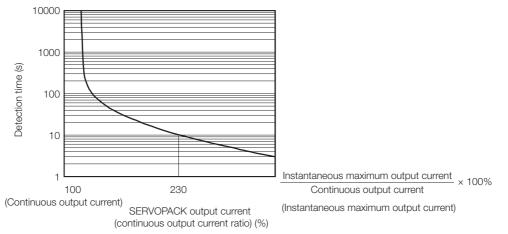
The overload detection level is set for hot start conditions with a SERVOPACK surrounding air temperature of 55°C.

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.

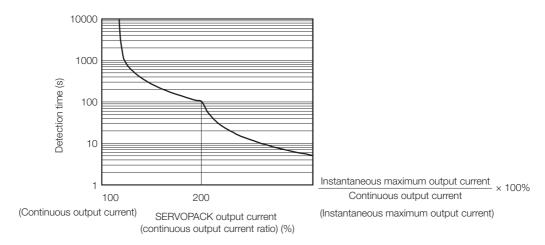
• SGD7S-R70A, -R90A, -1R6A, -2R8A, -R70F, -R90F, -2R1F, and -2R8F



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.

2.1.3 Specifications

	Item	Specification						
Control Meth	nod	IGBT-base	IGBT-based PWM control, sine wave current drive					
	With Rotary Servomotor	Serial enco	encod	s or 24 bits (incremental encoder/absolute er) s (absolute encoder)				
Feedback	With Linear Servomotor	lute linea • Incremer	 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*1	(With dera Refer to th	-5°C to 55°C (With derating, usage is possible between 55°C and 60°C.) Refer to the following section for derating specifications. 3.6 Derating Specifications on page 3-7					
	Storage Temperature	-20°C to 8	5°C					
	Surrounding Air Humidity	95% relativ	ve humidity max	x. (with no freezing or condensation)				
	Storage Humidity	95% relativ	e humidity max	x. (with no freezing or condensation)				
	Vibration Resistance	4.9 m/s^2						
	Shock Resistance	19.6 m/s ²						
	Degree of Protection	Degree		SERVOPACK Model: SGD7S-				
Environ- mental		IP20	R70A, R90A, 1R6A, 2R8A, 3R8A, 5R5A, 7R6A, 120A, R70F, R90F, 2R1F, 2R8F					
Conditions		IP10 120AA0A008, 180A, 200A, 330A, 470A, 550A, 590A, 780A						
	Pollution Degree	 Must be 	 Must 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	1,000 m or less. (With derating, usage is possible between 1,000 m and 2,000 m.) Refer to the following section for derating specifications. 3.6 Derating Specifications on page 3-7						
	Others	Do not use the SERVOPACK in the following locations: Locations subject to static electricity noise, strong electromagnetic/magnetic fields, oradioactivity						
A C	Na a alamala	Refer to the following section for details.						
Applicable Standards			liance with UL St on page xxv	andards, EU Directives, and Other Safety Stan-				
Mounting		M	ounting	SERVOPACK Model: SGD7S-				
		Base-mo	ounted	All Models				
		Rack-mo	ounted	R70A, R90A, 1R6A, 2R8A, 3R8A, 5R5A, 7R6A, 120A, 180A, 200A, 330A, R70F, R90F, 2R1F, 2R8F				
		Duct-ver	ntilated	470A, 550A, 590A, 780A				

Continued from previous page.

			Continued from previous page.				
	Item		Specification				
	Speed Con	trol Range	1:5000 (At the rated torque, the lower limit of the speed control range must not cause the Servomotor to stop.)				
			±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%)				
Perfor- mance	Fluctuation*	*2	±0.1% of rated speed max. (for a temperature fluctuation of 25°C ±25°C)				
	Torque Con sion (Repea		±1%				
	Soft Start T Setting	ime	0 s to 10 s (Can be set separately for acceleration and deceleration.)				
	Encoder Div Pulse Outpu		Phase A, phase B, phase C: Line-driver output Number of divided output pulses: Any setting is allowed.				
	Overheat Pl	rotection	Number of input points: 1 Input voltage range: 0 V to +5 V				
			Allowable voltage range: 24 VDC ±20% Number of input points: 7 (Input method: Sink inputs or source inputs)				
	Sequence Input Signals	Input Signals That Can Be Allo- cated	Input Signals • P-OT (Forward Drive Prohibit) and N-OT (Reverse Drive Prohibit) signals • /Probe1 (Probe 1 Latch Input) signal • /Probe2 (Probe 2 Latch Input) signal • /Home (Home Switch Input) signal • /P-CL (Forward External Torque Limit) and /N-CL (Reverse External Torque Limit) signals • FSTP (Forced Stop Input) signal A signal can be allocated and the positive and negative logic can be changed.				
I/O Signals		Fixed Output	Allowable voltage range: 5 VDC to 30 VDC Number of output points: 1 (A photocoupler output (isolated) is used.) Output signal: ALM (Servo Alarm) signal				
	Sequence Output Signals That Can Be Allo- cated		Allowable voltage range: 5 VDC to 30 VDC Number of output points: 3 (A photocoupler output (isolated) is used.) Output Signals • /COIN (Positioning Completion) signal • /V-CMP (Speed Coincidence Detection) signal • /TGON (Rotation Detection) signal • /S-RDY (Servo Ready) signal • /CLT (Torque Limit Detection) signal • /VLT (Speed Limit Detection) signal • /WLT (Speed Limit Detection) signal • /WARN (Warning) signal • /WARN (Warning) signal • /NEAR (Near) signal A signal can be allocated and the positive and negative logic can be changed.				

2.1.3 Specifications

Continued from previous page.

Itom			Continued from previous page.			
	Item	Intor	Specification A JUSP-JC001 Communications Unit is required to connect to a Digital			
		Inter- faces	Operator (JUSP-OP05A-1-E).			
	RS-422A Communi- cations	1:N Commu- nications	Up to N = 15 stations possible for RS-422A port			
Communi- cations	(CN502)	Axis Address Setting	Set with parameters.			
	USB Com-	Interface	Personal computer (with SigmaWin+)			
	munica- tions (CN7)	Commu- nica- tions Standard	Conforms to USB2.0 standard (12 Mbps).			
Displays/Indi	icators		CHARGE, PWR, CN, RUN, ERR, and L/A (A and B) indicators, and one-digit seven-segment display			
EtherCAT Co Switches	ommunication	ns Setting	EtherCAT secondary address (S1 and S2), 16 positions			
	Applicable (cations Star		IEC 61158 Type 12, IEC 61800-7 CiA402 Drive Profile			
	Physical Lag	yer	100BASE-TX (IEEE 802.3)			
	Communica Connectors		CN6A (RJ45): EtherCAT signal input connector CN6B (RJ45): EtherCAT signal output connector			
	Cable		Category 5, 4 shielded twisted pairs			
			* The cable is automatically detected with AUTO MDIX.			
	Sync Manager		SM0: Mailbox output, SM1: Mailbox input, SM2: Process data output and SM3: Process data input			
EtherCAT	FMMU		FMMU 0: Mapped in process data output (RxPDO) area. FMMU 1: Mapped in process data input (TxPDO) area. FMMU 2: Mapped to mailbox status.			
Communi- cations	EtherCAT Commands (Data Link Layer)		APRD, FPRD, BRD, LRD, APWR, FPWR, BWR, LWR, ARMW, and FRMW (APRW, FPRW, BRW, and LRW commands are not supported			
	Process Da	ta	Assignments can be changed with PDO mapping.			
	Mailbox (Co	E)	Emergency messages, SDO requests, SDO responses, and SDO information (TxPDO/RxPDO and remote TxPDO/RxPDO are not supported.)			
	Distributed	Clocks	Free-Run Mode and DC Mode (Can be switched.) Applicable DC cycles: 125 µs to 4 ms in 125-µs increments			
	Slave Inform Interface	nation	256 bytes (read-only)			
	Indicators		EtherCAT communications in progress: Link/Activity x 2 EtherCAT communications status: RUN x 1 EtherCAT error status: ERR x 1			
CiA402 Drive Profile			Homing Mode Profile Position Mode Interpolated Position Mode Profile Velocity Mode Profile Torque Mode Cyclic Synchronous Position Mode Cyclic Synchronous Velocity Mode Cyclic Synchronous Torque Mode Touch Probe Function Torque Limit Function			
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) Continued on next page.			

2.1.3 Specifications

Continued from previous page.

Item		Specification			
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 manual for details. Σ-7-Series AC Servo Drive Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)			
Overtravel (OT) Prevention		Stopping with dynamic brake, deceleration to a stop, or coasting to a stop for the P-OT (Forward Drive Prohibit) or N-OT (Reverse Drive Prohibit) signal			
Protective F	unctions	Overcurrent, overvoltage, low voltage, overload, regeneration error, etc.			
Utility Funct	ions	Gain adjustment, alarm history, jogging, origin search, etc.			
	Inputs	/HWBB1 and /HWBB2: Base block signals for Power Modules			
Safety	Output	EDM1: Monitors the status of built-in safety circuit (fixed output).			
Functions	Applicable Standards*3	ISO13849-1 PLe (Category 3), IEC61508 SIL3			
Applicable Option Modules		Fully-closed Modules and Safety Modules Note: You cannot use a Fully-closed Module and a Safety Module together.			

^{*1.} If you combine a Σ -7-Series SERVOPACK with a Σ -V-Series Option Module, the following Σ -V-Series SERVOPACKs specifications must be used: a surrounding air temperature of 0°C to 55°C and an altitude of 1,000 m max. Also, the applicable surrounding range cannot be increased by derating.

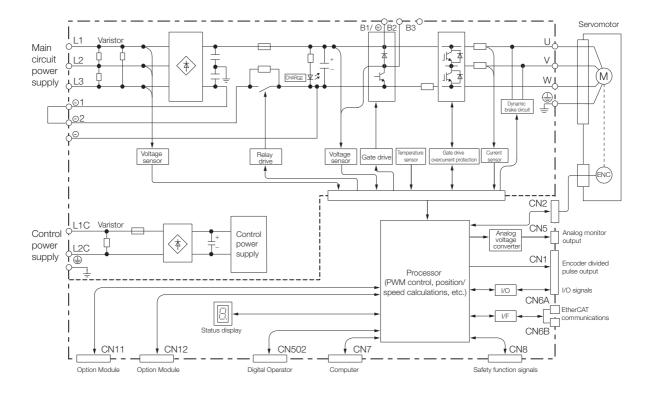
Coefficient of speed fluctuation = $\frac{\text{No-load motor speed - Total-load motor speed}}{\text{Rated motor speed}} \times 100\%$

^{*2.} The coefficient of speed fluctuation for load fluctuation is defined as follows:

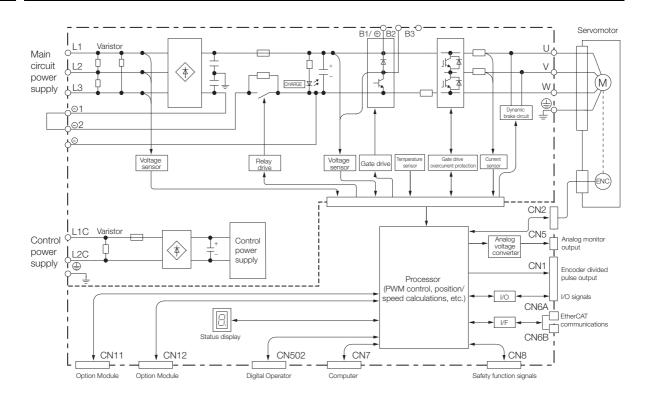
^{*3.} Always perform risk assessment for the system and confirm that the safety requirements are met.

2.2 Block Diagrams

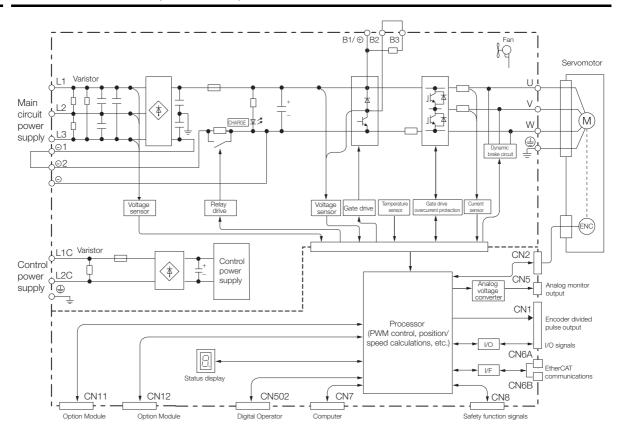
2.2.1 SGD7S-R70A, -R90A, and -1R6A



2.2.2 SGD7S-2R8A

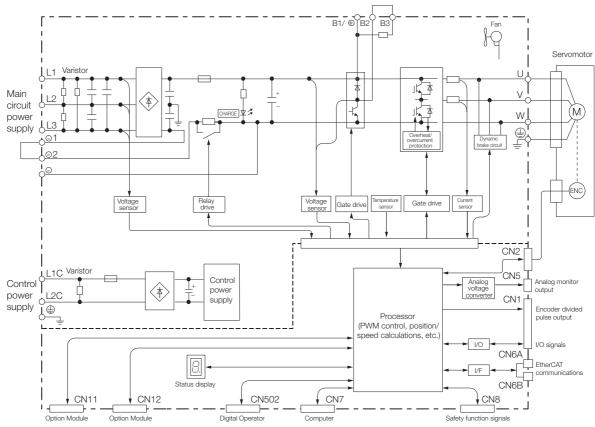


2.2.3 SGD7S-3R8A, -5R5A, and -7R6A

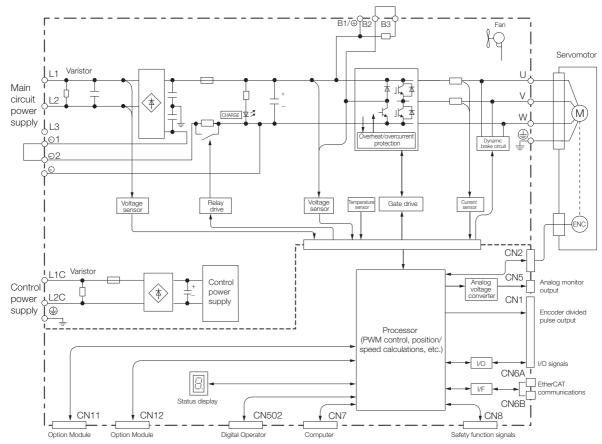


2.2.4 SGD7S-120A

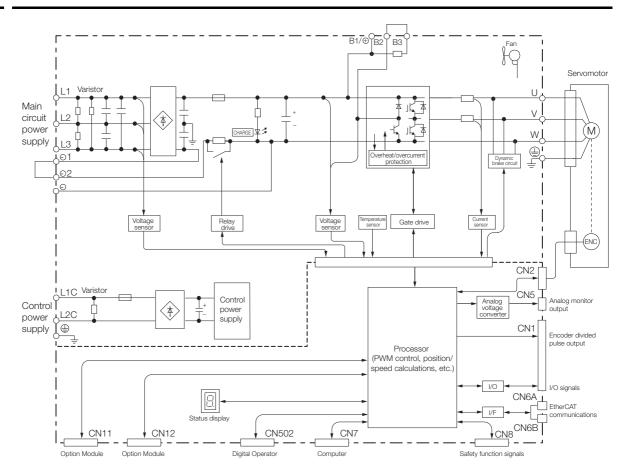
• Standard Specifications: Three-Phase, 200-VAC Power Supply Input



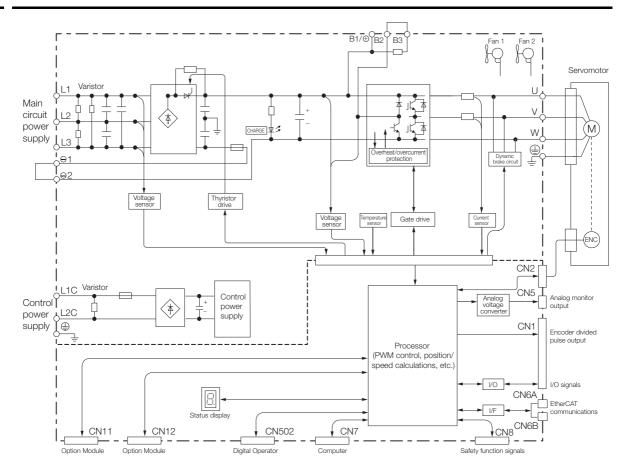
 Optional Specifications: Single-Phase, 200-VAC Power Supply Input (SERVOPACK Model: SGD7S-120AA0A008)



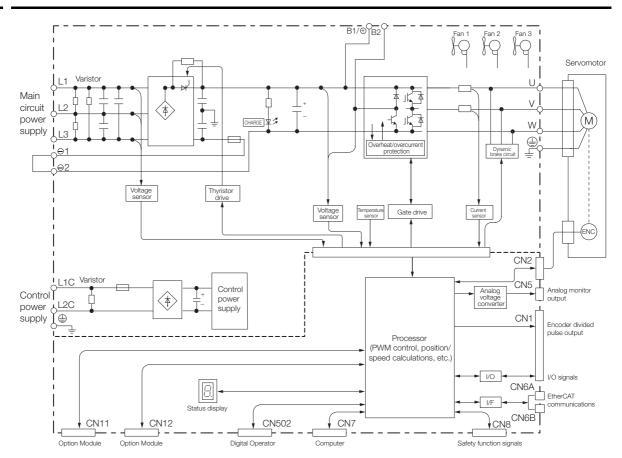
2.2.5 SGD7S-180A and -200A



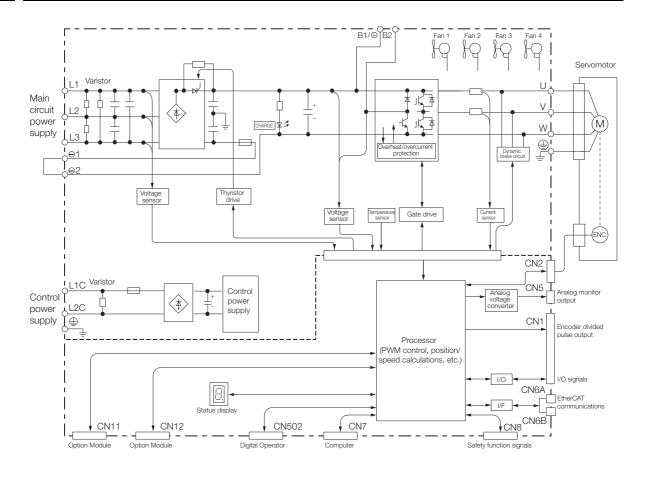
2.2.6 SGD7S-330A



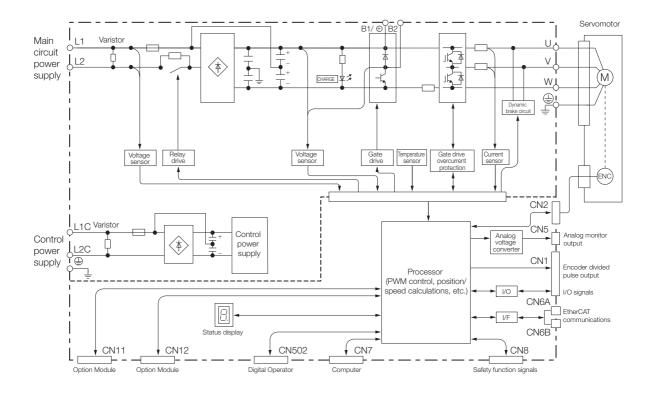
2.2.7 SGD7S-470A and -550A



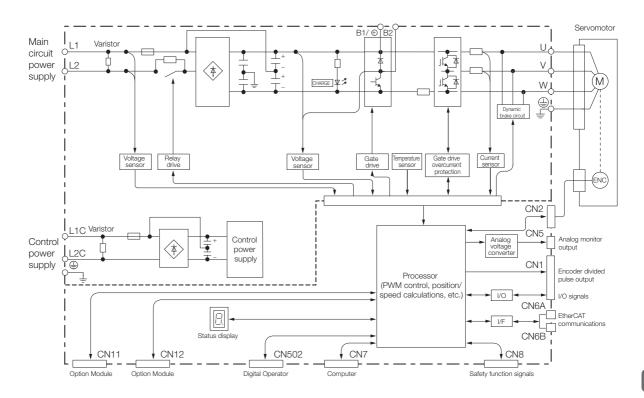
2.2.8 SGD7S-590A and -780A



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



2.2.10 SGD7S-2R8F



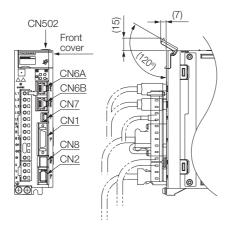
2.3

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

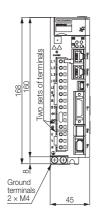
Connector No.	Model	Number of Pins	Manufacturer
CN1	10226-59A3MB	26	3M Japan Limited
CN2	3E106-0220KV	6	3M Japan Limited
CN502	S8B-ZR-SM4A- TF(LF)(SN)	8	J.S.T. Mfg. Co., Ltd.
CN6A/B	1903815-1	8	Tyco Electronics Japan G.K.
CN7	2172034-1	5	Tyco Electronics Japan G.K.
CN8	1981080-1	8	Tyco Electronics Japan G.K.

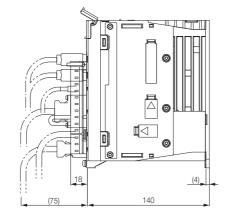
Note: The above connectors or their equivalents are used for the SERVOPACKs.

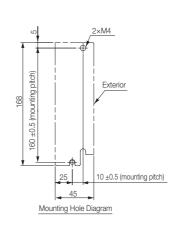
2.3.2 SERVOPACK External Dimensions

Base-mounted SERVOPACKs

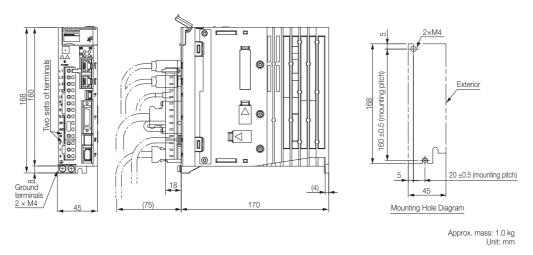
• Three-phase, 200 VAC: SGD7S-R70A, -R90A, and -1R6A



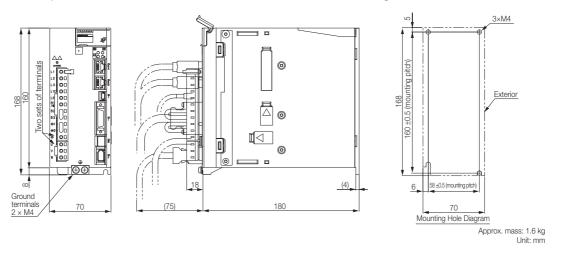




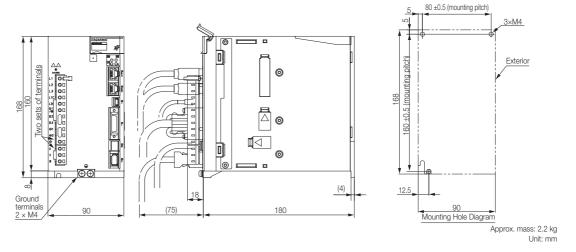
Approx. mass: 0.8 kg Unit: mm • Three-phase, 200 VAC: SGD7S-2R8A; Single-Phase, 100 VAC: SGD7S-R70F, -R90F, and -2R1F



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

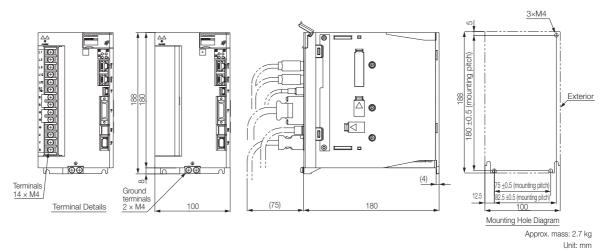


• Three-phase, 200 VAC: SGD7S-120A

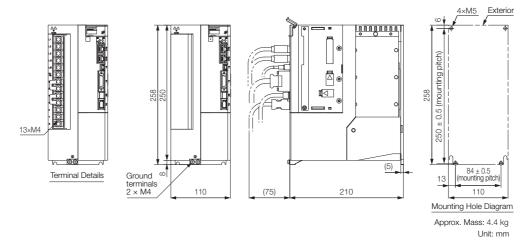


2.3.2 SERVOPACK External Dimensions

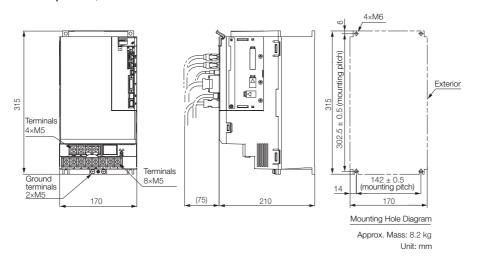
 Three-phase, 200 VAC: SGD7S-180A and -200A; Single-phase, 200 VAC: SGD7S-120AA0A008



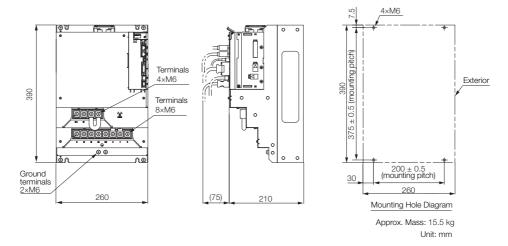
• Three-phase, 200 VAC: SGD7S-330A



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



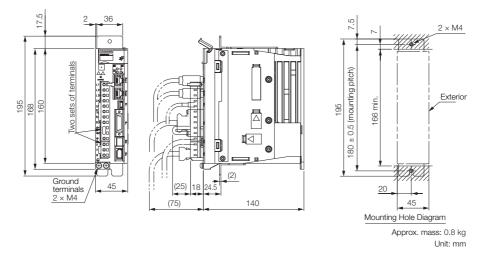
• Three-phase, 200 VAC: SGD7S-590A and -780A



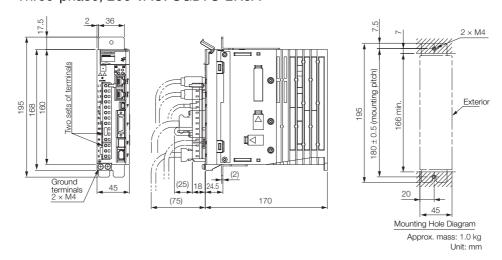
Rack-mounted SERVOPACKs

Hardware Option Code: 001

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

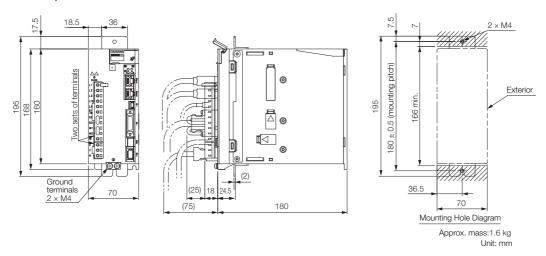


• Three-phase, 200 VAC: SGD7S-2R8A

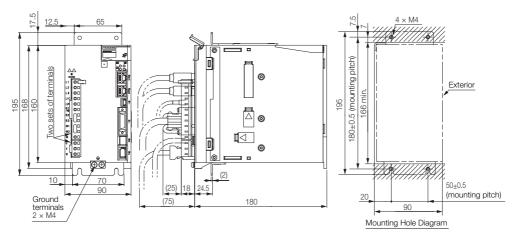


2.3.2 SERVOPACK External Dimensions

• Three-phase, 200 VAC: SGD7S-3R8A, -5R5A, and -7R6A

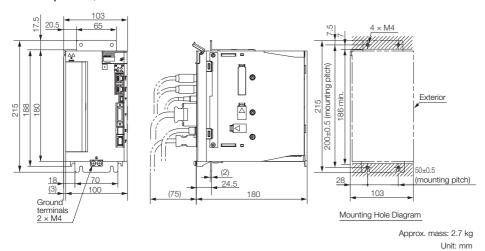


• Three-phase, 200 VAC: SGD7S-120A

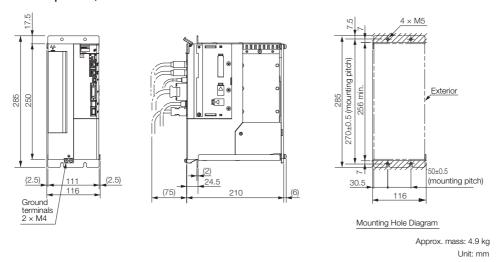


Approx. mass: 2.2 kg Unit: mm

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

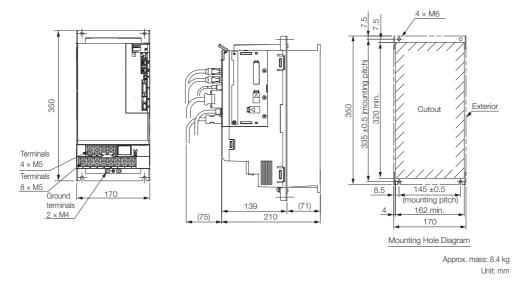


• Three-phase, 200 VAC: SGD7S-330A

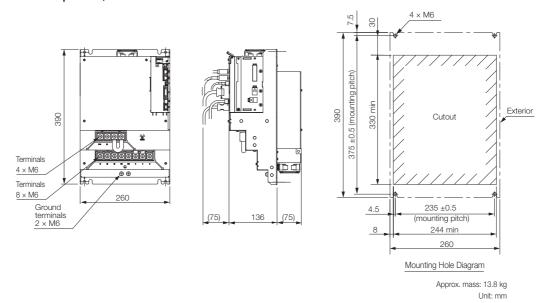


Duct-ventilated SERVOPACK

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



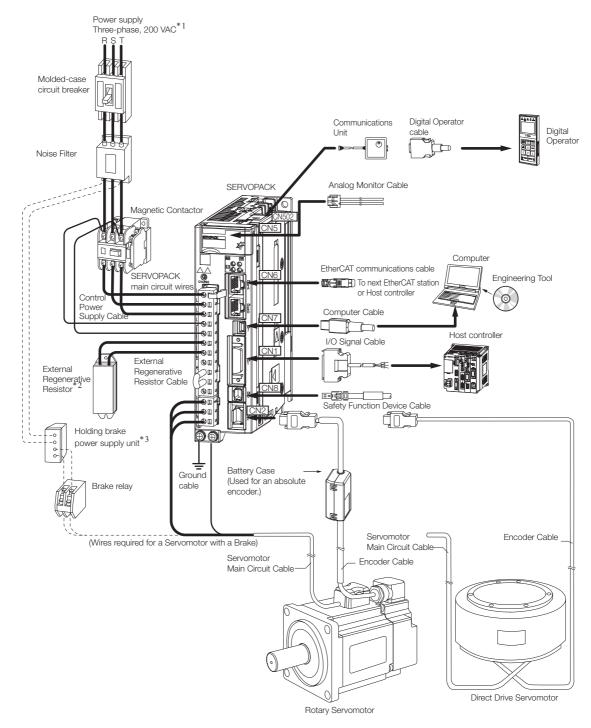
• Three-phase, 200 VAC: SGD7S-590A or -780A



2.4

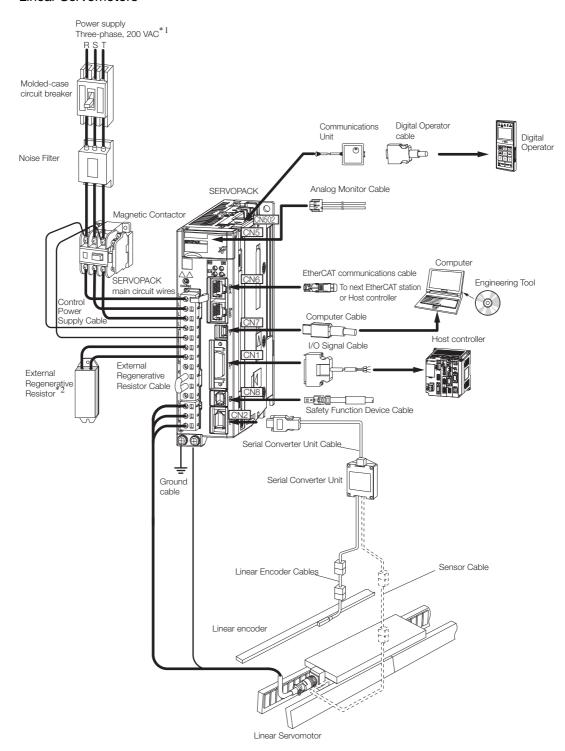
Examples of Standard Connections between SERVOPACKs and Peripheral Devices

Rotary 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.
- *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.

SERVOPACK Installation

3

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

3.1	Installation Precautions				
3.2	Mounting Types and Orientation 3-3				
3.3	Mounting Hole Dimensions3-4				
3.4	Mounting Interval3-5				
	 3.4.1 Installing One SERVOPACK in a Control Panel 3-5 3.4.2 Installing More Than One SERVOPACK in a Control Panel				
3.5	Monitoring the Installation Environment 3-6				
3.6	Derating Specifications				
3.7	EMC Installation Conditions3-8				

3.1

Installation Precautions

Refer to the following section for the ambient installation conditions. \bigcirc 2.1.3 Specifications on page 2-6

■ 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 installation surface of the SERVOPACK so that the SERVOPACK 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.

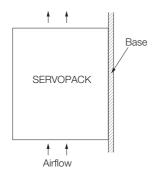
3.2 Mounting Types and Orientation

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.

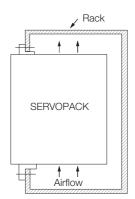
Also, mount the SERVOPACK so that the front panel is facing toward the operator.

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.)

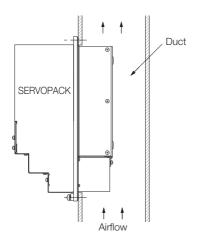
Base-mounted SERVOPACK



Rack-mounted SERVOPACK



Duct-ventilated SERVOPACK

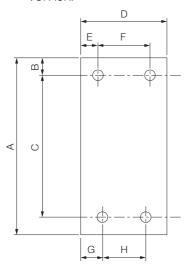


3.3

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 SER-VOPACK



◆ Σ-7-series Mounting Hole Dimensions

SERVOPACK Model		Dimensions (mm)							Screw	Number	
		Α	В	С	D	Е	F	G	Н	Size	of Screws
SGD7S-	R70A, R90A, 1R6A	168	5	160 ±0.5	45	35	-	25	-	M4	2
	2R8A, R70F, R90F, 2R1F	168	5	160 ±0.5	45	5	_	25	-	M4	2
	3R8A, 5R5A, 7R6A, 2R8F	168	5	160 ±0.5	70	6	58 ±0.5	64	_	M4	3
	120A	168	5	160 ±0.5	90	5	80 ±0.5	12.5	_	M4	3
	180A, 200A, 120A□□□008	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

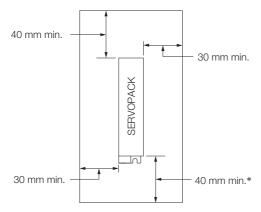
If you are replacing a Σ -V-Series SERVOPACK with a Σ -7-Series SERVOPACK, you can also use the mounting holes that were used for the Σ -V-Series SERVOPACK. Refer to the following table.

SERVOPACK Model		Dimensions (mm)							Screw	Number	
		Α	В	С	D	Е	F	G	Н	Size	of Screws
SGD7S-	R70A, R90A, 1R6A	168	5	150 ±0.5	45	35	-	35	_	M4	2
	2R8A, R70F, R90F, 2R1F	168	5	150 ±0.5	45	5	-	35	-	M4	2
	3R8A, 5R5A, 7R6A, 2R8F	168	5	150 ±0.5	70	6	58 ±0.5	6	_	M4	3
	120A	168	5	150 ±0.5	90	5	80 ±0.5	5	_	M4	3
	180A, 200A, 120A□□□008	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	A spe	ecial at	tachment is	require	ed. Co	ntact your	Yaska	wa represe	ntative fo	or details.

3.4 Mounting Interval

3.4.1 Installing One SERVOPACK in a Control Panel

Provide the following spaces around the SERVOPACK.



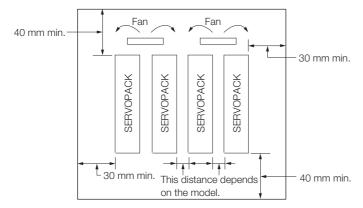
^{*} For this dimension, ignore items protruding from the main body of the SERVOPACK.

3.4.2 Installing More Than One SERVOPACK in a Control Panel

Provide the following intervals between the SERVOPACKs and spaces around the SERVO-PACKs.



Install cooling fans above the SERVOPACKs so that hot spots do not occur around the SERVOPACKs. Provide sufficient intervals and spaces as shown in the following figure to enable cooling by the fans and natural convection.



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: 1.0 m/s min.
	120A, 180A, 200A, 330A, 470A, 550A, 590A, 780A	10 mm min.	Air speed: 1.0 m/s min.

3.5

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.

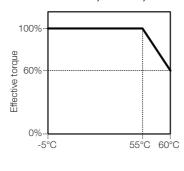


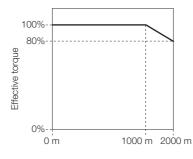
Always observe the surrounding air temperature given in the SERVOPACK environment conditions. Even if the monitor value is 100% or lower, you cannot use a SERVOPACK in a location that exceeds the specified surrounding air temperature.

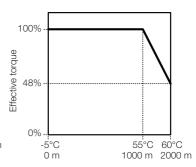
3.6 Derating Specifications

If you use the SERVOPACK at a surrounding air temperature of 55°C to 60°C or at an altitude of 1,000 m to 2,000 m, you must apply the derating rates given in the following graphs.

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





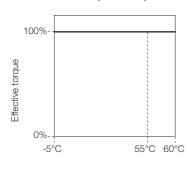


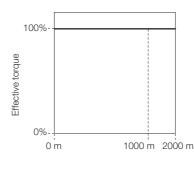
Surrounding air temperature

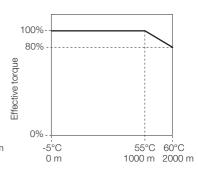
Altitude

Surrounding air temperature and altitude

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







Surrounding air temperature

Altitude

Surrounding air temperature and altitude

3.7

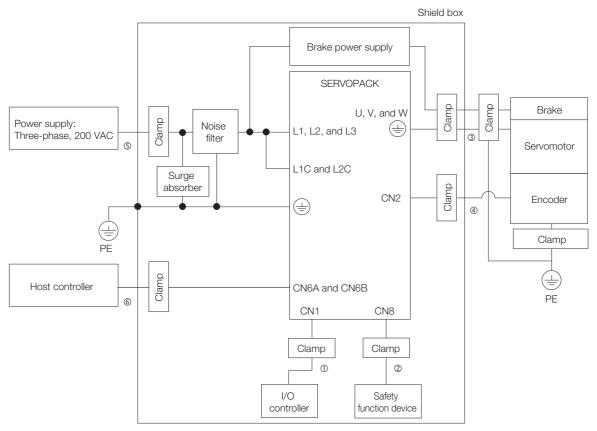
EMC Installation Conditions

This section gives the 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.

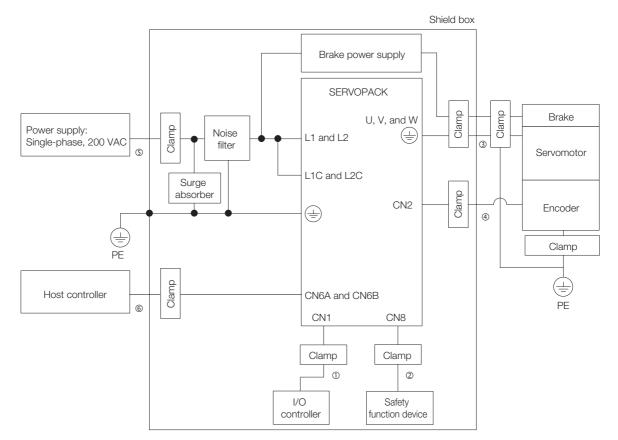
The applicable standards are EN 55011 group 1 class A, EN 61000-6-2, EN 61000-6-4, and EN 61800-3 (category C2, second environment).

• Three-Phase, 200 VAC



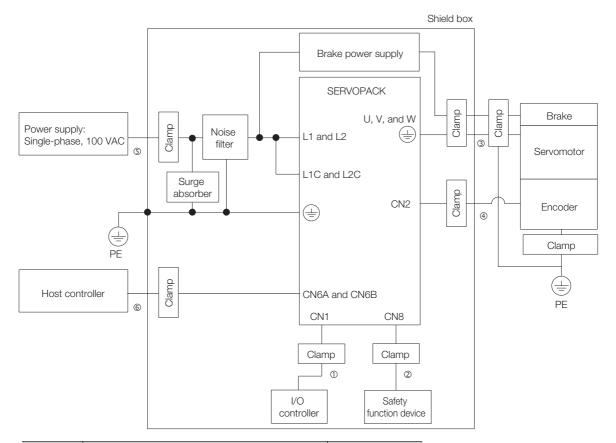
Symbol	Cable Name	Specification
1	I/O Signal Cable	Shielded cable
2	Safety Function Device Cable	Shielded cable
3	Servomotor Main Circuit Cable	Shielded cable
4	Encoder Cable	Shielded cable
(5)	Main Circuit Power Cable	Shielded cable
6	EtherCAT Communications Cable	Shielded cable

• Single-Phase, 200 VAC



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	EtherCAT Communications Cable	Shielded cable

• Single-Phase, 100 VAC



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	EtherCAT Communications Cable	Shielded cable

Wiring and Connecting SERVOPACKs

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

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4.2	Basic	Wiring Diagrams4-10
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4.4	Wiring	g Servomotors 4-27
	4.4.1 4.4.2 4.4.3 4.4.4	Terminal Symbols and Terminal Names 4-27 Pin Arrangement of Encoder Connector (CN2)
4.5	I/O Si	gnal Connections4-35
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	4.7.1 4.7.2	EtherCAT Connectors (RJ45)
4.8	Conn	ecting the Other Connectors 4-46
	4.8.1 4.8.2 4.8.3	Serial Communications Connector (CN502) 4-46 Computer Connector (CN7)

Wiring and Connecting SERVOPACKs

General Precautions 4.1.1

DANGER

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

WARNING

- 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
- 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/⊕ and ⊖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.

4.1.1 General Precautions

CAUTION

- Wait for at least six minutes after turning OFF the power supply (with a SERVOPACK for a 100-VAC power supply 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 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 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 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 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.



- 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.
 - AC Servo Drives Σ-7 Series (Catalog No.: KAEP S800001 23)
 - 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



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.

If the equipment is to be used near private houses or if radio interference is a problem, take countermeasures against noise.

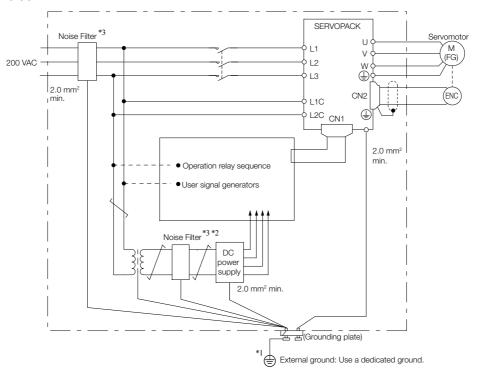
The SERVOPACK uses microprocessors. Therefore, it may be affected by switching noise from peripheral devices.

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 Host Controller 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.
 - (a) 4.1.3 Grounding on page 4-9

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.



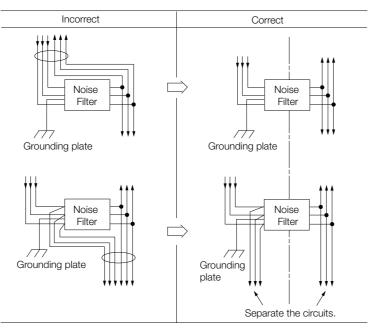
- *1. For the ground wire, use a wire with a thickness of at least 2.0 mm² (preferably, flat braided copper wire).
- *2. Whenever possible, use twisted-pair wires to wire all connections marked with
- *3. Refer to the following section for precautions when using Noise Filters.

 *3 Noise Filter Wiring and Connection Precautions on page 4-8

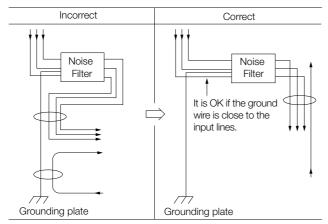
Noise Filter Wiring and Connection Precautions

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

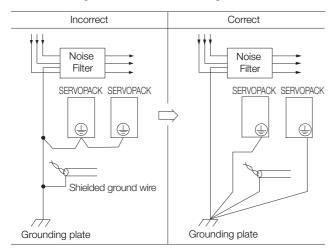
• Separate input lines from output lines. Do not place input lines and output lines in the same duct or bundle them together.



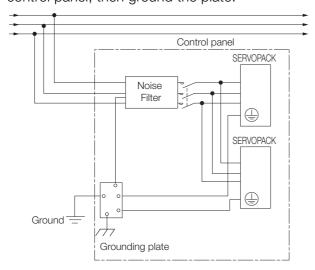
• Separate the Noise Filter ground wire from the output lines. Do not place the Noise Filter ground wire, output lines, and other signal lines in the same duct or bundle them together.



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



• 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, switching noise current 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 on the SERVOPACK. Also be sure to ground the ground terminal . Always connect the shield wire of the Encoder Cable connected to the Servomotor to the connector case (shell).

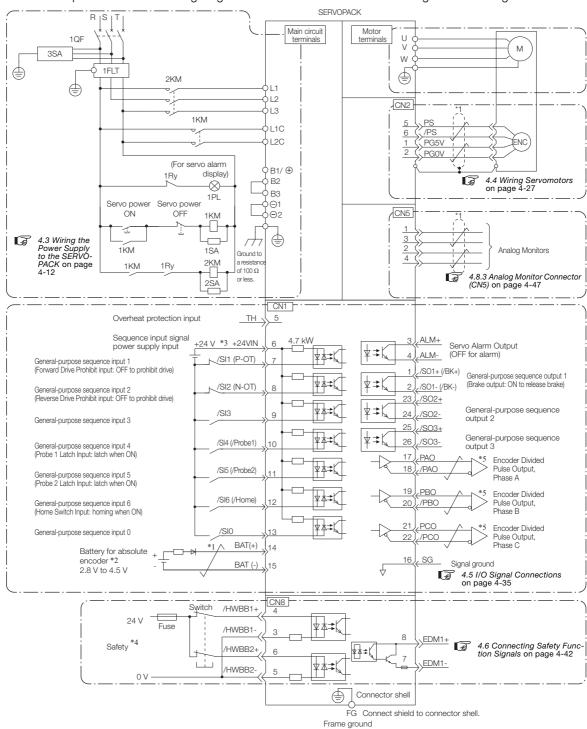
Ground both the Moving Coil and Magnetic Way of a Linear Servomotor.

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.} represents twisted-pair wires.

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.

^{*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.

Note: 1. You can use parameters to change the functions allocated to the /SI0, /SI3, P-OT, N-OT, /Probe1, /Probe2, and /Home input signals and the /SO1, /SO2, and /SO3 output signals. Refer to the following section for details.

6.1 I/O Signal Allocations on page 6-3

- 2. 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.
- 3. Default settings are given in parentheses.

4.3.1 Terminal Symbols and Terminal Names

Wiring the Power Supply to the SERVOPACK

Refer to the following manual or catalog for information on cables and peripheral devices.

- AC Servo Drives Σ-7 Series (Catalog No.: KAEP S800001 23)
- Σ-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.

CAUTION

• 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.

- Information 1. For the single-phase, 100 VAC power supply input specification, only a single-phase AC power supply can be connected to the control power supply terminals.
 - 2. For the other main circuit power supply input specifications, excluding the single-phase, 100 VAC power supply input specification, a single-phase AC power supply or a DC power supply can be connected to the control power supply terminals.

· Three-Phase, 200-VAC Power Supply Input

Terminal Symbols	Terminal Name	Specifications and Reference				
L1, L2, L3	Main circuit power supply input terminals for AC power supply input	Three-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz				
	Control power supply	AC power supply	Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz			
L1C, L2C	Control power supply terminals	DC power supply	L1C: 270 VDC to 324 VDC, -15% to +10%, L2C: 0 VDC or L2C: 270 VDC to 324 VDC, -15% to +10%, L1C: 0 VDC			
		4.3.5 Wiring Regenerative Resistors on page 4-24				
	Regenerative Resistor terminals	• For SGD7S-R70A, -R90A, -1R6A, and -2R8A 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.				
B1/⊕, B2, B3		• For SGD7S-3R8A,- 5R5A, -7R6A, -120A, -180A, -200A, and -330A 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. The External Regenerative Resistor is not included. Obtain it separately.				
		• For SGD	7S-470A, -550A, -590A, and -780A			
		Connect a Regenerative Resistor Unit between B1/⊕ and B2. Obtain a Regenerative Resistor Unit separately. These models do not have a B3 terminal.				
	DC Reactor terminals	4.3.6 V	Niring Reactors for Harmonic Suppression on page 4-26			
⊖1, ⊖2	for power supply har- monic suppression	These terminals are used to connect a DC Reactor for power supply harmonic suppression or power factor improvement.				
\ominus	_	None. (Do	not connect anything to this terminal.)			

• Single-Phase, 200-VAC Power Supply Input

Terminal Symbols	Terminal Name	Specifications and Reference			
L1, L2	Main circuit power supply input termi- nals for AC power supply input	Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz			
	Control nower supply	AC power supply	Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz		
L1C, L2C	Control power supply terminals	DC power supply	L1C: 270 VDC to 324 VDC, -15% to +10%, L2C: 0 VDC or L2C: 270 VDC to 324 VDC, -15% to +10%, L1C: 0 VDC		
	Regenerative Resistor terminals	€ 4.3.5 W	4.3.5 Wiring Regenerative Resistors on page 4-24		
R1/⋒ R2 R2		■ For SGD7S-R70A, -R90A, -1R6A, and -2R8A 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.			
B1/⊕, B2, B3		If the inter short bar Resistor b	S-5R5A, and -120A□0A008 rnal regenerative resistor is insufficient, remove the lead or between B2 and B3 and connect an External Regenerative between B1/⊕ and B2. nal Regenerative Resistor is not included. Obtain it sepa-		
	DC Reactor terminals	€ 4.3.6 W	firing Reactors for Harmonic Suppression on page 4-26		
⊖1, ⊖2	for power supply harmonic suppression	These terminals are used to connect a DC Reactor for power supply harmonic suppression or power factor improvement.			
L3, ⊖	_	None. (Do r	not connect anything to these terminals.)		

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. \$\sim\$1 \subseteq\$ (Use a three-phase power supply input as a single-phase power supply input). Refer to the following section for details.

5.2.2 Single-phase AC Power Supply Input/Three-phase AC Power Supply Input Setting on page 5-13

Information

You do not need to change the setting of Pn00B to n.□1□□ (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 numbers: SGD7S-120A□□□008).

• DC Power Supply Input

Terminal Symbols	Terminal Name	Specifications and Reference	
L1C, L2C	Control power supply terminals	AC power supply	Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz
		DC power supply	L1C: 270 VDC to 324 VDC, -15% to +10%, L2C: 0 VDC or 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 terminals for DC power supply input	0 VDC	
L1, L2, L3, B2, B3, ⊖1, ⊖	_	None. (Do not connect anything to these terminals.)	

If you use a DC power supply input to the SERVOPACK, make sure to set parameter Pn001 to $n.\Box 1\Box\Box$ (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 5-12

4.3.1 Terminal Symbols and Terminal Names

• Single-Phase, 100-VAC Power Supply Input

Terminal Symbols	Terminal Name	Specifications and Reference
L1 and L2	Main circuit power supply input terminals for AC power supply input	Single-phase, 100 VAC to 120 VAC, -15% to +10%, 50 Hz/60 Hz
L1C and L2C	Control power supply terminals	Single-phase, 100 VAC to 120 VAC, -15% to +10%, 50 Hz/60 Hz
		4.3.5 Wiring Regenerative Resistors on page 4-24
B1 and B2	Regenerative Resistor terminals	If the regenerative capacity is insufficient, connect an External Regenerative Resistor between B1/⊕ and B2. Obtain an External Regenerative Resistor separately.

You can use a single-phase, 100-VAC power supply input with the following models.

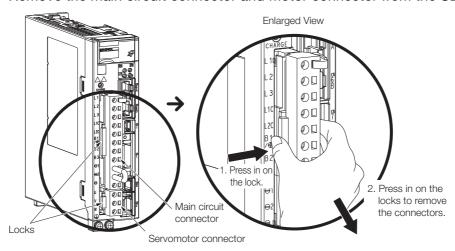
• SGD7S-R70F, -R90F, -2R1F, -2R8F

4.3.2 Wiring Procedure for Main Circuit Connector

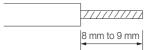
· Required Items

Required Item	Remarks
Spring Opener or Flat- blade Screwdriver	 Spring Opener SERVOPACK accessory (You can also use model 1981045-1 from Tyco Electronics Japan G.K.)
biade Sciewdiivei	 Flat-blade screwdriver 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.

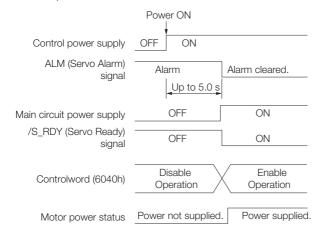
①Using a Spring Opener	©Using a Flat-blade Screwdriver
Open the insertion hole with the Spring Opener as shown in the figure.	Firmly insert a flat-blade screwdriver into the screwdriver insertion hole to open the wire insertion hole.
Spring Opener Wire	

- 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

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).

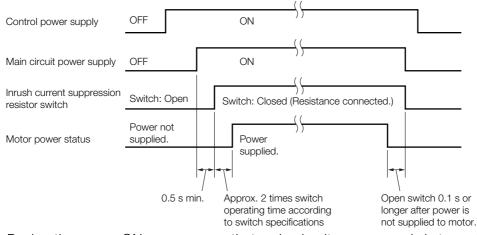


Information

If the servo ON state cannot be achieved by inputting the Servo ON command (Enable Operation command), the /S_RDY signal is not ON. Check the status of the /S_RDY signal. Refer to the following section for details.

6.1.6 /S-RDY (Servo Ready) Signal on page 6-7

• 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.



Turn ON the control power supply before the main circuit power supply or turn ON the control power supply and the main circuit power supply at the same time.

Turn OFF the main circuit power supply first, and then turn OFF the control power supply.

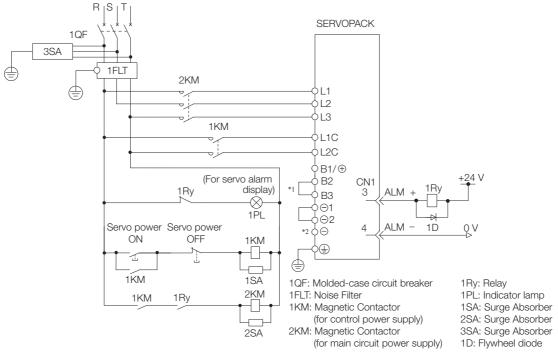
MARNING

• 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.

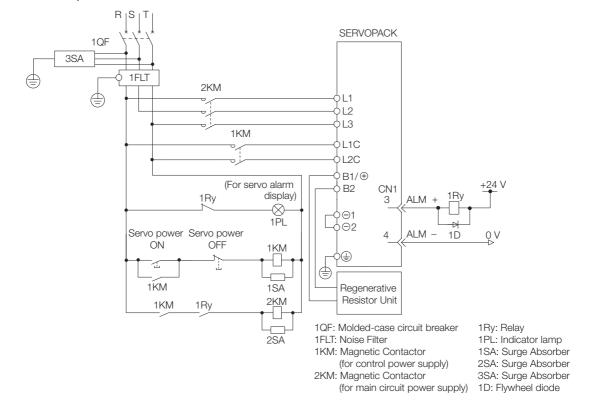
4.3.4 Power Supply Wiring Diagrams

Using Only One SERVOPACK

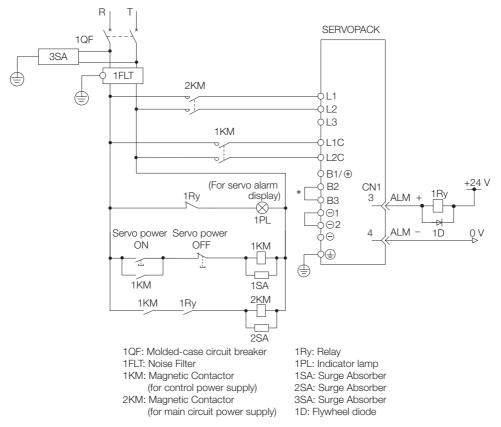
Wiring Example for Three-Phase, 200-VAC Power Supply Input: SGD7S-R70A, -R90A, -1R6A, -2R8A, -3R8A, -5R5A, -7R6A, -120A, -180A, -200A, and -330A



- *1. 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



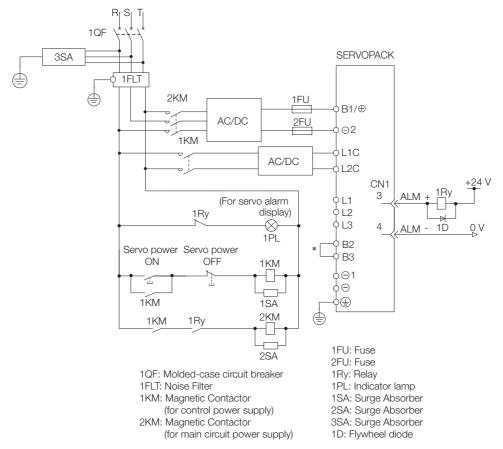
• Wiring Example for Single-Phase, 200-VAC Power Supply Input



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

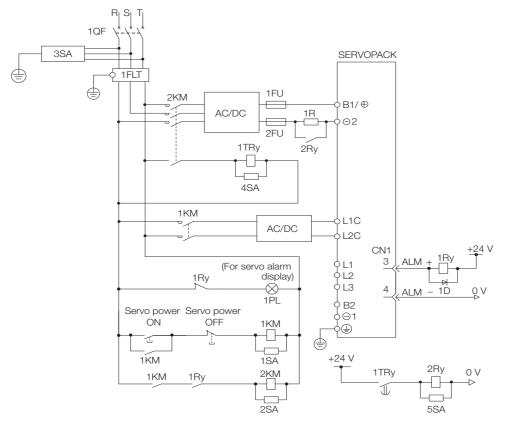
4.3.4 Power Supply Wiring Diagrams

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



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

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



1QF: Molded-case circuit breaker

1FLT: Noise Filter

1KM: Magnetic Contactor (for control power supply)

2KM: Magnetic Contactor (for main circuit power supply,

auxiliary contact) 1FU: Fuse, positive side

2FU: Fuse, negative side

1Ry: Relay

2Ry: Relay (for inrush current suppression resistor switch)

1TRy: Timer relay 1PL: Indicator lamp 1SA: Surge Absorber

2SA: Surge Absorber

3SA: Surge Absorber

4SA: Surge Absorber

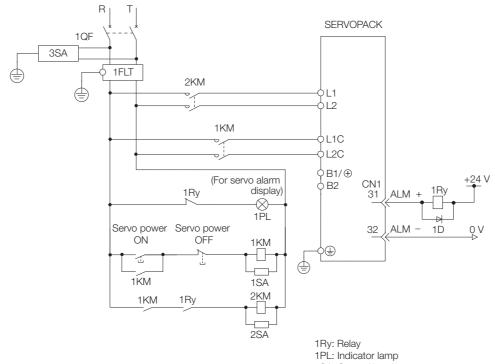
5SA: Surge Absorber

1D: Flywheel diode

1R: External inrush current suppression resistor

4.3.4 Power Supply Wiring Diagrams

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



1QF: Molded-case circuit breaker

1FLT: Noise Filter

1KM: Magnetic Contactor (for control power supply)

2KM: Magnetic Contactor (for main circuit power supply)

1SA: Surge Absorber 2SA: Surge Absorber

3SA: Surge Absorber

1D: Flywheel diode

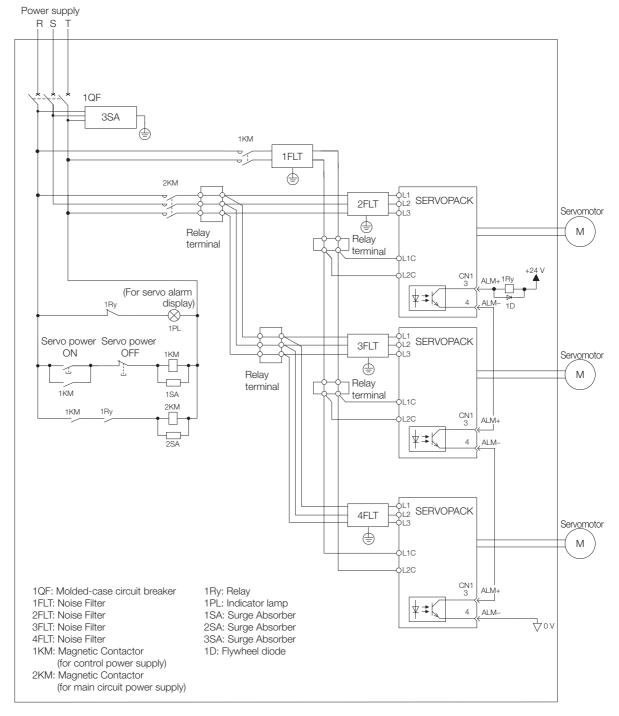
Using More Than One SERVOPACK

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.



Note: Refer to the following document for details on international standards.

 \square Σ -7-Series Σ -7S and Σ -7W SERVOPACK Safety Precautions (TOMP C710828 00)

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.

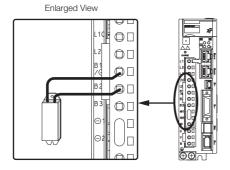
 \square Σ -7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)

MARNING

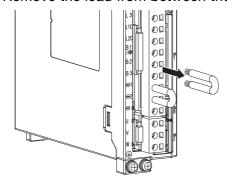
Be sure to wire Regenerative Resistors correctly. Do not connect B1/⊕ and B2.
 Doing so may result in fire or damage to the Regenerative Resistor or SERVOPACK.

Connecting Regenerative Resistors

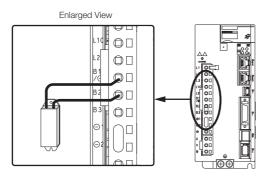
- ◆ SERVOPACK Models SGD7S-R70A, -R90A, -1R6A, -2R8A, -R70F, -R90F, -2R1F, and -2R8F
- 1. Connect the External Regenerative Resistor between the B1/⊕ and B2 terminals on the SERVOPACK.



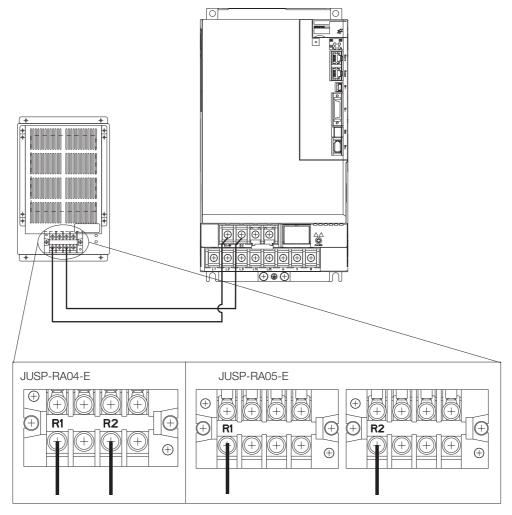
- 2. Set Pn600 (Regenerative Resistor Capacity) and Pn603 (Regenerative Resistance). Refer to the following section for details on the settings.
 5.17 Setting the Regenerative Resistor Capacity on page 5-57
- ◆ SERVOPACK Models SGD7S-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, and -330A
- 1. Remove the lead from between the B2 and B3 terminals on the SERVOPACK.



2. Connect the External Regenerative Resistor between the B1/⊕ and B2 terminals.



- Set Pn600 (Regenerative Resistor Capacity) and Pn603 (Regenerative Resistance).
 Refer to the following section for details on the settings.
 5.17 Setting the Regenerative Resistor Capacity on page 5-57
- ◆ 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 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.

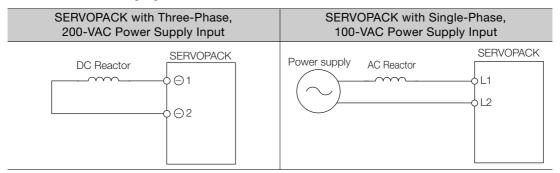
5.17 Setting the Regenerative Resistor Capacity on page 5-57

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 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 Symbols	Terminal/Connector Name	Remarks
U, V, and W	Servomotor terminals	Refer to the following section for the wiring procedure. 4.3.2 Wiring Procedure for Main Circuit Connector on page 4-15
	Ground terminal	-
CN2	Encoder connector	_

4.4.2 Pin Arrangement of Encoder Connector (CN2)

· When Using a Rotary Servomotor

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	_

 $[\]boldsymbol{*}$ 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

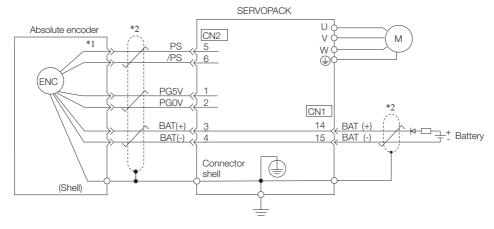
When Using an Absolute Encoder

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.

15.1.3 Replacing the Battery on page 15-3

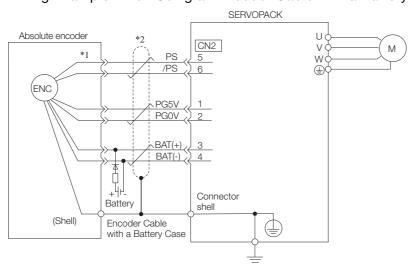
· Wiring Example When Installing a Battery on the Host Controller



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

*2. represents a shielded twisted-pair cable.

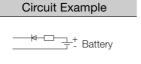
· Wiring Example When Using an Encoder Cable with a Battery Case



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



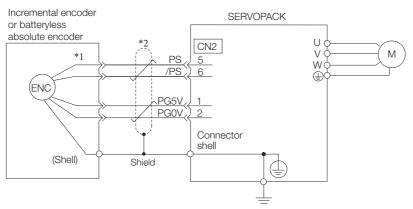
- When Installing a Battery on the Encoder Cable
 Use the Encoder Cable with a Battery Case that is specified by Yaskawa.
 Refer to the following manual for details.
 - Σ-7-Series AC Servo Drive Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)
- When Installing a Battery on the Host Controller Insert a diode near the battery to prevent reverse current flow.



Required Component Specifications

- Schottky Diode Reverse Voltage: Vr ≥ 40 V Forward Voltage: Vf ≤ 0.37 V Reverse current: Ir ≤ 5 µA Junction temperature: Tj ≥ 125°C
- Resistor Resistance: 22 Ω Tolerance: $\pm 5\%$ max. Rated power: 0.25 W min.

When Using an Incremental Encoder or Batteryless Absolute Encoder

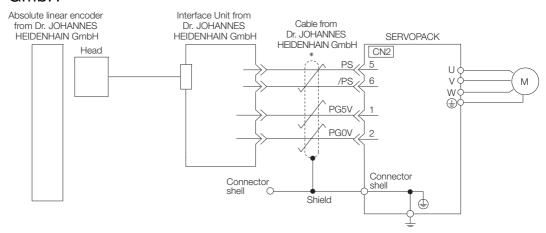


- *1. The encoder pin numbers for wiring the connector depend on the Servomotor that you use.
- *2. represents a shielded twisted-pair cable.

When Using an Absolute Linear Encoder

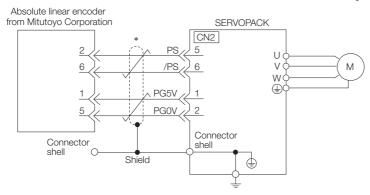
The wiring depends on the manufacturer of the linear encoder.

Connections to Linear Encoder from Dr. JOHANNES HEIDENHAIN GmbH

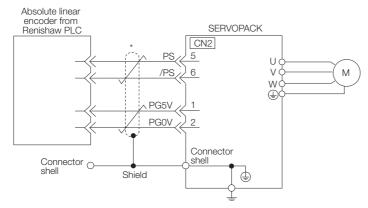


4.4.3 Wiring the SERVOPACK to the Encoder

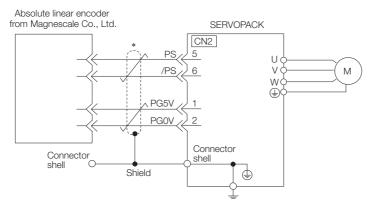
◆ Connections to Linear Encoder from Mitutoyo Corporation



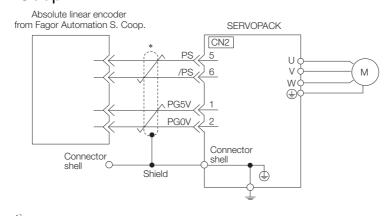
- * represents a shielded twisted-pair cable.
- ◆ Connections to Absolute Linear Encoder from Renishaw PLC



- * represents a shielded twisted-pair cable.
- ◆ Connections to Absolute Linear Encoder from Magnescale Co., Ltd.



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

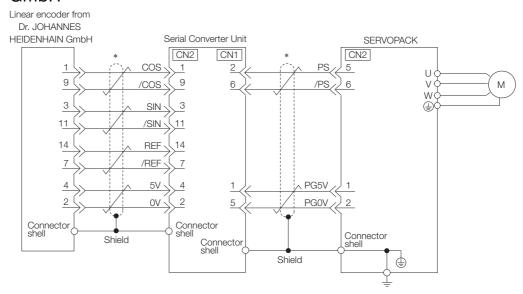


* represents a shielded twisted-pair cable.

When Using an Incremental Linear Encoder

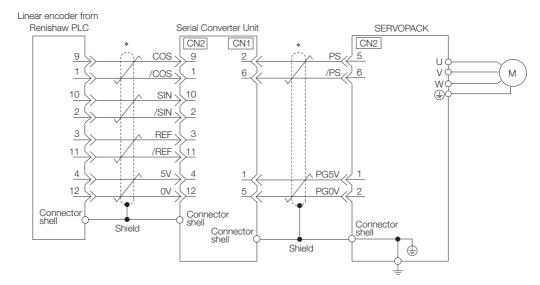
The wiring depends on the manufacturer of the linear encoder.

Connections to Linear Encoder from Dr. JOHANNES HEIDENHAIN GmbH



4.4.3 Wiring the SERVOPACK to the Encoder

◆ Connections to Linear Encoder from Renishaw PLC

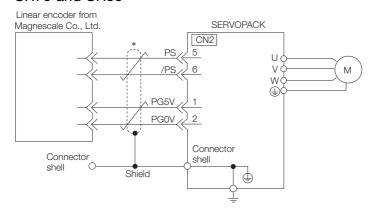


* represents a shielded twisted-pair cable.

◆ 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

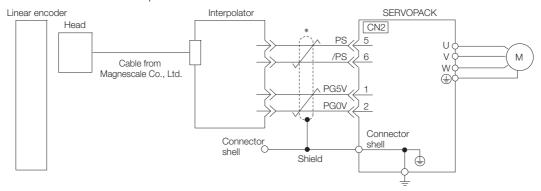


■ SL700, SL710, SL720, SL730, and SQ10

• 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
3010	MQ10-GLA*2

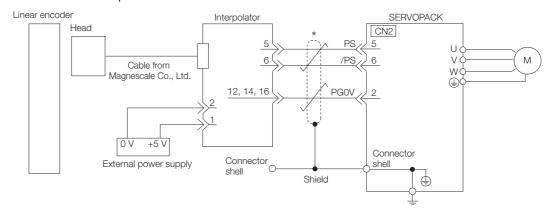
- *1. This is the model of the Head with Interpolator.
- *2. This is the model of the Interpolator.



* represents a shielded twisted-pair cable.

■ SL700, SL710, SL720, and SL730

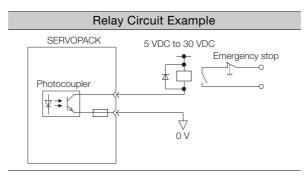
• MJ620-T13 Interpolator



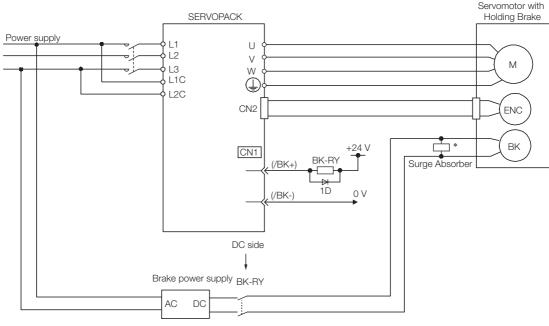
4.4.4 Wiring the SERVOPACK to the Holding Brake



- 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.



- You can change the output signal allocation of the /BK signal. Refer to the following section for details.
 - Allocating the /BK (Brake) Signal on page 5-35
- 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 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 the I/O signal pins for the default settings.

Input Signals

Default settings are given in parentheses.

Signal	Pin No.	Name	Function	Reference
/SI1* (P-OT)	7	General-purpose Sequence Input 1 (Forward Drive Prohibit Input)	You can allocate the input signal to use with a parameter. (Stops Servomotor drive (to prevent over-	
/SI2* (N-OT)	8	General-purpose Sequence Input 2 (Reverse Drive Prohibit Input)	travel) when the moving part of the machine exceeds the range of movement.)	page 5-27
/SI3*	9	General-purpose Sequence Input 3	You can allocate the input signal to use with parameters. (Used for general-purpose input.)	_
/SI4* (/Probe1)	10	General-purpose Sequence Input 4 (Probe 1 Latch Input)	You can allocate the input signals to use with parameters.	
/SI5* (/Probe2)	11	General-purpose Sequence Input 5 (Probe 2 Latch Input)	(Connect the external signals that latch the current feedback pulse counter.)	_
/SI6* (/Home)	12	General-purpose Sequence Input 6 (Home Switch Input)	You can allocate the input signal to use with parameters. (Connect the switch that starts homing.)	
/SI0*	13	General-purpose Sequence Input 0	You can allocate the input signal to use with a parameter. (Used for general-purpose input.)	_
+24VIN	6	Sequence Input Signal Power Supply Input	Inputs the sequence input signal power supply. Allowable voltage range: 24 VDC ±20% The 24-VDC power supply is not provided by Yaskawa.	_
BAT+	14	Battery for Absolute Encoder (+)	These are the pins to connect the absolute encoder backup battery.	
BAT-	15	Battery for Absolute Encoder (-)	Do not connect these pins if you use the Encoder Cable with a Battery Case.	_
тн	5	Overheat Protection Input	Inputs the overheat protection signal from a Linear Servomotor or from a sensor attached to the machine.	page 6-56

^{*} You can change the allocations. Refer to the following section for details.
3 6.1.1 Input Signal Allocations on page 6-3

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.

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

Output Signals

Default settings are given in parentheses.

Signal	Pin No.	Name	Function	Reference	
ALM+	3	Servo Alarm Output	Turns OFF (opens) when an error is detected.	page 6-6	
ALM-	4	Servo Alarm Output	Turns Or 1 (opens) when all error is detected.	page 6-6	
/SO1+* (/BK+)	1	General-purpose Sequence Output 1	You can allocate the output signal to use with a parameter.	5.00	
/SO1-* (/BK-)	2	(Brake Output)	(Controls the brake. The brake is released when the signal turns ON (closes).)	page 5-33	
/SO2+*	23	General-purpose			
/SO2-*	24	Sequence Output 2	Used for general-purpose outputs.	page 14-47	
/SO3+*	25	General-purpose	Set the parameters to allocate functions.		
/SO3-*	26	Sequence Output 3			
PAO	17	Encoder Divided Pulse		page 6-30 page 6-39	
/PAO	18	Output, Phase A	Output the encoder divided pulse output sig-		
PBO	19	Encoder Divided Pulse	nals with a 90° phase differential.		
/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.	_	

^{*} You can change the allocations. Refer to the following section for details.

^{6.1.2} Output Signal Allocations on page 6-4

4.5.2 I/O Signal Connector (CN1) Pin Arrangement

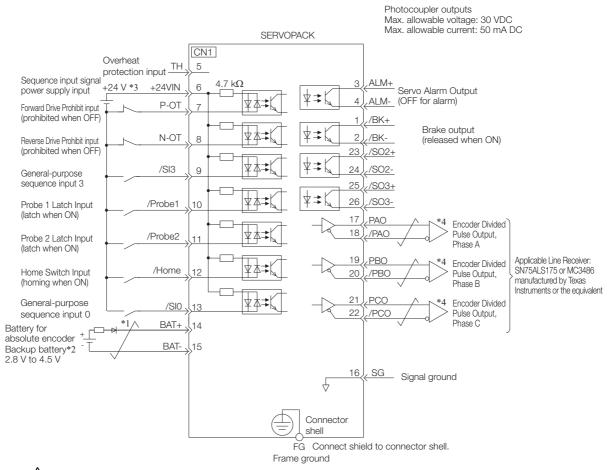
The following figure gives the pin arrangement of the of the I/O signal connector (CN1) for the default settings.

	2	/SO1-	General- purpose	1	/SO1+ (/BK+)	General- purpose Sequence Output 1	15	BAT-	Battery for Absolute	14	BAT+	Battery for Absolute Encoder (+)	
		(/BK-)	Sequence Output 1			Servo		5, 11	Encoder (-)			Signal	
Pin 1			Servo	3	ALM+	Alarm Out- put			Encoder Divided	16	SG	Ground	
Pin 2 Pin 14	4	ALM-	Alarm Output	5	TH	Overheat Protection	17	PAO	Pulse Output, Phase A	18	/PAO	Encoder Divided Pulse Out-	
Pin 12 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			Sequence Input Sig-			Input			Encoder Divided			put, Phase A	
Pin 12 Pin 25	6	+24VIN	nal Power Supply Input	7	/SI1 (P-OT)	General- purpose Sequence	19	PBO	Pulse Out- put, Phase B	20	/PBO	Encoder Divided Pulse Out-	
The above view is from the direction		/010	General-	(1 01)	Input 1			Encoder Divided			put, Phase B		
of the following arrow without the connector shell	8	/SI2 (N-OT)	purpose Sequence Input 2	9	/SI3 (/DEC)	General- purpose Sequence	21	PCO	Pulse Output, Phase C	22	/PCO	Encoder Divided Pulse Out-	
attached.	10	/SI4	General- purpose		(/ 020)	Input 3	'	23	/SO2+	General- purpose			put, Phase C
	10	(/Probe1)	Sequence Input 4	/SI5	General- /SI5 purpose	23 /30	/502+	Sequence Output 2	24	/SO2-	General- purpose		
	10	/SI6	General- purpose	11	(/Probe2)	Sequence Input 5	0.5	1000	General- purpose	24	7502	Sequence Output 2	
	12	(/Home)	Sequence Input 6	13	/SIO	General- purpose Sequence Input 0	25	/SO3+	Sequence Output 3	26	/SO3-	General- purpose Sequence Output 3	

4.5.3

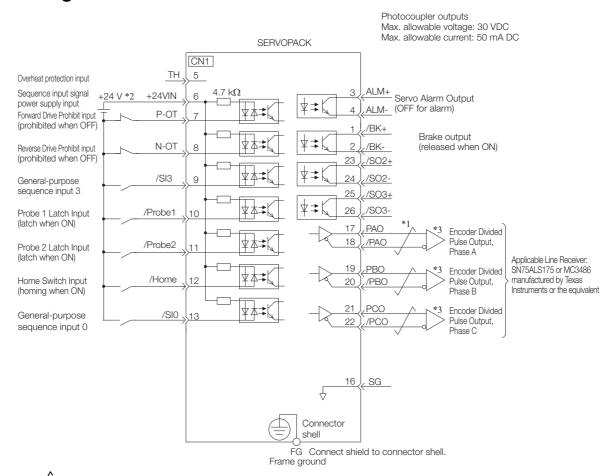
I/O Signal Wiring Examples

Using a Rotary Servomotor



- *1. 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: 1. You can use parameters to change the functions allocated to the /SI0, /SI3, P-OT, N-OT, /Probe1, /Probe2, and /Home input signals and the /SO1, /SO2, and /SO3 output signals.
 - 6.1 I/O Signal Allocations on page 6-3
 - 2. 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.

Using a Linear Servomotor



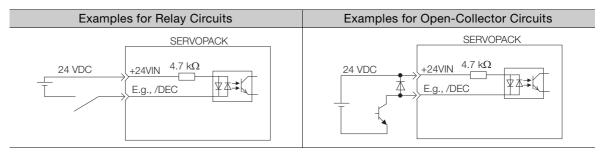
- 1. represents twisted-pair wires.
- *2. The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.
- *3. Always use line receivers to receive the output signals.
- Note: 1. You can use parameters to change the functions allocated to the /SI0, /SI3, P-OT, N-OT, /Probe1, /Probe2, and /Home input signals and the /SO1, /SO2, and /SO3 output signals.
 - 6.1 I/O Signal Allocations on page 6-3
 - 2. 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

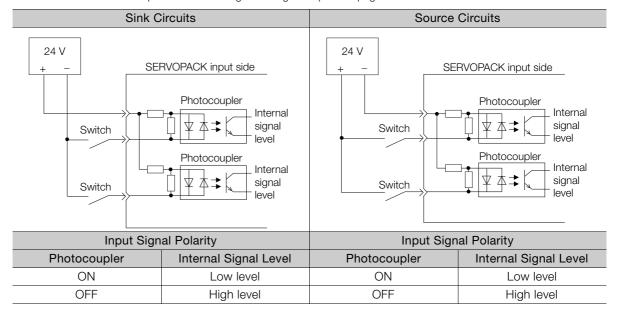
This section describes CN1 connector terminals 6 to 13.



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 4-38 are for sink circuit connections.



Sequence Output Circuits

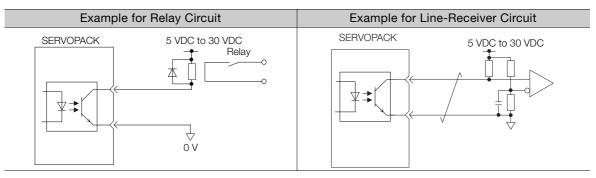


Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures.

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 a photocoupler output circuit to a relay or line-receiver circuit.



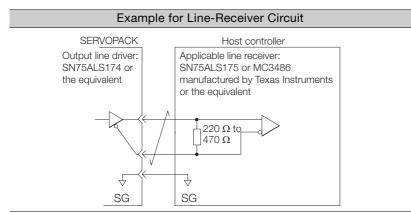
Note: The maximum allowable voltage and current range for photocoupler output circuits are as follows:

- 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) and origin pulse signal (PCO and /PCO) 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 those pine because they c	se pins because they are connected to internal circuits.)				
2	_	- (Do not use these pins because they a	are connected to internal circuits.)				
3	/HWBB1-	Hard Wire Base Block Input 1	For a hard wire base block input. The base block (motor power turned OFF) is in effect when the signal is OFF.				
4	/HWBB1+	naid wife base block lilput i					
5	/HWBB2-	Hard Wire Base Block Input 2					
6	/HWBB2+	Traid Wife base block input 2					
7	EDM1-	- External Device Monitor Output	Turns ON when the /HWBB1 and the / HWBB2 signals are input and the SER-				
8	EDM1+	External Device Monitor Output	VOPACK enters a base block state.				

4.6.2 I/O Circuits



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.

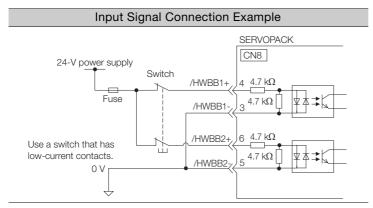
To avoid confusion, the ON and OFF status of signals for the safety function are defined as follows:

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.



◆ Input (HWBB) Signal Specifications

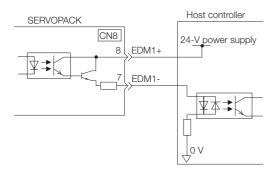
Туре	Signal	Connector Pin No.	Status	Meaning
	/HWBB1 CN8-4 CN8-3	ON (closed)	Does not activate the HWBB (normal operation).	
Inputs			OFF (open)	Activates the HWBB (motor current shut-OFF request).
	/HWBB2	CN8-6 CN8-5	ON (closed)	Does not activate the HWBB (normal operation).
			OFF (open)	Activates 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 Sta- tus	Meaning
Output	EDM1	CN8-8 CN8-7	ON	Both the /HWBB1 and /HWBB2 signals are operating normally.
			OFF	The /HWBB1 signal, the /HWBB2 signal, or both are not operating.

The electrical characteristics of the EDM1 signal are as follows:

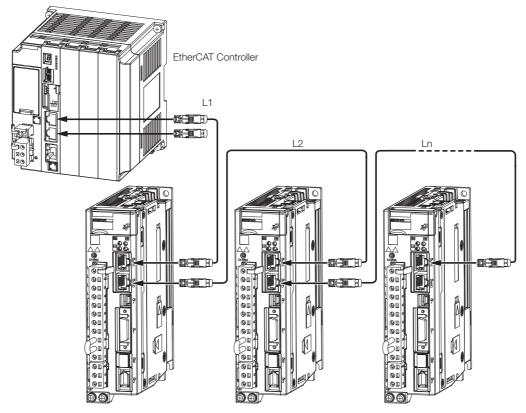
Item	Character- istics	Remarks
Maximum Allow- able Voltage	30 VDC	_
Maximum Allow- able Current	50 mA DC	_
Maximum ON Voltage Drop	1.0 V	Voltage between EDM1+ and EDM1- when current is 50 mA
Maximum Delay Time	8 ms	Time from a change in /HWBB1 or /HWBB2 until a change in EDM1

4.7.1 EtherCAT Connectors (RJ45)

4.7

Connecting EtherCAT Communications Cables

Connect the EtherCAT Communications Cables to the CN6A and CN6B connectors.



Note: The length of the cable between stations (L1, L2, ... Ln) must be 50 m or less.

4.7.1 EtherCAT Connectors (RJ45)

Connector	Description	
CN6A	EtherCAT input signals	
CN6B	EtherCAT output signals	

■ Connector Pin Assignments

Pin	Signal	Remarks
1	TD+	Send data
2	TD-	Seria data
3	RD+	Receive data
4	-	N.C.*
5	-	N.C.*
6	RD-	Receive data
7	-	N.C.*
8	_	N.C.*

^{*} These pins are not connected to any signals.

4.7.2 Ethernet Communications Cables

Use Category 5e Ethernet communications cables to make the connections.

Use cables with the following specifications.

Shielded: S/STP or S/UTP

Length: 50 m max. (between nodes) The following cable is recommended.

Manufacturer	Model
Beckhoff	ZB9020

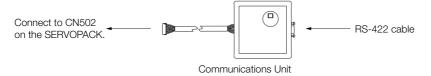
4.8.1 Serial Communications Connector (CN502)

4.8

Connecting the Other Connectors

4.8.1 Serial Communications Connector (CN502)

To use an RS-422 cable to connect a Digital Operator, connect a JUSP-JC001-1 Communications Unit to CN502 on the SERVOPACK and connect the RS-422 cable to the Communications Unit.



Communications Unit

Item	Description
Inquiries	Your Yaskawa representative
Order Number	JUSP-JC001-1
External Dimensions	CN53: ZHR-8 J.S.T. Mfg. Co., Ltd. CN3: HDR-EC14LFDTN-SLE-PLUS Honda Tsushin Kogyo Co., Ltd. 67 4 302
	Approx. mass: 0.08 kg Unit: mm

Refer to the following manual for the operating procedures for the Digital Operator.

 \square Σ -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.

Refer to the following manual for the operating procedures for the SigmaWin+. AC Servo Drive Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

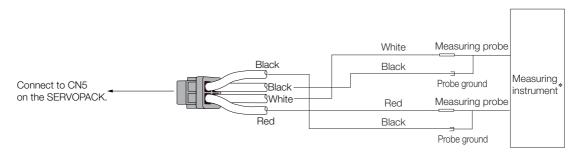


Use the Yaskawa-specified cables. Operation will not be dependable due to low noise resistance with any other cable.

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. \bigcirc 9.3 Monitoring Machine Operation Status and Signal Waveforms on page 9-6

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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5.1 Manipulating SERVOPACK Parameters (Pn□□□)

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

5.1.1 Classifications of SERVOPACK Parameters

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 the SigmaWin+, setup parameters and tuning parameters are displayed.

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

Parameter		Meaning	When Enabled	Classification
Pn00B (200Bh) n.□□□0 (default setting)		Display only setup parameters.	After restart Setup	
(200Bn)	n.□□□1	Display all parameters.		

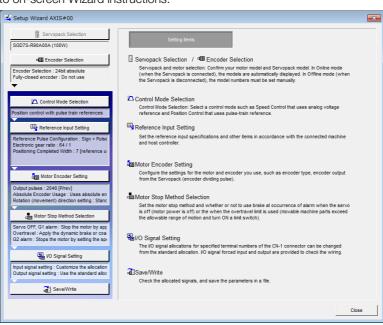
The setting method for each type of parameter is described below.

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 SERVOPACK 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.

- 8.6 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 8-41

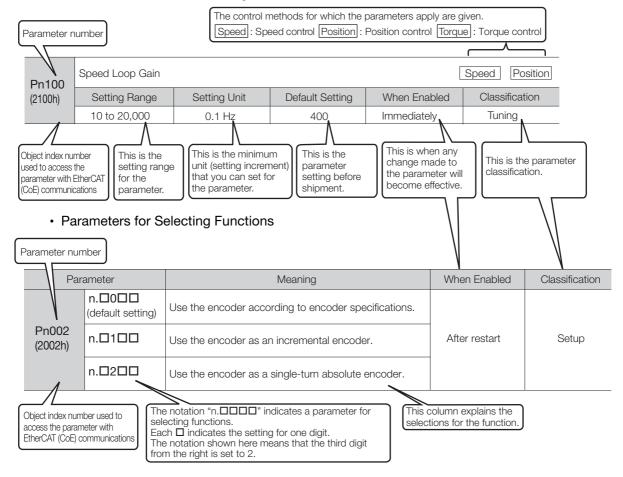
You can also set the tuning parameters individually to make adjustments. Refer to the following section for details.

8.13 Manual Tuning on page 8-78

5.1.2 Notation for SERVOPACK Parameters

There are two types of notation used for SERVOPACK 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



Setting Methods for SERVOPACK Parameters

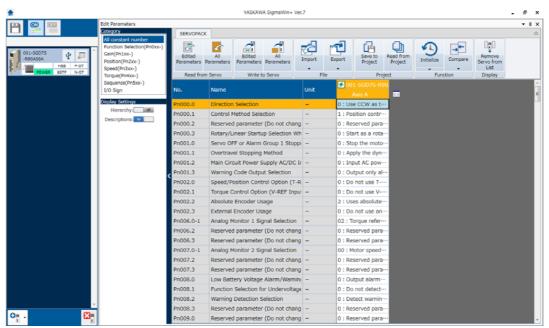
You can use the SigmaWin+ or a Digital Operator to set the SERVOPACK parameters. A sample operating procedure is given below.

Setting SERVOPACK 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.

5.1.3

If the parameter to edit is not displayed in the Parameter Editing Dialog Box, click the <a> or <a> Button to display the parameter to edit.



4. Change the setting of the parameter.

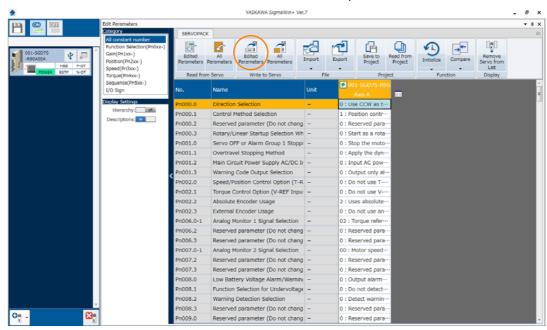
Information

- 1. For a parameter for a numeric setting, input the numeric setting.
- 2. 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.

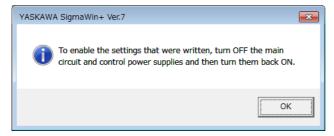
5.1.3 Setting Methods for SERVOPACK Parameters

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. 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 SERVOPACK Parameters with a Digital Operator

Refer to the following manual for information on setting the SERVOPACK parameters with a Digital Operator.

Ω Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)

5.1.4 Write Prohibition Setting for SERVOPACK Parameters

Setting SERVOPACK Parameters with EtherCAT (CoE) Communications

You can set objects 2000h to 26FFh with EtherCAT(CoE) communications to set the SERVO-PACK parameters (Pn000 to Pn6FF).

Object index 2000h corresponds to SERVOPACK parameter number Pn000.

Example Index 2100h is the same as parameter number Pn100 (2100h = Pn100).

When you use EtherCAT (CoE) communications objects, you must write the SERVOPACK parameters to non-volatile memory.

To write the SERVOPACK parameters to non-volatile memory, set the store parameters (1010h) object.

Refer to the following section for information on store parameters (1010h).
14.2 General Objects on page 14-5

5.1.4 Write Prohibition Setting for SERVOPACK Parameters

You can prohibit writing SERVOPACK parameters from a Digital Operator. Even if you do, you will still be able to change SERVOPACK parameter settings from the SigmaWin+ or with Ether-CAT (CoE) communications.

Preparations

No preparations are required.

Applicable Tools

The following table lists the tools that you can use to change the Write Prohibition Setting for SERVOPACK parameters and the applicable tool functions.

Tool	Function	Reference
Digital Operator	Fn010	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Write Prohibited Setting	Operating Procedure on page 5-7

Operating Procedure

Use the following procedure to prohibit or permit writing parameters.

- 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 ▼ or ▲ for the rightmost digit and set one of the following. 0000: Writing is permitted (default setting). 0001: Writing is prohibited.



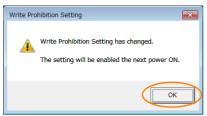
5.1.4 Write Prohibition Setting for SERVOPACK Parameters

4. Click the Setting Button.



5. Click the OK Button.

The setting will be written to the SERVOPACK.



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.

5.1.4 Write Prohibition Setting for SERVOPACK Parameters

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	When Writ-	
Menu Dialog Box Button	SigmaWin+ Function Name	Fn No.	Utility Function Name	ing Is Pro- hibited	Reference
	Origin Search*1	Fn003	Origin Search	Cannot be executed.	page 7-20
	Absolute Encoder Reset	Fn008	Reset Absolute Encoder	Cannot be executed.	page 5-52
	Adjusting the Analog Moni-	Fn00C	Adjust Analog Monitor Output Offset	Cannot be executed.	page 9-9
	tor Output	Fn00D	Adjust Analog Monitor Output Gain	Cannot be executed.	page 9-9
	Motor Current Detection	Fn00E	Autotune Motor Current Detection Signal Offset	Cannot be executed.	page 6-49
	Offset Adjustment	Fn00F	Manually Adjust Motor Current Detection Signal Offset	Cannot be executed.	page 0-49
Setup	Multiturn Limit Setting	Fn013	Multiturn Limit Setting after Multiturn Limit Disagreement Alarm	Cannot be executed.	page 6-36
	Reset Configuration Error of Option Module	Fn014	Reset Option Module Configuration Error	Cannot be executed.	page 15-43
	Vibration Detection Level Initialization	Fn01B	Initialize Vibration Detection Level	Cannot be executed.	page 6-45
	Set Origin	Fn020	Set Absolute Linear Encoder Origin	Cannot be executed.	page 5-54
	Software Reset	Fn030	Software Reset	Can be executed.	page 6-43
	Polarity Detection	Fn080	Polarity Detection	Cannot be executed.	page 5-26
	Tuning-less Level Setting	Fn200	Tuning-less Level Setting	Cannot be executed.	page 8-16
	EasyFFT	Fn206	Easy FFT	Cannot be executed.	page 8-94
Parameters	Initialize*2	Fn005	Initialize Parameters	Cannot be executed.	page 5-10
	Autotuning without Reference Input	Fn201	Advanced Autotuning with- out Reference	Cannot be executed.	page 8-23
	Autotuning with Reference Input	Fn202	Advanced Autotuning with Reference	Cannot be executed.	page 8-34
Tuning	Custom Tuning	Fn203	One-Parameter Tuning	Cannot be executed.	page 8-41
	Anti-Resonance Control Adjustment	Fn204	Adjust Anti-resonance Control	Cannot be executed.	page 8-50
	Vibration Suppression	Fn205	Vibration Suppression	Cannot be executed.	page 8-55
		Fn011	Display Servomotor Model	Can be executed.	page 9-2
Monitor	Product Information	Fn012	Display Software Version	Can be executed.	page 3-2
WOTHLOT	Troduct information	Fn01E	Display SERVOPACK and Servomotor IDs	Can be executed.	page 9-2
		Fn01F	Display Servomotor ID from Feedback Option Module	Can be executed.	paye 3-2

Continued on next page.

5.1.5 Initializing SERVOPACK Parameter Settings

Continued from previous page.

	SigmaWin+		Digital Operator	When Writ-	
Menu Dialog Box Button	Box SigmaWin+ Function		Utility Function Name	ing Is Pro-	Reference
Test Opera-	Jogging	Fn002	Jog	Cannot be executed.	page 7-7
tion	Program Jogging	Fn004	Jog Program	Cannot be executed.	page 7-13
	Display Alarm	Fn000	Display Alarm History	Can be executed.	page 15-41
Alarm	Display Alaim	Fn006	Clear Alarm History	Cannot be executed.	page 15-42
	Reset Motor Type Alarm	Fn021	Reset Motor Type Alarm	Cannot be executed.	page 15-45

^{*1.} Cannot be used when connecting a Linear Servomotor.

5.1.5 Initializing SERVOPACK Parameter Settings

You can return the SERVOPACK parameters to their default settings.

This function will not initialize the settings of the parameters that are adjusted for the Fn00C, Fn00D, Fn00E, and Fn00F utility functions.



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

Preparations

Check the following settings before you initialize the SERVOPACK parameter settings.

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

Applicable Tools

The following table lists the tools that you can use to initialize the SERVOPACK parameter settings and the applicable tool functions.

Tool	Function	Reference
Digital Operator	Fn005	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Parameters - Edit Parameters	Operating Procedure on page 5-10
EtherCAT Communications	Restore Default Parameters (1011h)	Restore Default Parameters (1011h) on page 14-7

Operating Procedure

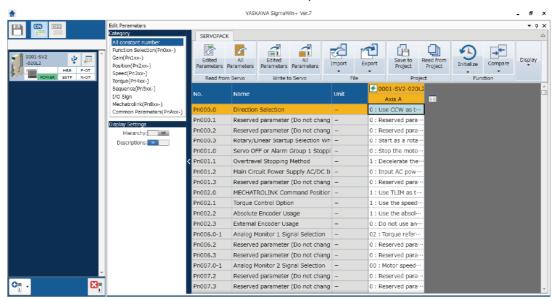
Use the following procedure to initialize the parameter settings.

- 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.

^{*2.} An Initialize Button will be displayed in the Parameter Editing Dialog Box.

- 3. Select any parameter of the axis to initialize.
- 4. Click the Initialize Button in the Function Group.

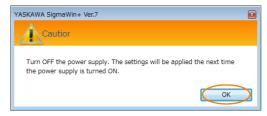


5. Click the OK Button.



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

6. Click the OK Button.



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.

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 supply.



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. \(\PiX\Pi\Pi\) (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□□).

Parai	Parameter Meaning		When Enabled	Classification
Pn001 (2001h)	n.□0□□ (default set- ting)	Use an AC power supply input.	After restart	Setup
	n.🗆1🗆 🗆	Use a DC power supply input.		

MARNING

- Connect the AC or 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/⊕ and ⊕2 terminals and the L1C and L2C terminals on the SERVOPACK.

There is a risk of failure or fire.

- Always specify a DC power supply input (Pn001 = n.□1□□) before you input DC power for the main circuit power supply.
 - If you input DC power without specifying a DC power supply input (i.e., without setting Pn001 to $n.\Box 1\Box\Box$), the SERVOPACK's internal elements may burn and may cause fire or damage to the equipment.
- With a DC power supply input, time is required to discharge electricity after the main power supply is turned OFF. A high residual voltage may remain in the SERVOPACK after the power supply is turned OFF. Be careful not to get an electric shock.
- Install fuses on the power supply line if you use DC power.
- The Servomotor returns regenerative energy to the power supply. If you use a SERVOPACK
 with a DC power supply input, regenerative energy is not processed. Process the regenerative energy at the power supply.
- If you use a DC power supply input with any of the following SERVOPACKs, externally connect an inrush current limiting circuit and use the power ON and OFF sequences recommended by Yaskawa: SGD7S-330A, -470A, -550A, -590A, or -780A.

There is a risk of equipment damage.

Refer to the following section for the power ON and OFF sequences.

4.3.3 Power ON Sequence on page 4-16

Refer to the following section for information on wiring the SERVOPACK.

4.3.4 Power Supply Wiring Diagrams on page 4-18

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, change the setting to specify a single-phase AC power supply input (Pn00B = n.D1DD).

Information

You do not need to change the setting of Pn00B to n.□1□□ (Use a three-phase power supply input as a single-phase power supply input) for a SERVOPACK with a single-phase 200-V power supply input (model numbers: SGD7S-120A□□□008) or for a SERVOPACK with a single-phase 100-V power supply input.

Pa	rameter	meter Meaning		Classification
Pn00B	n.□0□□ (default setting)	Use a three-phase power supply input.	After restart	Setup
(200Bh)	n.🗆1🗆 🗆	Use a three-phase power supply input and as a single-phase power supply input.	Alter restart	Getap



- 1. If you use a single-phase power supply input without specifying a single-phase AC power supply (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 4-19

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 SERVOPACK 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□□□ (default setting)	When an encoder is not connected, start as SERVOPACK for Rotary Servomotor.	After restart	Setup
(2000h)	n.1□□□	When an encoder is not connected, start as SERVOPACK for Linear Servomotor.	Aiter restait	Setup

5.4 Motor Direction Setting

You can reverse the direction of Servomotor rotation by changing the setting of $Pn000 = n.\Box\Box\Box X$ (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 6-17

Rotary Servomotors

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

F	Parameter	Forward/Reverse Reference	Motor Direction and Encoder Divided Pulse Outputs		Applicable Overtravel Signal (OT)
	n.□□□0 Use CCW as	Forward reference	Time Motor speed	Encoder Divided Pulse Outputs PAO PBO Phase-B lead	P-OT (Forward Drive Prohibit) signal
Pn000	the forward direction. (default setting)	Reverse reference	Torque reference Time OW Motor speed	Encoder Divided Pulse Outputs PAO Phase-A lead PBO	N-OT (Reverse Drive Prohibit) signal
(2000h)	n.□□□1 Use CW as the forward	Forward reference	Torque reference Wotor speed	Encoder Divided Pulse Outputs PAOPhase-B lead	P-OT (Forward Drive Prohibit) signal
	direction. (Reverse Rota- tion Mode)	Reverse reference	Torque reference Time Motor speed	Encoder Divided Pulse Outputs PAO Phase-A lead PBO PBO	N-OT (Reverse Drive Prohibit) 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. \$\square\$ (Motor Phase Sequence Selection) is set correctly.

I	Parameter	Forward/Reverse Reference	Motor Moving Direction and Encoder Divided Puls Outputs	Applicable Overtravel Signal (OT)
	n.□□□0 Use the direction in which the linear	Forward reference	Moves in the count-up direction. Here Force reference Encoder Divided Pulse Outputs PAO Phase-B leading to the count-up of the count-up direction.	P-OT (Forward Drive Prohibit) signal
Pn000	encoder counts up as the for- ward direction. (default setting)	Reverse reference	Moves in the count-down direction. Force reference Encoder Divided Pulse Outputs PAO Phase-A lead PBO PBO PBO	N-OT (Reverse Drive Prohibit) signal
(2000h)	n.□□□1 Use the direction in which the linear	Forward reference	Motor speed direction. Force reference Encoder Divided Pulse Outputs PAO Phase-B lear	P-OT (Forward Drive Prohibit) signal
	encoder counts down as the forward direc- tion.	Reverse reference	Force reference Moves in the count-up direction. Force reference Encoder Divided Pulse Outputs PAO Phase-A leader Divided Pulse Outputs PAO Phase-A leader Divided Pulse Outputs	N-OT (Reverse Drive Prohibit) 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, you do not need to set Pn282.



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

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

D=000	Linear Encoder Pit	Speed Po	osition Force		
Pn282 (2282h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(ZZOZII)	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 Encoder	Manufacturer	Model	Serial Converter Unit Model	Linear Encoder Pitch [μm]	
		LIDA48□	JZDP-H003-□□□-E	20	
	Dr. JOHANNES HEIDENHAIN GmbH Renishaw PLC	LIDA40 L	JZDP-J003-□□□-E	20	
Ingramental		LIF48□	JZDP-H003-□□□-E	4	
Incremental			JZDP-J003-□□□-E		
		RGH22B	JZDP-H005-□□□-E	20	
	Heristiaw FLO	ndi izzb	JZDP-J005-□□□-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.



Linear Encoder Pitch

If you do not use a Serial Converter Unit, the linear encoder pitch is automatically set. It is not necessary to set Pn282. You can use the SigmaWin+ to check the linear encoder pitch that was automatically set. Refer to the following section for details.

9.1 Monitoring Product Information on page 9-2

5.6 Writing Linear Servomotor Parameters

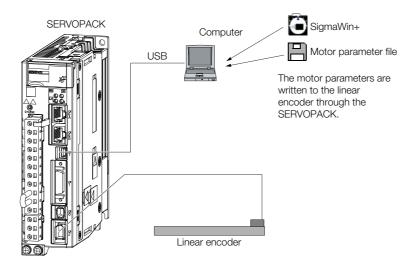
If you connect a linear encoder to the SERVOPACK without going through a Serial Converter Unit, you must use the SigmaWin+ to write the motor parameters to the linear encoder. The motor parameters contain the information that is required by the SERVOPACK to operate the Linear Servomotor.

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

♠ WARNING

Check the Servomotor and linear encoder information before you write the motor parameters.

If you do not write the correct motor parameters, the Servomotor may run out of control or burning may occur, possibly resulting in equipment damage or fire.





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.CAO 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),
 - A.550 (Maximum Speed Setting Error), A.710 (Instantaneous Overload),
 - 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 and the applicable tool functions.

Tool	Function	Reference	
Digital Operator	You cannot write Linear Servomotor parameters from the Digital Operator.		
SigmaWin+	Setup - Motor Parameter Scale Write	© Operating Procedure on page 5-18	

Operating Procedure

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

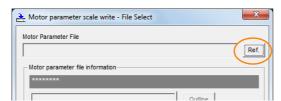
- 1. Prepare the motor parameter file to write to the linear encoder.
- 2. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **3.** Select Motor Parameter Scale Write in the Menu Dialog Box. The Motor Parameter Scale Write Dialog Box will be displayed.
- 4. Click the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



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.

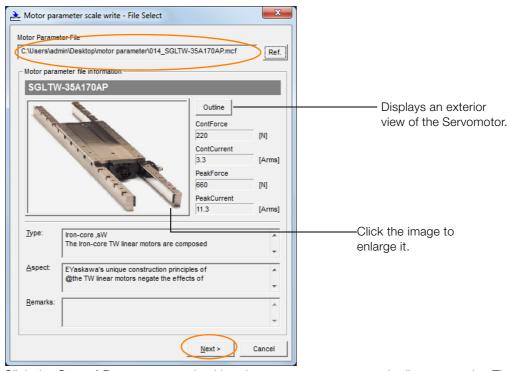
5. Click the Ref. Button.



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

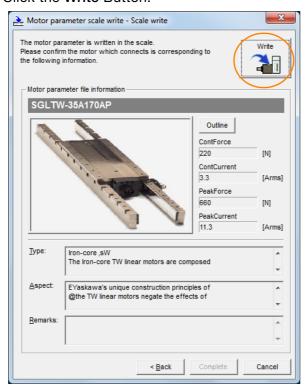


7. Confirm that the motor parameter file information that is displayed is suitable for your Servomotor, and then click the **Next** Button.

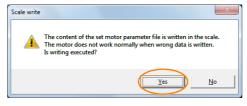


Click the **Cancel** Button to cancel writing the motor parameters to the linear encoder. The Main Window will return.

8. Click the Write Button.



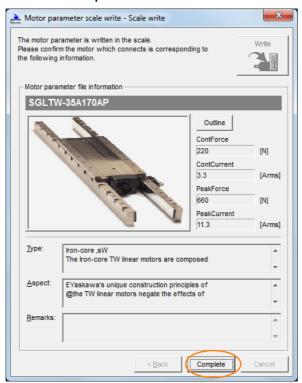
9. Click the Yes Button.



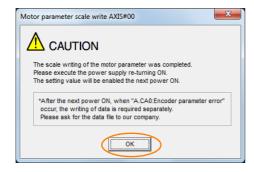
Click the No Button to cancel writing the motor parameters to the linear encoder.

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

10. Click the Complete Button.



11. Click the OK Button.



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 ($Pn080 = n.\square\square X\square$), 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 motor.

Related Parameters

Parameter		Meaning	When Enabled	Classification
Pn080 (2080h)	n.□□0□ (default setting)	Set a phase-A lead as a phase sequence of U, V, and W.	After restart	Setup
(200011)	n. 🗆 🗆 1 🗆	Set a phase-B lead as a phase sequence of U, V, and W.		

Setting Procedure

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

- 1. Set Pn000 to n.□□□0 (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 in the Menu Dialog Box.

The Operation Panel 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 μm 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



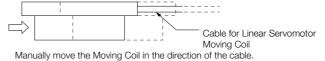
If there are 128,000 pulses on the feedback pulse counter after you manually move the Moving Coil in the direction of the cable, you have completed the confirmation.

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 in the Operation Panel 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.□□□X (Rotation 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 = $n.\Box\Box\Box\Box$ X (Polarity Sensor Selection).

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

If the Linear Servomotor does not have a polarity sensor, set Pn080 to n. \$\square\$D\$ 1 (Do not use polarity sensor). Turn the power supply OFF and ON again to enable the new setting.

Parameter		Meaning	When Enabled	Classification
Pn080 (2080h)	n.□□□0 (default setting)	Use polarity sensor.	After restart	Setup
(200011)	n.□□□1	Do not use polarity sensor.		

Information

If you set Pn080 to n. \$\square\$ Output\$ (Use polarity sensor) and the Linear Servomotor that is connected to the SERVOPACK does not have a polarity sensor, an A.C21 alarm (Polarity Sensor Error) will occur when you turn the power supply OFF and ON again.

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 phase angle 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
Incremental encoder	Each time the control power supply to the SERVOPACK is turned ON (Even after you execute polarity detec- tion, the position of the polarity will be lost the next time the control power supply to the SERVOPACK is turned OFF.)	 Use the Servo ON command (Enable Operation command). Use the polarity detection function of the SigmaWin+. Execute the Fn080 (Polarity Detection) utility function from the Digital Operator.
Only for initial setup, or after the SER-VOPACK, linear encoder, or Servomotor has been replaced Absolute encoder (The results of polarity detection is stored in the absolute encoder, so the polarity position is not lost when the control power supply is turned OFF.)		Use the polarity detection function of the SigmaWin+. 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 μm or less. (We recommend a pitch of 40 μm 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

Check the following settings before you execute polarity detection.

- Not using a polarity sensor must be specified (Pn080 = n.□□□1).
- 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 (Enable Operation 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.□□□0).
- 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.



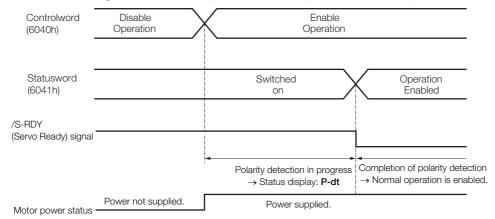
- 1. Power is supplied to the Servomotor during polarity detection. Be careful not to get an electric shock. Also, the Moving Coil of the Linear Servomotor may greatly move during detection. Do not approach the moving parts of the Servomotor.
- 2. Polarity detection is affected by many factors.

 For example, polarity detection may fail if the mass ratio or friction is too large or the cable tension is too strong.

5.9.2 Using the Servo ON Command (Enable Operation Command) to Perform Polarity Detection

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

Polarity detection will start simultaneously with execution of the Servo ON command (Enable Operation command). As soon as polarity detection is completed, the /S-RDY will turn ON and the servo will change to ON status (statusword = operation enabled).



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 and the applicable tool functions.

Tool	Function	Reference
Digital Operator	Fn080	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Polarity Detection	Operating Procedure on page 5-26

Operating Procedure

Use the following procedure to perform polarity detection.

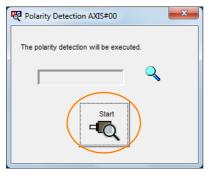
- 1. Click the P Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Polarity Detection in the Menu Dialog Box. The Polarity Detection Dialog Box will be displayed.
- 3. Click the Continue Button.



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.

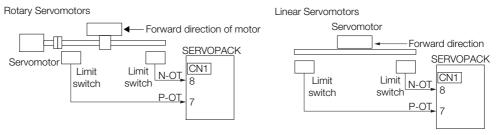
5.10 Overtravel and Related Settings

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 P-OT (Forward Drive Prohibit) and the N-OT (Reverse Drive Prohibit) signals.

You use the P-OT and N-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.

CAUTION

- To prevent accidents that may result from contact faults or disconnections, use normally closed limit switches.
 - Do not change the default settings of the polarity of the overtravel signals (P-OT and N-OT).
- If you use a Servomotor for a vertical axis, the /BK (Brake) signal will remain ON (i.e., the brake will be released) when overtravel occurs. This may result in the workpiece falling when overtravel occurs. To prevent the workpiece from falling, set Pn001 to n.□□1□ to place the Servomotor in a zero-clamped state when it stops.
- A base block state is entered after stopping for overtravel. This may cause the Servomotor to be pushed back by an external force on the load shaft. To prevent the Servomotor from being pushed back, set Pn001 to n.□□1□ to place the Servomotor in a zero-clamped state when it stops.

5.10.1 Overtravel Signals

The overtravel signals include the P-OT (Forward Drive Prohibit) and the N-OT (Reverse Drive Prohibit) signals.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input P-OT N-OT			ON	Forward drive is enabled (actual operation).
	P-OT	CN1-7	OFF	Forward drive is prohibited (forward overtravel).
	N-OT	CN1-8	ON	Reverse drive is enabled (actual operation).
			OFF	Reverse drive is prohibited (reverse overtravel).

You can operate the Servomotor in the opposite direction during overtravel by inputting a reference.

5.10.2 Setting to Enable/Disable Overtravel

5.10.2 Setting to Enable/Disable Overtravel

You can use $Pn50A = n.X \square \square \square$ (P-OT (Forward Drive Prohibit) Signal Allocation) and $Pn50B = n.\square \square \square \square X$ (N-OT (Reverse Drive Prohibit) Signal Allocation) to enable and 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	When Enabled	Classification
Pn50A	n.1□□□ (default setting)	The forward overtravel function is enabled and the P-OT (Forward Drive Prohibit) signal is input from CN1-7.		
(250Ah)	n.8□□□	The reverse overtravel function is disabled. Forward drive is always enabled.	After restart	Setup
n.□□□2 Pn50B (default setting		The reverse overtravel function is enabled and the N-OT (Reverse Drive Prohibit) signal is input from CN1-8.	Aitel lestait	σσιαρ
(250Bh)	n.□□□8	The reverse overtravel function is disabled. Reverse drive is always enabled.		

You can allocate the P-OT and N-OT signals to other connector pins. Refer to the following section for details.

6.1.1 Input Signal Allocations on page 6-3

5.10.3 Motor Stopping Method for Overtravel

You can set the stopping method of the Servomotor when overtravel occurs in Pn001 = $n.\square\square XX$ (Motor Stopping Method for Servo OFF and Group 1 Alarms, Overtravel Stopping Method).

Р	arameter	Motor Stopping Method*	Status after Stopping	When Enabled	Classification	
	n.□□00 (default setting)	Dynamic brake				
n.□□01 n.□□02 n.□□1□			Coasting			
		Coasting				
		Deceleration	Zero clamp			
(2001h)	(2001h) accord setting (2406h		Coasting	After restart	Setup	
n	n.□□3□	Deceleration	Zero clamp			
	n.□□4□	according to setting of Pn30A (230Ah)	Coasting			

^{*} You cannot decelerate a Servomotor to a stop during torque control. For torque control, the Servomotor will be stopped with the dynamic braking or coast to a stop (according to the setting of Pn001 = n.□□□X (Motor Stopping Method for Servo OFF and Group 1 Alarms)), and then the Servomotor will enter a coasting state.

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 5-39

5.10.3 Motor Stopping Method for Overtravel

Stopping the Servomotor by Setting Emergency Stop Torque

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

If $Pn001 = n.\square\squareX\square$ 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.

D: 400	Emergency Stop Torque			Speed Positio	n
Pn406 (2406h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(240011)	0 to 800	1%*	800	Immediately	Setup

^{*} Set a percentage of the motor rated torque.

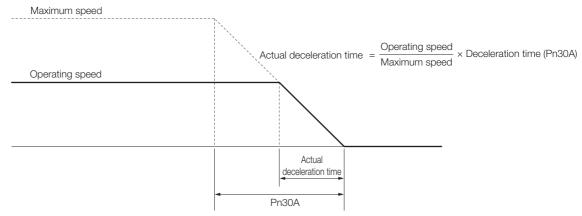
Stopping the Servomotor by Setting the Deceleration Time

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

D00A	Deceleration Time f	or Servo OFF and Fo	Speed Position	า	
Pn30A (230Ah)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(2007111)	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.



5.10.4 Overtravel Warnings

You can set the system to detect an A.9A0 warning (Overtravel) if overtravel occurs while the servo is ON. This allows the SERVOPACK to notify the host controller with a warning even when the overtravel signal is input only momentarily. An alarm occurs only if overtravel occurs while the servo is ON. An overtravel warning will not be detected when the servo is OFF, even if overtravel occurs.

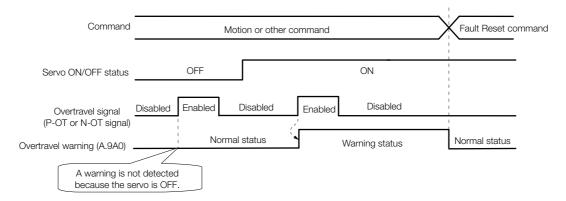


- 1. The occurrence of an A.9A0 warning will not stop the motor or have any effect on host controller motion operations. The next step (e.g., the next motion or command) can be executed even if an overtravel warning exists.
 - However, depending on the processing specifications and programming for warnings in the host controller, operation may be affected when an overtravel warning occurs (e.g., motion may stop or not stop). Confirm the specifications and programming in the host controller.
- 2. When overtravel occurs, the SERVOPACK will perform stop processing for overtravel. Therefore, when an A.9A0 warning occurs, the Servomotor may not reach the target position specified by the host controller. Check the feedback position to make sure that the axis is stopped at a safe position.

The following parameter is set for this function.

Parameter Meaning		When Enabled	Classification	
Pn00D (200Dh)	n.0□□□ (default setting)	Do not detect overtravel warnings.	After restart	Setup
n.1□□□ Detect overtravel war		Detect overtravel warnings.		

A timing chart for warning detection is provided below.



Information

- 1. Warnings are detected for overtravel in the same direction as the reference.
- Warnings are not detected for overtravel in the opposite direction from the reference. Example: A warning will not be output for a forward reference even if the N-OT signal turns ON.
- A warning can be detected in either the forward or reverse direction if there is no reference.
- A warning will not be detected when the servo is turned ON even if overtravel status exists.
- 5. You can use the ALM_CLR (Clear Alarms and Warnings) command to clear the warning regardless of the servo ON/OFF status and overtravel signal status.
- 6. If you clear the warning with the Fault Reset command during overtravel status, a warning will not be detected again until the overtravel status is left.
- 7. An overtravel warning will be detected even when the software limit has been detected.

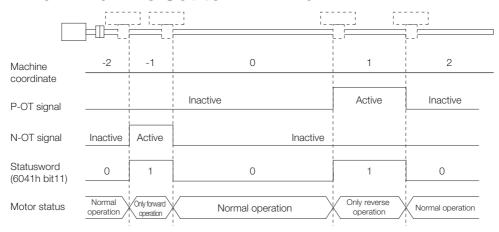
5.10.5 Overtravel Release Method Selection

You can set Pn022 = n. \(\subseteq \subseteq \text{X}\) (Overtravel Release Method Selection) to release overtravel. Internal limit active (bit 11) in statusword changes to 1 during overtravel. The motor will not be driven if there is overtravel in the same direction as the reference.

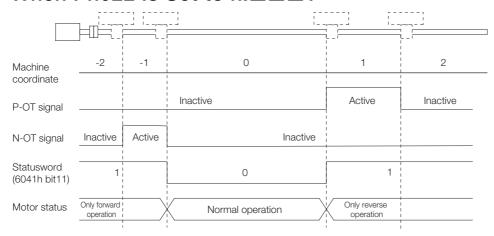
Р	Parameter Meaning		When Enabled	Classification
Pn022	n.□□□0 (default setting)	Overtravel exists while the P-OT or N-OT signal is being input.		
(2022h)	n.□□□1	Overtravel exists while the P-OT or N-OT signal is input and the current position of the workpiece is separated* from the P-OT signal or N-OT signal.	After restart	Setup

^{*} Here, "separated" means a position that is further in the positive direction than the P-OT signal or a position that is further in the negative direction than the N-OT signal.

When Pn022 Is Set to n.□□□0



When Pn022 Is Set to n.□□□1



5.10.6 Overtravel Status

If an overtravel signal is input, the following SERVOPACK status will change to 1 and the Servomotor will be stopped according to the overtravel stopping method set in Pn001. When the overtravel signal is reset, the status changes to 0.

Internal limit active (bit 11) in statusword (6041h)

Negative limit switch (bit 0) or positive limit switch (bit 1) in digital inputs (60FDh)

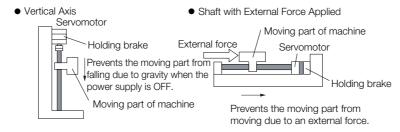
5.10.7 Overtravel Operation by Mode

Operation Mode	Operation
Profile position mode	 If an overtravel signal is input, the positioning operation to the current target position will be canceled and, after the motor stops, target reached in statusword will be reset. A positioning operation (return operation) is started only when a movement reference to a target position in the opposite direction from the overtravel signal is specified in the current Position Actual Value (e.g., a negative movement reference if the P-OT signal is input).
Homing mode	 For Homing Method 1, 11, 12, 13, 14, 28, or 34: If the P-OT signal is input, homing error (bit 13) in statusword (6041h) changes to 1 and the homing operation is canceled. For Homing Method 2, 7, 8, 9, 10, 24, or 33: If the N-OT signal is input, homing error (bit 13) in statusword (6041h) changes to 1 and the homing operation is canceled.
 If an overtravel signal is input, the positioning operation to the conget position mode, cyclic synchronous position mode A positioning operation (return operation) is started only when a reference to a target position in the opposite direction from the opinion is specified in the current position actual value (e.g., a negmovement references if the P-OT signal is input). 	
Profile velocity mode, Cyclic synchronous velocity mode	During overtravel, the motor is operated only when a speed in the direction opposite from the overtravel signal is specified (e.g., a negative target speed when the P-OT signal is input).
Profile torque mode, Cyclic synchronous torque mode	During overtravel, torque is applied only when a torque in the direction opposite from the overtravel signal is specified (e.g., a negative torque when the P-OT signal is input).

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.

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.

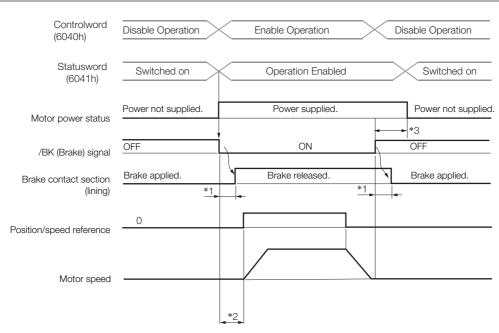


Brake Release Delay Time

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.



*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

5.11.2 /BK (Brake) Signal

Model	Voltage	Brake Release Delay Time [ms]	Brake Operation Delay Time [ms]	
SGM7M-A1 to -A3		60		
SGM7J-A5 to -04		60		
SGM7J-06 and -08		80	100	
SGM7A-A5 to -04		60		
SGM7A-06 to -10		80		
SGM7A-15 to -25		170	90	
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		250	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 SV_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.

**a4.4 Wiring the SERVOPACK to the Holding Brake on page 4-34*

5.11.2 /BK (Brake) Signal

The following settings are for the output signal that controls the brake. You can change the connector pin that is allocated. For details, refer to *Allocating the /BK (Brake) Signal.* 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).

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	/BK	CN1-1, CN1-2	ON (closed)	Releases the brake.
			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

Allocating the /BK (Brake) Signal

Set the allocation for the /BK signal in Pn50F = $n.\Box X\Box\Box$ (/BK (Brake Output) Signal Allocation).

Parameter		Connector Pin No.		Meaning	When	Classification
		+ Pin	- Pin	ivicaring	Enabled	Classification
	n.□0□□	-	-	The /BK signal is not used.		
Pn50F	50F ting)	CN1-1	CN1-2	The /BK signal is output from CN1-1 and CN1-2.	After restart	Setup
(250Fh)		CN1-24	The /BK signal is output from CN1-23 and CN1-24.	Alterrestart	σοιαρ	
	n.□3□□	CN1-25	CN1-26	The /BK signal is output from CN1-25 and CN1-26.		



If you allocate more than one signal to the same output connector pin, a logical OR of the signals is output. Allocate the /BK signal to its own output connector pin, i.e., do not use the same output terminal for another signal.

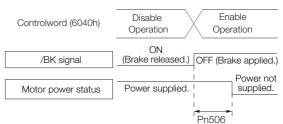
For example, never allocate the /TGON (Rotation Detection) signal and /BK signal to the same output connector pin. If you did so, the /TGON signal would be turned ON by the falling speed on a vertical axis, and the brake would not operate.

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 (Disable Operation command) 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 (Disable Operation command) is input.

	Brake Reference-Servo OFF Delay Time			Speed Position	Torque
Pn506 (2506h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(250611)	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.

Rotary Servomotors

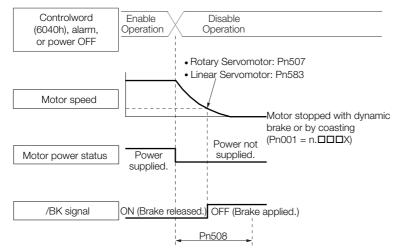
Pn507 (2507h)	Brake Reference Output Speed Level Spee			Speed Positi	ed Position Torque	
	Setting Range Setting Unit Default Setting		When Enabled	Classification		
	0 to 10,000	to 10,000 1 min ⁻¹ 100		Immediately	Setup	
Pn508 (2508h)	Servo OFF-Brake Reference Waiting Time Speed Position Torq			on Torque		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	10 to 100	10 ms	50	Immediately	Setup	

Linear Servomotors

Pn583 (2583h)	Brake Reference Οι	utput Speed Level		Speed Positi	on Force
	Setting Range Setting Unit Default Setting		When Enabled	Classification	
	0 to 10,000	to 10,000 1 mm/s 10		Immediately Setup	
Pn508 (2508h)	Servo OFF-Brake Reference Waiting Time Speed Position			on Force	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 100	10 ms	50	Immediately	Setup

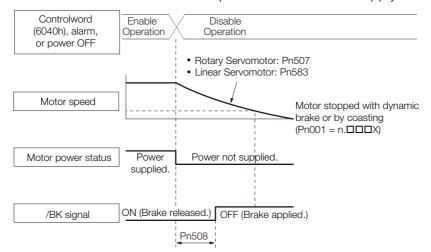
The brake operates when either of the following conditions is satisfied:

• 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



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

• 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 Methods 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.)



- The dynamic brake is used for emergency stops. The dynamic brake circuit will operate frequently if the power supply is turned ON and OFF or the servo is turned ON and OFF while a reference input is applied to start and stop the Servomotor. This may result in deterioration of the internal elements in the SERVOPACK. Use speed input references or position references to start and stop the Servomotor.
- If you turn OFF the main circuit power supply or control power supply during operation before you turn OFF the servo, the Servomotor stopping method depends on the SERVOPACK model as shown in the following table.

	Servomotor Stopping Method		
Condition	SGD7S-R70A, -1R6A, -2R8A, -3R8A, -5R5A, -7R6A, -120A, -180A, -200A, -R70F, -R90F, -2R1F, or -2R8F	SGD7S-330A, -470A, -550A, -590A, or -780A	
Main circuit power supply turned OFF before turning OFF the servo	Stopping with dynamic brake		
Control power supply turned OFF before turning OFF the servo	Stopping with dynamic brake	Coasting to a stop	

 To minimize the coasting distance of the Servomotor to come to a stop when an alarm occurs, zero-speed stopping is the default method for alarms to which it is applicable. However, depending on the application, stopping with the dynamic brake may be more suitable than zero-speed stopping.

For example, when coupling two shafts (twin-drive operation), machine damage may occur if a zero-speed stopping alarm occurs for one of the coupled shafts and the other shaft stops with a dynamic brake. In such cases, change the stopping method to the dynamic brake.

5.12.1 Stopping Method for Servo OFF

Set the stopping method for when the servo is turned OFF in Pn001 = $n.\Box\Box\Box$ X (Motor Stopping Method for Servo OFF and Group 1 Alarms).

Parameter		Servomotor Stop- ping Method	Status after Servo- motor Stops	When Enabled	Classifi- cation
Pn001	n.□□□0 (default setting) Dynamic brake*		Dynamic brake*	A 64 1 1	
(2001h)	n.□□□1		Coasting	After restart	Setup
	n.□□□2	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. \(\sim \subseteq 0\) (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. 15.2.1 List of Alarms on page 15-5

Motor Stopping Method for Group 1 Alarms

When a group 1 alarm occurs, the Servomotor will stop according to the setting of Pn001 = $n.\Box\Box\Box\Box$ X. 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 5-39

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.□□□X (Motor Stopping Method for Servo OFF and Group 1 Alarms)
- Pn00A = n.□□□X (Motor Stopping Method for Group 2 Alarms)
- Pn00B = n.□□X□ (Motor Stopping Method for Group 2 Alarms)

However, during torque control, the group 1 stopping method is always used.

If you set Pn00B to n. \$\square\$ \square\$ (Apply the dynamic brake or coast the 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

	Paramete	er	Servomotor	Status after	When	
Pn00B (200Bh)	Pn00A (200Ah)	Pn001 (2001h)	Stopping Method	Servomotor Stops	Enabled	Classification
n.□□0□		n.□□□0 (default setting)	Zero-speed stop-	Dynamic brake		
(default setting)	_	n.□□□1	ping	Coasting		
		n.□□□2		Oddsting		
n.□□1□		n.□□□0 (default setting)	Dynamic brake	Dynamic brake		
	_	n.□□□1		Coasting		
		n.□□□2	Coasting	Codoling		
		n.□□□0 (default setting)	Dynamic brake	Dynamic brake		
	n.□□□0	n.□□□1		Coasting		Classification
		n.□□□2	Coasting	Coasting		
	n.□□□1 (default setting)	n.□□□0 (default setting)		Dynamic brake	After restart	
		n.□□□1	Motor is deceler- ated using the	Coasting		
	ootting)	n.□□□2	torque set in	Coasting		
n.□□2□	n.□□□2	n.□□□0 (default setting) n.□□□1	Pn406 (2406h) as the maximum torque.	Coasting		Setup
		n.□□□2				
	5550	n.□□□0 (default setting)		Dynamic brake		
	n.□□□3	n.□□□1	Motor is deceler-	Coasting		
		n.□□□2	ated according to	Coasting		
		n.□□□0 (default setting)	setting of Pn30A (230Ah).			
	n.□□□4	n.□□□1		Coasting		
		n.□□□2				

Note: 1. The setting of Pn00A is ignored if Pn00B is set to n. $\Box\Box\Box\Box$ or n. $\Box\Box\Box\Box$.

^{2.} The setting of Pn00A = n.□□□X is enabled for position control and speed control. During torque control, the setting of Pn00A = n.□□□X will be ignored and only the setting of Pn001 = n.□□□X will be used.

^{3.} Refer to the following section for details on Pn406 (Emergency Stop Torque).

**Stopping the Servomotor by Setting Emergency Stop Torque on page 5-29

^{4.} 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 5-29

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.

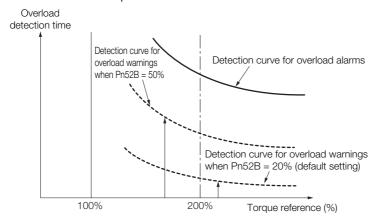
It is designed to prevent Servomotor overheating.

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.



D=COD	Overload Warning L	evel		Speed Position	Torque
Pn52B (252Bh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(LOLDII)	1 to 100	1%	20	Immediately	Setup

5.13.2 Detection Timing for Overload Alarms (A.720)

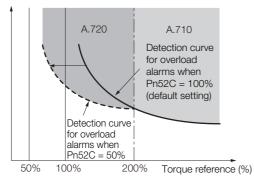
If Servomotor heat dissipation is insufficient (e.g., if the heat sink is too small), you can lower the overload alarm detection level to help prevent overheating.

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

D=500	Base Current Derati	ng at Motor Overload	d Detection	Speed Position			
Pn52C (252Ch)	Setting Range	Setting Unit	Default Setting	When Enabled Classification			
(232011)	10 to 100	1%	100	After restart	Setup		

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

Overload detection time



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)
- Σ-7-Series Linear Servomotor Product Manual (Manual No.: SIEP S800001 37)
- Σ-7-Series Direct Drive Servomotor Product Manual (Manual No.: SIEP S800001 38)

5.14 Setting Unit Systems

You can set the SERVOPACK reference units with EtherCAT (CoE) communications. You can set the following four reference units with EtherCAT communications.

- Position reference unit
- · Speed reference unit
- · Acceleration reference unit
- Torque reference unit

The setting procedures are given below.

5.14.1 Setting the Position Reference Unit

Set the position reference unit in *position user unit* (2701h). The position reference unit setting will be used for the electronic gear ratio setting.



- For a Rotary Servomotor with an encoder resolution of 24 bits (16,777,216), Pn20E (Electronic Gear Ratio (Numerator)) is automatically set to 16 and Pn210 (Electronic Gear Ratio (Denominator)) is automatically set to 1. Therefore, the encoder resolution will be equivalent to 20 bits (1,048,576). Consider this when you set the position reference unit in position user unit (2701h).
- Set the position reference unit within the following range.
 1/4,096 < Numerator/Denominator < 65,536
 If the setting range is exceeded, an A.A20 alarm (Parameter Setting Error) will occur.

Index	Subin- dex	Name	Data Type	Access	PDO Mappings	Value	Saving to EEPROM
2701h	0	Number of entries	USINT	RO	No	2	No
	1	Numerator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes
	2	Denominator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes

Note: Refer to the following section for information on position user unit (2701h).

Position User Unit (2701h) on page 14-17

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 μ m or °) that are easier to understand.

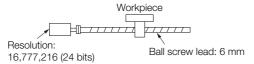
The electronic gear is used to convert the travel distances that are specified in reference units to pulses, which are required for actual movements.

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.

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

To move a workpiece 10 mm:

①Calculate the number of revolutions.

The Servomotor will move 6 mm for each revolution, so 10/6 revolutions are required to move 10 mm.

©Calculate the required number of reference pulses.

One revolution is 1,048,576 pulses, therefore $10/6 \times 1,048,576 = 1,747,626.66$ pulses.

3 Input 1,747,627 pulses as the reference.

Calculating the number of reference pulses for each reference is troublesome.



When the Electronic Gear Is Used

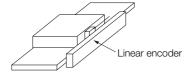
If you use reference units to move the workpiece when one reference unit is set to 1 μm , the travel distance is 1 μm per pulse.

To move the workpiece 10 mm $(10,000 \mu m)$, $10,000 \div 1 = 10,000 \text{ pulses}$, 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 $20~\mu m$.



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 μ m, the travel distance is 1 μ m per pulse. To move the load 10 mm (10,000 μ 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.

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:

$$\label{eq:electronic gear ratio} \begin{array}{l} \frac{B}{A} \ = \ \frac{\text{Numerator}}{\text{Denominator}} = \frac{\text{Encoder resolution}}{\text{Travel distance per load shaft revolution (reference units)}} \times \frac{m}{n} \\ \end{array}$$

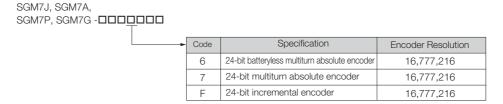
Information

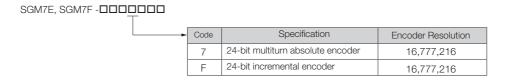
For a Rotary Servomotor with an encoder resolution of 24 bits (16,777,216), Pn20E (Electronic Gear Ratio (Numerator)) is automatically set to 16 and Pn210 (Electronic Gear Ratio (Denominator)) is automatically set to 1. Therefore, the encoder resolution will be equivalent to 20 bits (1,048,576). Consider this when you set the position reference unit in *position user unit* (2701h).

■ Encoder Resolution

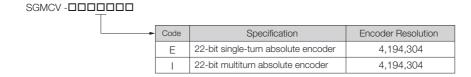
You can check the encoder resolution in the Servomotor model number.











◆ 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.

Electronic gear ratio
$$\frac{B}{A} = \frac{Numerator}{Denominator} = \frac{Travel distance per reference unit (reference units) × Linear encoder resolution}{Linear encoder pitch (the value from the following table)}$$

When Using a Serial Converter Unit

Electronic gear ratio
$$\frac{B}{A} = \frac{Numerator}{Denominator} = \frac{Travel distance per reference unit (reference units) × Resolution of the Serial Converter Unit Linear encoder pitch (setting of Pn282)$$

■ 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 Linear Encoder	Manufacturer	Linear Encoder Model	Linear Encoder Pitch [µm]*1	Model of Serial Converter Unit or Model of Head with Interpolator	Resolution	Resolution
	Dr.	LIDA48□	20	JZDP-H003-□□□-E*2	256	0.078 μm
	JOHANNES	LIDA40LI	20	JZDP-J003-□□□-E*2	4,096	0.0049 μm
	HEIDENHAIN GmbH	115405	4	JZDP-H003-□□□-E*2	256	0.016 μm
	GIIIDH	LIF48□	4	JZDP-J003-□□□-E*2	4,096	0.00098 μm
	Renishaw	DOLLOOD	00	JZDP-H005-□□□-E*2	256	0.078 μm
	PLC	RGH22B	20	JZDP-J005-□□□-E*2	4,096	0.0049 μm
Incre-		SR75-0000LF*5	80	_	8,192	0.0098 μm
mental		SR75-0000MF	80	_	1,024	0.078 μm
		SR85-0000LF*5	80	_	8,192	0.0098 μm
	Magnescale	SR85-0000MF	80	_	1,024	0.078 μm
	Co., Ltd.	SL700*5, SL710*5,	800	PL101-RY*3	8,192	0.0977 μm
		SL720*5, SL730*5		MJ620-T13*4		•
		SQ10	400	MQ10-FLA*4	8,192	0.0488 µm
			100	MQ10-GLA*4	0,102	οιο του μιτι
		LIC4100 Series	20.48	EIB3391Y*4	4,096	0.005 μm
	Dr. JOHANNES HEIDENHAIN	LIC2100 Series	204.8	EIB3391Y*4	4,096	0.05 μm
		LIGZ 100 Series	409.6	EIB3391Y*4	4,096	0.1 μm
	GmbH	LC115	40.96	EIB3381Y*4	4,096	0.01 μm
		LC415	40.96	EIB3391Y*4	4,096	0.01 μm
		ST781A/ST781AL	256	_	512	0.5 μm
		ST782A/ST782AL	256	_	512	0.5 μm
		ST783/ST783AL	51.2	_	512	0.1 μm
Absolute	Mitutoyo	ST784/ST784AL	51.2	_	512	0.1 μm
	Corporation	ST788A/ST788AL	51.2	_	512	0.1 μm
		ST789A/ST789AL	25.6	_	512	0.05 μm
		ST1381	5.12	_	512	0.01 μm
		ST1382	0.512	_	512	0.001 μm
		EL36Y-0050F000	12.8	_	256	0.05 μm
	Deniek	EL36Y-00100F000	25.6	_	256	0.1 μm
	Renishaw PLC	EL36Y-00500F000	128	_	256	0.5 μm
	-5	RL36Y-00500000	12.8	_	256	0.05 μm
		RL36Y-0001000	0.256	_	256	0.001 μm

Continued on next page.

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Type of Linear Encoder	Manufacturer	Linear Encoder Model			Resolution	Resolution	
		SR77-0000LF*5	80	-	8,192	0.0098 μm	
		SR77-0000MF	80	-	1,024	0.078 μm	
		SR87-0000LF*5	80	-	8,192	0.0098 μm	
		SR87-0000MF	80	_	1,024	0.078 μm	
	Magnescale Co., Ltd.	SQ47/SQ57- □□□□S□F□□□ SQ47/SQ57- □□□□□T□F□□□	20.48	-	4,096	0.005 μm	
Absolute		SQ47/SQ57-	40.96	-	4,096	0.01 μm	
		L2AK208	20	-	256	0.078 μm	
		L2AK211	20	_	2,048	0.0098 μm	
		LAK209	40	-	512	0.078 μm	
	5	LAK212	40	-	4,096	0.0098 μm	
	Fagor Automation S.	S2AK208	20	-	256	0.078 μm	
	Coop.	SV2AK208	20	-	256	0.078 μm	
	'	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	

- *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. 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).

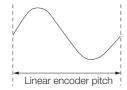
6.5.2 Setting for the Encoder Divided Pulse Output on page 6-22

Information

Resolution

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

Resolution (travel distance per feedback pulse) = Linear encoder pitch
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

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 Load shaft Encoder: Ball screw lead: 24 bits 6 mm	Reference unit: 0.01° Gear ratio: 1/100 Load shaft Encoder: 24 bits	Reference unit: 0.005 mm Load shaft Gear ratio: Pulley dia.: 100 mm 1/50 Encoder: 24 bits
1	Machine Specifications	Ball screw lead: 6 mm Gear ratio: 1/1	Rotation angle per revolution: 360° Gear ratio: 1/100	Pulley dia.: 100 mm (Pulley circumference: 314 mm) Gear ratio: 1/50
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 Load Shaft Revolution (Reference Units)	6 mm/0.001 mm = 6,000	360°/0.01° = 36,000	314 mm/0.005 mm = 62,800
5	Electronic Gear Ratio*	$\frac{B}{A} = \frac{16,777,216}{6,000} \times \frac{1}{16} \times \frac{1}{1}$	$\frac{B}{A} = \frac{16,777,216}{36,000} \times \frac{1}{16} \times \frac{100}{1}$	$\frac{B}{A} = \frac{16,777,216}{62,800} \times \frac{1}{16} \times \frac{50}{1}$
6	Position User Unit (2701h)	Numerator: 1,048,576	Numerator: 104,857,600	Numerator: 52,428,800
	(210111)	Denominator: 6,000	Denominator: 36,000	Denominator: 62,800

^{*} For a Rotary Servomotor with an encoder resolution of 24 bits (16,777,216), Pn20E (Electronic Gear Ratio (Numerator)) is automatically set to 16 and Pn210 (Electronic Gear Ratio (Denominator)) is automatically set to 1. Therefore, the encoder resolution will be equivalent to 20 bits (1,048,576). Consider this when you set the position reference unit in *position user unit* (2701h).

Linear Servomotors

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

		Machine Configuration				
Step	Description	Reference unit: 0.02 mm (20 µm) Forward direction				
1	Linear Encoder Pitch	0.02 mm (20 μm)				
2	Reference Unit	0.001 mm (1 μm)				
3	Electronic Gear Ratio*	$\frac{B}{A} = \frac{1 (\mu m)}{20 (\mu m)} \times \frac{1}{1}$				
1	Position User Unit	Numerator: 256				
4	(2701h)	Denominator: 20				

^{*} For a Linear Servomotor, both Pn20E (Electronic Gear Ratio (Numerator)) and Pn210 (Electronic Gear Ratio (Denominator)) are automatically set to 1. Consider this when you set the position reference unit in position user unit (2701h).

5.14.2 Setting the Speed Reference Unit

Set the speed reference unit [Vel. Unit] in velocity user unit (2702h).



For a Rotary Servomotor with an encoder resolution of 24 bits (16,777,216), Pn20E (Electronic Gear Ratio (Numerator)) is automatically set to 16 and Pn210 (Electronic Gear Ratio (Denominator)) is automatically set to 1. Therefore, the encoder resolution will be equivalent to 20 bits (1,048,576). Consider this when you set the position reference unit in *position user unit* (2701h).

Index	Subin- dex	Name	Data Type	Access	PDO Mappings	Value	Saving to EEPROM
2702h	0	Number of entries	USINT	RO	No	2	No
	1	Numerator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes
	2	Denominator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes

Setting range: 1/128 ≤ Numerator/Denominator ≤ 8,388,608

(Alarm A.A20 will be detected if the setting exceeds the setting range.)

Example

Speed Reference Unit Setting Example (Electronic Gear Ratio Setting Example for a Ball Screw)

Velocity User Unit (2702h)
 Converting one user-defined velocity reference unit [0.1 mm/s] into [inc/s]:

$$= \frac{16,777,216 \text{ [inc]} \times (1/16)}{6 \text{ [mm]}} \times 0.1 \text{ [mm/s]}$$

$$= \frac{1,048,576}{60} \text{ [inc/s]}$$

Therefore, the objects are set as follows: Object 2702h: 01 (Numerator) = 1,048,576 Object 2702h: 02 (Denominator) = 60 5.14.3 Setting the Acceleration Reference Unit

5.14.3 Setting the Acceleration Reference Unit

Set the acceleration reference unit [Acc. Unit] in acceleration user unit (2703h).



For a Rotary Servomotor with an encoder resolution of 24 bits (16,777,216), Pn20E (Electronic Gear Ratio (Numerator)) is automatically set to 16 and Pn210 (Electronic Gear Ratio (Denominator)) is automatically set to 1. Therefore, the encoder resolution will be equivalent to 20 bits (1,048,576). Consider this when you set the position reference unit in *position user unit* (2701h).

Index	Subin- dex	Name	Data Type	Access	PDO Mappings	Value	Saving to EEPROM
2703h	0	Number of entries	USINT	RO	No	2	No
	1	Numerator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes
	2	Denominator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes

Setting range: 1/128 ≤ Numerator/Denominator ≤ 262,144

(Alarm A.A20 will be detected if the setting exceeds the setting range.)

Example

Acceleration Reference Unit Setting Example (Electronic Gear Ratio Setting Example for a Ball Screw)

Acceleration User Unit (2703h)
 Converting one user-defined acceleration reference unit [0.1 mm/s²] into [10⁴ inc/s²]:

$$= \frac{16,777,216 \text{ [inc]} \times (1/16)}{6 \text{ [mm]}} \times 0.1 \text{ [mm/s}^2] \times 10^{-4}$$
$$= \frac{1,048,576}{6 \times 10^{-5}} \text{ [10}^4 \text{ inc/s}^2]$$

Therefore, the objects are set as follows: Object 2703h: 01 (Numerator) = 1,048,576 Object 2703h: 02 (Denominator) = 600,000

5.14.4 Setting the Torque Reference Unit

Set the torque reference unit [Torque Unit] in torque user unit (2704h).

Index	Subin- dex	Name	Data Type	Access	PDO Mappings	Value	Saving to EEPROM
	0	Number of entries	USINT	RO	No	2	No
2704h	1	Numerator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes
	2	Denominator	UDINT	RW	No	1 to 1,073,741,823 (default: 10)	Yes

Setting range: 1/256 ≤ Numerator/Denominator ≤ 1

(Alarm A.A20 will be detected if the setting exceeds the setting range.)

5.14.5 Setting the Encoder Resolution

If you use an SGM7J, SGM7A, SGM7P, SGM7G, SGM7E, or SGM7F Servomotor, you can set the resolution of the encoder to 20 bits or 24 bits.

Set the encoder resolution in encoder selection (2705h).

Index	Subin- dex	Name	Data Type	Access	PDO Mappings	Value	Saving to EEPROM
2705h	0	Encoder Selection	USINT	RW	No	0000h (20 bits), 0001h (24 bits) (default: 0000h)	Yes

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

A CAUTION

 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

- 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

- The parameters must not be write prohibited.
- The servo must be OFF to reset the absolute encoder.
- You cannot use the Alarm/Warning Clear (Fault Reset) 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 \(\sigma\) alarm (Internal Encoder Monitoring Alarm) occurs, turn OFF the power supply to reset the alarm.

5.15.2 Applicable Tools

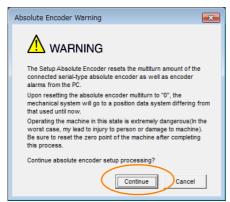
The following table lists the tools that you can use to reset the absolute encoder and the applicable tool functions.

Tool	Function	Reference		
Digital Operator	Fn008	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)		
SigmaWin+	Setup - Absolute Encoder Reset	5.15.3 Operating Procedure on page 5-52		
EtherCAT (CoE) communications	SERVOPACK Adjusting Command (2710h)	SERVOPACK Adjusting Command (2710h) on page 14-19		

5.15.3 Operating Procedure

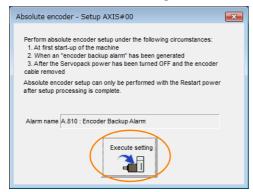
Use the following procedure to reset the absolute encoder.

- 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 Absolute Encoder Reset 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.

6. Click the Continue Button.



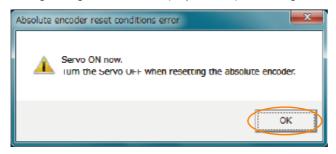
Click the Cancel Button to cancel resetting the absolute encoder. The previous dialog box will return.

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.



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.



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

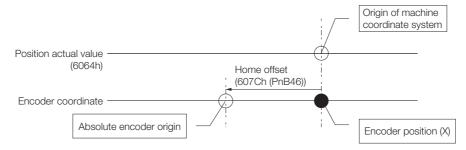
The origin offset of the absolute encoder is a correction that is used to set the origin of the machine coordinate system in addition to the origin of the absolute encoder. Set the offset between the absolute encoder origin and the machine coordinate system position in *home off-set* (607Ch).

The offset is added to *position actual value* (6064h) after the parameters are enabled when the power supply is turned ON or with *user parameter configuration* (2700h).

Index	Subindex	Name	Data Type	Access	Data Ranges	Default Value	Saving to EEPROM
607Ch	0	Home offset	DINT	RW	-536,870,912 to 536,870,911	0	Yes

Example

If the encoder position (X) is at the origin (0), then *home offset* (607Ch) would be set to the value of -X.



5.16.2 Setting the Origin of the Absolute Linear Encoder

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

From 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-



- 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

The following conditions must be met to set the origin of the absolute linear encoder.

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

5.16.2 Setting the Origin of the Absolute Linear Encoder

Applicable Tools

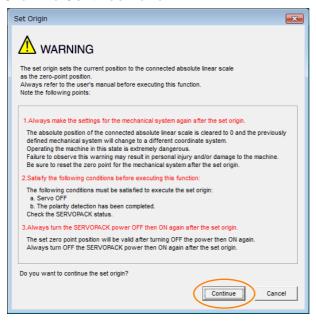
The following table lists the tools that you can use to set the origin of the absolute linear encoder and the applicable tool functions.

Tool	Function	Reference
Digital Operator	Fn020	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Set Origin	© Operating Procedure on page 5-55

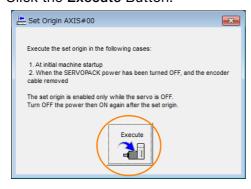
Operating Procedure

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 Set Origin in the Menu Dialog Box. The Set Origin Dialog Box will be displayed.
- 3. Click the Continue Button.



4. Click the Execute Button.



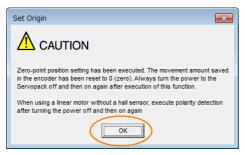
5.16.2 Setting the Origin of the Absolute Linear Encoder

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.

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.

5.9 Polarity Detection on page 5-24

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 Resistance).

Refer to the following manual to select the capacity of a Regenerative Resistor.

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

MARNING

- 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 Resist	or Capacity		Speed Position Torque		
Pn600	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
(2600h)	0 to SERVOPACK's maximum applica- ble motor capacity	10 W	0	Immediately	Setup	
D=000	Regenerative Resist	ance	Speed Pos	Sition Torque		
Pn603 (2603h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
(200011)	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 (\times 10 W) (100 W \times 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 I/O Signal Allocations

Functions are allocated to the pins on the I/O signal connector (CN1) in advance. You can change the allocations and the polarity for some of the connector pins. Function allocations and polarity settings are made with parameters.

This section describes the I/O signal allocations.

6.1.1 Input Signal Allocations



- If you change the default polarity settings for the P-OT (Forward Drive Prohibit) or N-OT
 (Reverse Drive Prohibit) signal, the overtravel function will not operate if there are signal line disconnections or other problems. If you must change the polarity of one of these signals, verify operation and make sure that no safety problems will exist.
- If you allocate two or more signals to the same input circuit, a logical OR of the inputs will be
 used and all of the allocated signals will operate accordingly. This may result in unexpected
 operation.

The input signals that you can allocate to the pins on the I/O signal connector (CN1) and the related parameters are given in the following table.

Input Signal	Input Signal Name	Parameter
P-OT	Forward Drive Prohibit	Pn50A (250Ah) = n.X□□□
N-OT	Reverse Drive Prohibit	Pn50B (250Bh) = n.□□□X
/P-CL	Forward External Torque Limit	Pn50B (250Bh) = n.□X□□
/N-CL	Reverse External Torque Limit	Pn50B (250Bh) = n.X□□□
/Probe1	Probe 1 Latch Input	Pn511 (2511h) = n.□□X□
/Probe2	Probe 2 Latch Input	Pn511 (2511h) = n.□X□□
/Home	/Home Input	Pn511 (2511h) = n.X□□□
FSTP	Forced Stop Input	Pn516 (2516h) = n.□□□X

Relationship between Parameter Settings, Allocated Pins, and Polarities

The following table shows the relationship between the input signal parameter settings, the pins on the I/O signal connector (CN1), and polarities.

Parameter Setting	Pin No.	Description
0	13	
1	7	+24 V
2	8	
3	9	A reverse signal (a signal with "/" before the signal abbreviation, such as the /
4	10	P-CL signal) is active when the contacts are ON (closed).
5	11	A signal that does not have "/" before the signal abbreviation (such as the P-OT signal) is active when the contacts are OFF (open).
6	12	or digitally to active when the contacte are of the porty.
7	_	The input signal is not allocated to a connector pin and it is always active. If the signal is processed on a signal edge, then it is always inactive.
8	_	The input signal is not allocated to a connector pin and it is always inactive. Set the parameter to 8 if the signal is not used.
-		·

Continued on next page.

6.1.2 Output Signal Allocations

Continued from previous page.

Parameter Setting	Pin No.	Description
9	13	
А	7	+24 V
В	8	
С	9	A reverse signal (a signal with "/" before the signal abbreviation, such as the /
D	10	P-CL signal) is active when the contacts are OFF (open).
E	11	A signal that does not have "/" before the signal abbreviation (such as the P-OT signal) is active when the contacts are ON (closed).
F	12	

Note: 1. You can allocate the /Probe1, /Probe2, and /Home input signals only to pins 10 to 12 on the I/O signal connector (CN1).

Example of Changing Input Signal Allocations

The following example shows reversing the P-OT (Forward Drive Prohibit) signal allocated to CN1-7 and the /DEC (Origin Return Deceleration Switch) signal allocated to CN1-9.

Pn50A = n.1
$$\square$$
1 Pn511 = n. \square 2 Before change

$$\downarrow \qquad \qquad \downarrow$$
Pn50A = n.3 \square 2 Pn511 = n. \square 2 After change

Refer to the following section for the parameter setting procedure.

5.1.3 Setting Methods for SERVOPACK Parameters on page 5-5

Confirming Input Signals

You can confirm the status of input signals on the I/O signal monitor. Refer to the following section for information on the I/O signal monitor.

9.2.3 I/O Signal Monitor on page 9-5

6.1.2 Output Signal Allocations

You can allocate the desired output signals to pins 1, 2, and 23 to 26 on the I/O signal connector (CN1). You set the allocations in the following parameters: Pn50E, Pn50F, Pn510, and Pn514.



- The signals that are not detected are considered to be OFF. For example, the /COIN (Positioning Completion) signal is considered to be OFF during speed control.
- Reversing the polarity of the /BK (Brake) signal, i.e., changing it to positive logic, will prevent the holding brake from operating if its signal line is disconnected. If you must change the polarity of this signal, verify operation and make sure that no safety problems will exist.
- If you allocate more than one signal to the same output circuit, a logical OR of the signals will be output.

Output signals are allocated as shown in the following table.

Refer to Interpreting the Output Signal Allocation Tables and change the allocations accordingly.

^{2.} Refer to the following section for details on input signal parameter settings.

^{16.1.2} List of Parameters on page 16-3

Interpreting the Output Signal Allocation Tables

These columns give the parameter settings to use. Signals are allocated to CN1 pins according to the settings.

Output Signal Name	Output Signals		CN1 Pin No.		Disabled
and Parameter	. 0	1 and 2	23 and 24	25 and 26	(Not Used)
Brake Pn50F (250Fh) = □X□□	/BK	1	2	3	0

Output Signal Name and	Output Sig-		CN1 Pin No.		Disabled
Parameter	nals	1 and 2	23 and 24	25 and 26	(Not Used)
Positioning Completion Pn50E (250Eh) = n.□□□X	/COIN	1	2	3	0 (default setting)
Speed Coincidence Detection Pn50E (250Eh) = n.□□X□	/V-CMP	1	2	3	0 (default setting)
Rotation Detection Pn50E (250Eh) = n.□X□□	/TGON	1	2	3	0 (default setting)
Servo Ready Pn50E (250Eh) = n.X□□□	/S-RDY	1	2	3	0 (default setting)
Torque Limit Detection Pn50F (250Fh) = n.□□□X	/CLT	1	2	3	0 (default setting)
Speed Limit Detection Pn50F (250Fh) = n.□□X□	/VLT	1	2	3	0 (default setting)
Brake Pn50F (250Fh) = n.□X□□	/BK	1 (default setting)	2	3	0
Warning Pn50F (250Fh) = n.X□□□	/WARN	1	2	3	0 (default setting)
Near Pn510 (2510h) = n.□□□X	NEAR	1	2	3	0 (default setting)
Preventative Maintenance Pn514 (2514h) = n.□X□□	/PM	1	2	3	0 (default setting)
Pn512 (2512h) = n.□□□1		ry for CN1-1 and N1-2			0 (default setting)
Pn512 (2512h) = n.□□1□	Reverse polarity for CN1-23 and CN1-24			The polarity is not reversed in the default	
Pn512 (2512h) = n.□1□□	Reverse polarity for CN1-25 and CN1-26			settings.	

Example of Changing Output Signal Allocations

The following example shows disabling the /COIN (Positioning Completion) signal allocated to CN1-25 and CN1-26 and allocating the /SRDY (Servo Ready) signal.

Pn50E = n.0 \square 3 Before change \downarrow Pn50E = n.3 \square 0 After change

Refer to the following section for the parameter setting procedure.

5.1.3 Setting Methods for SERVOPACK Parameters on page 5-5

6.1.3 ALM (Servo Alarm) Signal

Checking Output Signal Status

You can confirm the status of output signals on the I/O signal monitor. Refer to the following section for information on the I/O signal monitor.

9.2.3 I/O Signal Monitor on page 9-5

6.1.3 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.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	ALM	CN1-3 and CN1-4	ON (closed)	Normal SERVOPACK status
Output	ALIVI	ONT-5 and ONT-4	OFF (open)	SERVOPACK alarm

Alarm Reset Methods

Refer to the following section for information on the alarm reset methods.
15.2.3 Resetting Alarms on page 15-41

6.1.4 /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.

The /WARN (Warning) signal indicates that a condition exists that may result in an alarm.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output /WARN	ΛΛ/Λ DNI	Must be allocated.	ON (closed)	Warning
	/ VVAIN		OFF (open)	Normal status

Note: You must allocate the /WARN signal to use it. Use Pn50F = n.XDDD (/WARN (Warning Output) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

6.1.2 Output Signal Allocations on page 6-4

6.1.5 /TGON (Rotation Detection) Signal

The /TGON signal indicates that the Servomotor is operating.

This signal is output when the shaft of the Servomotor rotates at the setting of Pn502 (Rotation Detection Level) or faster or the setting of Pn581 (Zero Speed Level) or faster.

Туре	Signal	Connector Pin No.	Signal Status	Servomotor	Meaning
Output /T		Must be allocated.	ON (closed)	Rotary Servomotors	The Servomotor is operating at the setting of Pn502 or faster.
			ON (closed)	Linear Servomotors	The Servomotor is operating at the setting of Pn581 or faster.
	/TGON		055 ()	Rotary Servomotors	The Servomotor is operating at a speed that is slower than the setting of Pn502.
			OFF (open)	en) Linear Servomotors	The Servomotor is operating at a speed that is slower than the setting of Pn581.

Note: You must allocate the /TGON signal to use it. Use Pn50E = n.\(\Delta\text{D}\Delta\) (/TGON (Rotation Detection Output) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

6.1.2 Output Signal Allocations on page 6-4

Setting the Rotation Detection Level

Use the following parameter to set the speed detection level at which to output the /TGON signal.

· Rotary Servomotors

D 500	Rotation Detection I	Level	Speed Position	Torque	
Pn502 (2502h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(2502n)	1 to 10,000	1 min ⁻¹	20	Immediately	Setup

Linear Servomotors

D== C01	Zero Speed Level		Speed Position	Force	
Pn581 (2581h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(256111)	1 to 10,000	1 mm/s	20	Immediately	Setup

6.1.6 /S-RDY (Servo Ready) Signal

The /S-RDY (Servo Ready) signal turns ON when the SERVOPACK is ready to accept the Servo ON command (Enable Operation 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.
- If a Servomotor without a polarity sensor is used, polarity detection has been completed. *
- * Do not include this condition if the Servo ON command (Enable Operation command) is input for the first time after the control power supply was turned ON. In that case, when the first Servo ON command (Enable Operation command) is input, polarity detection is started immediately and the /S-RDY signal turns ON at the completion of polarity detection.

6.1.7 /V-CMP (Speed Coincidence Detection) Signal

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	starut (C.DDV	Must be allocated.	ON (closed)	Ready to receive Servo ON command (Enable Operation command).
Output /	/3-ND1		OFF (open)	Not ready to receive Servo ON command (Enable Operation command).

Note: 1. You must allocate the /S-RDY signal to use it. Use Pn50E = n.XDDD (/S-RDY (Servo Ready) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

6.1.2 Output Signal Allocations on page 6-4

2. Refer to the following section for information on the hard wire base block and the /S-RDY signal.

11.2.8 /S-RDY (Servo Ready Output) Signal on page 11-10

6.1.7 /V-CMP (Speed Coincidence Detection) Signal

The /V-CMP (Speed Coincidence Output) signal is output when the Servomotor speed is the same as the reference speed. This signal is used, for example, to interlock the SERVOPACK and the host controller. You can use this output signal only during speed control.

The /V-CMP signal is described in the following table.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output /V-CMP	Must be allocated.	ON (closed)	The speed coincides.	
		OFF (open)	The speed does not coincide.	

Note: You must allocate the /V-CMP signal to use it. Use Pn50E = n.□□X□ (/V-CMP (Speed Coincidence Detection Output) Signal Allocation) to allocate the signal to connector pins. Refer to the following section for details on allocations.

6.1.2 Output Signal Allocations on page 6-4

You can set the speed detection width for the /V-CMP signal in Pn503 (Speed Coincidence Detection Signal Output Width) for a Rotary Servomotor or in Pn582 (Speed Coincidence Detection Signal Output Width) for a Linear Servomotor.

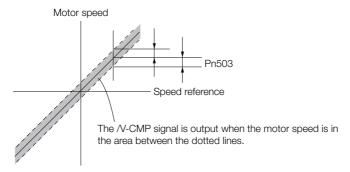
Rotary Servomotors

D 500	Speed Coincidence	Speed			
Pn503 (2503h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(230311)	0 to 100	1 min ⁻¹	10	Immediately	Setup

The signal is output when the difference between the reference speed and motor speed is equal or less than the setting.

Example

If Pn503 is set to 100 and the speed reference is 2,000 min⁻¹, the signal would be output when the motor speed is between 1,900 and 2,100 min⁻¹.



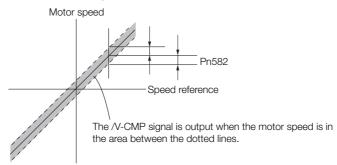
Linear Servomotors

D 500	Speed Coincidence	Speed			
Pn582 (2582h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200211)	0 to 100	1 mm/s	10	Immediately	Setup

The signal is output when the difference between the reference speed and motor speed is equal or less than the setting.

Example

If Pn582 is set to 100 and the speed reference is 2,000 mm/s the signal would be output when the motor speed is between 1,900 and 2,100 mm/s.



6.1.8 /COIN (Positioning Completion) Signal

The /COIN (Positioning Completion) signal indicates that Servomotor positioning has been completed during position control.

The /COIN signal is output when the difference between the reference position output by the host controller and the current position of the Servomotor (i.e., the position deviation as given by the value of the deviation counter) is equal to or less than the setting of the positioning completed width (Pn522).

Use this signal to check the completion of positioning from the host controller.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output /COIN	Must be allocated.	ON (closed)	Positioning has been completed.	
		OFF (open)	Positioning has not been completed.	

Note: You must allocate the /COIN signal to use it. Use Pn50E = n. \$\square\$ (/COIN (Positioning Completion Output) Signal Allocation) to allocate the signal to connector pins. Refer to the following section for details on allocations.

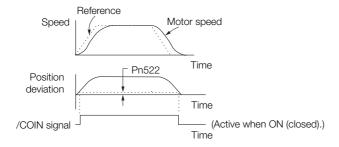
6.1.2 Output Signal Allocations on page 6-4

Setting the Positioning Completed Width

The /COIN signal is output when the difference between the reference position and the current position (i.e., the position deviation as given by the value of the deviation counter) is equal to or less than the setting of the positioning completed width (Pn522).

D=500	Positioning Complet	ted Width	Position	n	
Pn522 (2522h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(232211)	0 to 1,073,741,824	1 reference unit	7	Immediately	Setup

The setting of the positioning completed width has no effect on final positioning accuracy.



Note: If the parameter is set to a value that is too large, the /COIN signal may be output when the position deviation is low during a low-speed operation. If that occurs, reduce the setting until the signal is no longer output.

6.1.9 /NEAR (Near) Signal

Setting the Output Timing of the /COIN (Positioning Completion Output) Signal

You can add a reference input condition to the output conditions for the /COIN signal to change the signal output timing.

If the position deviation is always low and a narrow positioning completed width is used, change the setting of $Pn207 = n.X \square \square \square \square$ (/COIN (Positioning Completion Output) Signal Output Timing) to change output timing for the /COIN signal.

Parameter		Description	When Enabled	Classification
	n.0□□□ (default setting)	Output the /COIN signal when the absolute value of the position deviation is the same or less than the setting of Pn522 (Positioning Completed Width).		
Pn207 (2207h)	n. 1□□□ Output the /COIN signal when the absolute value of the position deviation is the same or less than the setting of Pn522 (Positioning Completed Width) and the reference after the position reference filter is 0.		After restart	Setup
	n. 2000	Output the /COIN signal when the absolute value of the position deviation is the same or less than the setting of Pn522 (Positioning Completed Width) and the reference input is 0.		

6.1.9 /NEAR (Near) Signal

The /NEAR (Near) signal indicates when positioning completion is being approached.

The host controller receives the NEAR signal before it receives the /COIN (Positioning Completion) signal, it can start preparations for the operating sequence to use after positioning has been completed. This allows you to reduce the time required for operation when positioning is completed.

The NEAR signal is generally used in combination with the /COIN signal.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output /NEAR	Must be allocated.	ON (closed)	The Servomotor has reached a point near to positioning completion.	
	Wast be allocated.	OFF (open)	The Servomotor has not reached a point near to positioning completion.	

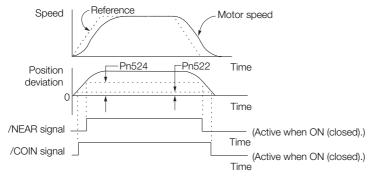
Note: You must allocate the /NEAR signal to use it. Use Pn510 = n. \(\sigma \sqrt{\text{NEAR}}\) (/NEAR (Near) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

6.1.2 Output Signal Allocations on page 6-4

/NEAR (Near) Signal Setting

You set the condition for outputting the /NEAR (Near) signal (i.e., the near signal width) in Pn524 (Near Signal Width). The /NEAR signal is output when the difference between the reference position and the current position (i.e., the position deviation as given by the value of the deviation counter) is equal to or less than the setting of the near signal width (Pn524).

D=504	Near Signal Width				
Pn524 (2524h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(202411)	1 to 1,073,741,824	1 reference unit	1,073,741,824	Immediately	Setup



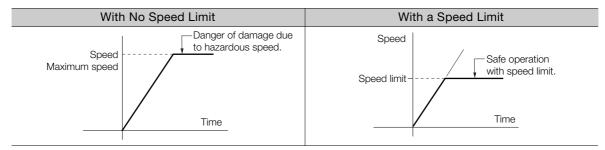
Note: Normally, set Pn524 to a value that is larger than the setting of Pn522 (Positioning Completed Width).

6.1.10 Speed Limit during Torque Control

You can limit the speed of the Servomotor to protect the machine.

When you use a Servomotor for torque control, the Servomotor is controlled to output the specified torque, but the motor speed is not controlled. Therefore, if a reference torque is input that is larger than the machine torque, the speed of the Servomotor may increase greatly. If that may occur, use this function to limit the speed.

Note: The actual limit of Servomotor speed depends on the load conditions on the Servomotor.



/VLT (Speed Limit Detection) Signal

The signal that is output when the motor speed is being limited by the speed limit is described in the following table.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output /VLT		Must be allocated.	ON (closed)	The Servomotor speed is being limited.
	/VLT		OFF (open)	The Servomotor speed is not being limited.

Note: You must allocate the /VLT signal to use it. Use Pn50F = n. \$\square\$ \text{ID} \text{ (/VLT (Speed Limit Detection) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

6.1.2 Output Signal Allocations on page 6-4

6.1.10 Speed Limit during Torque Control

Internal Speed Limiting

Set the speed limit for the motor in Pn407 (Speed Limit during Torque Control) or Pn480 (Speed Limit during Force Control). Also set Pn408 = $n.\square\squareX\square$ (Speed Limit Selection) to specify using the maximum motor speed or the overspeed alarm detection speed as the speed limit. Select the overspeed alarm detection speed to limit the speed to the equivalent of the maximum motor speed.

Parameter		Meaning	When Enabled	Classification
Pn408	n.□□0□ (default setting)	Use the smaller of the maximum motor speed and the setting of Pn407 or Pn480 as the speed limit. After restart		Setup
(2408h)	n.□□1□	Use the smaller of the overspeed alarm detection speed and the setting of Pn407 or Pn480 as the speed limit.	Allei Testart	Setup

Note: If you are using a Rotary Servomotor, set Pn407 (Speed Limit during Torque Control). If you are using a Linear Servomotor, set Pn480 (Speed Limit during Force Control).

Rotary Servomotors

D 407	Speed Limit during	Torque Control			Torque
Pn407 (2407h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(240711)	0 to 10,000	1 min ⁻¹	10000	Immediately	Setup

Linear Servomotors

D 400	Speed Limit during I	Force			
Pn480 (2480h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(246011)	0 to 10,000	1 mm/s	10000	Immediately	Setup

Note: If the parameter setting exceeds the maximum speed of the Servomotor, the Servomotor's maximum speed or the overspeed alarm detection speed will be used.

6.2

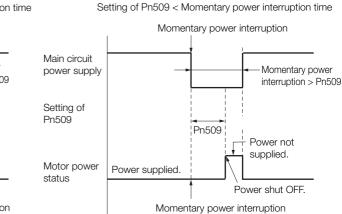
Operation for Momentary Power Interruptions

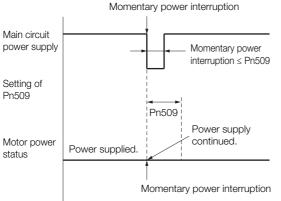
Even if the main power supply to the SERVOPACK is interrupted momentarily, power supply to the motor (servo ON status) will be maintained for the time set in Pn509 (Momentary Power Interruption Hold Time).

	Momentary Power Interruption Hold Time			Speed Position	Torque
Pn509 (2509h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200311)	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.

Setting of Pn509 ≥ Momentary power interruption time





Information

- 1. If the momentary power interruption time exceeds the setting of Pn509, the /S-RDY (Servo Ready) signal will turn 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

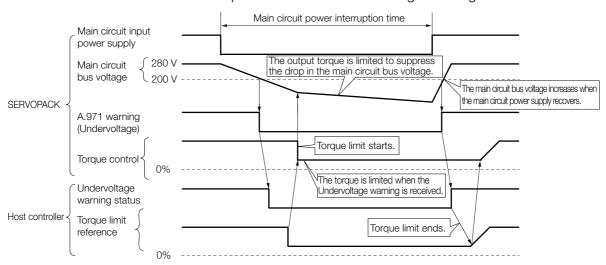
This function can be executed either with the host controller or with the SERVOPACK. Use $Pn008 = n.\square\squareX\square$ (Function Selection for Undervoltage) to specify whether the function is executed by the host controller or by the SERVOPACK.

The default setting (Pn008 = $n.\Box\Box0\Box$) disables detection of an A.971 warning (Undervoltage).

Parameter		Meaning	When Enabled	Classification
	n.□□0□ (default setting)	Do not detect undervoltage.		Setup
	n.□□1□	Detect undervoltage warning and limit torque at host controller.	After restart	
	n.□□2□	To detect undervoltage warnings, use Pn424 (Torque Limit at Main Circuit Voltage Drop) and Pn425 (Release Time for Torque Limit at Main Circuit Voltage Drop). (i.e., only in SERVOPACK).		

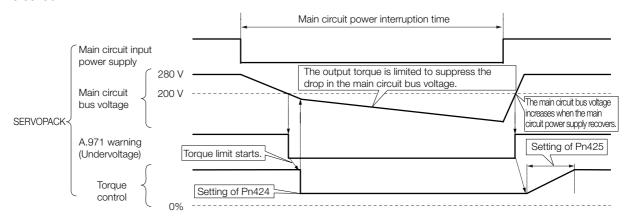
◆ Execution with the Host Controller (Pn008 = n.□□1□)

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.□□2□)

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.

D:- 40.4	Torque Limit at Main Circuit Voltage Drop			Speed Position Torque	
Pn424 (2424h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(272711)	0 to 100	1%*	50	Immediately	Setup
D= 405	Release Time for To	rque Limit at Main C	ircuit Voltage Drop	Speed Position	Torque
Pn425 (2425h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(2 12011)	0 to 1,000	1 ms	100	Immediately	Setup
D 500	Momentary Power Interruption Hold Time			Speed Position	Torque
Pn509 (2509h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200011)	20 to 50,000	1 ms	20	Immediately	Setup

^{*} Set a percentage of the motor rated torque.

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, use the Servo OFF command (Disable Operation command).

6.4

Setting the Motor Maximum Speed

You can set the maximum speed of the Servomotor with the following parameter.

• Rotary Servomotors

D 010	Maximum Motor Sp	eed	Speed Positi	on Torque	
Pn316 (2316h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(2316H)	0 to 65,535	1 min ⁻¹	10,000	After restart	Setup

Linear Servomotors

D=005	Maximum Motor Sp	peed	Speed Positi	on Force	
Pn385 (2385h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200011)	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 6-17

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)
 - Ω Σ-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

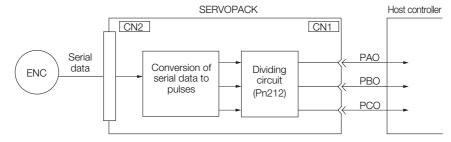
The encoder divided pulse output is a signal that is output from the encoder and processed inside the SERVOPACK. It is then output externally in the form of two phase pulse signals (phases A and B) with a 90° phase differential. At the host controller, it is used as the position feedback.

The following table describes the signals and output phase forms.

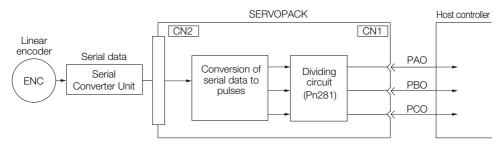
6.5.1 Encoder Divided Pulse Output Signals

Type	Signal	Connector Pin No.	Name	Remarks	
	PAO	CN1-17	Encoder Divided Pulse Output,	Rotary Servomotors These encoder divided pulse output pins output the number	
	/PAO	CN1-18	Phase A	of pulses per Servomotor reso- lution that is set in Pn212 (Number of Encoder Output	
	РВО	CN1-19		Pulses). The phase difference between phase A and phase B is an electric angle of 90°.	
Output	/PBO	CN1-20	Encoder Divided Pulse Output, Phase B	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°.	
	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 a RGS20 Scale and RGH22B Sensor Head on page 6-18
- Rotary Servomotor

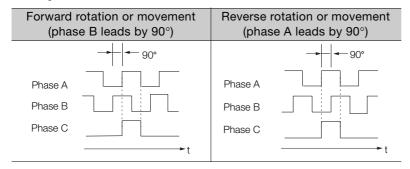


· Linear Servomotors



6.5.1 Encoder Divided Pulse Output Signals

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.□□□1), 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⁻¹ or lower. If the motor speed is higher than 600 min⁻¹, 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.

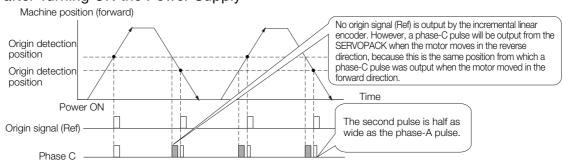
 Relation between Renishaw PLC Incremental Linear Encoders and Encoder Output Pulse Signal from the SERVOPACK When Using a RGS20 Scale and RGH22B Sensor Head

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.

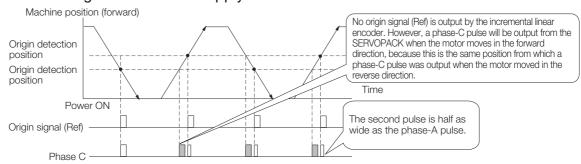
In that case, the phase-C pulse of the SERVOPACK is output at two positions.

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

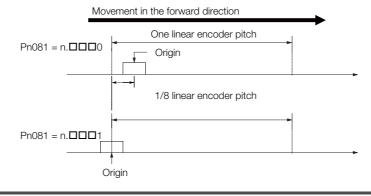
You can also output the encoder's phase-C pulse for reverse movement. To do so, set Pn081 to n. $\Box\Box\Box\Box$ 1.

F	arameter	Meaning	When Enabled	Classification
		Output phase-C pulses only in the forward direction.	After restart	Setup
(2081h)	n.□□□1	Output phase-C pulses in both the forward and reverse directions.	Aitei Testait	Getup



Precautions on Setting the Phase-C Pulse Output Selection (Pn081 = n.□□□X)

- If you set Pn081 to n. \(\sigma\) \(\sigma\) (Output phase-C pulses in both the forward and reverse directions), the width of the phase-C pulse output may be narrower than the width of the phase-A pulse.
- There is a difference of 1/8th of the scale pitch in the phase-C detection position for the encoder's phase-C pulse output position, origin return command, or phase-C latch between when Pn081 = n.□□□X is set to 0 (Output phase-C pulses only in the forward direction) and when it is set to 1 (Output phase-C pulses in both the forward and reverse directions).



Observe the following precaution if you set Pn081 to n. \(\sim \subseteq 0\) (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.□□□1).

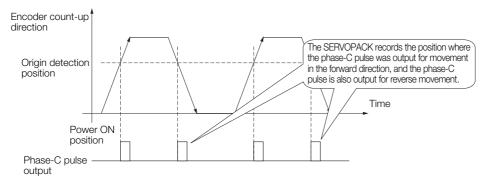
6.5.1 Encoder Divided Pulse Output Signals

Encoder Model	Interpolator	Linear Encoder Pitch [μm]		
SL710	DI 101 DV	800		
SL720	PL101-RY MJ620-T13	800		
SL730		800		
	SR75	80		
	SR85	80		
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.

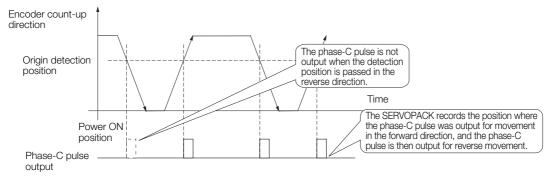
After that, the phase-C pulse is output whenever the origin detection position is passed in the forward or reverse direction.



■ When First Passing the Origin Signal in the Reverse Direction and Returning after Turning ON the Power Supply

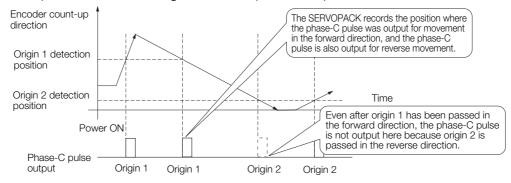
The encoder's phase-C pulse (CN1-19 and CN1-20) is not output when the origin detection position is passed for the first time in the reverse direction after the power supply is turned ON.

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

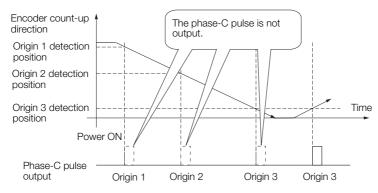
The encoder's phase-C pulse is output when the origin detection position is passed for the first time in the forward direction after the power supply is turned ON. After that, the phase-C pulse is output whenever the origin detection position is passed in the forward or reverse direction.



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

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).

Pn212 (2212h)	Number of Encoder C	Output Pulses	Speed Position	Torque	
	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.

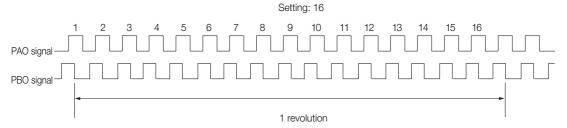
Satting of the Number		En	coder Resoluti	Upper Limit of Servo-	
Setting of the Number of Encoder Output Pulses [P/Rev]	Setting Increment	20 bits (1,048,576 pulses)	22 bits (4,194,304 pulses)	24 bits (16,777,216 pulses)	motor Speed for Set Number of Encoder Output Pulses [min ⁻¹]
16 to 16,384	1	0	0	0	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

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.

2. 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).

Pn281 (2281h)	Encoder Output Re	solution	Speed Posit	ion Force	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 4,096	1 edge/pitch	20	After restart	Setup

Note: The maximum setting for the encoder output resolution is 4,096. Pulse output at a linear encoder resolution of 4,096 or higher is not possible.

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).* 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 ignored. You can use the monitor functions of the SigmaWin+ to check the linear encoder pitch that was automatically detected.

Information

When the linear encoder pitch is $4 \mu m$, the maximum motor speed is limited to 1 mm/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

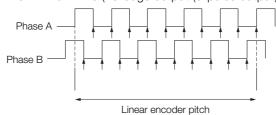
Correct setting for a linear encoder pitch of 20 μ m and a maximum motor speed of 5 m/s (Pn385 = 50): Pn281 = 28 (edges/pitch)

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)



6.6

Software Limits

You can set limits in the software for machine movement that do not use the overtravel signals (P-OT and N-OT). If a software limit is exceeded, an emergency stop will be executed in the same way as it is for overtravel.

Refer to the following section for details on this function.

Software Position Limits (607Dh) on page 14-30

6.7 Selecting Torque Limits

You can limit the torque that is output by the Servomotor.

There are four different ways to limit the torque. These are described in the following table.

Limit Method	Outline	Control Method	Reference
Internal Torque Limits	The torque is always limited with the setting of a parameter.		6.7.1
External Torque Limits	The torque is limited with an input signal from the host computer.		6.7.2
Limiting Torque with controlword (6040h)	A command from the Controller enables the torque limit that is set in a parameter.	Speed control, position control, or	14.6
Limiting Torque with posi- tive torque limit value (60E0h), negative torque limit value (60E1h), and max. torque (6072h)	Torque is controlled with torque limits from the Controller.	torque control	13.7 14.14

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.

6.7.1 Internal Torque Limits

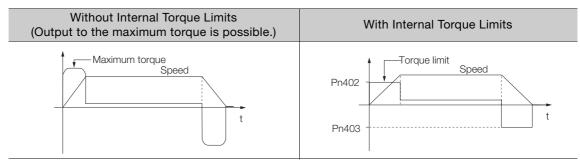
If you use internal torque limits, the maximum output torque will always be limited to the specified forward torque limit (Pn402) and reverse torque limit (Pn403).

Rotary Servomotors

Pn402 (2402h)	Forward Torque Limit			Speed Position Torque		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 800	1%*	800	Immediately	Setup	
D:- 400	Reverse Torque Limit			Speed Position	Torque	
Pn403 (2403h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
(240011)	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.



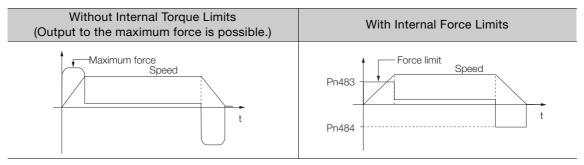
6.7.2 External Torque Limits

Linear Servomotors

Pn483 (2483h)	Forward Force Limit		Speed Position Force		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	30	Immediately	Setup
	Reverse Force Limit		Speed Position Force		
Pn484 (2484h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(240411)	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.



6.7.2 External Torque Limits

You can limit the torque only when required by the operating conditions of the machine by turning a signal ON and OFF.

You can use this for applications such as stopping on physical contact, or holding a workpiece with a robot.

External Torque Limit Reference Signals

The /P-CL (Forward External Torque Limit) and /N-CL (Reverse External Torque Limit) signals are used as the external torque limit reference signals. The /P-CL signal is used for the forward torque limit and the /N-CL signal is used for the reverse torque limit.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/P-CL	Must be allocated.	ON (closed)	Applies the forward external torque limit. The torque is limited to the smaller of the settings of Pn402*1 and Pn404.
			OFF (open)	Cancels the forward external torque limit. The torque is limited to the setting of Pn402*1.
Input	/N-CL	Must be allocated.	ON (closed)	Applies the reverse external torque limit. The torque is limited to the smaller of the settings of Pn403*2 and Pn404.
			OFF (open)	Cancels the reverse external torque limit. The torque is limited to the setting of Pn403*2.

^{*1.} Pn483 is used for a Linear Servomotor.

Note: You must allocate the /P-CL and /N-CL signals to use them. You can use the following parameters to allocate the signal to a terminal.

^{*2.} Pn484 is used for a Linear Servomotor.

Pn50B = n.□X□□ (/P-CL (Forward External Torque Limit Input) Signal Allocation)

[•] Pn50B = n.X□□□ (/N-CL (Reverse External Torque Limit Input) Signal Allocation) Refer to the following section for details.

^{6.1.1} Input Signal Allocations on page 6-3

Setting the Torque Limits

The parameters that are related to setting the torque limits are given below.

Rotary Servomotors

If the setting of Pn402 (Forward Torque Limit), Pn403 (Reverse Torque Limit), Pn404 (Forward External Torque Limit), or Pn405 (Reverse External Torque Limit) is too low, the torque may be insufficient for acceleration or deceleration of the Servomotor.

Pn402 (2402h)	Forward Torque Lim	it		Speed Position	Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(240211)	0 to 800	1%*	800	Immediately	Setup
D 400	Reverse Torque Limit			Speed Position	on Torque
Pn403 (2403h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(240011)	0 to 800	1%*	800	Immediately	Setup
D= 404	Forward External Torque Limit			Speed Position	on Torque
Pn404 (2404h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(240411)	0 to 800	1%*	100	Immediately	Setup
Pn405 (2405h)	Reverse External To	rque Limit		Speed Position	on Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	100	Immediately	Setup

^{*} Set a percentage of the rated motor torque.

• Linear Servomotors

If the setting of Pn483 (Forward Force Limit), Pn484 (Reverse Force Limit), Pn404 (Forward External Force Limit), or Pn405 (Reverse External Force Limit) is too low, the force may be insufficient for acceleration or deceleration of the Servomotor.

Pn483 (2483h)	Forward Force Limit			Speed Position	n Force	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
(240011)	0 to 800	1%*	30	Immediately	Setup	
D= 404	Reverse Force Limit			Speed Position	Force	
Pn484 (2484h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 800	1%*	30	Immediately	Setup	
Pn404	Forward External Fo	orce Limit		Speed Position Force		
(2404h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
(240411)	0 to 800	1%*	100	Immediately	Setup	
Pn405 (2405h)	Reverse External Fo	Reverse External Force Limit			Force	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 800	1%*	100	Immediately	Setup	

^{*} Set a percentage of the rated motor force.

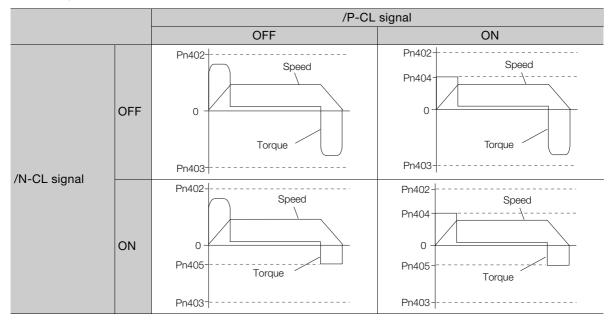
6.7.2 External Torque Limits

Changes in the Output Torque for External Torque Limits

The following table shows the changes in the output torque when the internal torque limit is set to 800%.

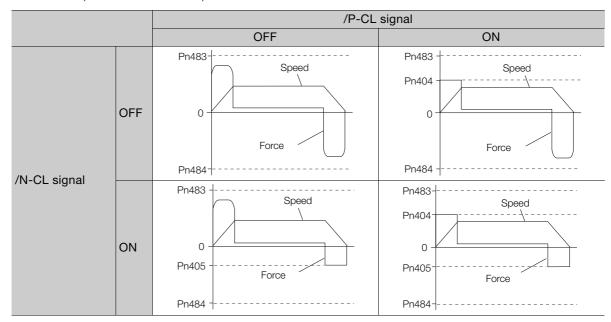
• Rotary Servomotors

It is assumed that counterclockwise is set as the forward direction of motor rotation (Pn000 = $n.\Box\Box\Box\Box$ 0).



• Linear Servomotors

It is assumed that the linear encoder count-up direction is set as the forward direction of motor movement ($Pn000 = n.\square\square\square\square$ 0).



6.7.3 /CLT (Torque Limit Detection) Signal

This section describes the /CLT signal, which indicates the status of limiting the motor output torque.

Туре	Signal	Connector Pin No.	Signal Status	Meaning	
Outrot (O	/CLT	Must be allegated	ON (closed)	The motor output torque is being limited.	
Output	/OLI	Must be allocated.	OFF (open)	The motor output torque is not being limited.	

Note: You must allocate the /CLT signal to use it. Use Pn50F = n. \(\sigma \square\) \(\text{CLT (Torque Limit Detection)}\) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

6.1.2 Output Signal Allocations on page 6-4

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 $Pn002 = n.\Box X \Box \Box$.

SERVOPACKs with software version 0023 or higher support batteryless absolute encoders.

Refer to the following section for encoder models.

■ Encoder Resolution on page 5-45

· Parameter Settings When Using an Incremental Encoder

Parameter		Meaning	When Enabled	Classification
n.□0□□ Use the encoder as an incremental encoder. (default setting) A battery is not required.				
Pn002 (2002h)	n.□1□□	Use the encoder as an incremental encoder. A battery is not required.	After restart	Setup
	n.□2□□	Use the encoder as a single-turn absolute encoder. A battery is not required.		

· Parameter Settings When Using a Single-Turn Absolute Encoder

Parameter		Meaning	When Enabled	Classification
n.□0□□ (default setting) Pn002 (2002h) n.□1□□		Use the encoder as a single-turn absolute encoder. A battery is not required.		
		Use the encoder as an incremental encoder. A battery is not required.	After restart	Setup
	n.□2□□	Use the encoder as a single-turn absolute encoder. A battery is not required.		

· Parameter Settings When Using a Multiturn Absolute Encoder

Parameter		Meaning	When Enabled	Classification
n.□0□□ (default setting)		Use the encoder as a multiturn absolute encoder. A battery is required.		
Pn002 (2002h) n.□1□□		Use the encoder as an incremental encoder. A battery is not required.	After restart	Setup
	n.□2□□	Use the encoder as a single-turn absolute encoder. A battery is not required.		

· Parameter Settings When Using a Batteryless Multiturn Absolute Encoder

Parameter		Meaning	When Enabled	Classification
n.□0□□ (default setting)		Use the encoder as a batteryless multiturn absolute encoder. A battery is not required.	multiturn absolute	
Pn002 (2002h) n.□1□□	n.□1□□	Use the encoder as an incremental encoder. A battery is not required.	After restart	Setup
	n.□2□□	Use the encoder as a single-turn absolute encoder. 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

You can get the position data from the absolute encoder with EtherCAT communications. 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 4-28

4.5.3 I/O Signal Wiring Examples on page 4-38

6.8.2 Structure of the Position Data of the Absolute Encoder

The position data of the absolute encoder is the position coordinate from the origin of the absolute encoder.

If you use the encoder divided pulse output (PAO, PBO, and PCO) signals to get the position information, the position data from the absolute encoder contains the following two items.

- The number of rotations from the origin of the encoder coordinate system (called the multiturn data)
- The position (number of pulses) within one rotation

The position data of the absolute encoder is as follows:

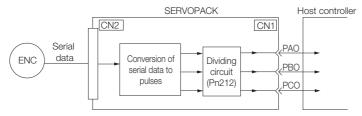
Position data of absolute encoder = Multiturn data × Number of pulses within one encoder rotation (setting of Pn212) + Position (number of pulses) within one rotation.

For a single-turn absolute encoder, the multiturn data is 0.

6.8.3 Output Ports for the Position Data from the Absolute Encoder

You can read the position data of the absolute encoder from the PAO, PBO, and PCO (Encoder Divided Pulse Output) signals.

The output method and timing for the position data of the absolute encoder are different in each case. A conceptual diagram of the connections of the PAO, PBO, and PCO (Encoder Divided Pulse Output) signals to the host controller is provided below.



Signal	Status	Signal Contents	
Signal	Otatus	When Using an Absolute Encoder	
PAO First signal		Multiturn data position within one rotation (pulse train)	
	During normal operation	Incremental pulses	
PBO	First signal	Position within one rotation (pulse train)	
FBO	During normal operation	Incremental pulses	
PCO	Always	Origin pulse	

The PAO (Encoder Divided Pulse Output) signal outputs the position data from the absolute encoder after the control power supply is turned ON.

The position data of the absolute encoder is the current stop position. The absolute encoder outputs the multiturn data with the specified protocol. The absolute encoder outputs the position within one rotation as a pulse train. It then outputs pulses as an incremental encoder (incremental operation status).

6.8.4 Reading the Position Data from the Absolute Encoder

The host controller must have a reception circuit (e.g., UART) for the position data from the absolute encoder. The pulse counter at the host controller will not count pulses when the multiturn data (communications message) is input because only phase A is input. Counting starts from the position of the absolute encoder within one rotation.

The output circuits for the PAO, PBO, and PCO signals use line drivers. Refer to the following section for details on line drivers.

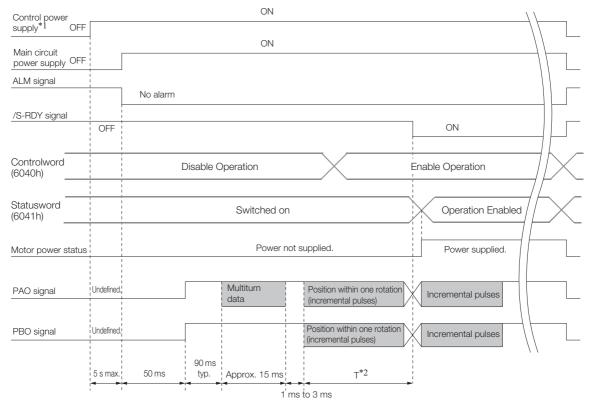
4.5.4 I/O Circuits on page 4-40

6.8.4 Reading the Position Data from the Absolute Encoder

The sequence to read the position data from the absolute encoder of a Rotary Servomotor is given below.

The multiturn data is sent according to the transmission specifications.

The position of the absolute encoder within one rotation is output as a pulse train.



*1. The pulse output time T for the position of the absolute encoder within one rotation depends on the setting of Pn212 (Number of Encoder Output Pulses). Refer to the following table.

Setting of Pn212	Calculation of the Pulse Output Speed for the Position of the Absolute Encoder within One Rotation	Calculation of the Pulse Output Time T for the Position of the Absolute Encoder within One Rotation
16 to 16,384	680 × Pn212/16,384 [kpps]	25 ms max.
16,386 to 32,768	680 × Pn212/32,768 [kpps]	50 ms max.
32,722 to 65,536	680 × Pn212/65,536 [kpps]	100 ms max.
65,544 to 131,072	680 × Pn212/131,072 [kpps]	200 ms max.
131,088 to 262,144	680 × Pn212/262,144 [kpps]	400 ms max.
262,176 to 524,288	680 × Pn212/524,288 [kpps]	800 ms max.
524,352 to 1,048,576	680 × Pn212/1,048,576 [kpps]	1,600 ms max.
1,048,704 to 2,097,152	680 × Pn212/2,097,152 [kpps]	3,200 ms max.
2,097,408 to 4,194,304	680 × Pn212/4,194,304 [kpps]	6,400 ms max.

6.8.5 Transmission Specifications

The position data transmission specifications for the PAO (Encoder Divided Pulse Output) signal are given in the following table.

The PAO signal sends only the multiturn data.

Refer to the following section for the timing of sending the position data from the absolute encoder.

6.8.4 Reading the Position Data from the Absolute Encoder on page 6-32

Item	PAO signal
Synchronization Method	Start-stop synchronization (ASYNC)
Baud Rate	9,600 bps
Start Bits	1 bit
Stop Bits	1 bit
Parity	Even
Character Code	ASCII, 7 bits
Data Format	Refer to Data Format of PAO Signal.
Data Output Period	Only once after the control power supply is turned ON

Data Format of PAO Signal

As shown below, the message format consists of eight characters: "P," the sign, the 5-digit multiturn data, and "CR" (which indicates the end of the message).



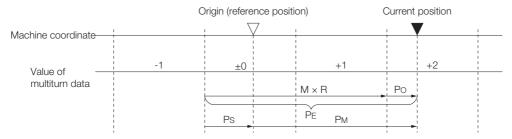
Calculating the Current Position in Machine Coordinates 6.8.6

When you reset the absolute encoder, the reset position becomes the reference position.

The host controller reads the coordinate Ps from the origin of the encoder coordinate system. The host controller must record the value of coordinate Ps.

This section describes the reference position in the machine coordinate system.

The method to calculate the coordinate value of the present position from the origin of the machine coordinate system is given below.



The current position P_{M} in the machine coordinate system is calculated as follows:

$$P_M = P_E - P_S$$

$$P_F = M \times R + P_O$$

$$P_S = M_S \times R + P_S$$

Symbol	Meaning
PE	Position data for the current position of the absolute encoder
М	Current position of the multiturn data of the absolute encoder
Po	Position of the current position within one rotation
P _S	Position data of the absolute encoder when absolute encoder was reset
M _S	Multiturn data of the absolute encoder when absolute encoder was reset
Ps'	Position of the absolute encoder within one rotation when absolute encoder was reset
P _M	Current position in machine coordinate system
R	Pulses output per encoder rotation (value after dividing; setting of Pn212)

Note: The following formulas apply in reverse rotation mode ($Pn000 = n.\square\square\square1$).

$$P_{M} = P_{E} - P_{S}$$

$$P_{E} = -M \times R + P_{O}$$

$$P_{S} = M_{S} \times R + P_{S}$$

Information

1. If you are using a Rotary Servomotor, you must reset the absolute encoder. Refer to the following section for information on resetting the absolute encoder.

5.15 Resetting the Absolute Encoder on page 5-51

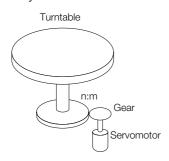
2. You can set the origin to a different position from the reset position. Refer to the following section for information on the origin position offset.

5.16 Setting the Origin of the Absolute Encoder on page 5-54

Multiturn Limit Setting

6.8.7

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.

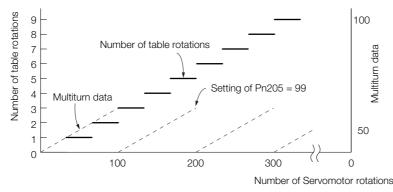
The multiturn limit is used in cases like this to prevent fractions from being produced by the integral ratio of the number of Servomotor rotations and the number of turntable rotations.

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 multiturn 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



D::005	Multiturn Limit Speed Position Torque				
Pn205 (2205h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(220011)	0 to 65,535	1 Rev	65,535	After restart	Setup

Note: This parameter is enabled when you use an absolute encoder.

The data will change as shown below when this parameter is set to anything other than the default setting.

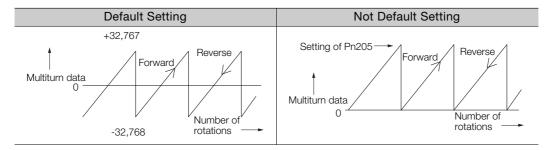
- If the Servomotor operates in the reverse direction when the multiturn data is 0, the multiturn data will change to the value set in Pn205.
- If the motor operates in the forward direction when the multiturn data is at the value set in Pn205, the multiturn data will change to 0.

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.

6.8.8 Multiturn Limit Disagreement Alarm (A.CC0) on page 6-36

6.8.8 Multiturn Limit Disagreement Alarm (A.CC0)



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.□2□□) Absolute encoder-related alarms (A.810 and A.820) will not occur.

6.8.8 Multiturn Limit Disagreement Alarm (A.CC0)

If you change the multiturn limit in Pn205 (Multiturn Limit), an A.CC0 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-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	Function	Operating Procedure Reference
Digital Operator	Fn013	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Multiturn Limit Setting	Operating Procedure on page 6-37
EtherCAT communications	SERVOPACK Adjusting Command (2710h)	SERVOPACK Adjusting Command (2710h) on page 14-19

Operating Procedure

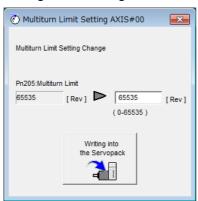
Use the following procedure to adjust the multiturn limit setting.

- 1. Click the 🔑 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Multiturn Limit Setting in the Menu Dialog Box. The Multiturn Limit Setting Dialog Box will be displayed.
- 3. Click the Continue Button.

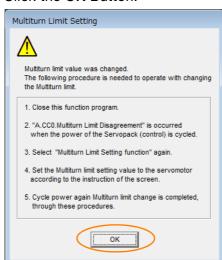


Click the **Cancel** Button to cancel setting the multiturn limit. The Main Window will return.

4. Change the setting.



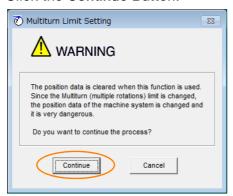
- 5. Click the Writing into the Servopack Button.
- 6. Click the OK Button.



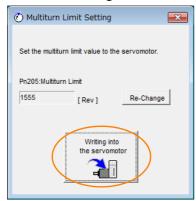
6.8.8 Multiturn Limit Disagreement Alarm (A.CC0)

- 7. Turn the power supply to the SERVOPACK OFF and ON again.

 An A.CCO 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.



10. Click the Writing into the Motor Button.



Click the **Re-change** Button to change the setting.

11. Click the OK Button.



This concludes the procedure to set the multiturn limit.

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 5-46

· Parameter Settings When Using an Incremental Linear Encoder

Parameter		Meaning	When Enabled	Classification
Pn002 (2002h) n.□0□□ (default setting)		Use the encoder as an incremental linear encoder.		Setup
(200211)	n.□1□□	Use the encoder as an incremental linear encoder.		

· Parameter Settings When Using an Absolute Linear Encoder

Parameter		Meaning	When Enabled	Classification
Pn002 (2002h)	n.□0□□ (default setting)	Use the encoder as an absolute linear encoder.	After restart	Setup
(200211)	n.🗆1🗆 🗆	Use the encoder as an incremental linear encoder.		

6.9.1 Connecting an Absolute Linear Encoder

You can get the position data from the absolute linear encoder with EtherCAT communications. 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.

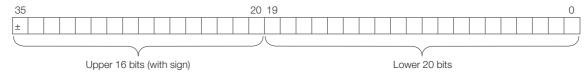
4.4.3 Wiring the SERVOPACK to the Encoder on page 4-28

4.5.3 I/O Signal Wiring Examples on page 4-38

6.9.2 Structure of the Position Data of the Absolute Linear Encoder

The position data of the absolute linear encoder is the distance (number of pulses) from the origin of the absolute linear encoder.

The position data is signed 36-bit data.



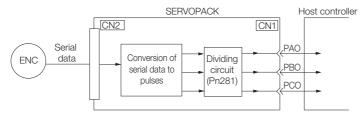
When the SERVOPACK sends the position data, it sends the upper 16-bit data (with sign) separately from the lower 20-bit data.

6.9.3 Output Ports for the Position Data from the Absolute Linear Encoder

You can read the position data of the absolute linear encoder from the PAO, PBO, and PCO (Encoder Divided Pulse Output) signals.

The output method and timing for the position data of the absolute linear encoder are different in each case

A conceptual diagram of the connections of the PAO, PBO, and PCO (Encoder Divided Pulse Output) ports to the host controller is provided below.



Signal	Status	Signal Contents
Signal	Status	When Using an Absolute Linear Encoder
PAO	First signal	Upper 16-bit data (with sign) Lower 20-bit data (pulse train)
	During normal operation	Incremental pulses
PBO	First signal	Lower 20-bit data (pulse train)
1 00	During normal operation	Incremental pulses
PCO	Always	Origin pulse

The PAO (Encoder Divided Pulse Output) signal outputs the position data from the absolute linear encoder after the control power supply is turned ON.

The position data of the absolute linear encoder is the current stop position. The absolute linear encoder outputs the upper 16-bit data (with sign) according to the specified protocol. The absolute encoder outputs the lower 20-bit data as a pulse train. It then outputs pulses as an incremental linear encoder (incremental operation status).

The host controller must have a reception circuit (e.g., UART) for the position data from the absolute linear encoder. The pulse counter at the host controller will not count pulses when the upper 16-bit data (with sign) (communications message) is input because only phase A is input.

The output circuits for the PAO, PBO, and PCO signals use line drivers. Refer to the following section for details on line drivers.

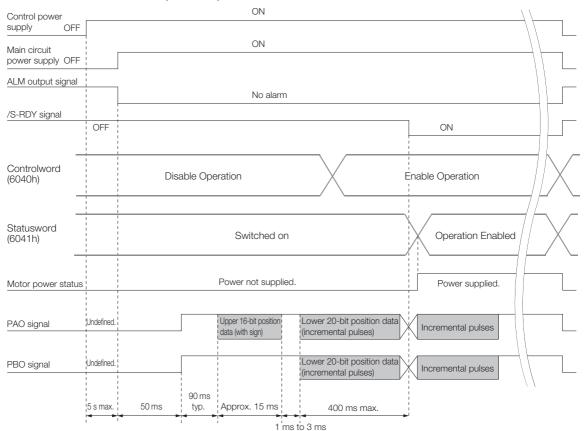
(a) 4.5.4 I/O Circuits on page 4-40

6.9.4 Reading the Position Data from the Absolute Linear Encoder

The sequence to read the position data from the absolute linear encoder of a Linear Servomotor is given below.

The upper 16-bit position data (with sign) are sent according to the transmission specifications.

The lower 20-bit data is output as a pulse train.



6.9.5 Transmission Specifications

The position data transmission specifications for the PAO (Encoder Divided Pulse Output) signal are given in the following table.

The PAO signal sends only the 16-bit data (with sign).

Refer to the following section for the timing of sending the position data from the absolute encoder.

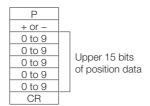
6.9.4 Reading the Position Data from the Absolute Linear Encoder on page 6-41

Item	PAO signal
Synchronization Method	Start-stop synchronization (ASYNC)
Baud Rate	9,600 bps
Start Bits	1 bit
Stop Bits	1 bit
Parity	Even
Character Code	ASCII, 7 bits
Data Format	Refer to Data Format of PAO Signal.
Data Output Period	Only once after the control power supply is turned ON

6.9.6 Calculating the Current Position in Machine Coordinates

Data Format of PAO Signal

As shown below, the message format consists of eight characters: "P," the sign, the 5-digit upper 15-bit position data, and "CR" (which indicates the end of the message).



6.9.6 Calculating the Current Position in Machine Coordinates

With an absolute linear encoder, you must set the position of the origin (i.e., the origin of the machine coordinate system).

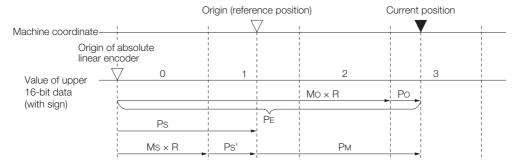
The host controller reads the coordinate from the origin of the encoder coordinate system. The host controller must record the value of this coordinate.

The method to calculate the coordinate value of the present position from the origin of the machine coordinate system is given below.

The position data from the absolute linear encoder is signed 36-bit data, but the upper 16 bits (with sign) and the lower 20 bits are output separately.

For the upper 16-bit data (with sign), the upper bits (16 bits, including the sign) of the current position after dividing by the setting of Pn281 are output with serial communications according to the transmission specifications.

For the lower 20-bit data, the lower bits (20 bits) of the current position after dividing by the setting of Pn281 are output as a pulse train.



The current position P_M in the machine coordinate system is calculated as follows:

$$P_M = P_E - P_S$$

$$P_F = M_O \times R + P_O$$

$$P_S = M_S \times R + P_S$$

Symbol	Meaning
PE	Position data for the current position of the absolute linear encoder
M _O	Upper 16 bits (with sign) of the position data for the current position of the absolute linear encoder
Po	Lower 20 bits of the position data for the current position of the absolute linear encoder
P _S	Position data of the origin
Ms	Upper 16 bits (with sign) of the position data of the origin
P _S '	Lower 20 bits of the position data of the origin
P _M	Current position in machine coordinate system
R	1048576 (=2 ²⁰)

Note: The above formulas also apply in reverse movement mode (Pn000 = $n.\square\square\square1$).

Information

If you are using a Linear Servomotor, you do not need to reset the absolute linear encoder to define the origin. (Some absolute linear encoders also allow you to set any position as the origin.)

6.10 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.
- 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

Confirm that the following conditions are met 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	Function	Operating Procedure Reference
Digital Operator	Fn030	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Software Reset	6.10.3 Operating Procedure on page 6-44

6.10.3 Operating Procedure

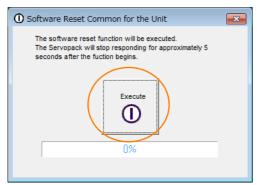
Use the following procedure to perform a software reset.

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



Click the Cancel Button to cancel the software reset. The Main Window will return.

4. Click the Execute Button.



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.



This concludes the procedure to reset the software.

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 Enabled	Classification
n.□□□0 Pn310 (default setting)		Do not detect vibration.		0 - 1
(2310h)	n.□□□1	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 Selections).

· Rotary Servomotors

Detection level = Vibration detection level (Pn312 [min-1]) × Vibration detection sensitivity (Pn311 [%])

Linear Servomotors

Detection level = Vibration detection level (Pn384 [mm/s]) × Vibration detection sensitivity (Pn311 [%])

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).

D=044	Vibration Detection Sensitivity			Speed Position	on Torque
Pn311 (2311h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(201111)	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

Check the following settings 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.□□□0).

6.11.2 Applicable Tools

6.11.2 Applicable Tools

The following table lists the tools that you can use to initialize the vibration detection level and the applicable tool functions.

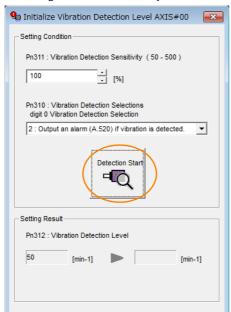
Tool	Function	Operating Procedure Reference
Digital Operator	Fn01B	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Initialize Vibra- tion Detection Level	6.11.3 Operating Procedure on page 6-46

6.11.3 Operating Procedure

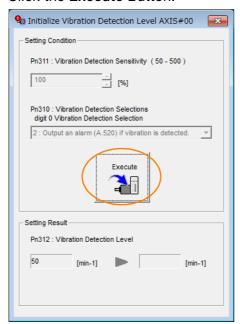
Use the following procedure to initialize the vibration detection level.

- 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.

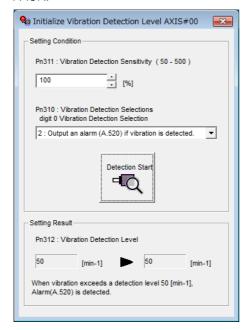
A setting execution standby mode will be entered.



4. Click the Execute Button.



The newly set vibration detection level will be displayed and the value will be saved in the SERVO-PACK.



This concludes the procedure to initialize the vibration detection level.

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 Changes
Pn311 (2311h)	Vibration Detection Sensitivity	Allowed	No
Pn312 (2312h)	Vibration Detection Level	Not allowed	Yes
Pn384 (2384h)	Vibration Detection Level	Not allowed	Yes

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.



The offset does not use a parameter, so it will not change even if the parameter settings are initialized

Preparations

The following conditions must be met to 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	Function	Operating Procedure Reference
Digital Operator	Fn00E	Σ-7-Series Digital Operator Operating Manual (document No. SIEP S800001 33)
SigmaWin+	Setup - Adjust Offset - Adjust the Motor Current Detection Offset	Operating Procedure on page 6-49
EtherCAT communications	SERVOPACK Adjusting Command (2710h)	SERVOPACK Adjusting Command (2710h) on page 14-19

Operating Procedure

Use the following procedure to automatically adjust the motor current detection signal offset.

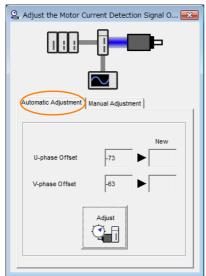
- 1. Click the P Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Adjust the Motor Current Detection Signal Offsets in the Menu Dialog Box. The Adjust the Motor Current Detection Signal Offsets Dialog Box will be displayed.

6.12.1 Automatic Adjustment

3. Click the Continue Button.

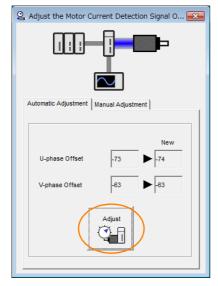


4. Click the **Automatic Adjustment** Tab in the Adjust the Motor Current Detection Signal Offsets Dialog Box.



5. Click the Adjust Button.

The values that result from automatic adjustment will be displayed in the **New** Boxes.



This concludes the procedure to automatically adjust the motor current detection signal offset.

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.

- Operate the Servomotor at a speed of approximately 100 min⁻¹.
- 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.



The offset does not use a parameter, so it will not change even if the parameter settings are initialized.

Preparations

The following conditions must be met to manually adjust the motor current detection signal offset.

• The parameters must not be write prohibited.

Applicable Tools

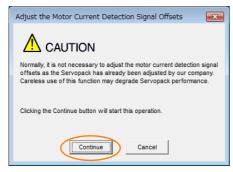
The following table lists the tools that you can use to manually adjust the offset and the applicable tool functions.

Tool	Function	Operating Procedure Reference
Digital Operator	Fn00F	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Adjust Offset - Adjust the Motor Current Detection Offset	Operating Procedure on page 6-51

Operating Procedure

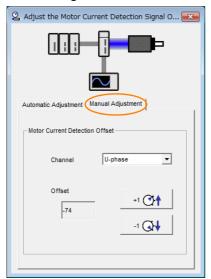
Use the following procedure to manually adjust the motor current detection signal offset.

- 1. Operate the Servomotor at approximately 100 min⁻¹.
- 2. Click the P Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **3.** Select Adjust the Motor Current Detection Signal Offsets 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.



- 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 Forcing the Motor to Stop

You can force the Servomotor to stop for a signal from the host controller or an external device.

To force the motor to stop, you must allocate the FSTP (Forced Stop Input) signal in Pn516 = $n.\Box\Box\Box$ X. You can specify one of the following stopping methods: dynamic brake (DB), coasting to a stop, or decelerating to a stop.

Note: Forcing the motor to stop is not designed to comply with any safety standard. In this respect, it is different from the hard wire base block (HWBB).

Information

Panel Display and Digital Operator Display

When a forced stop is performed, the panel and the Digital Operator will display FSTP.

CAUTION

 To prevent accidents that may result from contact faults or disconnections, use a normally closed switch for the Forced Stop Input signal.

6.13.1 FSTP (Forced Stop Input) Signal

Classifica- tion	Signal	Connector Pin No.	Signal Status	Description
Input	FSTP	Must be allocated.	ON (closed)	Drive is enabled (normal operation).
			OFF (open)	The motor is stopped.

Note: You must allocate the FSTP signal to use it. Use Pn516 = n.□□□X (FSTP (Forced Stop Input) Signal Allocation) to allocate the FSTP signal to a connector pin. Refer to the following section for details.

6.1.1 Input Signal Allocations on page 6-3

6.13.2 Stopping Method Selection for Forced Stops

Use $Pn00A = n.\square\square X\square$ (Stopping Method for Forced Stops) to set the stopping method for forced stops.

Parameter		ameter	Description	When Enabled	Classifi- cation
		n.□□0□	Apply the dynamic brake or coast the motor to a stop (use the stopping method set in $Pn001 = n.\square\square\squareX$).		
		n.□□1□ (default set- ting)	default set- Pn406 as the maximum torque. Use the setting of Pn001		
	Pn00A (200Ah)	n.□□2□	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then let the motor coast.	After restart	Setup
		n.□□3□	Decelerate the motor to a stop using the deceleration time set in Pn30A. Use the setting of Pn001 = n. \(\sigma \square \square X\) for the status after stopping.		
		n.□□4□	Decelerate the motor to a stop using the deceleration time set in Pn30A and then let the motor coast.		

Note: You cannot decelerate a Servomotor to a stop during torque control. For torque control, the Servomotor will be stopped with the dynamic braking or coast to a stop according to the setting of Pn001 = n. \(\sigma \square\$\square\$\square\$\text{(Motor Stopping Method for Servo OFF and Group 1 Alarms)}\).

6.13.2 Stopping Method Selection for Forced Stops

Stopping the Servomotor by Setting Emergency Stop Torque (Pn406)

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

If $Pn00A = n.\Box\Box X\Box$ 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.

Pn406 (2406h)	Emergency Stop Torque			Speed Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	800	Immediately	Setup

^{*} Set a percentage of the motor rated torque.

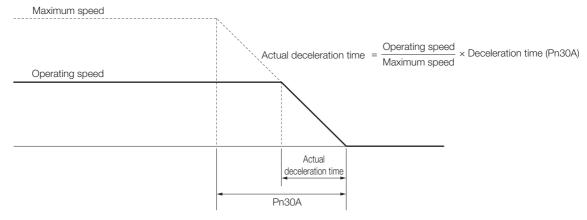
Stopping the Servomotor by Setting the Deceleration Time for Servo OFF and Forced Stops (Pn30A)

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

Pn30A (230Ah)	Deceleration Time for Servo OFF and Forced Stops			Speed Position		
	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.

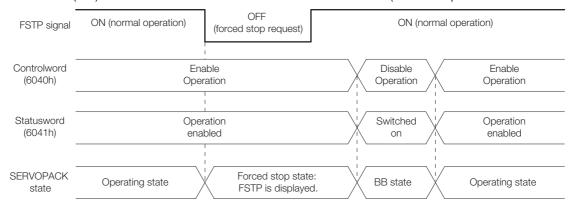


6.13.3 Resetting Method for Forced Stops

This section describes the reset methods that can be used after stopping operation for an FSTP (Forced Stop Input) signal.

If the FSTP (Forced Stop Input) signal is OFF and the Servo ON command (Enable Operation command) is input, the forced stop state will be maintained even after the FSTP signal is turned ON.

Send the Servo OFF command (Disable Operation command) to place the SERVOPACK in the base block (BB) state and then send the Servo ON command (Enable Operation command).



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 (TH) 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 ($Pn61A = n.\square\square\square\square X$).

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

- If you use a Serial Converter Unit, connect the connector for the polarity sensor and thermostat cable of the Linear Servomotor to the Serial Converter Unit.
- If you do not use a Serial Converter Unit, connect the thermostat cable of the Linear Servomotor to CN1-5.

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.

6.14.2 Overheat Protection Selections

The overheat protection function is selected with Pn61A = $n.\Box\Box\Box$ X (Overheat Protection Selections).

Parameter		Meaning	When Enabled	Classifi- cation
n.□□□0 (default set- ting)		Disable overheat protection.		
(261Ah)	n.□□□1	Use overheat protection in the Yaskawa Linear Servomotor.*	After	Setup
	n.□□□2	Monitor a negative voltage input from a sensor attached to the machine and use overheat protection.	restart Solo	·
	n.□□□3	Monitor a positive voltage input from a sensor attached to the machine and use overheat protection.		

^{*} The SGLFW2 is the only Yaskawa Linear Servomotor that supports this function.

Using Overheat Protection in the Yaskawa Linear Servomotor

To use the overheat protection in a Yaskawa Linear Servomotor (SGLFW2), set Pn61A to n. $\Box\Box\Box$ 1.

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. \$\square\$ 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 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.

D-04D	Overheat Alarm Level			Speed Position Torque	
Pn61B (261Bh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(201011)	0 to 500	0.01 V	250	Immediately	Setup
D=040	Overheat Warning L	evel		Speed Position	on Torque
Pn61C (261Ch)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	1%	100	Immediately	Setup
D04D	Overheat Alarm Filt	er Time		Speed Position	on Torque
Pn61D (261Dh)	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. \(\sim \sim \sim \sim \alpha\), an A.862 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).

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
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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 Install the Servomotor and SERVOPACK according to the installation conditions. First, operation is checked with no load. Do not connect the Servomotor to the machine.	Chapter 3 SERVOPACK Installation	
2	Wiring and Connections Wire and connect the SERVOPACK. First, Servomotor operation is checked without a load. Do not connect the CN1 connector on the SERVOPACK.	Chapter 4 Wiring and Connecting SERVOPACKs	
3	Confirmations before Trial Operation	7.2 Inspections and Confirmations before Trial Operation on page 7-6	
4	Power ON	_	
5	Resetting the Absolute Encoder This step is necessary only for a Servomotor with an Absolute Encoder.	5.15 Resetting the Absolute Encoder on page 5-51	

7.1.1 Flow of Trial Operation for Rotary Servomotors

• Trial Operation

Step	Meaning	Reference
1	Trial Operation for the Servomotor without a Load To power supply Secure the motor flange to the machine. Do not connect the motor shaft to the load shaft.	7.3 Trial Operation for the Servomotor without a Load on page 7-7
2	Trial Operation with EtherCAT (CoE) Communications CN6A, to host controller To power CN1, to host controller Secure the motor flange to the machine. Do not connect the motor shaft to the load shaft.	7.4 Trial Operation with EtherCAT (CoE) Communications on page 7-10
3	Trial Operation with the Servomotor Connected to the Machine CN6A, to host controller CN1, to host supply Secure the motor flange to the machine, and connect the motor shaft to the load shaft with a coupling or other means.	7.5 Trial Operation with the Servomotor Connected to the Machine on page 7-11

7.1.2 Flow of Trial Operation for Linear Servomotors

The procedure for trial operation is given below.

• Preparations for Trial Operation

Step	Meaning	Reference
1	Installation Install the Servomotor and SERVOPACK according to the installation conditions. First, operation is checked with no load. Do not connect the Servomotor to the machine.	Chapter 3 SERVOPACK Installation
2	Wiring and Connections Wire and connect the SERVOPACK. First, Servomotor operation is checked without a load. Do not connect the CN1 connector on the SERVOPACK.	Chapter 4 Wiring and Connecting SERVOPACKs
3	Confirmations before Trial Operation	7.2 Inspections and Confirmations before Trial Operation on page 7-6
4	Power ON	_

Setting Parameters in the SERVOPACK

	Step	No. of Parameter to Set	Description	Remarks	Reference
	5-1	Pn282 (2282h)	Linear Encoder Pitch	Set this parameter only if you are using a Serial Converter Unit.	page 5-16
	5-2	_	Writing Parameters to the Linear Servomotor	Set this parameter only if you are not using a Serial Converter Unit.	page 5-17
5	5-3	Pn080 (2080h) = n.□□X□	Motor Phase Sequence Selec- tion	_	page 5-21
	5-4	Pn080 (2080h) = n.□□□X	Polarity Sensor Selection	_	page 5-23
	5-5	_	Polarity Detection	This step is necessary only for a Linear Servomotor with a Polarity Sensor.	page 5-24
	5-6	Pn50A (250Ah) = n.X□□□ and Pn50B (250Bh) = n.□□□X	Overtravel Signal Allocations	_	page 5-27
	5-7	Pn483 (2483h), Pn484 (2484h)	Force Control	_	page 6-25

6 Setting the Origin of the Absolute Linear Encoder

5.16.2 Setting the Origin of the Absolute Linear Encoder on page 5-54

7.1.2 Flow of Trial Operation for Linear Servomotors

• Trial Operation

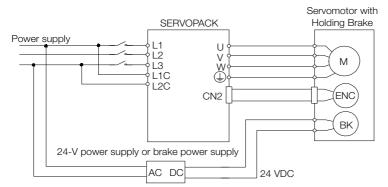
Step	Meaning	Reference
1	Trial Operation for the Servomotor without a Load To power supply Trial Operation with EtherCAT (CoE) Commu-	7.3 Trial Operation for the Servomotor without a Load on page 7-7
2	To power supply CN1, to host controller controller	7.4 Trial Operation with EtherCAT (CoE) Communications on page 7-10
3	Trial Operation with the Servomotor Connected to the Machine To power CN6A, to host controller CN1, to host controller	7.5 Trial Operation with the Servomotor Connected to the Machine on page 7-11

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.



3 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.

⚠ CAUTION

 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 ($Pn170 = n.\square\square\square\square$).

7.3.1 Preparations

Confirm the following conditions before you jog the Servomotor.

- 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

D 004	Jogging Speed			Speed	osition Torque
Pn304 (2304h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(230411)	0 to 10,000	1 min ⁻¹	500	Immediately	Setup
Pn305 (2305h)	Soft Start Acceler	ation Time		Speed	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup
D000	Soft Start Deceler	ation Time		Speed	
Pn306 (2306h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200011)	0 to 10,000	1 ms	0	Immediately	Setup

• Direct Drive Servomotors

Pn304 (2304h)	Jogging Speed			Speed	osition Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200411)	0 to 10,000	0.1 min ⁻¹	500	Immediately	Setup
D 005	Soft Start Acceler	ation Time		Speed	
Pn305 (2305h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200011)	0 to 10,000	1 ms	0	Immediately	Setup
D=000	Soft Start Deceler	ation Time		Speed	
Pn306 (2306h)	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

Pn383 (2383h)	Jogging Speed Speed Position				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 mm/s	50	Immediately	Setup
D 005	Soft Start Acceler	ation Time		Speed	
Pn305 (2305h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup
D000	Soft Start Deceler	ration Time		Speed	
Pn306 (2306h)	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 and the applicable tool functions.

Tool	Function	Operating Procedure Reference
Digital Operator	Fn002	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Test Run - Jog	© Operating Procedure on page 7-8

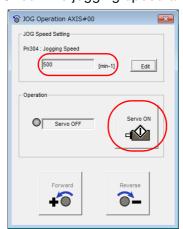
7.3.3 Operating Procedure

Use the following procedure to jog the motor.

- 1. Click the P 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.



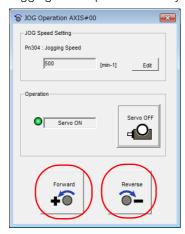
4. Check the jogging speed and then click the Servo ON Button.



The display in the **Operation** Area will change to **Servo ON**.

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 EtherCAT (CoE) Communications

A trial operation example for EtherCAT (CoE) communications is given below.

In this example, operation in Profile Position Mode is described.

Refer to the following chapter for details on operation with EtherCAT (CoE) communications.

Chapter 13 CiA402 Drive Profile

1. Confirm that the wiring is correct, and then connect the I/O signal connector (CN1) and EtherCAT communications connector (CN6A).

Refer to the following chapter for details on wiring.

Chapter 4 Wiring and Connecting SERVOPACKs

2. Set the EtherCAT (CoE) communications station address and PDO mappings.

The PDO mappings are set from the host controller. Refer to the following section for details on PDO mappings.

12.4 PDO Mappings on page 12-6

3. Turn ON the power supplies to the SERVOPACK.

If power is being supplied correctly, the CHARGE indicator on the SERVOPACK will light.

Note: If the COM indicator does not light, recheck the settings of EtherCAT setting switches (S1 and S2) and then turn the power supply OFF and ON again.

4. Place the EtherCAT communications in the Operational state.

Refer to the following chapter for details on the EtherCAT communications status.

12.2 EtherCAT State Machine on page 12-3

5. Set the Modes of Operation to Profile Position Mode.

Refer to the following section for details on Modes of Operation.

Modes of Operation (6060h) on page 14-28

6. Change the *controlword* to supply power to the motor.

When statusword shows the Operation Enabled state, power is supplied to the motor.

Note: Manipulate the objects that were mapped to PDOs. Values will not be written if you manipulate SDOs.

7. Set target position, profile velocity, profile acceleration, and profile deceleration, and then manipulate controlword to start positioning.

Note: Manipulate the objects that were mapped to PDOs. Values will not be written if you manipulate SDOs.

8. While operation is in progress for step 6, confirm the following items.

Confirmation Item	Reference	
Confirm that the rotational direction of the Servomotor agrees with the forward or reverse reference. If they do not agree, correct the rotation direction of the Servomotor.	\$\overline{\pi} 5.4 Motor Direction Setting on page 5-15	
Confirm that no abnormal vibration, noise, or temperature rise occurs. If any abnormalities are found, implement corrections.	15.4 Troubleshooting Based on the Operation and Conditions of the Servomotor on page 15-53	

Note: If the load machine is not sufficiently broken in before trial operation, the Servomotor may become overloaded.

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

MARNING

 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 (P-OT and N-OT signal) before you perform 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.

A4.4 Wiring the SERVOPACK to the Holding Brake on page 4-34

5.11 Holding Brake on page 5-33



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.

Observe the precautions and instructions for wiring and trial operation precisely as described in this manual.

7.5.2 Preparations

Confirm the following items 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 EtherCAT (CoE) Communications on page 7-10 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
 - Allocation of the /BK (Brake) signal to a pin on the I/O signal connector (CN1)
 - · Emergency stop circuit wiring
 - · Host controller wiring

7.5.3 Operating Procedure

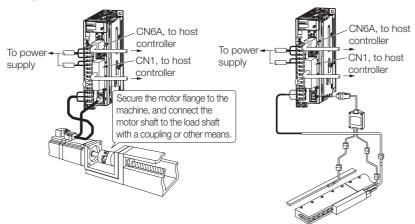
1. Enable the overtravel signals.

5.10.2 Setting to Enable/Disable Overtravel on page 5-28

- 2. Make the settings for the protective functions, such as the safety function, overtravel, and the brake.
 - 4.6 Connecting Safety Function Signals on page 4-42
 - 5.10 Overtravel and Related Settings on page 5-27
 - 5.11 Holding Brake on page 5-33
- 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 EtherCAT (CoE) Communications on page 7-10 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 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

Confirm the following conditions before you perform 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.

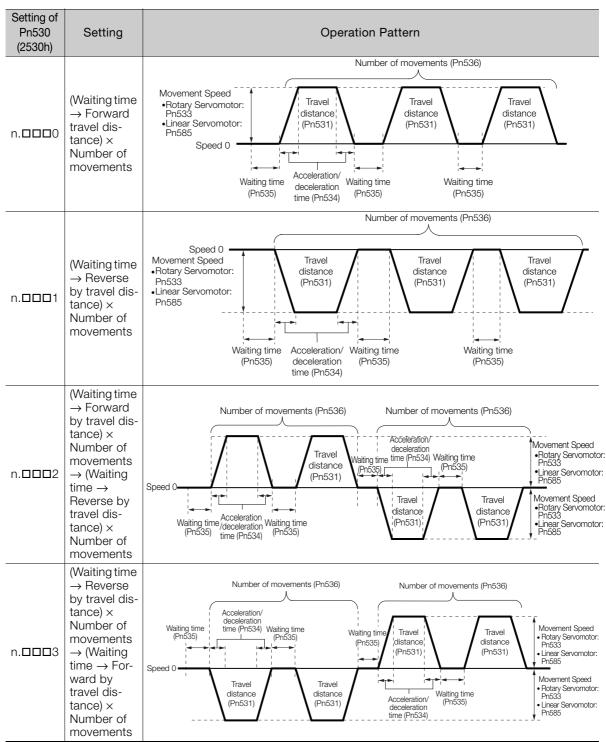
Additional Information

- You can use the functions that are applicable to position control. However, parameters related to motion control through EtherCAT communications are disabled.
- The overtravel function is enabled.
- The software limits are disabled.

7.6.1 Program Jogging

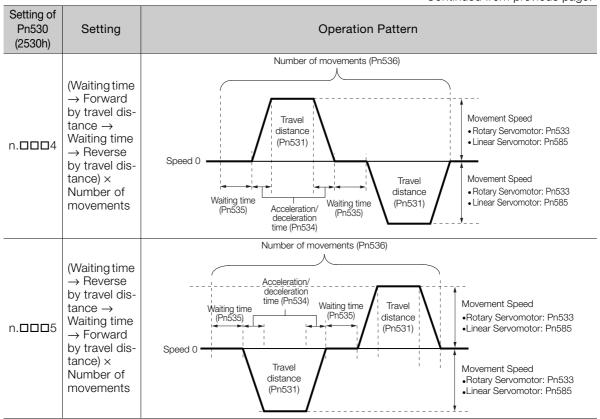
Program Jogging Operation Pattern

An example of a program jogging operation pattern is given below. In this example, the Servo-motor direction is set to $Pn000 = n.\square\square\square\square$ (Use CCW as the forward direction).



Continued on next page.

Continued from previous page.



Information

If Pn530 is set to n.□□□0, n.□□□1, n.□□□4, or n.□□□5, 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.□□□2 or n.□□□3. 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.

7.6.1 Program Jogging

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

D 500	Program Jogging-R	elated Selections		Speed Posit	ion Torque
Pn530 (2530h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200011)	0000 to 0005	_	0000	Immediately	Setup
D= 501	Program Jogging Tr	avel Distance		Speed Posit	ion Torque
Pn531 (2531h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200111)	1 to 1,073,741,824	1 reference unit	32,768	Immediately	Setup
D 500	Program Jogging M	lovement Speed		Speed Po	sition Torque
Pn533 (2533h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200011)	1 to 10,000	1 min ⁻¹	500	Immediately	Setup
D 50.4	Program Jogging Acceleration/Deceleration Time			Speed Posit	ion Torque
Pn534 (2534h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200411)	2 to 10,000	1 ms	100	Immediately	Setup
D., 505	Program Jogging W	aiting Time		Speed Posit	ion Torque
Pn535 (2535h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200011)	0 to 10,000	1 ms	100	Immediately	Setup
D=500	Program Jogging N	umber of Moveme	nts	Speed Po	sition Torque
Pn536 (2536h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200011)	0 to 1,000	1	1	Immediately	Setup

• Direct Drive Servomotors

D 500	Program Jogging-Re	elated Selections		Speed	sition Torque
Pn530 (2530h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200011)	0000 to 0005	-	0000	Immediately	Setup
D 504	Program Jogging Tr	avel Distance		Speed Po	sition Torque
Pn531 (2531h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200111)	1 to 1,073,741,824	1 reference unit	32,768	Immediately	Setup
D 500	Program Jogging M	ovement Speed		Speed Po	sition Torque
Pn533 (2533h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200011)	1 to 10,000	0.1 min ⁻¹	500	Immediately	Setup
D 50.4	Program Jogging Acceleration/Deceleration Time			Speed Po	sition Torque
Pn534 (2534h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200411)	2 to 10,000	1 ms	100	Immediately	Setup
D= 505	Program Jogging W	aiting Time		Speed Po	sition Torque
Pn535 (2535h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(233311)	0 to 10,000	1 ms	100	Immediately	Setup
Daese	Program Jogging No	umber of Movemen	nts	Speed Po	sition Torque
Pn536 (2536h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(255011)	0 to 1,000	1	1	Immediately	Setup

• Linear Servomotors

D., 500	Program Jogging-R	elated Selections		Speed	sition Force
Pn530 (2530h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200011)	0000 to 0005	-	0000	Immediately	Setup
D=501	Program Jogging Tr	avel Distance		Speed	sition Force
Pn531 (2531h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200111)	1 to 1,073,741,824	1 reference unit	32,768	Immediately	Setup
D F0F	Program Jogging M	ovement Speed		Speed	sition Force
Pn585 (2585h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(230311)	1 to 10,000	1 mm/s	50	Immediately	Setup
D 50.4	Program Jogging Acceleration/Deceleration Time			Speed	sition Force
Pn534 (2534h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200411)	2 to 10,000	1 ms	100	Immediately	Setup
D F0F	Program Jogging W	aiting Time		Speed	sition Force
Pn535 (2535h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(233311)	0 to 10,000	1 ms	100	Immediately	Setup
D 500	Program Jogging N	umber of Movemer	nts	Speed	sition Force
Pn536 (2536h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(233011)	0 to 1,000	1	1	Immediately	Setup

Applicable Tools

The following table lists the tools that you can use to perform program jogging and the applicable tool functions.

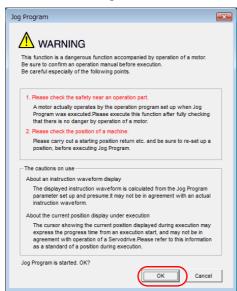
Tool	Function	Reference
Digital Operator	Fn004	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Test Run - Program JOG Operation	@ Operating Procedure on page 7-18

7.6.1 Program Jogging

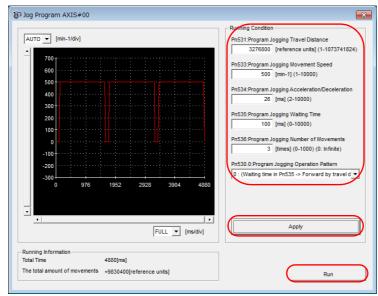
Operating Procedure

Use the following procedure for a program jog operation.

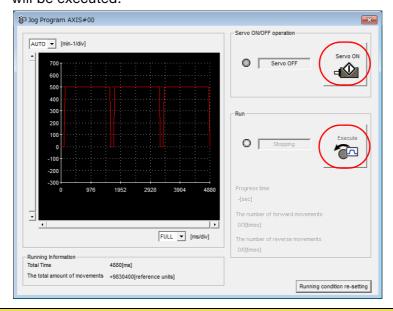
- 1. Click the 🔑 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select JOG Program in the Menu Dialog Box. The Jog Program Dialog Box will be displayed.
- 3. Read the warnings and then click the OK Button.



4. Set the operating conditions, click the Apply Button, and then click the Run Button. A graph of the operation pattern will be displayed.



5. Click the Servo ON Button and then the Execute Button. The program jogging operation will be executed.



A CAUTION

- 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.□□□X).
 - 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

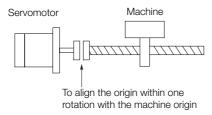
The origin search operation positions the motor to the origin within one rotation and then clamps it there.

⚠ CAUTION

Make sure that the load is not coupled when you execute an origin search.
 The Forward Drive Prohibit (P-OT) signal and Reverse Drive Prohibit (N-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⁻¹
- Direct Drive Servomotors: 6 min⁻¹
- Linear Servomotors: 15 mm/s



Preparations

Confirm the following conditions before you start 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 and the applicable tool functions.

Tool	Function	Reference
Digital Operator	Fn003	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+*	Setup - Origin Search	© Operating Procedure on page 7-20

^{*} Cannot be used when connecting a Linear Servomotor.

Operating Procedure

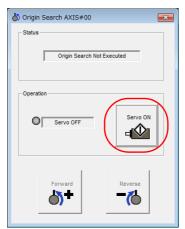
Use the following procedure to perform an origin search.

- 1. Click the P 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.

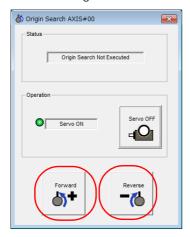


4. Click the Servo ON Button.



5. Click the Forward Button or the Reverse Button.

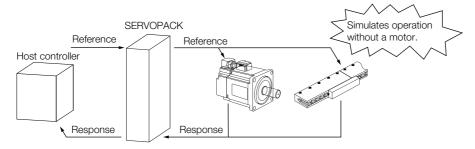
An origin search will be performed only while you hold down the mouse button. The motor will stop when the origin search has been completed.



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 $Pn00C = n.\square\square\square\square X$ to enable or disable the test without a motor.

	P	Parameter Meaning W		When Enabled	Classification
	$D_n \cap \cap \cap$	n.□□□0 (default setting)	Disable tests without a motor.	After restart	Setup
(200Ch)	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 Status	Information That Is Used	Source of Information
	Motor information	
Connected	Encoder information • Encoder resolution • Encoder type	Information in the Servomotor that is connected
Not connected	Motor information • Rated motor speed • Maximum motor speed	Setting of Pn000 = n.X□□□ (Rotary/Linear Startup Selection When Encoder Is Not Connected) 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. Use the monitor displays (Un020: Rated Motor Speed and Un021: Maximum Motor Speed) to check the values.
	Encoder information • Encoder resolution • Encoder type	 Encoder resolution: Setting of Pn00C = n.□□X□ (Encoder Resolution for Tests without a Motor) Encoder type: Setting of Pn00C = n.□X□□ (Encoder Type Selection for Tests without a Motor)

If you use fully-closed loop control, the external encoder information is also used.

External Encoder Connection Status	Information That Is Used	Source of Information
Connected	External encoder information	Information in the external encoder that is connected
Not connected	ResolutionEncoder type	Resolution: 256Encoder type: Incremental encoder

· Linear Servomotors

Motor Connection Status	Information That Is Used	Source of Information
	Motor information	Information in the motor that is connected
Connected	Linear encoder information Resolution Encoder pitch 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 information Resolution Encoder pitch Encoder type	Resolution: 256 Encoder pitch: Setting of Pn282 (Linear Encoder Pitch) Encoder type: Setting of Pn00C = n.□X□□ (Encoder Type Selection for Tests without a Motor)

· Related Parameters

P	arameter	Meaning	When Enabled	Classification
Pn000	n.0□□□ (default setting)	When an encoder is not connected, start as SERVOPACK for Rotary Servomotor.	After restart	Setup
(2000h)	n.1□□□	When an encoder is not connected, start as SERVOPACK for Linear Servomotor.	Alterrestart	Setup

Pn282 (2282h)	Linear Encoder Pitch			Speed	Position Force
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 6,553,600	0.01 μm	0	After restart	Setup

Parameter		Meaning	When Enabled	Classification
Pn00C (200Ch)	n.□□0□ (default setting)	Use 13 bits as encoder resolution for tests without a motor.		Setup
	n.□□1□	Use 20 bits as encoder resolution for tests without a motor.	- After restart	
	n.□□2□	Use 22 bits as encoder resolution for tests without a motor.		
	n.□□3□	Use 24 bits as encoder resolution for tests without a motor.		
	n.□0□□ (default setting)	Use an incremental encoder for tests without a motor.		
	n.□1□□	Use an absolute encoder for tests without a motor.		

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.

7.6.3 Test without a Motor

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

SigmaWin+			Digital Operator	Execu	table?	
Menu Dialog Box Button	SigmaWin+ Function Name	Fn No.	Utility Function Name	Motor Not Connected	Motor Connected	Reference
	Origin Search*1	Fn003	Origin Search	0	0	page 7-20
	Absolute Encoder Reset	Fn008	Reset Absolute Encoder	×	0	page 5-52
	Analog Monitor Out-	Fn00C	Adjust Analog Monitor Output Offset	0	0	page 9-9
	put Adjustment	Fn00D	Adjust Analog Monitor Output Gain	0	0	page 9-9
	Motor Current Detec-	Fn00E	Autotune Motor Current Detection Signal Offset	×	0	naga 6 40
	tion Offset Adjust- ment	Fn00F	Manually Adjust Motor Current Detection Sig- nal Offset	×	0	page 6-49
	Parameter Write Pro- hibition Setting	Fn010	Write Prohibition Set- ting	0	0	page 5-7
Setup	Multiturn Limit Setting	Fn013	Multiturn Limit Setting after Multiturn Limit Disagreement Alarm	×	0	page 6-36
	Reset Configuration Error of Option Mod- ule	Fn014	Reset Option Module Configuration Error	0	0	page 15-43
	Initializing the Vibration Detection Level	Fn01B	Initialize Vibration Detection Level	×	×	page 6-45
	Set Origin	Fn020	Set Absolute Linear Encoder Origin	×	0	page 5-54
	Reset Motor Type Alarm	Fn021	Reset Motor Type Alarm	0	0	-
	Software Reset	Fn030	Software Reset	0	0	page 6-43
	Polarity Detection	Fn080	Polarity Detection	×	×	page 5-24
	Tuning-less Level Setting	Fn200	Tuning-less Level Set- ting	×	×	page 8-16
	Easy FFT	Fn206	Easy FFT	×	×	page 8-94
Parameter	Initialize*2	Fn005	Initialize Parameters	0	0	page 5-10
	Autotuning without Host Reference	Fn201	Advanced Autotuning without Reference	×	×	page 8-23
	Autotuning with Host Reference	Fn202	Advanced Autotuning with Reference	×	×	page 8-34
Tuning	Custom Tuning	Fn203	One-Parameter Tuning	×	×	page 8-41
	Adjust Anti-reso- nance Control	Fn204	Adjust Anti-resonance Control	×	×	page 8-50
	Vibration Suppression	Fn205	Vibration Suppression	×	×	page 8-55

Continued on next page.

7.6.3 Test without a Motor

Continued from previous page.

SigmaWin+		Digital Operator		Executable?		
Menu Dialog Box Button	SigmaWin+ Function Name	Fn No.	Utility Function Name	Motor Not Connected	Motor Connected	Reference
	Product Information	Fn011	Display Servomotor Model	0	0	nago 0 2
		Fn012	Display Software Version	0	0	page 9-2
Monitoring		Fn01E	Display SERVOPACK and Servomotor IDs	0	0	
		Fn01F	Display Servomotor ID from Feedback Option Module	0	0	page 9-2
Test Oper-	Jogging	Fn002	Jogging	0	0	page 7-7
ation	Program Jogging	Fn004	Program Jogging	0	0	page 7-13
Alarms	Dieplay Alarm	Fn000	Display Alarm History	0	0	page 15-41
Maiiiis	Display Alarm	Fn006	Clear Alarm History	0	0	page 15-42

^{*1.} Cannot be used when connecting a Linear Servomotor.

^{*2.} An Initialize Button will be displayed in the Parameter Editing Dialog Box.

This chapter provides information on the flow of tuning, details on tuning functions, and related operating procedures.

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8.1

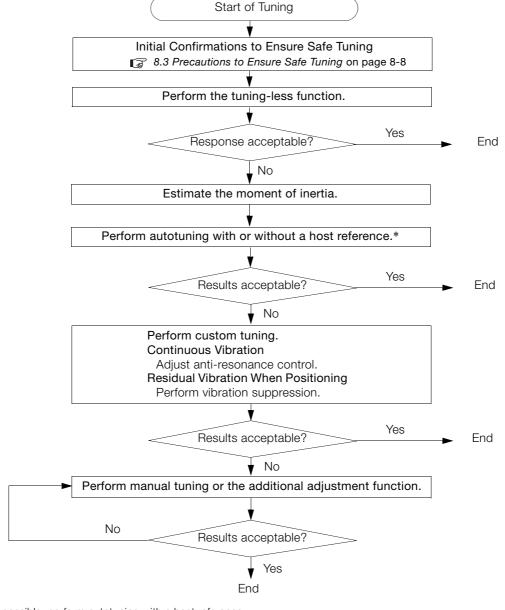
Overview and Flow of Tuning

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 while performing program jogging.

8.1.1 Tuning Functions

The following table provides an overview of the tuning functions.

Tuning Function	Outline	Applicable Con- trol Methods	Reference
Tuning-less Function	This automatic adjustment function is designed to enable stable operation 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 can use it with the default settings.	Speed control or position control	page 8-12
Moment of Inertia Estimation	The moment of inertia ratio is calculated by operating the Servomotor a few times. The moment of inertia ratio that is calculated here is used in other tuning functions.	Speed control, position control, or torque control	page 8-16
Autotuning without Host Reference	The following parameters are automatically adjusted in the internal references in the SERVO-PACK during automatic operation. • Gains (e.g., position loop gain and speed loop gain) • Filters (torque reference filter and notch filters) • Friction compensation • Anti-resonance control • Vibration suppression	Speed control or position control	page 8-23
Autotuning with Host Reference	The following parameters are automatically adjusted with the position reference input from the host controller while the machine is in operation. You can use this function for fine-tuning after you perform autotuning without a host reference. • Gains (e.g., position loop gain and speed loop gain) • Filters (torque reference filter and notch filters) • Friction compensation • Anti-resonance control • Vibration suppression	Position control	page 8-34
Custom Tuning	The following parameters are adjusted with the position reference or speed reference input from the host controller while the machine is in operation. • Gains (e.g., position loop gain and speed loop gain) • Filters (torque reference filter and notch filters) • Friction compensation • Anti-resonance control	Speed control or position control	page 8-41
Anti-resonance Control Adjustment	This function effectively suppresses continuous vibration.	Speed control or position control	page 8-50
Vibration Suppression	This function effectively suppresses residual vibration if it occurs when positioning.	Position control	page 8-55
Speed Ripple Compensation	This function reduces the ripple in the motor speed.	Speed control, position control, or torque control	page 8-59
Additional Adjustment Function	This function combines autotuning with custom tuning. You can use it to improve adjustment results.	Depends on the functions that you use.	page 8-65
Manual Tuning	You can manually adjust the servo gains to adjust the response.	Speed control, position control, or torque control	page 8-78

8.1.2 Diagnostic Tool

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	Applicable Control Methods	Reference
Mechanical Analysis	The machine is subjected to vibration to detect resonance frequencies. The measurement results are displayed as waveforms or numeric data.	Speed control, position control, or torque control	page 8-92
Easy FFT	The machine is subjected to vibration to detect resonance frequencies. The measurement results are displayed only as numeric data.	Speed control, position control, or torque control	page 8-94

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.

• Position Control

	Unit		
Item	Rotary Servomotor	Linear Servomotor	
Torque reference	%		
Feedback speed	min ⁻¹	mm/s	
Position reference speed	min ⁻¹ mm/s		
Position deviation	Reference units		

• Speed Control

Item	Unit		
Item	Rotary Servomotor	Linear Servomotor	
Torque reference	%		
Feedback speed	min ⁻¹	mm/s	
Reference speed	min ⁻¹	mm/s	

• Torque Control

Item	Unit		
	Rotary Servomotor	Linear Servomotor	
Torque reference	%		
Feedback speed	min ⁻¹	mm/s	

8.3.1 Overtravel Settings

8.3

Precautions to Ensure Safe Tuning

M CAUTION

- 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 5-27

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 Selecting Torque Limits on page 6-25

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] =
$$\frac{\text{Motor speed [min}^{\cdot 1}]}{60} \times \frac{\text{Encoder resolution}}{\text{Pn102 [0.1/s]/10}^{*2}, *3} \times \frac{\text{Denominator}^*}{\text{Numerator}}$$

Linear Servomotors

$$Position \ deviation \ [reference \ units] = \frac{Motor \ speed \ [mm/s]}{Pn102 \ [0.1/s]/10^{*2}, *3} \ \times \ \frac{Resolution}{Linear \ encoder \ pitch \ [\mu m]/1,000} \ \times \ \frac{Denominator}{Numerator}$$

Position Deviation Overflow Alarm Level (Pn520) [setting unit: reference units]

Rotary Servomotors

$$Pn520 > \frac{\text{Maximum motor speed [min-1]}}{60} \times \frac{\text{Encoder resolution}}{\text{Pn102 [0.1/s]/10}^{*2}, *3} \times \frac{\text{Denominator}^{*}l}{\text{Numerator}} \times \underbrace{\frac{(1.2 \text{ to 2})^{*44}}{(1.2 \text{ to 2})^{*44}}}_{\text{Encoder resolution}} \times \underbrace{\frac{\text{Denominator}^{*}l}{\text{Numerator}}}_{\text{Numerator}} \times \underbrace{\frac{(1.2 \text{ to 2})^{*44}}{(1.2 \text{ to 2})^{*44}}}_{\text{Numerator}} \times \underbrace{\frac{(1.2 \text{ to 2})^{*44}}{(1.2 \text{ to 2})^{*44}}}_{\text{Encoder resolution}} \times \underbrace{\frac{\text{Denominator}^{*}l}{\text{Numerator}}}_{\text{Numerator}} \times \underbrace{\frac{(1.2 \text{ to 2})^{*44}}{(1.2 \text{ to 2})^{*44}}}_{\text{Numerator}} \times \underbrace{\frac{(1.2 \text{ to 2})^{*44}}{(1.2 \text{ to 2})^{*44}}}_{\text{Encoder resolution}} \times \underbrace{\frac{\text{Denominator}^{*}l}{\text{Numerator}}}_{\text{Numerator}} \times \underbrace{\frac{(1.2 \text{ to 2})^{*44}}{(1.2 \text{ to 2})^{*44}}}_{\text{Encoder resolution}} \times \underbrace{\frac{\text{Denominator}^{*}l}{\text{Numerator}}}_{\text{Encoder resolution}} \times \underbrace{\frac{\text{Denominator}^{*}l}{\text{Numerator}}}_{\text$$

Linear Servomotors

$$Pn520 > \frac{\text{Maximum motor speed [mm/s]}}{Pn102 [0.1/s]/10^{*2}, *3} \times \frac{\text{Resolution}}{\text{Linear encoder pitch [µm]/1,000}} \times \frac{\frac{\text{Denominator}^{*1}}{\text{Numerator}}}{\text{Numerator}} \times \frac{(1.2 \text{ to } 2)^{*4}}{\text{Numerator}}$$

*1. Refer to the following section for details.

5.14 Setting Unit Systems on page 5-43

- *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. $\frac{\text{Denominator}}{\text{Numerator}} = \frac{1}{16}$

$$Pn520 = \frac{6,000}{60} \times \frac{16,777,216}{400/10} \times \frac{1}{16} \times 2$$
$$= 2,621,440 \times 2$$

= 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 over-flow alarm level.

Related Parameters

Pn520 (2520h)	Position Deviation Overflow Alarm Level			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(202011)	1 to 1,073,741,823	1 reference unit	5,242,880	Immediately	Setup
D C4 E	Position Deviation Overflow Warning Level			Position	
Pn51E (251Eh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(201211)	10 to 100	1%	100	Immediately	Setup

Related Alarms

Alarm Number	Alarm Name	Alarm Meaning
A.d00	Position Deviation Overflow	This alarm occurs if the position deviation exceeds the setting of Pn520 (2520h) (Position Deviation Overflow Alarm Level).

Related Warnings

Warning Number	Warning Name	Warning Meaning
A.900	Position Deviation Overflow	This warning occurs if the position deviation exceeds the specified percentage (Pn520 × Pn51E/100).

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 6-45

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

D 500	Position Deviation Overflow Alarm Level at Servo ON			Position	
Pn526 (2526h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(202011)	1 to 1,073,741,823	1 reference unit	5,242,880	Immediately	Setup
D F00	Position Deviation Overflow Warning Level at Servo ON			Position	
Pn528 (2528h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(232011)	10 to 100	1%	100	Immediately	Setup

· Rotary Servomotors

D 500	Speed Limit Level at Servo ON			Position	
Pn529 (2529h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(232311)	0 to 10,000	1 min ⁻¹	10,000	Immediately	Setup

Linear Servomotors

	Speed Limit Level at Servo ON			Position	
Pn584 (2584h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200411)	0 to 10,000	1 mm/s	10,000	Immediately	Setup

Related Alarms

Alarm Number	Alarm Name	Alarm Meaning
A.d01	Position Deviation Overflow Alarm at Servo ON	This alarm occurs if Servo ON command (Enable Operation command) is executed after the position deviation exceeded the setting of Pn526 (Position Deviation Overflow Alarm Level at Servo ON) while the servo was OFF.
A.d02	Position Deviation Overflow Alarm for Speed Limit at Servo ON	If position deviation remains in the deviation counter, the setting of Pn529 or Pn584 (Speed Limit Level at Servo ON) will limit the speed when the servo is turned ON. This alarm occurs if a position reference is input and the setting of Pn520 (Position Deviation Overflow Alarm Level) is exceeded.

Refer to the following section for information on troubleshooting alarms.

15.2.3 Resetting Alarms on page 15-41

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 Overflow Warning 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.

CAUTION

- The tuning-less function is disabled during torque control.
- The Servomotor may momentarily emit a sound 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. The sound will not be emitted from the next time the servo is turned ON.
- 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

The following application restrictions apply to the tuning-less function.

Function	Executable?	Remarks
Vibration Detection Level Initialization	0	-
Moment of Inertia Estimation	×	Disable the tuning-less function (Pn170 = n.□□□0) before you execute moment of inertia estimation.
Autotuning without Host Reference	×	Disable the tuning-less function (Pn170 = n.□□□0) before you execute autotuning without a host reference.
Autotuning with Host Reference	×	-
Custom Tuning	×	-
Anti-Resonance Control Adjustment	×	-
Vibration Suppression	×	-
Easy FFT	0	The tuning-less function is disabled while you execute Easy FFT and then it is enabled when Easy FFT has been 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.

^{*} O: Yes x: 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 (default setting)	Enable tuning-less function.			
(2170h) n.□□0□ (default setting)		Use for speed control.	After restart	Setup
	n.□□1□	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 $n.\square\square2\square$ (Use tuning-less type 3) (default setting). If compatibility with previous models is required, set Pn14F to $n.\square\square0\square$ (Use tuning-less type 1) or $n.\square\square1\square$ (Use tuning-less type 2).

Parameter Meaning		Meaning	When Enabled	Classification
	n.□□0□	Use tuning-less type 1.		
Pn14F n.□□1□ (214Fh)	Use tuning-less type 2. (The noise level is improved more than with tuning-less type 1.)	After restart	Tuning	
(214111)	n.□□2□ (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

Check the following settings before you set the tuning-less levels.

- The tuning-less function must be enabled (Pn170 = n.□□□1).
- The test without a motor function must be disabled (Pn00C = n.□□□0).

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 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

3. 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.□□0□ or n.□□1□) is used.
5		
4 (default setting)		
3		
2		_
1	7	
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. $\square\square$ 0 \square 0 or n. \square 1 \square 1, set the tuning-less level to between 0 and 4 (Pn170 = n. \square 0 \square 1 to n. \square 4 \square 1). Do not set the tuning-less level to between 5 and 7 (Pn170 = n. \square 5 \square 1 to n. \square 7 \square 1).

Parameter		Description		When Enabled	Classification
n.l n.l Pn170 (2170h)	n.□0□□	Tuning-less rigidity level 0 (low rigid	dity)		
	n.🗆1 🗆 🗆	Tuning-less rigidity level 1			
	n.□2□□	Tuning-less rigidity level 2			
	n.□3□□	Tuning-less rigidity level 3			
		Tuning-less rigidity level 4		Immediately	Setup
	(default setting)				
	n.□5□□	Tuning-less rigidity level 5			
	n.□6□□	Tuning-less rigidity level 6			
	n.0700	Tuning-less rigidity level 7 (high rigid	dity)		

■ Tuning-less Load Level

Parameter		Description	When Enabled	Classification
	n.0□□□	Tuning-less load level 0		
Pn170 (2170h)	n.1□□□ (default setting)	Tuning-less load level 1	Immediately	Setup
	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 = $n.X\square\square\square$ or the setting of Pn170 = $n.\square X\square\square$.
- 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

Parameters Disabled by Tuning-less Function 8.4.4

When the tuning-less function is enabled (Pn170 = $n.\Box\Box\Box$ 1) (default setting), the parameters in the following table are disabled.

Item	Parameter Name	
	Speed Loop Gain Second Speed Loop Gain	Pn100 (2100h) Pn104 (2104h)
Gain-Related Parameters	Speed Loop Integral Time Constant Second Speed Loop Integral Time Constant	Pn101 (2101h) Pn105 (2105h)
	Position Loop Gain Second Position Loop Gain	Pn102 (2102h) Pn106 (2106h)
	Moment of Inertia Ratio	Pn103 (2103h)
Advanced Control-Related	Friction Compensation Function Selection	Pn408 (2408h) = n.X□□□
Parameters	Anti-Resonance Control Selection	Pn160 (2160h)= n.□□□X
Gain Selection-Related Parameters	Gain Switching Selection	Pn139 (2139h)= n.□□□X

The tuning-less function is disabled during torque control, Easy FFT, and mechanical analysis for a vertical axis. The gain-related parameters in the above table are enabled for torque control, Easy FFT, and mechanical analysis. Of these, Pn100, Pn103, and Pn104 are enabled for torque control.

Automatically Adjusted Function Setting 8.4.5

You can also automatically adjust notch filters.

Normally, set Pn460 to n.□1□□ (Adjust automatically) (default setting). Vibration is automatically detected and a notch filter is set.

Set Pn460 to n. □0 □ □ (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
Pn460	n.□0□□	Do not 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.	Immediately	Tuning
(2460h)	n.□1□□ (default setting)	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.	miniculately	Turilly

Related Parameters 8.4.6

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 (2401h)	First Stage First Torque Reference Filter Time Constant
Pn40C (240Ch)	Second Stage Notch Filter Frequency
Pn40D (240Dh)	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.

8.6.4 Operating Procedure on page 8-25

8.5.1 Outline

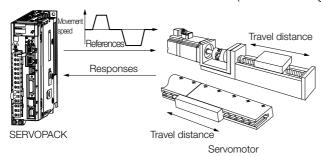
The moment of inertia during operation is automatically calculated by the SERVOPACK for round-trip (forward and reverse) operation. A reference from the host controller is not used.

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 moment of inertia estimation, you can get an accurate load moment of inertia simply by operating the Servomotor in the actual system in forward and reverse a few times.

The Servomotor is operated with the following specifications.

- Maximum speed: ±1,000 min⁻¹ (can be changed)
- Acceleration rate: ±20,000 min⁻¹/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

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 proportional control is used

Preparations

Check the following settings 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 control method must not be set to torque control.
- The gain selection switch must be set to manual gain selection (Pn139 = n.□□□□0).
- The first gains must be selected.
- The test without a motor function must be disabled (Pn00C = n.□□□0).
- 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).

8.5.3 Applicable Tools

The following table lists the tools that you can use to estimate the moment of inertia and the applicable tool functions.

Tool	Function	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

8.5.4 Operating Procedure

Use the following procedure to set the moment of inertia ratio.

MARNING

- Estimating the moment of inertia 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.

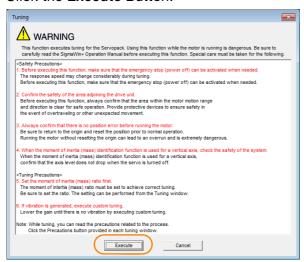
CAUTION

- 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 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select **Tuning** in the Menu Dialog Box.

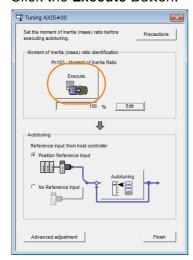
The Tuning Dialog Box will be displayed. Click the **Cancel** Button to cancel tuning.

8.5.4 Operating Procedure

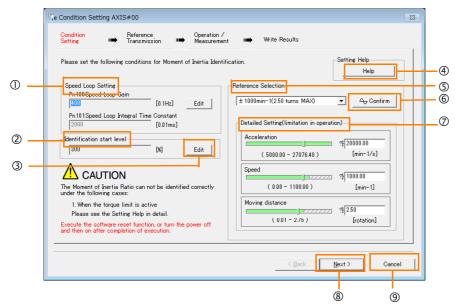
3. Click the Execute Button.



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

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.

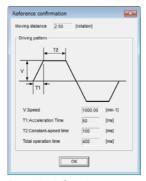
S Reference Selection Area

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.

© Confirm Button

Click this button to display the Reference Confirmation Dialog Box.



② Detailed Setting Area

You can change the settings by moving the bars or directly inputting the settings to create the required reference pattern.

Next Button

Click this button to display the Reference Transmission Dialog Box.

Click this button to return to the Tuning Dialog Box.

CAUTION

- The travel distance is the distance for one operation in the forward or reverse direction. During multiple operations, the operation starting position may move in one direction or the other. Confirm the possible operating range for each measurement or operation.
- Depending on the parameter settings and the moment of inertia of the machine, overshooting and undershooting may occur and may cause the maximum speed setting to be exceeded temporarily. Allow sufficient leeway in the settings.

8.5.4 Operating Procedure

Information

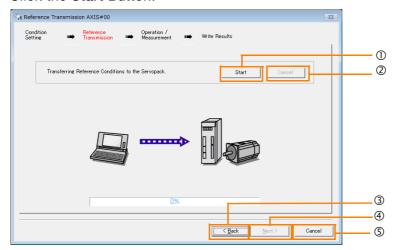
When Measurement Is Not Correct

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.

Mext 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.



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.

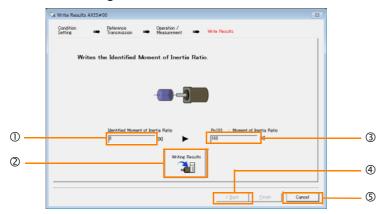
Information

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.



8.5.4 Operating Procedure

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.

Back Button

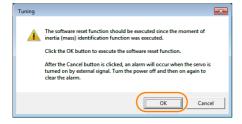
This button is disabled.

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.



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.

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 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.

 $Pn140 = n.\Box\Box\Box\Box$ (Do not use model following control.)

 $Pn160 = n.\square\square\square\square 0$ (Do not use anti-resonance control.)

Pn408 = n.00□0 (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.

Outline 8.6.1

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)

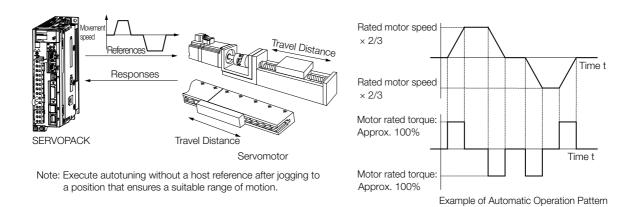
Refer to the following section for details on the parameters that are adjusted.

8.6.7 Related Parameters on page 8-33

The Servomotor is operated with the following specifications.

Maximum speed	Rated motor speed $\times \frac{2}{3}$		
Acceleration Torque	Rated motor torque: Approx. 100% Note: The acceleration torque depends on the setting of the moment of inertia ratio (Pn103), and the influences of machine friction and external disturbance.		
	Rotary Servomotors	You can set the desired travel distance. The default setting is for a value equivalent to 3 Servomotor shaft rotations.	
Travel Distance	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



↑ WARNING

- 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.

8.7 Autotuning with a Host Reference on page 8-34

8.8 Custom Tuning on page 8-41

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 proportional control 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 speed feedforward or torque feedforward is input
- When the positioning completed width (Pn522) is too narrow

Preparations

Check the following settings 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 control method must not be set to torque control.
- The gain selection switch must be set to manual gain selection (Pn139 = n.□□□0).
- The first gains must be selected.
- The test without a motor function must be disabled ($Pn00C = n.\square\square\square\square0$).
- 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 and the applicable tool functions.

Tool	Function	Operating Procedure Reference
Digital Operator	Fn201	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Tuning - Tuning	8.6.4 Operating Procedure on page 8-25

8.6.4 Operating Procedure

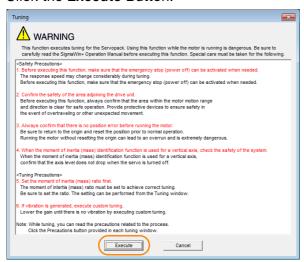
Use the following procedure to perform autotuning without a host reference.

↑ CAUTION

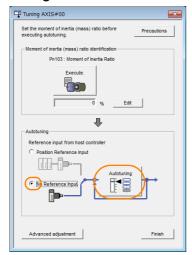
- If you specify not estimating the moment of inertia, set the moment of inertia ratio (Pn103) correctly. If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.
- 1. Confirm that the moment of inertia ratio (Pn103) is set correctly.
- 2. Click the 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.

8.6.4 Operating Procedure

4. Click the Execute Button.

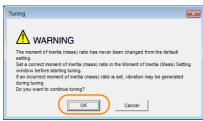


5. Select the No Reference Input Option in the Autotuning Area and then click the Autotuning Button.

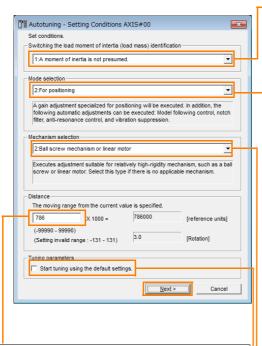


Information

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).



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.



• Distance Box

Set the travel distance.

Movement range: -99,990,000 to +99,990,000 [reference units]
Minimum setting increment for travel distance: 1,000 [reference units]

Negative values are for reverse operation and positive values are for forward operation from the current position.

Default settings:

Rotary Servomotors: Approx. 3 rotations Direct Drive Servomotors: Approx. 0.3 rotations

Linear Servomotors: Approx 90 mm Set the distance to the following values or higher. To ensure tuning precision, we recommend that you use approximately the default distance setting.

Rotary Servomotors: 0.5 rotations Direct Drive Servomotors: 0.05 rotations Linear Servomotors: 5 mm

Switching the load moment of inertia (load mass) identification Box

Specify whether to estimate the moment of inertia.

0: A moment of inertia is presumed. (default setting)

1: A moment of inertia is presumed. (delate

Mode selection Box

Set the mode.

Mode Selection	Description
1: Standard	Standard gain adjustment is per- formed. In addition to gain adjust- ment, notch filters and anti-resonance control are automatically adjusted.
2: For positioning	Tuning is performed for positioning applications. In addition to gain adjustment, model following control, notch filters, anti-resonance control, and vibration suppression are automatically adjusted.
3: For positioning especially to prevent overshooting	Tuning is performed for positioning applications with emphasis on eliminating overshooting. In addition to gain adjustment, notch filters, antiresonance control, and vibration suppression are automatically 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 mech- anism 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 model	Tuning is performed for a mechanism with high rigidity, e.g., a rigid body system.

• Tuning parameters Box

Specify the parameters to use for tuning. If you select the **Start tuning using the default settings** Check Box, the tuning parameters will be returned to the default settings before tuning is started.

8.6.4 Operating Procedure

7. Click the Servo ON Button.



8. Click the Start tuning Button.



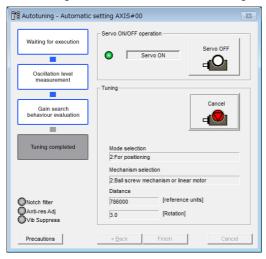
8.6.5 Troubleshooting Problems in Autotuning without a Host Reference

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.



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 procedure.	
The settings for the tuning-less function are not correct.	 Disable the tuning-less function (Pn170 = n.□□□0). Enable the tuning-less function (Pn170 = n.□□□1) and specify moment of inertia estimation. 	

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 were not successfully completed.	Machine vibration occurs or the positioning completion signal is not stable when the Servomotor stops.	 Increase the setting of the positioning completed width (Pn522). Change the mode from 2 to 3. If machine vibration occurs, suppress the vibration with the anti-resonance control adjustment and the vibration suppression function. 	
An error occurred during calculation of the moment of inertia.	Refer to the following section for troubleshooting information. When an Error Occurs during Calculation of Moment of Inertia on page 8-30		
Positioning was not completed within approximately 10 seconds after position adjustment was completed.	The positioning completed width is too narrow or proportional control is being used.	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.	 Increase the setting of the speed loop gain (Pn100). Increase the stroke (travel distance).
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.	 If you are using the torque limit, increase the torque limit. Double the setting of moment of inertia calculation starting level (Pn324).
Speed control changed to proportional control during calculation of the moment of inertia.	Use PI control when calculating the moment of inertia.

◆ 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 position reference unit (Position User Unit (2701h)).

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.

Pn561		Overshoot Detection	n Level		Speed Positi	Torque
	(2561h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	(200111)	0 to 100	1%	100	Immediately	Setup

Automatically Adjusted Function Settings

You can specify whether to automatically adjust the following functions during autotuning.

◆ Automatic Notch Filters

8.6.6

Normally, set Pn460 to n.□1□□ (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. $\square 0 \square \square$ (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
	n.□□□0	Do not adjust the first stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.		
	n.□□□1 (default setting)	Adjust the first stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.		
Pn460 (2460h)	n.□0□□	Do not 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.	Immediately	Tuning
	n.□1□□ (default setting)	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.		

◆ Anti-Resonance Control Adjustment

This function reduces low vibration frequencies, for which the notch filters cannot be used.

Normally, set Pn160 to n. □□1□ (Adjust automatically) (default setting).

Vibration will be detected during autotuning without a host reference and anti-resonance control will be automatically adjusted.

Р	arameter	Function	When Enabled	Classification
Pn160	n.□□0□	Do not adjust anti-resonance control automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately	Tuning
(2160h)	n.□□1□ (default setting)	Adjust anti-resonance control automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	immediately	Turillig

◆ 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. \(\sigma 1 \square \square \) (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.

8.6.6 Automatically Adjusted Function Settings

Р	arameter	Function	When Enabled	Classification
Pn140	n.□0□□	Do not adjust vibration suppression automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately	Tuning
(2140h)	n.□1□□ (default setting)	Adjust vibration suppression automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	inimediately	Turning

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□□□ (Friction Compensation Function Selection)*	
2: For position control	Adjusted with friction compensation.	
3: For position control (emphasis on overshooting)	- Adjusted with inction compensation.	

Parameter		Function	When Enabled	Classification
Pn408 (2408h)	n. 0□□□ (default setting)	Disable friction compensation.	Immediately	Setup
(240011)	n. 1□□□	Enable friction compensation.		

^{*} Refer to the following section for details.

◆ Feedforward

If Pn140 is set to n.0 \(\sigma\) (Do not use model following control and speed/torque feedforward together (default setting)) and tuning is performed with the mode selection set to 2 or 3, feedforward (Pn109), the speed feedforward input (VFF), and the torque feedforward input (TFF) will be disabled.

To use the speed feedforward input (VFF), the torque feedforward input (TFF), and model following control from the host controller in the system, set Pn140 to n.1 \(\sigma \sigma \) (Use model following control and speed/torque feedforward together).

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□ (default setting)	Do not use model following control and speed/torque feedforward together.	Immediately	Tuning
(2140h)	n.1□□□	Use model following control and speed/torque feedforward together.	ITITIEGIALETY	rumig



When model following control is used with the feedforward function, it is used to make optimum feedforward settings in the SERVOPACK. Therefore, model following control is not normally used together with either the speed feedforward input (VFF) or torque feedforward input (TFF) from the host controller. However, model following control can be used with the speed feedforward input (VFF) or torque feedforward input (TFF) if required. An unsuitable feedforward input may result in overshooting.

Required Parameter Settings on page 8-68

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 (2100h)	Speed Loop Gain	Yes
Pn101 (2101h)	Speed Loop Integral Time Constant	Yes
Pn102 (2102h)	Position Loop Gain	Yes
Pn103 (2103h)	Moment of Inertia Ratio	Yes
Pn121 (2121h)	Friction Compensation Gain	Yes
Pn123 (2123h)	Friction Compensation Coefficient	Yes
Pn124 (2124h)	Friction Compensation Frequency Correction	No
Pn125 (2125h)	Friction Compensation Gain Correction	Yes
Pn401 (2401h)	First Stage First Torque Reference Filter Time Constant	Yes
Pn408 (2408h)	Torque-Related Function Selections	Yes
Pn409 (2409h)	First Stage Notch Filter Frequency	Yes
Pn40A (240Ah)	First Stage Notch Filter Q Value	Yes
Pn40C (240Ch)	Second Stage Notch Filter Frequency	Yes
Pn40D (240Dh)	Second Stage Notch Filter Q Value	Yes
Pn140 (2140h)	Model Following Control-Related Selections	Yes
Pn141 (2141h)	Model Following Control Gain	Yes
Pn142 (2142h)	Model Following Control Gain Correction	Yes
Pn143 (2143h)	Model Following Control Bias in the Forward Direction	Yes
Pn144 (2144h)	Model Following Control Bias in the Reverse Direction	Yes
Pn145 (2145h)	Vibration Suppression 1 Frequency A	Yes
Pn146 (2146h)	Vibration Suppression 1 Frequency B	Yes
Pn147 (2147h)	Model Following Control Speed Feedforward Compensation	Yes
Pn160 (2160h)	Anti-Resonance Control-Related Selections	Yes
Pn161 (2161h)	Anti-Resonance Frequency	Yes
Pn163 (2163h)	Anti-Resonance Damping Gain	Yes
Pn531 (2531h)	Program Jogging Travel Distance	No
Pn533 (2533h)	Program Jogging Movement Speed for Rotary Servomotor	No
Pn585 (2585h)	Program Jogging Movement Speed for Linear Servomotor	No
Pn534 (2534h)	Program Jogging Acceleration/Deceleration Time	No
Pn535 (2535h)	Program Jogging Waiting Time	No
Pn536 (2536h)	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

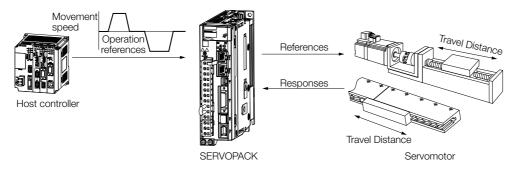
Autotuning with a host reference automatically makes optimum adjustments for operation references from the host controller.

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 8-40



A CAUTION

 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

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 proportional control 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 8-41

Preparations

Check the following settings 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 selection switch must be set to manual gain selection (Pn139 = n.□□□□0).
- The first gains must be selected.
- The test without a motor function must be disabled (Pn00C = n.□□□0).
- There must be no warnings.
- The tuning-less function must be disabled (Pn170 = n.□□□0).
- The parameters must not be write prohibited.

8.7.3 Applicable Tools

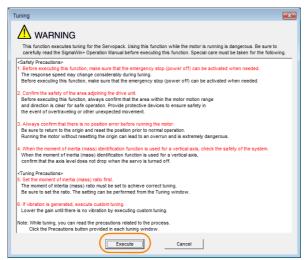
The following table lists the tools that you can use to perform autotuning with a host reference and the applicable tool functions.

Tool	Function Operating Procedure Reference	
Digital Operator	Fn202	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Tuning - Tuning	8.7.4 Operating Procedure on page 8-36

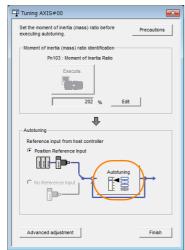
8.7.4 Operating Procedure

Use the following procedure to perform autotuning with a host reference.

- 1. Confirm that the moment of inertia ratio (Pn103) is set correctly.
- 2. 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.



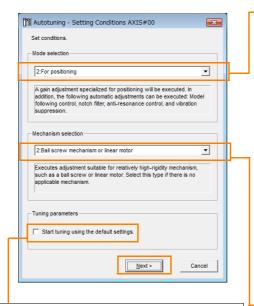
Information

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.



• Tuning parameters Box

Specify the parameters to use for tuning. If you select the **Start tuning using the default settings** Check Box, the tuning parameters will be returned to the default settings before tuning is started.

•	Mode selection Box
	Set the mode.

Mode Selection	Description
1: Standard	Standard gain adjustment is performed. In addition to gain adjustment, notch filters and antiresonance control are automatically adjusted.
2: For positioning	Tuning is performed for positioning applications. In addition to gain adjustment, model following control, notch filters, anti-resonance control, and vibration suppression are automatically adjusted.
3: For positioning especially to prevent overshooting	Tuning is performed for positioning applications with emphasis on eliminating overshooting. In addition to gain adjustment, notch filters, antiresonance control, and vibration suppression are automatically 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 model	Tuning is performed for a mechanism with high rigidity, e.g., a rigid body system.

7. Click the Yes Button.



8.7.4 Operating Procedure

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.



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.



8.7.5 Troubleshooting Problems in Autotuning with a Host Reference

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

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 occurs or positioning completion is not stable when the Servomotor stops.	 Increase the setting of Pn522 (2522h) (Positioning Completed Width). Change the mode from 2 to 3. If machine vibration occurs, suppress the vibration with the anti-resonance control adjustment and the vibration suppression function.
Positioning was not completed within approximately 10 seconds after position adjustment was completed.	The positioning completed width is too narrow or proportional control is being used.	Increase the setting of Pn522 (2522h) (Positioning Completed Width).

◆ 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 position reference unit (position user unit (2701h)).

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.
- This will allow tuning to be performed without overshooting within the positioning completed width, but the positioning completed width may be extended.

D=501	Overshoot Detection	n Level		Speed Positi	Torque
Pn561 (2561h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200111)	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

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.

Pn100 (2100h)Speed Loop GainYesPn101 (2101h)Speed Loop Integral Time ConstantYesPn102 (2102h)Position Loop GainYesPn103 (2103h)Moment of Inertia RatioNoPn121 (2121h)Friction Compensation GainYesPn123 (2123h)Friction Compensation CoefficientYesPn124 (2124h)Friction Compensation Frequency CorrectionNoPn125 (2125h)Friction Compensation Gain CorrectionYesPn401 (2401h)First Stage First Torque Reference Filter Time ConstantYesPn408 (2408h)Torque-Related Function SelectionsYesPn409 (2409h)First Stage Notch Filter FrequencyYesPn40A (240Ah)First Stage Notch Filter Q ValueYes	
Pn102 (2102h)Position Loop GainYesPn103 (2103h)Moment of Inertia RatioNoPn121 (2121h)Friction Compensation GainYesPn123 (2123h)Friction Compensation CoefficientYesPn124 (2124h)Friction Compensation Frequency CorrectionNoPn125 (2125h)Friction Compensation Gain CorrectionYesPn401 (2401h)First Stage First Torque Reference Filter Time ConstantYesPn408 (2408h)Torque-Related Function SelectionsYesPn409 (2409h)First Stage Notch Filter FrequencyYesPn40A (240Ah)First Stage Notch Filter Q ValueYes	
Pn103 (2103h)Moment of Inertia RatioNoPn121 (2121h)Friction Compensation GainYesPn123 (2123h)Friction Compensation CoefficientYesPn124 (2124h)Friction Compensation Frequency CorrectionNoPn125 (2125h)Friction Compensation Gain CorrectionYesPn401 (2401h)First Stage First Torque Reference Filter Time ConstantYesPn408 (2408h)Torque-Related Function SelectionsYesPn409 (2409h)First Stage Notch Filter FrequencyYesPn40A (240Ah)First Stage Notch Filter Q ValueYes	
Pn121 (2121h)Friction Compensation GainYesPn123 (2123h)Friction Compensation CoefficientYesPn124 (2124h)Friction Compensation Frequency CorrectionNoPn125 (2125h)Friction Compensation Gain CorrectionYesPn401 (2401h)First Stage First Torque Reference Filter Time ConstantYesPn408 (2408h)Torque-Related Function SelectionsYesPn409 (2409h)First Stage Notch Filter FrequencyYesPn40A (240Ah)First Stage Notch Filter Q ValueYes	
Pn123 (2123h)Friction Compensation CoefficientYesPn124 (2124h)Friction Compensation Frequency CorrectionNoPn125 (2125h)Friction Compensation Gain CorrectionYesPn401 (2401h)First Stage First Torque Reference Filter Time ConstantYesPn408 (2408h)Torque-Related Function SelectionsYesPn409 (2409h)First Stage Notch Filter FrequencyYesPn40A (240Ah)First Stage Notch Filter Q ValueYes	
Pn124 (2124h)Friction Compensation Frequency CorrectionNoPn125 (2125h)Friction Compensation Gain CorrectionYesPn401 (2401h)First Stage First Torque Reference Filter Time ConstantYesPn408 (2408h)Torque-Related Function SelectionsYesPn409 (2409h)First Stage Notch Filter FrequencyYesPn40A (240Ah)First Stage Notch Filter Q ValueYes	
Pn125 (2125h)Friction Compensation Gain CorrectionYesPn401 (2401h)First Stage First Torque Reference Filter Time ConstantYesPn408 (2408h)Torque-Related Function SelectionsYesPn409 (2409h)First Stage Notch Filter FrequencyYesPn40A (240Ah)First Stage Notch Filter Q ValueYes	
Pn401 (2401h)First Stage First Torque Reference Filter Time ConstantYesPn408 (2408h)Torque-Related Function SelectionsYesPn409 (2409h)First Stage Notch Filter FrequencyYesPn40A (240Ah)First Stage Notch Filter Q ValueYes	
Pn408 (2408h)Torque-Related Function SelectionsYesPn409 (2409h)First Stage Notch Filter FrequencyYesPn40A (240Ah)First Stage Notch Filter Q ValueYes	
Pn409 (2409h)First Stage Notch Filter FrequencyYesPn40A (240Ah)First Stage Notch Filter Q ValueYes	
Pn40A (240Ah) First Stage Notch Filter Q Value Yes	
. , ,	
Pn40C (240Ch) Second Stage Notch Filter Frequency Yes	
Pn40D (240Dh) Second Stage Notch Filter Q Value Yes	
Pn140 (2140h) Model Following Control-Related Selections Yes	
Pn141 (2141h) Model Following Control Gain Yes	
Pn142 (2142h) Model Following Control Gain Correction Yes	
Pn143 (2143h) Model Following Control Bias in the Forward Direction Yes	
Pn144 (2144h) Model Following Control Bias in the Reverse Direction Yes	
Pn145 (2145h) Vibration Suppression 1 Frequency A Yes	
Pn146 (2146h) Vibration Suppression 1 Frequency B Yes	
Pn147 (2147h) Model Following Control Speed Feedforward Compensation Yes	
Pn160 (2160h) Anti-Resonance Control-Related Selections Yes	
Pn161 (2161h) Anti-Resonance Frequency Yes	
Pn163 (2163h) 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 Custom Tuning

This section describes custom tuning.

8.8.1 Outline

You can use custom tuning to manually adjust the servo during operation using a speed or position reference input 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 8-49

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.

↑ CAUTION

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

Check the following settings before you execute custom tuning.

- The test without a motor function must be disabled (Pn00C = n.□□□0).
- The tuning-less function must be disabled (Pn170 = n.□□□□0).
- If speed control is used, tuning mode 0 or 1 must be set.
- The parameters must not be write prohibited.

8.8.3 Applicable Tools

The following table lists the tools that you can use to perform custom tuning and the applicable tool functions.

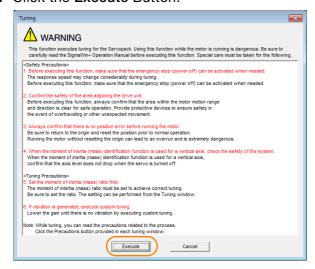
Tool	Function	Operating Procedure Reference
Digital Operator	Fn203	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Tuning – Tuning	8.8.4 Operating Procedure on page 8-42

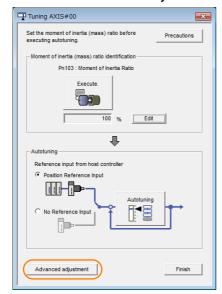
8.8.4 Operating Procedure

Use the following procedure to perform custom tuning.

WARNING

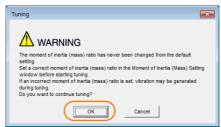
- Before you execute custom tuning, check the information provided in the SigmaWin+ operating manual.
 - Observe the following precautions.
 - Make sure that you can perform an emergency stop at any time.
 When custom tuning is started, several parameters will be overwritten with the recommended settings, which may greatly affect the response before and after execution. Make sure that you can perform an emergency stop at any time.
 - Set the moment of inertia correctly before you execute custom tuning. If the setting greatly differs from the actual moment of inertia, vibration may occur.
 - If you change the feedforward level, the new setting will not be used immediately. It will be used after positioning is completed.
- 1. Confirm that the moment of inertia ratio (Pn103) is set correctly.
- 2. 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.



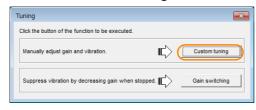


Information

When the following dialog box is displayed, click the \mathbf{OK} Button and then confirm that the correct moment of inertia ratio is set in Pn103 (Moment of Inertia Ratio).

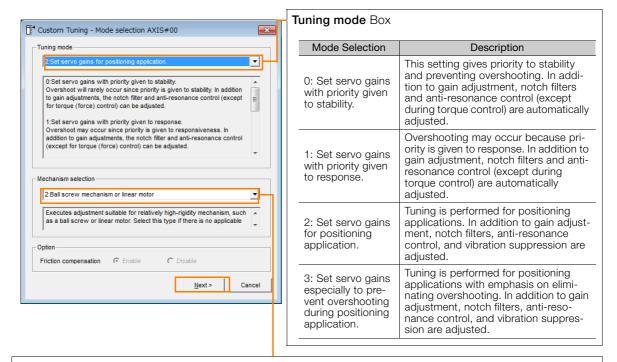


6. Click the Custom tuning Button.



8.8.4 Operating Procedure

Set the Tuning mode Box and Mechanism selection Box, and then click the Next Button.



Mechanism Selection Box

Select the type according to the machine element to drive.

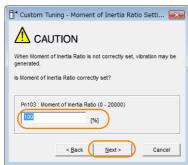
If there is noise or if the gain does not increase, better results may be obtained by changing the rigidity type. Select the type according to the following guidelines.

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.

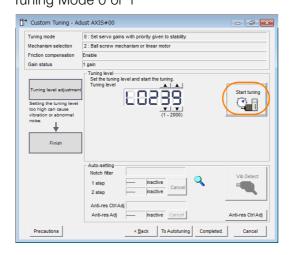
Information

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.

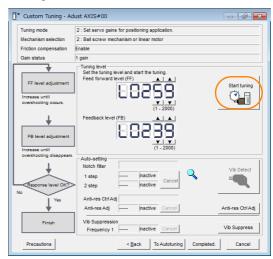


tuning Button. Tuning Mode 0 or 1



Tuning Mode 2 or 3

9. Turn ON the servo, enter a reference from the host controller, and then click the Start

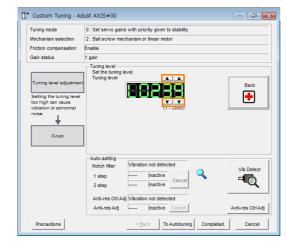


10. Use the ▲ and ▼ Buttons to change the tuning level.

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.

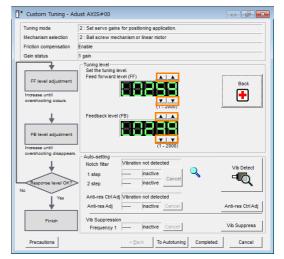
Tuning Mode 0 or 1

Increase the tuning level until overshooting occurs.



Tuning Mode 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.



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.

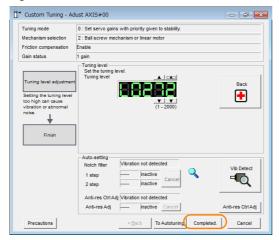
Refer to the following section for details.

Vibration Suppression Functions on page 8-46

8.8.4 Operating Procedure

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.



This concludes the procedure to set up custom tuning.

Vibration Suppression Functions

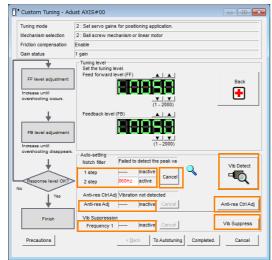
◆ Notch Filters and Automatic Anti-resonance Control Setting

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.



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.

8.9 Anti-Resonance Control Adjustment on page 8-50

• 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 8-55

◆ 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

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.

8.6.6 Automatically Adjusted Function Settings on page 8-31

8.8.6 Tuning Example for Tuning Mode 2 or 3

Step	Measurement Display Examples	Operation
1	Position deviation Reference speed Positioning completion signal	The positioning time is measured after the moment of inertia ratio (Pn103) is set correctly. Tuning is completed if the specifications are met. The tuning results are saved in the SERVOPACK.
2		The positioning time will be reduced if the feedforward level is increased. Tuning is completed if the specifications are met. The tuning results are saved in the SERVOPACK. If overshooting occurs before the specifications are met, proceed to step 3.
3		Overshooting will be reduced if the feedback level is increased. If the overshooting is eliminated, proceed to step 4.
4		The graph shows overshooting that occurred when the feed-forward level was increased even more after step 3. In this state, overshooting occurs, but the positioning settling time is shorter. Tuning is completed if the specifications are met. The tuning results are saved in the SERVOPACK. If overshooting occurs before the specifications are met, repeat steps 3 and 4. If vibration occurs before the overshooting is eliminated, the vibration is suppressed with the notch filters and anti-resonance control.
5	-	The tuning results are saved in the SERVOPACK.

8.8.7 Related Parameters

The following parameters are automatically adjusted or used as reference when you execute custom tuning.

Do not change the settings while custom tuning is being executed.

Parameter	Name	Automatic Changes
Pn100 (2100h)	Speed Loop Gain	Yes
Pn101 (2101h)	Speed Loop Integral Time Constant	Yes
Pn102 (2102h)	Position Loop Gain	Yes
Pn103 (2103h)	Moment of Inertia Ratio	No
Pn121 (2121h)	Friction Compensation Gain	Yes
Pn123 (2123h)	Friction Compensation Coefficient	Yes
Pn124 (2124h)	Friction Compensation Frequency Correction	No
Pn125 (2125h)	Friction Compensation Gain Correction	Yes
Pn401 (2401h)	First Stage First Torque Reference Filter Time Constant	Yes
Pn408 (2408h)	Torque-Related Function Selections	Yes
Pn409 (2409h)	First Stage Notch Filter Frequency	Yes
Pn40A (240Ah)	First Stage Notch Filter Q Value	Yes
Pn40C (240Ch)	Second Stage Notch Filter Frequency	Yes
Pn40D (240Dh)	Second Stage Notch Filter Q Value	Yes
Pn140 (2140h)	Model Following Control-Related Selections	Yes
Pn141 (2141h)	Model Following Control Gain	Yes
Pn142 (2142h)	Model Following Control Gain Correction	Yes
Pn143 (2143h)	Model Following Control Bias in the Forward Direction	Yes
Pn144 (2144h)	Model Following Control Bias in the Reverse Direction	Yes
Pn145 (2145h)	Vibration Suppression 1 Frequency A	No
Pn146 (2146h)	Vibration Suppression 1 Frequency B	No
Pn147 (2147h)	Model Following Control Speed Feedforward Compensation	Yes
Pn160 (2160h)	Anti-Resonance Control-Related Selections	Yes
Pn161 (2161h)	Anti-Resonance Frequency	Yes
Pn163 (2163h)	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.

8.9.1 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.

A CAUTION

- 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.



- Anti-resonance control adjustment detects vibration frequencies between 100 Hz and 1,000 Hz. If the vibration frequency is not within this range, use custom tuning with tuning mode 2 selected to automatically set a notch filter or use vibration suppression.
- 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

Check the following settings before you execute anti-resonance control adjustment.

- The tuning-less function must be disabled (Pn170 = n.□□□0).
- The test without a motor function must be disabled (Pn00C = n.□□□□0).
- The control method must not be set to torque control.
- The parameters must not be write prohibited.

8.9.3 Applicable Tools

The following table lists the tools that you can use to perform anti-resonance control adjustment and the applicable tool functions.

Tool	Function	Operating Procedure Reference
Digital Operator	Fn204	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Tuning - Tuning	8.9.4 Operating Procedure on page 8-51

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.

CAUTION

- Before you execute anti-resonance control adjustment, check the information provided in the SigmaWin+ operating manual.
 Observe the following precautions.
 - Make sure that you can perform an emergency stop at any time. 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 (to turn OFF the power supply) at any time.
 - Set the moment of inertia correctly before you execute anti-resonance control adjustment. If the setting greatly differs from the actual moment of inertia, effective vibration reduction may not be possible.
 - If you have already performed anti-resonance control adjustment and then you change the frequency, the current anti-resonance control effect may be lost. Caution is particularly required when automatically detecting the vibration frequency.
 - If effective vibration reduction is not achieved even after you execute anti-resonance control adjustment, cancel the function and lower the control gain by using a different method, such as custom tuning.
 - Perform custom tuning separately if required to increase the response after performing anti-resonance control adjustment.
 - If the servo 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.

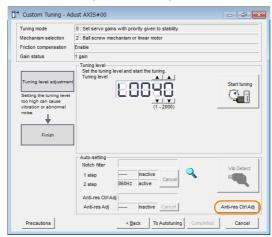
8.9.4 Operating Procedure

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 8-42

2. Click the Anti-res Ctrl Adj Button.

The rest of the procedure depends on whether you know the vibration frequency.



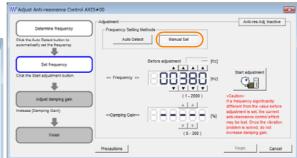
3. If you do not know the vibration frequency, click the **Auto Detect** Button. If you know the vibration frequency, click the **Manual Set** Button.

To Automatically Detect the Vibration Frequency

The frequency will be set.



To Manually Set the Vibration Frequency



- 4. Click the Start adjustment Button.
- 5. Use the ▲ and ▼ Buttons in the Adjustment Area to change the settings.

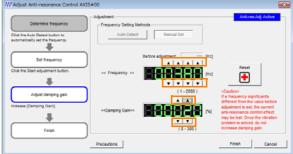
 Click the Reset Button during tuning to restore the setting to its original value. The tuning level will return to the value from before when custom tuning was started.

To Automatically Detect the Vibration Frequency

Change the setting of the damping gain.

To Manually Set the Vibration Frequency Change the settings of the frequency and damping gain.





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.



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 (2160h)	Anti-Resonance Control-Related Selections	Yes
Pn161 (2161h)	Anti-Resonance Frequency	Yes
Pn162 (2162h)	Anti-Resonance Gain Correction	No
Pn163 (2163h)	Anti-Resonance Damping Gain	Yes
Pn164 (2164h)	Anti-Resonance Filter Time Constant 1 Correction	No
Pn165 (2165h)	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

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) ≤ 3 to 4

Required Parameter Settings

The following parameter settings are required to use anti-resonance control for more than one vibration frequency.

Parameter		Description			When Enabled		Classifi- cation
Pn160 (2160h)	n.□□□0 (default setting)	Do not use anti-resona	Do not use anti-resonance control.		After restar		Setup
(210011)	n.□□□1	Use anti-resonance control.			Ibstait		
	Anti-Resonance Fr	equency		Speed	Positio	n	Torque
Pn161 (2161h)	Setting Range	Setting Unit	Default Setting	When En	abled	Cla	ssification
(210111)	10 to 20,000	0.1 Hz	1000	Immedia	ately		Tuning
D=100	Anti-Resonance G	ain Correction		Speed	Positio	n	Torque
Pn162 (2162h)	Setting Range	Setting Unit	Default Setting	When En	abled	Cla	ssification
(210211)	1 to 1,000	1%	100	Immedia	ately		Tuning
Pn163	Anti-Resonance Damping Gain			Speed	Positio	n	Torque
(2163h)	Setting Range	Setting Unit	Default Setting	When En	abled	Cla	ssification
(210011)	0 to 300	1%	0	Immedia	ately		Tuning
Pn164	Anti-Resonance Fi	nti-Resonance Filter Time Constant 1 Correction			Speed Position Torque		Torque
(2164h)	Setting Range	Setting Unit	Default Setting	When En	abled	Cla	ssification
(2:0:::)	-1,000 to 1,000	0.01 ms	0	Immedia	ately		Tuning
Pn165	Anti-Resonance Fi	Iter Time Constant 2 C	orrection	Speed	Position Torque		Torque
(2165h)	Setting Range	Setting Unit	Default Setting	When En	abled	Cla	ssification
(210011)	-1,000 to 1,000	0.01 ms	0	Immedia	ately		Tuning
Pn166	Anti-Resonance Da	amping Gain 2		Speed	Positio	n	Torque
(2166h)	Setting Range	Setting Unit	Default Setting	When En	abled	Cla	ssification
(2 10011)	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. Refer to the following section for details. 8.9.4 Operating Procedure on page 8-51
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. 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. However, if the vibration does not disappear even when you adjust Pn166 (Anti-Resonance Damping Gain 2), reduce the tuning level or feedback level until vibration does not occur.

۶

8.10 Vibration Suppression

This section describes vibration suppression.

8.10.1 Outline

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.

⚠ CAUTION

- 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.
- Before you execute vibration suppression, set the correct moment of inertia ratio (Pn103) with autotuning without a host reference or another method. 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 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.

Pn560 (2560h)	Residual Vibration Detection Width			Position		
	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 positioning operation. Perform positioning several times and make adjustments while checking the effect of vibration suppression.

8.10.2 Preparations

Check the following settings before you execute vibration suppression.

- · Position control must be used.
- The tuning-less function must be disabled (Pn170 = n.□□□0).
- The test without a motor function must be disabled (Pn00C = n.□□□0).
- The parameters must not be write prohibited.

8.10.3 Applicable Tools

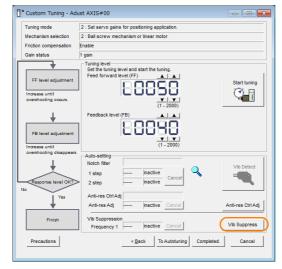
The following table lists the tools that you can use to perform vibration suppression and the applicable tool functions.

Tool	Function	Operating Procedure Reference
Digital Operator	Fn205	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Tuning - Tuning	8.10.4 Operating Procedure on page 8-56

8.10.4 Operating Procedure

Use the following procedure to perform vibration suppression.

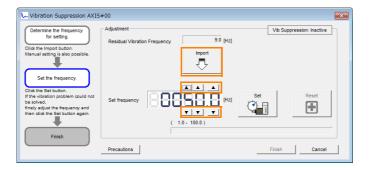
- 1. Perform steps 1 to 8 of the procedure for custom tuning. Refer to the following section for details.
 - 8.8.4 Operating Procedure on page 8-42
- 2. Click the Vib Suppress Button.



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.)



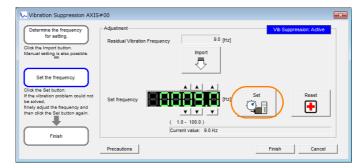
Frequency detection will not be performed if there is no vibration or if the vibration frequency is outside the range of detectable frequencies. If a vibration frequency is not detected, provide a means of measuring the vibration frequency.



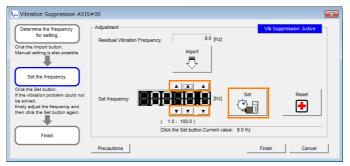
4. Click the Set Button.



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.



If the vibration is not eliminated, use the \triangle and \blacktriangledown Buttons for the set frequency to fine-tune the value and click the **Set** Button again.



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.

8.10.5 Setting Combined Functions

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 Setting Combined Functions

You can also use the feedforward function when you execute vibration suppression.

In the default settings, feedforward (Pn109), the speed feedforward input (VFF), and the torque feedforward input (TFF) are disabled.

To use the speed feedforward input (VFF), the torque feedforward input (TFF), and model following control from the host controller in the system, set Pn140 to n.1 \(\sigma\sup \square\$\) (Use model following control and speed/torque feedforward together).

Parameter		Function	When Enabled	Classification
Pn140 (2140h)	n.0□□□ (default setting)	Do not use model following control and speed/torque feedforward together.	Immediately	Tuning
	n.1□□□	Use model following control and speed/torque feedforward together.	irrimediately	runing



When model following control is used with the feedforward function, it is used to make optimum feedforward settings in the SERVOPACK. Therefore, model following control is not normally used together with either the speed feedforward input (VFF) or torque feedforward input (TFF) from the host controller. However, model following control can be used with the speed feedforward input (VFF) or torque feedforward input (TFF) if required. An unsuitable feedforward input may result in overshooting.

8.10.6 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 (2140h)	Model Following Control-Related Selections	Yes
Pn141 (2141h)	Model Following Control Gain	Yes
Pn142 (2142h)	Model Following Control Correction	No
Pn143 (2143h)	Model Following Control Bias in the Forward Direction	No
Pn144 (2144h)	Model Following Control Bias in the Reverse Direction	No
Pn145 (2145h)	Vibration Suppression 1 Frequency A	Yes
Pn146 (2146h)	Vibration Suppression 1 Frequency B	Yes
Pn147 (2147h)	Model Following Control Speed Feedforward Compensation	No
Pn14A (214Ah)	Vibration Suppression 2 Frequency	No
Pn14B (214Bh)	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

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+.

⚠ WARNING

 Speed ripple compensation requires operating the Servomotor and therefore presents hazards. Observe the following precaution.
 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

Check the following items 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

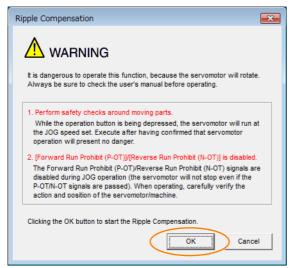
The following table lists the tools that you can use to set up speed ripple compensation and the applicable tool functions.

Tool	Function	Reference
Digital Operator	You cannot set up speed ripple comp	ensation from the Digital Operator.
SigmaWin+	Solutions – Ripple Compensation	© Operating Procedure on page 8-60

Operating Procedure

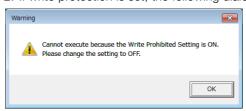
Use the following procedure to set up speed ripple compensation.

- 1. Click the 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.

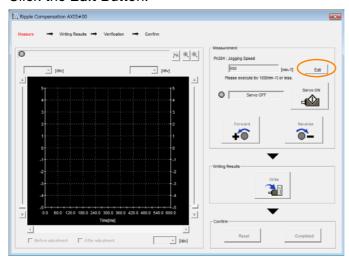


Information

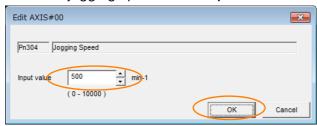
- 1. Click the **Cancel** Button to cancel ripple compensation. The Main Window will return.
- 2. If write protection is set, the following dialog box will be displayed.



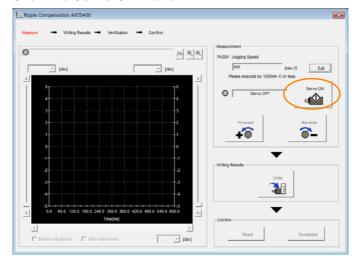
Click the ${\bf OK}$ Button to cancel write prohibition.



5. Enter the jogging speed in the Input Value Box and click the OK Button.



6. Click the Servo ON Button.



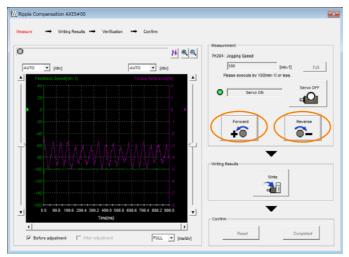
8.11.2 Setting Up Speed Ripple Compensation

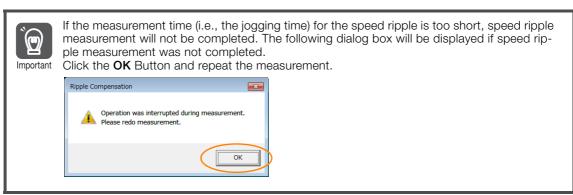
7. Click the Forward Button or the Reverse Button.

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.

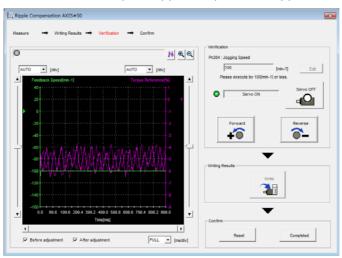


10. Click the Forward Button or the Reverse Button.

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 **Finish** 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 8-60. To cancel speed ripple compensation, use $Pn423 = n.\square\square\square\square$ 0 (Disable speed ripple compensation) to disable it.

Parameter		Description	When Enabled	Classifi- cation
Pn423 (2423h)	n.□□□0 (default setting)	Disable speed ripple compensation.	Immedi- ately	Setup
	n.□□□1	Enable speed ripple compensation.	alely	

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		Classifi- cation
Pn423	n.□0□□ (default setting)	Speed reference	After restart	Setup
(2423h)	n.🗆1🗆 🗆	Motor Speed	restart	

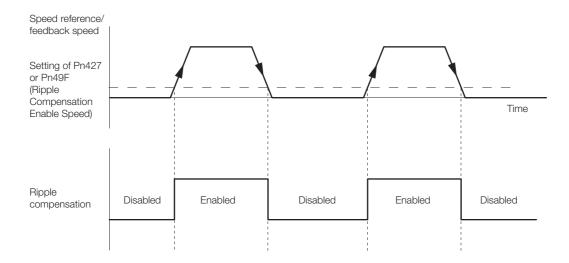
• For Rotary Servomotors

	Speed Ripple Compensation Enable Speed			Speed Position	n Torque
Pn427 (2427h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(272711)	0 to 10,000	1 min ⁻¹	0	Immediately	Tuning

• For Linear Servomotors

D= 40E	Speed Ripple Compensation Enable Speed			Speed Position Torque	
Pn49F (249Fh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(243111)	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.□□□0).
- Disable detection of A.942 (Pn423 = n.□□1□).

Parameter		Description		Classifi- cation
Pn423	n.□□0□ (default setting)	Detect A.942 alarms.	After	Setup
(2423h)	n.0010	Do not detect A.942 alarms.	restart	

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	Applicable Control Methods	Reference
Gain Switching	Position control, speed control, or torque control*	page 8-65
Friction Compensation	Position control or speed control	page 8-68
Current Control Mode Selection	Position control, speed control, or torque control	page 8-71
Current Gain Level Setting	Position control or speed control	page 8-71
Speed Detection Method Selection	Position control, speed control, or torque control	page 8-72
Backlash Compensation	Position Control	page 8-72

^{*} Automatic gain switching is enabled only for position control.

8.12.1 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 (2139h)	n.□□□0 (default setting)	T I Disable automatic dain switching		Tuning	
(2139h)	n.□□□2	Enable automatic gain switching.			

Note: Pn139 = n. □□□1 is a reserved setting. Do not use this setting.

Refer to the following section for gain switching combinations.

Gain Switching Combinations on page 8-65

Gain Switching Combinations

Selected Gains	Speed Loop Gain	Speed Loop Integral Time Constant	Position Loop Gain	Torque Reference Filter	Friction Compensation Gain
Gain Settings 1	Speed Loop Gain (Pn100)	Speed Loop Integral Time Constant (Pn101)	Position Loop Gain (Pn102)	First Stage First Torque Reference Filter Time Con- stant (Pn401)	Friction Compensation Gain (Pn121)
Gain Settings 2	Second Speed Loop Gain (Pn104)	Second Speed Loop Integral Time Constant (Pn105)	Second Position Loop Gain (Pn106)	First Stage Second Torque Reference Filter Time Con- stant (Pn412)	Second Friction Compensation Gain (Pn122)

Note: Automatic gain switching is not supported for Model Following Control Gain and Model Following Control Correction.

Automatic Gain Switching

Automatic gain switching is enabled only for position control. The switching conditions are specified by using the following settings.

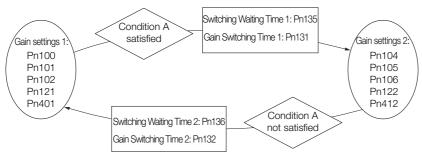
Parameter		Switching Condition	Selected Gains	Switching Waiting Time	Switching Time
Pn139		Condition A satisfied	Gain settings 1 to gain settings 2	Gain Switching Waiting Time 1 Pn135	Gain Switching Time 1 Pn131
(2139h)	n.□□□2	Condition A not satisfied	Gain settings 2 to gain settings 1	Gain Switching Waiting Time 2 Pn136	Gain Switching Time 2 Pn132

8.12.1 Gain Switching

Select one of the following settings for switching condition A.

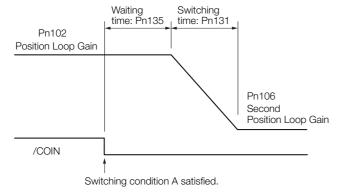
Parameter		Position Control Gain Switching Condition A	For Control Methods Other Than Position Control (No Switching)	When Enabled	Classification
	n.□□0□ (default setting)	/COIN (Positioning Completion) signal ON	Gain settings 1 used.		
	n.0010	/COIN (Positioning Completion) signal OFF	Gain settings 2 used.		
Pn139	n.□□2□	/NEAR (Near) signal ON	Gain settings 1 used.		
(2139h)	n.□□3□	/NEAR (Near) signal OFF	Gain settings 2 used.	Immediately	Tuning
,	n.□□4□	Position reference filter output is 0 and position reference input is OFF.	Gain settings 1 used.		
	n.□□5□	Position reference input is ON.	Gain settings 2 used.		

Automatic Switching Pattern 1 (Pn139 = n.□□□2)



Relationship between the Waiting Times and Switching Times for Gain Switching

In this example, an ON /COIN (Positioning Completion) signal is set as condition A 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).



Information You can use gain switching for either PI control or I-P control (Pn10B = $n.\Box\Box\Box\Box$ or $\Box\Box\Box\Box\Box$).

Related Parameters

D 400	Speed Loop Gain			Speed Posit	ion
Pn100 (2100h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(2 10011)	10 to 20,000	0.1 Hz	400	Immediately	Tuning
D=101	Speed Loop Integra	I Time Constant		Speed Posit	ion
Pn101 (2101h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(210111)	15 to 51,200	0.01 ms	2,000	Immediately	Tuning
Pn102	Position Loop Gain			Posit	ion
(2102h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(210211)	10 to 20,000	0.1/s	400	Immediately	Tuning
Pn401	First Stage First Tor	que Reference Filter	Time Constant	Speed Posit	ion Torque
(2401h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(= : 0 : : :)	0 to 65,535	0.01 ms	100	Immediately	Tuning
Pn121	Friction Compensation Gain Speed Position				
(2121h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(= := :::)	10 to 1,000	1%	100	Immediately	Tuning
Pn104	Second Speed Loop Gain Speed Position				
(2104h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(= : - : :)	10 to 20,000	0.1 Hz	400	Immediately	Tuning
Pn105		o Integral Time Cons	tant	Speed Posit	ion
(2105h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(= :)	15 to 51,200	0.01 ms	2,000	Immediately	Tuning
Pn106	Second Position Lo	op Gain		Posit	
(2106h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(= : :)	10 to 20,000	0.1/s	400	Immediately	Tuning
Pn412		Torque Reference Fil		Speed Posit	ion Torque
(2412h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
,	0 to 65,535	0.01 ms	100	Immediately	Tuning
Pn122	Second Friction Co	•		Speed Posit	
(2122h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
,	10 to 1,000	1%	100	Immediately	Tuning

Parameters Related to Automatic Gain Switching

				•	
D-404	Gain Switching Time	e 1		Posit	ion
Pn131 (2131h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(210111)	0 to 65,535	1 ms	0	Immediately	Tuning
D-400	Gain Switching Time	e 2		Posit	on
Pn132 (2132h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(210211)	0 to 65,535	1 ms	0	Immediately	Tuning
D=105	Gain Switching Wait	ting Time 1	Position		
Pn135 (2135h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(210011)	0 to 65,535	1 ms	0	Immediately	Tuning
D=100	Gain Switching Wait	ting Time 2		Posit	ion
Pn136 (2136h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(210011)	0 to 65,535	1 ms	0	Immediately	Tuning

8.12.2 Friction Compensation

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 (2006h) n.□□0B		Active Gain Monitor	1 V	Gain settings 1 are enabled.
Pn007 (2007h)	n. பப 08	Active Gair Mornton	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.

F	Parameter Function		When Enabled	Classification			
Pn408 (2408h)	n.0□□□ (default setting)	Disable friction compensation.		Immediately	Setup		
(240011)	n.1000	Enable friction compen	sation.				
	Friction Compens	sation Gain		Speed Posit	ion		
Pn121 (2121h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification		
(212111)	10 to 1,000	1%	100	Immediately	Tuning		
D 400	Second Friction (Compensation Gain		Speed Posit	ion		
Pn122 (2122h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification		
(212211)	10 to 1,000	1%	100	Immediately	Tuning		
D=100	Friction Compensation Coefficient			Speed Posit	Speed Position		
Pn123 (2123h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification		
(212011)	0 to 100	1%	0	Immediately	Tuning		
D=104	Friction Compens	sation Frequency Corre	ction	Speed Posit	ion		
Pn124 (2124h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification		
(212411)	-10,000 to 10,00	0 0.1 Hz	0	Immediately	Tuning		
D=105	Friction Compens	sation Gain Correction		Speed Posit	ion		
Pn125 (2125h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification		
(212011)	1 to 1,000	1%	100	Immediately	Tuning		

Operating Procedure for Friction Compensation

Use the following procedure to perform friction compensation.

A CAUTION

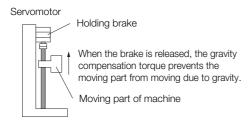
Before you execute friction compensation, set the moment of inertia ratio (Pn103) as accurately as possible. If the setting greatly differs from the actual moment of inertia, vibration may occur.

Step	Operation				
1	Set the following parameters related to friction compensation to their default settings. Friction compensation gain (Pn121): 100 Second friction compensation gain (Pn122): 100 Friction compensation coefficient (Pn123): 0 Friction compensation frequency correction (Pn124): 0 Friction compensation gain correction (Pn125): 100 Note: Always use the default settings for the friction compensation frequency correction (Pn124) and friction compensation gain correction (Pn125):				
2	Gradually increase the friction compensation coefficient (Pn123) to check the effect of friction compensation. Note: Usually, set the friction compensation coefficient (Pn123) to 95% or less. If the effect is insufficient, increase the friction compensation gain (Pn121) by 10% increments until vibration stops. Effect of Adjusted Parameters Pn121: Friction Compensation Gain and Pn122: Second Friction Compensation Gain 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. Pn123: Friction Compensation Coefficient 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.				
3	Effect of Adjustments The following graphs show the response with and without adjustment. Poor response because of friction Low friction Position deviation High friction Position reference speed Before Friction Compensation After Friction 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.

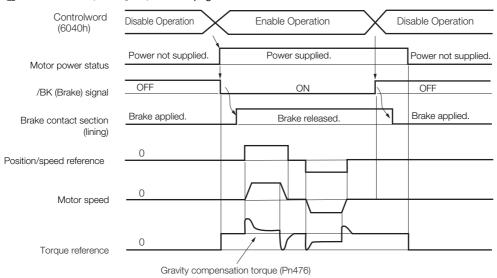
SERVOPACKs with software version 0023 or higher support gravity compensation.



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 5-33



Required Parameter Settings

The following parameter settings are required to use gravity compensation.

ı	arameter Description		When Enabled	Classification	
Pn475	n.□□□0 (default setting)	Disable gravity compensation.		After restart	Setup
(2475h) (asidali setting) n.□□□1		Enable gravity compensation.			
D 470	Gravity Compensation Torque			Speed Posi	tion Torque
Pn476 (2476h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(247011)	-1,000 to 1,000	0.1%	0	Immediately	Tuning

Operating Procedure for Gravity Compensation

Use the following procedure to perform gravity compensation.

- 1. Set Pn475 to n.□□□1 (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

Current control mode selection reduces high-frequency noise while the Servomotor is being stopped.

The setting depends on the capacity of the SERVOPACK.

• SERVOPACK Models SGD7S-R70A, -R90A, -1R6A, -2R8A, -3R8A, -5R5A, and -7R6A

Parameter		Meaning	When Enabled	Classification
	n. □□0□			
Pn009 (2009h)	n. □□1□ (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. □□0□	Use current control mode 1.		Tuning
Pn009 (2009h)	n. □□1□ (default setting)	Use current control mode 2 (low noise).	After restart	
	n. □□2□			



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.

D=10D	Current Gain Level Speed Position				
Pn13D (213Dh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(Z TODII)	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

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.

Parameter		Meaning	When Enabled	Classification
Pn009 (2009h)	n. □0□□ (default setting)	Use speed detection 1.	After restart	Tuning
(200311)	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			Speed Position		
Pn308	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(2308h)	0 to 65,535 (0.00 ms to 655.35 ms)	0.01 ms	0 (0.00 ms)	Immediately	Setup

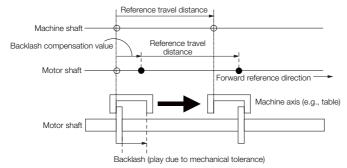
8.12.8 Backlash Compensation

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: 1. Backlash compensation can be used only with a Rotary Servomotor.

2. Backlash compensation can be used only for position control.



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 (2230h)	n. □□□0 (default setting)	Compensate forward references.	After restart	Setup
(223011)	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.

Example

When Pn231 = 6553.6 [reference units] and position reference unit (Numerator/Denominator) = 1/1:

 $6,553.6 \times 1 = 6,553.6$ [pulses]

⇒ The backlash compensation will be 6,553 encoder pulses.

	Backlash Compensatio	n	Position		
Pn231	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(2231h)	-500,000 to 500,000	0.1 reference units	0	Immediately	Setup



 The backlash compensation value is restricted by the following formula. Backlash compensation is not performed if this condition is not met.

$$Pn231 \leq \frac{Denominator}{Numerator} \times \frac{Maximum\ motor\ speed\ [min^{-1}]}{60} \times Encoder\ resolution* \times 0.00025$$

*Refer to the following section for the encoder resolution.

5.14 Setting Unit Systems on page 5-43

With fully-closed loop control, substitute the number of external encoder pulses per motor rotation for the encoder resolution in the above formula.

Example 1:

Denominator = 1, Numerator = 1, Maximum motor speed = 6,000 [min⁻¹], and Encoder resolution = 16,777,216 (24 bits)

 $1/4 \times 6,000/60 \times 16,777,216 \times 0.00025 = 104,857.6$ [reference units]

⇒ The backlash compensation will be limited to 104,857.6 reference units.

Example 2:

Denominator = 1, Numerator = 1, Maximum motor speed = 6,000 [min⁻¹], Number of External Encoder Scale Pitches (Pn20A) = 500, and Use of the JZDP-H00□-000 (signal resolution: 1/256):

 $1/4 \times 6,000/60 \times (500 \times 256) \times 0.00025 = 800.0$ [reference units]

 \Rightarrow The backlash compensation will be limited to 800.0 reference units.

• Do not exceed the upper limit of the backlash compensation value. You can check the upper limit on the operation monitor of the SigmaWin+.

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 Compensation Time Constant			Position	
Pn233 (2233h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(220011)	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.□□□0). The following monitor information is provided in the figures: target position (607Ah) (target position in the reference coordinate system), position demand value (6062h) (reference position in the reference coordinate system), and position actual value (6064h) (feedback position in the machine coordinate system). The monitor information includes the feedback position in machine coordinate system (position actual value) 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.

A CAUTION

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

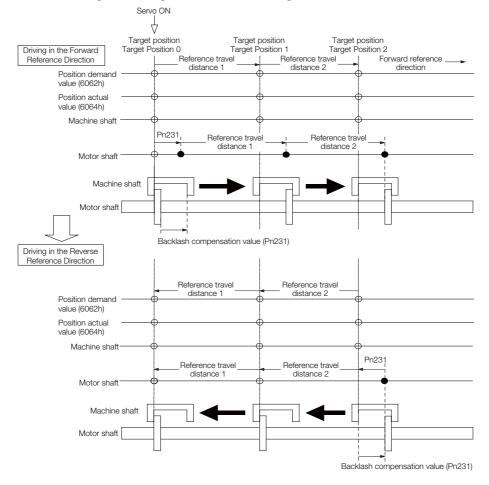
The backlash compensation value (Pn231) is added in the backlash compensation direction when the servo is ON (i.e., while power is supplied to the motor) and a reference is input in the same direction as the backlash compensation direction (Pn230.0 = $n.\Box\Box\Box$ X). When there is a reference input 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 *position actual value* (6064h) and the motor shaft position is as follows:

- If a reference is input in the compensation direction: Position actual value (6064h) = Motor shaft position Pn231
- If a reference is input in the direction opposite to the compensation direction: Position actual value (6064h) = Motor shaft position

The following figure shows driving the Servomotor in the forward direction from Target Position 0 (*target position*: 607Ah) to Target Position 1 and then to Target Position 2, and then returning from Target Position 2 to Target Position 1 and then to Target Position 0.

Backlash compensation is applied when moving from Target Position 0 to Target Position 1, but not when moving from Target Position 2 to Target Position 1.



8.12.8 Backlash Compensation

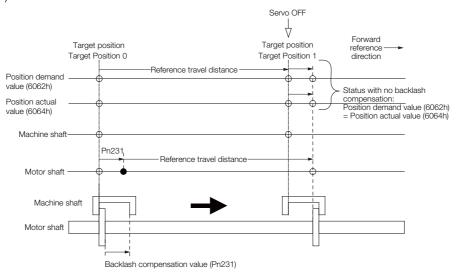
◆ Operation When the Servo Is OFF

Backlash compensation is not applied when the servo is OFF (i.e., when power is not supplied to motor). Therefore, the reference position (position demand value (6062h)) is moved by only the backlash compensation value.

The relationship between *position actual value* (6064h) and the motor shaft position is as follows:

• When servo is OFF: Position actual value (6064h) = 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 Target Position 0 to Target Position 1. Backlash compensation is not applied when the servo is OFF. (The SERVOPACK manages the position data so that *position actual value* (6064h) and *position demand value* (6062h) 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 (→ Operation When the Servo Is OFF on page 8-76), i.e., backlash compensation is not applied.

Operation When Control Is Changed

Backlash compensation is performed only for position control.

Backlash compensation is not applied when position control is changed to any other control method

Backlash compensation is applied in the same way as when the servo is ON (◆ Operation When the Servo Is ON on page 8-75) if any other control method is changed to position control.

Related Monitoring

You can monitor the following values on the operation monitor of the SigmaWin+.

Displayed Value	Unit	Specification
Input Reference Pulse Speed	min ⁻¹	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 Counter	Reference units	Displays the input reference pulse counter before backlash compensation.
Feedback Pulse Counter	Encoder pulses	Displays the number of pulses from the actually driven motor encoder.
Fully-Closed Feedback Pulse Counter	External encoder resolution	Displays the number of pulses of the actually driven external encoder.
Feedback Pulse Counter	Reference units	Displays the number of pulses from the actually driven encoder in reference units.

◆ Related Monitoring Diagrams

The following symbols are used in the related monitoring diagrams.

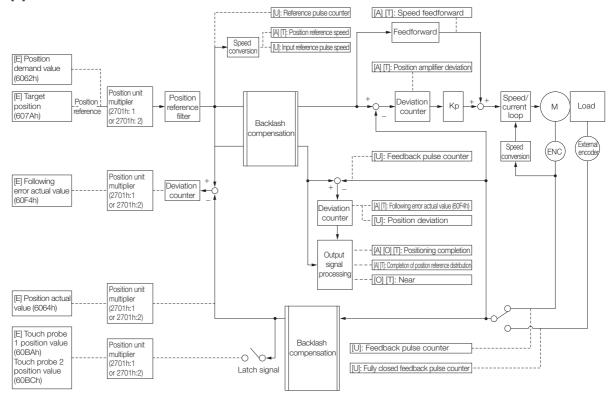
[A]: Analog monitor

[E]: EtherCAT monitor Information

[U]: Monitor mode (Un monitor)

[O]: Output signal

[T]: Trace data



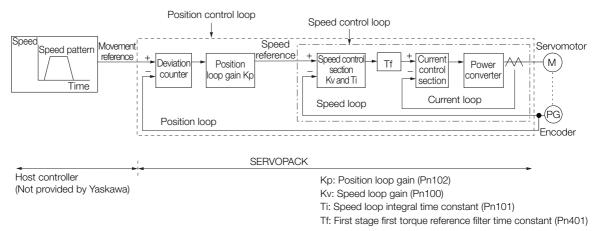
8.13

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

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. For example, you can reduce the positioning time for position control.

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.

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 = $n.\Box\Box\Box$ 2) to detect vibration. Refer to the following section for information on vibration detection.

6.11 Initializing the Vibration Detection Level on page 6-45

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 (for Position Control or Speed Control)

Step	Description
1	Adjust the first stage first torque reference filter time constant (Pn401) so that vibration does not occur.
2	Increase the speed 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	For position control, 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.

8.13.1 Tuning the Servo Gains

D=100	Position Loop Gain			Position	
Pn102 (2102h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(210211)	10 to 20,000	0.1/s	400	Immediately	Tuning

Information

For machines for which a high position loop gain (Pn102) cannot be set, overflow alarms can 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.

$$Pn520 \ge \frac{\text{Maximum feed speed [reference units/s]}}{Pn102 \div 10 (1/s)} \times 2.0$$

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			Position	
Pn520	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(2520h)	1 to 1,073,741,823	1 reference 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	eed Loop Gain			Speed Position Torque	
Pn100 (2100h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classifica- 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			Speed Position Torque	
Pn103 (2103h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classifica- tion
	0 to 20,000	1%	100	Immediately	Tuning

Speed Loop Integral Time Constant

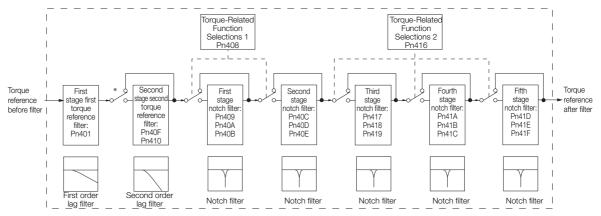
To enable response to even small inputs, the speed loop has an integral element. The integral element becomes a delay factor in the servo system. If the time constant is set too high, overshooting will occur, positioning settling time will increase, and the response characteristic will suffer.

	Speed Loop Integral Time Constant			Speed Position	
Pn101 (2101h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classifica- tion
	15 to 51,200	0.01 ms	2,000	Immediately	Tuning

◆ 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 $Pn416 = n.\Box XXX$.



^{*} 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.

Pn401 (2401h)	First Stage First Torque Reference Filter Time Constant		Speed Posit	ion Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(240111)	0 to 65,535	0.01 ms	100	Immediately	Tuning
D= 40F	Second Stage Seco	nd Torque Reference	Filter Frequency	Speed Posit	ion Torque
Pn40F (240Fh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(240111)	100 to 5,000	1 Hz	5,000*	Immediately	Tuning
D:- 440	Second Stage Second Torque Reference Filter Q Value		Speed Posit	ion Torque	
Pn410 (2410h)	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.

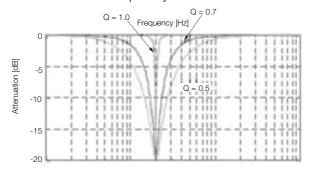
Notch filters are set with three parameters for the notch filter frequency, notch filter Q value, and notch filter depth. This section describes the notch filter Q value and notch filter depth.

· 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.

8.13.1 Tuning the Servo Gains

The notch filter frequency characteristics for different notch filter Q values are shown below.

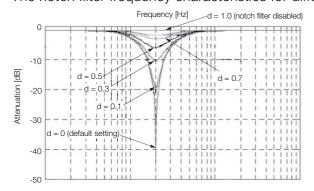


Note: The above notch filter frequency characteristics are based on calculated values and may be different from actual characteristics.

· 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.

F	Parameter	Meaning	When Enabled	Classification
	n.□□□0 (default setting)	Disable first stage notch filter.		
Pn408	n.□□□1	Enable first stage notch filter.		
(2408h)	n.□0□□ (default setting)	Disable second stage notch filter.		
	n.🗆1🗆 🗆	Enable second stage notch filter.		Setup
	n.□□□0 (default setting)	Disable third stage notch filter.	Immediately	
	n.□□□1	Enable third stage notch filter.	-	
Pn416	n.□□0□ (default setting)	Disable fourth stage notch filter.		
(2416h)	n.0010	Enable fourth stage notch filter.		
	n.□0□□ (default setting)	Disable fifth stage notch filter.		
	n.🗆1 🗆 🗆	Enable fifth stage notch filter.		

Set the machine vibration frequencies in the notch filter parameters.

D 400	First Stage Notch F	Filter Frequency		Speed	Position Torque
Pn409 (2409h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(240311)	50 to 5,000	1 Hz	5,000	Immediately	Tuning
D:- 40 A	First Stage Notch F	ilter Q Value		Speed	Position Torque
Pn40A (240Ah)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(2 10/11)	50 to 1,000	0.01	70	Immediately	Tuning
Pn40B	First Stage Notch F	ilter Depth		Speed	Position Torque
(240Bh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(2.10211)	0 to 1,000	0.001	0	Immediately	Tuning
Pn40C	Second Stage Note	ch Filter Frequency		Speed	Position Torque
(240Ch)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(= 10011)	50 to 5,000	1 Hz	5,000	Immediately	Tuning
Pn40D	Second Stage Note	ch Filter Q Value		Speed	Position Torque
(240Dh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(= :5=::)	50 to 1,000	0.01	70	Immediately	Tuning
Pn40E	Second Stage Note	ch Filter Depth		Speed	Position Torque
(240Eh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(2 10211)	0 to 1,000	0.001	0	Immediately	Tuning
Pn417	Third Stage Notch	Filter Frequency		Speed	Position Torque
(2417h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(=)	50 to 5,000	1 Hz	5,000	Immediately	Tuning
Pn418	Third Stage Notch	Filter Q Value		Speed	Position Torque
(2418h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(= : : : : :)	50 to 1,000	0.01	70	Immediately	Tuning
Pn419	Third Stage Notch	Filter Depth		Speed F	Position Torque
(2419h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
,	0 to 1,000	0.001	0	Immediately	Tuning
Pn41A	Fourth Stage Notcl	<u>.</u>		Speed	Position Torque
(241Ah)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
,	50 to 5,000	1 Hz	5,000	Immediately	Tuning
Pn41B	Fourth Stage Notch				Position Torque
(241Bh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
,	50 to 1,000	0.01	70	Immediately	Tuning
Pn41C	Fourth Stage Notcl	<u> </u>			Position Torque
(241Ch)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
,	0 to 1,000	0.001	0	Immediately	Tuning
Pn41D	Fifth Stage Notch F	· · · · · · · · · · · · · · · · · · ·			Position Torque
(241Dh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
,	50 to 5,000	1 Hz	5,000	Immediately	Tuning
Pn41E	Fifth Stage Notch F				Position Torque
(241Eh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 1,000	0.01	70	Immediately	Tuning
Pn41F	Fifth Stage Notch F	·			Position Torque
(241Fh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
, ,	0 to 1,000	0.001	0	Immediately	Tuning

8.13.1 Tuning the Servo Gains



- 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 to an appropriate
 value.) 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] $\leq 2\pi \times \text{Pn100/4}$ [Hz] Critical gain: Pn102 [/s] $< 2\pi \times \text{Pn100}$ [Hz]
- 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]) Critical gain: Pn101 [ms] > 1,000/($2\pi \times$ 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 π × Pn100 [Hz] × 4) Critical gain: Pn401 [ms] < 1,000/(2 π × Pn100 [Hz] × 1)

 Speed Loop Gain (Pn100 [Hz]) and Second Stage Second Torque Reference Filter Frequency (Pn40F [Hz])

Critical gain: Pn40F [Hz] $> 4 \times Pn100$ [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] $> 4 \times Pn100$ [Hz]

 Speed Loop Gain (Pn100 [Hz]) and Speed Feedback Filter Time Constant (Pn308 [ms]) Stable gain: Pn308 [ms] $\leq 1,000/(2\pi \times Pn100 [Hz] \times 4)$ Critical gain: Pn308 [ms] $< 1,000/(2\pi \times Pn100 [Hz] \times 1)$

\blacklozenge When Pn10B = n. $\Box\Box\Box\Box$ (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 Speed Loop Gain (Pn100), 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.



 Speed Loop Gain (Pn100 [Hz]) and Speed Loop Integral Time Constant (Pn101 [ms]) Stable gain: Pn101 [ms] $\geq 4,000/(2\pi \times \text{Pn100 [Hz]})$, therefore If Pn100 = 40.0 [Hz], then Pn101 = 4,000/ $(2\pi \times 40.0) \approx 15.92$ [ms].

Model Following Control

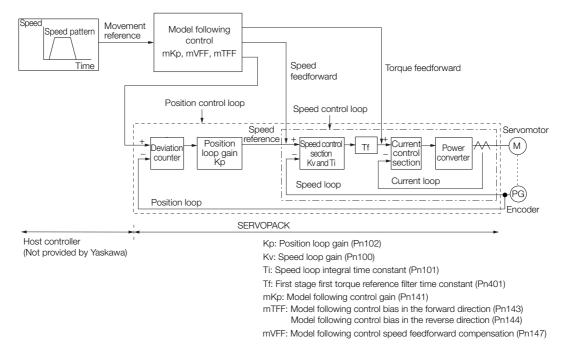
You can use model following control to improve response characteristic and shorten positioning time. You can use model following control only with position control.

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

8.13.1 Tuning the Servo Gains

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. 8.12.2 Friction Compensation on page 8-68
	Adjust the servo gains. Refer to the following section for an example procedure. Tuning Procedure Example (for Position Control or Speed Control) on page 8-79
2	Note: 1. Set the moment of inertia ratio (Pn103) as accurately as possible. 2. Refer to the guidelines for manually tuning the servo gains and set a stable gain for the position loop gain (Pn102). Given Guidelines for Manually Tuning Servo Gains on page 8-84
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 $Pn140 = n.\square\square\square\square X$ 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.□□1□ or Pn140 = n.□□2□), always set Pn140 to n.□□□1 (Use model following control).

Parameter		Function	When Enabled	Classification
	n.□□□0 (default setting)	Do not use model following control.		Tuning
	n.□□□1	Use model following control.	Immediately	
Pn140 (2140h)	n.□□0□ (default setting)	Do not perform vibration suppression.		
	n.□□1□	Perform vibration suppression for a specific frequency.		
	n.□□2□	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).

Pn141 (2141h)	Model Following Control Gain			Position		
	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
$$\geq \frac{\text{Maximum feed speed [reference units/s]}}{\text{Pn 141/10 [1/s]}} \times 2.0$$

	Position Deviation Overflow Alarm Level			Position	
Pn520 (2520h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,823	1 reference 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.

Pn143 (2143h)	Model Following Control Bias in the Forward Direction			Position		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	0.1%	1,000	Immediately	Tuning	
D-144	Model Following Control Bias in the Reverse Direction			Position		
Pn144 (2144h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	0.1%	1,000	Immediately	Tuning	

8.13.2 Compatible Adjustment Functions

■ 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.

Pn147 (2147h)	Model Following Control Speed Feedforward Compensation			Position	
	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. \$\square\$ (Use model following control type 2) (default setting). If compatibility with previous models is required, set Pn14F to n. \$\square\$ (Use model following control type 1).

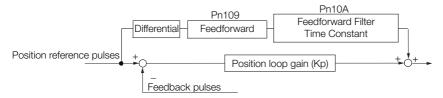
Parameter		Meaning	When Enabled	Classification
Pn14F (214Fh)	n.□□□0	Use model following control type 1.		
	n.□□□0 (default setting)	Use model following control type 2.	After restart	Tuning

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 Σ -III-Series SERVOPACKs to adjust Σ -7-Series SERVOPACKs.

Feedforward

The feedforward function applies feedforward compensation to position control to shorten the positioning time.



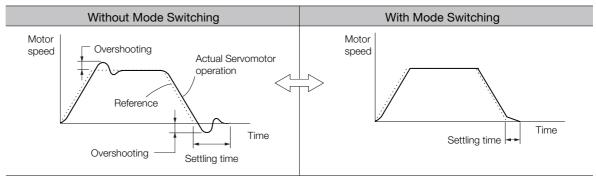
Pn109 (2109h)	Feedforward			Position		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 100	1%	0	Immediately	Tuning	
D104	Feedforward Filter Time Constant Position					
Pn10A (210Ah)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 6,400	0.01 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.

Mode Switching (Changing between Proportional and Pl 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 $Pn10B = n.\square\square\square\square X$.

Parameter		Mode Switching		Parameter That Sets the Level		Classification	
·	rarameter	Selection	Rotary Servomotor	Linear Servomotor	Enabled	Ciassification	
	n.□□□0 (default setting)	Use the internal torque reference as the condition.	Pn10C	(210Ch)	Immediately		
	n.□□□1	Use the speed reference as the condition.	Pn10D (210Dh)	Pn181 (2181h)		Setup	
Pn10B (210Bh)	n.□□□2	Use the acceleration reference as the condition.	Pn10E (210Eh)	Pn182 (2182h)			
	n.□□□3	Use the position deviation as the condition.	Pn10F (210Fh)				
	n.□□□4	Do not use mode switching.	_				

■ Parameters That Set the Switching Levels

· Rotary Servomotors

Pn10C (210Ch)	Mode Switching Level for Torque Reference			Speed Position		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
(210011)	0 to 800	1%	200	Immediately	Tuning	
D 40D	Mode Switching L	evel for Speed Refe	erence	Speed	Position	
Pn10D (210Dh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
(210011)	0 to 10,000	1 min ⁻¹	0	Immediately	Tuning	
D 405	Mode Switching Level for Acceleration			Speed Position		
Pn10E (210Eh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
(210011)	0 to 30,000	1 min ⁻¹ /s	0	Immediately	Tuning	
Pn10F (210Fh)	Mode Switching L	evel for Position De	eviation	Position		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	1 reference unit	0	Immediately	Tuning	

8.13.2 Compatible Adjustment Functions

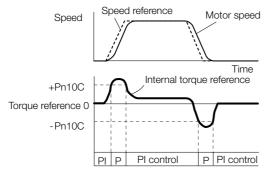
Linear Servomotors

Pn10C (210Ch)	Mode Switching Level for Force Reference			Speed Position		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
(210011)	0 to 800	1%	200	Immediately	Tuning	
D-101	Mode Switching L	evel for Speed Ref	erence	Speed	Position	
Pn181 (2181h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
(210111)	0 to 10,000	1 mm/s	0	Immediately	Tuning	
D 400	Mode Switching Level for Acceleration			Speed Position		
Pn182 (2182h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
(210211)	0 to 30,000	1 mm/s ²	0	Immediately	Tuning	
Pn10F (210Fh)	Mode Switching Level for Position Deviation			F	Position	
	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.

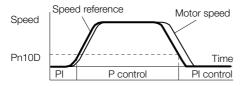
The default setting for the torque reference level is 200%.



■ Using the Speed Reference as the Mode Switching Condition

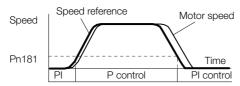
Rotary Servomotors

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

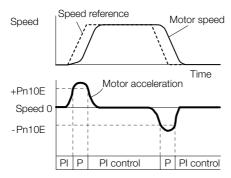
When the speed reference equals or exceeds the speed set for the mode switching level for a speed reference (Pn181), the speed loop is changed to P control.



■ Using the Acceleration as the Mode Switching Condition

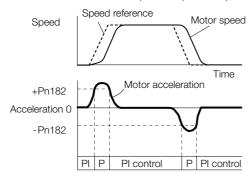
Rotary Servomotors

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

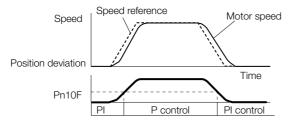
When the speed reference equals or exceeds the acceleration rate set for the mode switching level for acceleration (Pn182), the speed loop is changed to P control.



■ 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. This parameter is effective for electronic cams and electronic shafts.

D=115	Position Integral Time Constant			Position	
Pn11F (211Fh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(211111)	0 to 50,000	0.1 ms	0	Immediately	Tuning

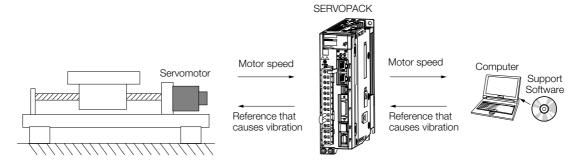
8.14

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.

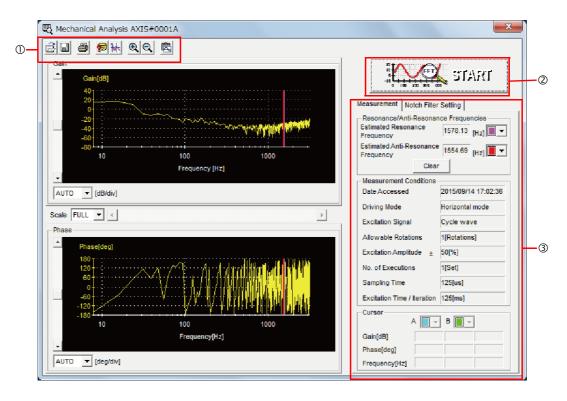
MARNING

Mechanical analysis requires operating the Servomotor and therefore presents hazards.
 Before you execute mechanical analysis, check the information provided in the SigmaWin+ operating manual.

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

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.

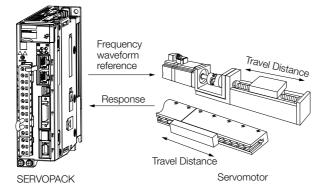
Execute Easy FFT after the servo is turned OFF if operation of the SERVOPACK results in high-frequency noise and vibration.

♠ WARNING

 Never touch the Servomotor or machine during execution of Easy FFT. Doing so may result in injury.

M CAUTION

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

Check the following settings 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.□□□0).
- 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.

Operating Procedure

Use the following procedure for Easy FFT.

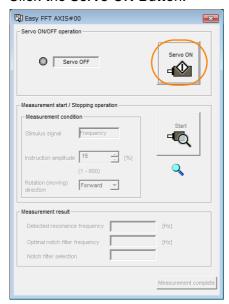
- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Easy FFT in the Menu Dialog Box.

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.



8.14.2 Easy FFT

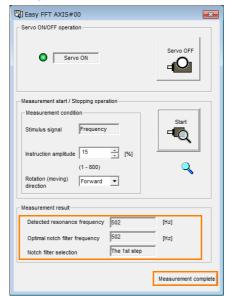
5. Select the instruction (reference) amplitude and the rotation direction in the **Measurement condition** Area, and then click the **Start** Button.

The Servomotor shaft will rotate and measurements will start.

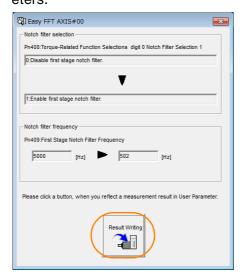


When measurements have been completed, the measurement results will be displayed.

6. Check the results in the **Measurement result** Area and then click the **Measurement complete** Button.



7. Click the Result Writing Button if you want to set the measurement results in the parameters.



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 (2408h)	Pn408 (2408h) Torque-Related Function Selections	
Pn409 (2409h) First Stage Notch Filter Frequency		Yes
Pn40A (240Ah) First Stage Notch Filter Q Value		No
Pn40C (240Ch) Second Stage Notch Filter Frequency		Yes
Pn40D (240Dh) Second Stage Notch Filter Q Value		No
Pn456 (2456h)	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.

This chapter provides information on monitoring SERVO-PACK product information and SERVOPACK status.

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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	 Model/Type Serial Number Manufacturing Date Software version (SW Ver.) Remarks
Information on Servomotors	 Model/Type Serial Number Manufacturing Date Remarks
Information on Encoders	 Model/Type Serial Number Manufacturing Date Software version (SW Ver.) Remarks
Information on Option Modules	Model/Type Serial Number Manufacturing Date Software version (SW Ver.) Remarks

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.



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+.

Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)

Monitoring SERVOPACK Status

9.2.1 Servo Drive Status

Use the following procedure to display the Servo Drive status.

 Start the SigmaWin+. The Servo Drive status will be automatically displayed when you go online with a SERVOPACK.



The Servo Drive status is displayed.

The Servomotor type is displayed.

9.2.2 **Monitoring Status and Operations**

Monitor Items

The items that you can monitor on the Status Monitor Window and Motion Monitor Window are listed below.

Status Monitor Window

· Polarity Sensor Signal

• Motor Power (Request)

· Active Gain Monitor · Main Circuit

• Encoder (PGRDY)

Motor Power ON

Direction • Mode Switch

(PULS)

Direction

Detection

Overcurrent

fication

Progress

Detection

AC Power ON

• Dynamic Brake (DB)

Rotation (Movement)

Speed Reference (V-Ref)

• Torque Reference (T-Ref)

• CLR (Position Deviation

• Surge Current Limiting

Resistor Short Relay

· Regenerative Error

Origin Not Passed

· Polarity Detection in

Completion of Polarity

• Regenerative Transistor

· Moment of Inertia Identi-

Clear Input Signal)

Position Reference

• Position Reference

Monitor

Monitor Items

- P-OT (Forward Drive Prohibit Input Signal)
- N-OT (Reverse Drive Prohibit Input Signal)
- /P-CL (Forward External Torque Limit Signal)
- /N-CL (Reverse External Torque Limit Signal)
- SEN (Absolute Data Request Input
- /SPD-D (Motor Direction Input) Signal
- /SPD-A (Internal Set Speed Selection Input Signal)
- /SPD-B (Internal Set Speed Selection Input Signal)
- Stati • /C-SEL (Control Selection Input Sig-Signal
 - /ZCLAMP (Zero Clamping Input Sig-
 - /INHIBIT (Reference Pulse Inhibit
 - Input Signal) • /G-SEL (Gain Selection Input Signal)
 - /P-DET (Polarity Detection Input Sig-
 - /DEC (Origin Return Deceleration Switch Input Signal)
 - /EXT1 (External Latch Input 1 Signal)
 - /EXT2 (External Latch Input 2 Signal)
 - /EXT3 (External Latch Input 3 Signal)
 - FSTP (Forced Stop Input Signal)

- · ALM (Servo Alarm Output Signal)
- /COIN (Positioning Completion Output Signal)
- /V-CMP (Speed Coincidence Detection Output Signal)
- /TGON (Rotation Detection Output Signal)
- · /S-RDY (Servo Ready Output Signal)
- /CLT (Torque Limit Detection Output Signal)
- /VLT (Speed Limit Detection Output Signal)
- /BK (Brake Output Signal)
- /WARN (Warning Output Signal)

Signal

- /NEAR (Near Output Signal)
- PAO (Encoder Divided Pulse Output Phase A Sig-
- PBO (Encoder Divided Pulse Output Phase B Sig-
- PCO (Encoder Divided) Pulse Output Phase C Sig-
- /PM (Preventative Maintenance Output Signal)

9.2.2 Monitoring Status and Operations

Motion Monitor Window

Monitor Items

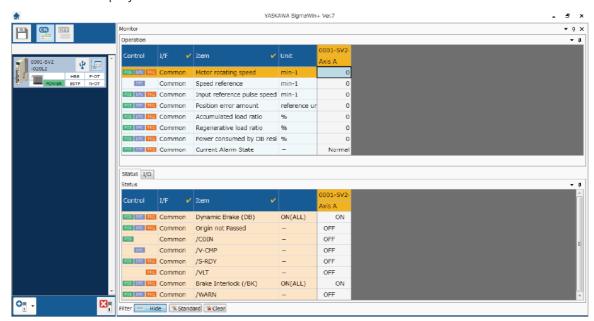
- · Current Alarm State
- · Motor Speed
- Speed Reference
- Internal Torque Reference
- Angle of Rotation 1 (number of encoder pulses from origin within one encoder rotation)
- · Angle of Rotation 2 (angle from origin within one encoder rotation)
- Input Reference Pulse Speed
- Deviation Counter (Position Deviation)
- · Cumulative Load
- Regenerative Load
- DB Resistor Consumption Power
- · Absolute Encoder Multiturn Data
- · Absolute Encoder Position within One Rotation
- Lower Bits of Absolute Encoder Position
- Upper Bits of Absolute Encoder Position
- Reference Pulse Counter
- · Feedback Pulse Counter
- Fully Closed Feedback Pulse Counter
- Total Operating Time
- Current Backlash Compensation Value
- Backlash Compensation Value Setting Limit
- Position Amplifier Deviation
- Feedback Position (APOS)
- Current Reference Position (CPOS)
- Position Deviation (PERR)

- Target Position (TPOS)
 - Latched Position 1 (LPOS1)
 - Latched Position 2 (LPOS2)
 - Latched Position 3 (LPOS3)
 - Target Speed (TSPD)
 - Feedback Speed (FSPD)
 - Current Position Command Speed (CSPD)
 - Torque Limit (TRQ_LIM)
 - Speed Limit (SPD_LIM)
 - 6041h: Statusword
 - 6061h: Modes of operation display
 - 6062h: Position demand value
 - 6063h: Position actual internal value
 - 6064h: Position actual value
 - 606Bh: Velocity demand value
 - 606Ch: Velocity actual value
 - 6074h: Torque demand value
 - 60B9h: Touch probe status
 - 60BAh: Touch probe 1 position value
 - 60BCh: Touch probe 2 position value
 - 60F4h: Following error actual value
 - 60FCh: Position demand internal value
 - 1C32h, 01: Synchronization type
 - 1C32h, 02: Cycle time
 - 1C32h, 12: SM2 event miss count

Operating Procedure

Use the following procedure to display the Motion Monitor and Status Monitor for the SERVO-PACK.

• Select *Monitor* in the Menu Dialog Box of the SigmaWin+. The Operation Pane and Status Pane will be displayed in the Monitor Window.



Information

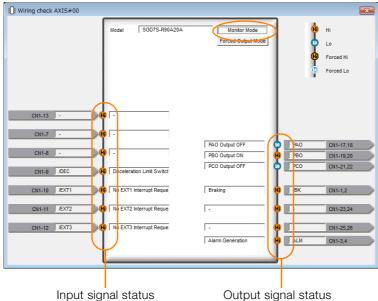
You can flexibly change the contents that are displayed in the Monitor Window. Refer to the following manual for details.

Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

9.2.3 I/O Signal Monitor

Use the following procedure to check I/O signals.

- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Wiring Check in the Menu Dialog Box. The Wiring Check Dialog Box will be displayed.
- 3. Click the Monitor Mode Button.



sarpar signar staras

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.

9.3.1 Items That You Can Monitor

9.3

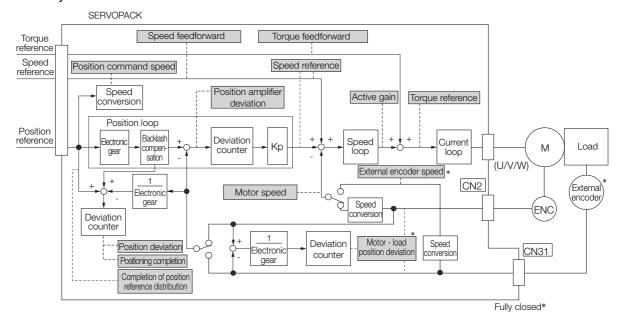
Monitoring Machine Operation Status and Signal Waveforms

To monitor waveforms, use the SigmaWin+ trace function or a measuring instrument, such as a memory recorder.

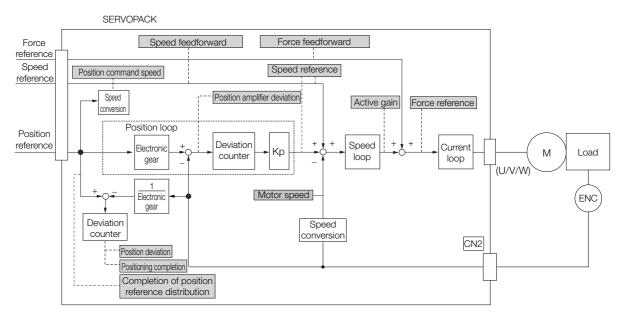
9.3.1 Items That You Can Monitor

You can use the SigmaWin+ or a measuring instrument to monitor the shaded items in the following block diagram.

· Rotary Servomotors



- * This speed is available when fully-closed loop control is being used.
- Linear Servomotors



Using the SigmaWin+ 9.3.2

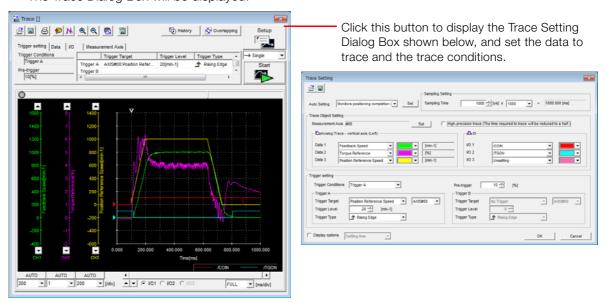
This section describes how to trace data and I/O with the SigmaWin+.

Refer to the following manual for detailed operating procedures for the SigmaWin+.

Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

Operating Procedure

- 1. Click the 🔎 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.



Trace Objects

You can trace the following items.

· Data Tracing

Trace Objects • Torque Reference · Motor - Load Position Deviation Feedback Speed · Speed Feedforward • Reference Speed Torque Feedforward

• Position Error (Deviation)

· Position Reference Speed

- Position Amplifier Error (Deviation)
- · Effective (Active) Gain
- · Main Circuit DC Voltage

9.3.2 Using the SigmaWin+

• I/O Tracing

	Trace Objects					
Input Signals	 P-OT (Forward Drive Prohibit Input Signal) N-OT (Reverse Drive Prohibit Input Signal) /P-CL (Forward External Torque/Force Limit Input Signal) /N-CL (Reverse External Torque/Force Limit Input Signal) /G-SEL (Gain Selection Input Signal) /P-DET (Polarity Detection Input Signal) /DEC (Origin Return Deceleration Switch Input Signal) /EXT1 (External Latch Input 1 Signal) /EXT2 (External Latch Input 2 Signal) /EXT3 (External Latch Input 3 Signal) FSTP (Forced Stop Input Signal) /HWBB1 (Hard Wire Base Block Input 1 Signal) /HWBB2 (Hard Wire Base Block Input 2 Signal) 	Output Signals	 ALM (Servo Alarm Output Signal) /COIN (Positioning Completion Output Signal) /V-CMP (Speed Coincidence Detection Output Signal) /TGON (Rotation Detection Output Signal) /S-RDY (Servo Ready Output Signal) /CLT (Torque Limit Detection Output Signal) /VLT (Speed Limit Detection Output Signal) /WLT (Speed Limit Detection Output Signal) /BK (Brake Output Signal) /WARN (Warning Output Signal) /NEAR (Near Output Signal) ALO1 (Alarm Code Output Signal) ALO2 (Alarm Code Output Signal) ALO3 (Alarm Code Output Signal) PAO (Encoder Divided Pulse Output Phase A Signal) PBO (Encoder Divided Pulse Output Phase B Signal) PCO (Encoder Divided Pulse Output Phase C Signal) 			
		Internal Status	ACON (Main Circuit ON Signal) PDETCMP (Polarity Detection Completed Signal) DEN (Position Reference Distribution Completed Signal)			

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 4-47

Setting the Monitor Object

Use $Pn006 = n.\square\square XX$ and $Pn007 = n.\square\square XX$ (Analog Monitor 1 and 2 Signal Selections) to set the items to monitor.

Line Color	Signal	Parameter Setting	
White	Analog monitor 1	Pn006 (2006h) = n.□□XX	
Red	Analog monitor 2	Pn007 (2007h) = n.□□XX	
Black (2 lines)	GND	_	

Parameter			Description	
rai	ameter	Monitor Signal	Output Unit	Remarks
	n.□□00 (default setting of Pn007 (2007h))	Motor Speed	• Rotary Servomotor: 1 V/1,000 min ⁻¹ • Linear Servomotor: 1 V/1,000 mm/s	_
	n.□□01	Speed Reference	 Rotary Servomotor:1 V/1,000 min⁻¹ Linear Servomotor:1 V/1,000 mm/s 	_
	n. □ □ 02 (default setting of Pn006 (2006h))	Torque Reference	1 V/100% rated torque	_
	n.□□03	Position Deviation	0.05 V/Reference unit	0 V for speed or torque control
	n.□□04	Position Amplifier Deviation	0.05 V/encoder pulse unit	Position deviation after electronic gear conversion
Pn006 (2006h)	n.□□05	Position Reference Speed	• Rotary Servomotor:1 V/1,000 min ⁻¹ • Linear Servomotor:1 V/1,000 mm/s	_
or Pn007 (2007h)	n.□□06	Reserved Setting (Do not change.)	_	_
(200711)	n.□□07	Load - Motor Position Deviation	0.01 V/Reference unit	_
	n.□□08	Positioning Completion	Positioning completed: 5 V Positioning not completed: 0 V	Completion is indicated by the output voltage.
	n.□□09	Speed Feedforward	 Rotary Servomotor:1 V/1,000 min⁻¹ Linear Servomotor:1 V/1,000 mm/s 	_
	n.□□0A	Torque Feedforward	1 V/100% rated torque	_
	n.□□0B	Active Gain*	1st gain: 1 V 2nd gain: 2 V	The gain that is active is indicated by the output voltage.
	n.□□0C	Completion of Position Reference Distribution	Distribution completed: 5 V Distribution not completed: 0 V	Completion is indicated by the output voltage.
	n.□□0D	External Encoder Speed	1 V/1,000 min ⁻¹	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.

^{8.12.1} Gain Switching on page 8-65

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:

The following parameters are set.

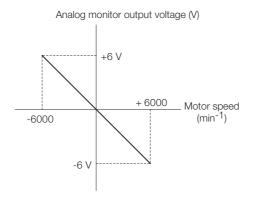
D550	Analog Monitor 1 Of	fset Voltage	Speed	osition Torque	
Pn550 (2550h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200011)	-10,000 to 10,000	0.1 V	0	Immediately	Setup
D=551	Analog Monitor 2 Of	fset Voltage		Speed	osition Torque
Pn551 (2551h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200111)	-10,000 to 10,000	0.1 V	0	Immediately	Setup
D=550	Analog Monitor 1 Ma	agnification	Speed Position Torque		
Pn552 (2552h)	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(200211)	-10,000 to 10,000	×0.01	100	Immediately	Setup
Pn553 (2553h)	Analog Monitor 2 Ma	agnification		Speed	osition Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-10,000 to 10,000	×0.01	100	Immediately	Setup

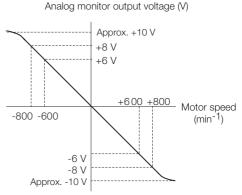


• Example for Setting the Item to Monitor to the Motor Speed (Pn006 = n.□□00)

When Pn552 = 100 (Setting Unit: \times 0.01)

When Pn552 = 1,000 (Setting Unit: \times 0.01)





Note: The effective linearity range is ± 8 V. The resolution is 16 bits.

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.

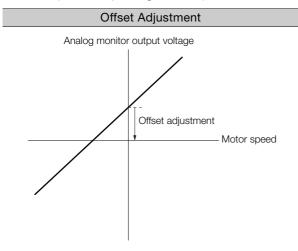
The offset is adjusted to compensate for offset in the zero point caused by output voltage drift or noise in the monitoring system.

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.



Gain Adjustment					
Analog monitor	output voltage				
1 [V]	Gain adjustment Motor speed				
	1000 [min ⁻¹]				

Gain Adjustment

Item	Specification
Offset Adjustment Range	-2.4 V to 2.4 V
Adjustment Unit	18.9 mV/LSB

Item	Specification
Gain Adjustment Range	100 ±50%
Adjustment Unit	0.4%/LSB

The gain adjustment range is made using a 100% output value (gain adjustment of 0) as the reference value with an adjustment range of 50% to 150%. A setting example is given below.

- Setting the Adjustment Value to -125 100 + (-125 × 0.4) = 50 [%] Therefore, the monitor output voltage goes to 50%
- of the original value.

 Setting the Adjustment Value to 125
- 100 + $(125 \times 0.4) = 150$ [%] Therefore, the monitor output voltage goes to 150% of the original value.

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

Confirm the following condition 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. The function that is used is given for each tool.

Offset Adjustment

Tool	Function	Operating Procedure Reference
Digital Operator	Fn00C	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Analog Monitor Output Adjustment	

9.3.3 Using the Analog Monitors

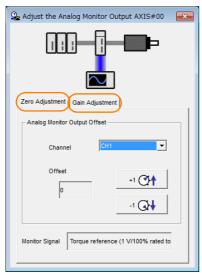
· Gain Adjustment

Tool	Function	Operating Procedure Reference
Digital Operator	Fn00D	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Analog Monitor Output Adjustment	

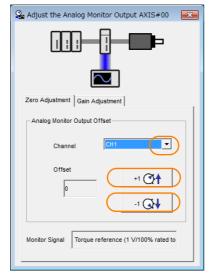
Operating Procedure

Use the following procedure to adjust the analog monitor output.

- 1. Click the 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.



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.



This concludes adjusting the analog monitor output.

4 Monitoring Product Life

9.4.1 Items That You Can Monitor

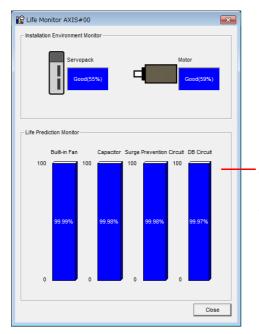
Monitor Item	Description
SERVOPACK Installation Environment	The operating status of the SERVOPACK in terms of the installation environment is displayed. Implement one or more of the following actions if the monitor value exceeds 100%. • Lower the surrounding temperature. • Decrease the load.
Servomotor Installation Environment	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%. • Lower the surrounding temperature. • Decrease the load.
Built-in Fan Service 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. 15.1.2 Guidelines for Part Replacement on page 15-2
Capacitor Service 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. 15.1.2 Guidelines for Part Replacement on page 15-2
Surge Prevention Circuit Service 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. 15.1.2 Guidelines for Part Replacement on page 15-2
Dynamic Brake Circuit Service 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. 15.1.2 Guidelines for Part Replacement on page 15-2

9.4.2 Operating Procedure

Use the following procedure to display the installation environment and service life prediction monitor dialog boxes.

- 1. Click the 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.



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.

Preventative Maintenance 9.4.3

You can use the following functions for preventative maintenance.

- Preventative maintenance warnings
- /PM (Preventative Maintenance Output) signal

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 $Pn00F = n.\square\square\square\square X$ to enable or disable these warnings.

Parameter		Description	When Enabled	Classifi- cation
Pn00F	n.□□□0 (default setting)	Do not detect preventative maintenance warnings.	After restart	Setup
(200Fh)	n.□□□1	Detect preventative maintenance warnings.	ายรเสาเ	

/PM (Preventative Maintenance Output) Signal

The /PM (Preventative Maintenance Output) signal is output when any of the following service life prediction values reaches 10% or less: SERVOPACK built-in fan life, capacitor life, inrush current limiting circuit life, and dynamic brake circuit life. The /PM (Preventative Maintenance Output) signal must be allocated.

Even if detection of preventive maintenance warnings is disabled (Pn00F = n. \$\square\$D\$), the /PM signal will still be output as long as it is allocated.

Classifi- cation	Signal	Connector Pin No.	Signal Status	Description
Output /PM	Monthly	ON (closed)	One of the following service life prediction values reached 10% or less: SERVOPACK built-in fan life, capacitor life, inrush current limiting circuit life, and dynamic brake circuit life.	
	/PM	Must be allocated.	OFF (open)	All of the following service life prediction values are greater than 10%: SERVOPACK built-in fan life, capacitor life, inrush current limiting circuit life, and dynamic brake circuit life.

Note: You must allocate the /PM signal to use it. Use Pn514 = n. \(\Delta X \Delta \Delta \) (/PM (Preventative Maintenance Output) Signal Allocation) to allocate the signal to connector pins. Refer to the following section for details.

9.5.1 Data for Which Alarm Tracing Is Performed

Alarm Tracing

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.

9.5.1 **Data for Which Alarm Tracing Is Performed**

Two types of data are recorded for alarm tracing: numeric data and I/O signal ON/OFF data.

Numeric Data
Torque reference
Feedback speed
Reference speed
Position reference speed
Position deviation
Motor-load position deviation
Main circuit bus voltage

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

9.5.2 **Applicable Tools**

The following table lists the tools that you can use to perform alarm tracing and the applicable tool functions.

Tool	Function	Operating Procedure Reference	
Panel Operator	You cannot display alarm tracing data from the Panel Operator.		
Digital Operator	You cannot display alarm tracing data from the Digital Operator.		
SigmaWin+ Alarm Tracing		Engineering Tool SigmaWin+ 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 System10-2
10.2	SERV	OPACK Commissioning Procedure10-3
10.3	Parame	ter and Object 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 Movement Direction
	10.3.3	Setting the Number of External Encoder Scale Pitches
	10.3.4	Setting the PAO, PBO, and PCO (Encoder Divided Pulse Output) Signals 10-7
	10.3.5	External Absolute Encoder Data Reception Sequence
	10.3.6	Setting Unit Systems
	10.3.7	Alarm Detection Settings
	10.3.8 10.3.9	Analog Monitor Signal Settings 10-9 Setting to Use an External Encoder
		for Speed Feedback
10.4	Monit	oring an External Encoder10-10
	10.4.1 10.4.2 10.4.3	Option Module Required for Monitoring 10-10 Related Parameters

10.1

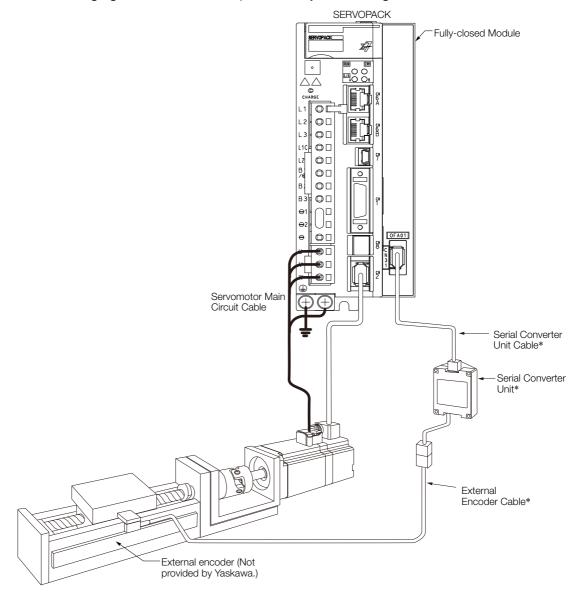
Fully-Closed System

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.

Σ-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 2-24

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.

Step	Description	Operation	Required Parameter and Object Settings	Con- trolling Device
1	Check operation of the entire sequence with semi-closed loop control and without a load. Items to Check • Power supply circuit wiring • Servomotor wiring • Encoder wiring • Wiring of I/O signal lines from the host controller • Servomotor rotation direction, motor speed, and multiturn data • Operation of safety mechanisms, such as the brakes and the overtravel mechanisms	Set the parameters so that the SERVOPACK operates correctly in semi-closed loop control without a load and check the following points. Set Pn002 to n.0□□□ to specify semi-closed loop control. • Are there any errors in the SER-VOPACK? • Does jogging function correctly when you operate the SERVO-PACK without a load? • Do the I/O signals turn ON and OFF correctly? • Is power supplied to the Servomotor when the Servo ON command (Enable Operation command) is sent from the host controller? • Does the Servomotor operate correctly when a position reference is input by the host controller?	Pn000 (Basic Function Selections 0) Pn001 (Application Function Selection 1) Pn002 = n.X□□□ (External Encoder Usage) Position reference unit (position user unit (2701h)) Pn50A, Pn50B, Pn511, and Pn516 (Input Signal Selections) Pn50E, Pn50F, Pn510, and Pn514 (Output Signal Selections)	SERVO- PACK or host con- troller
2	Check operation with the Servomotor connected to the machine with semi-closed loop control. Items to Check Initial response of the system connected to the machine Movement direction, travel distance, and movement speed as specified by the references from the host controller	Connect the Servomotor to the machine. Set the moment of inertia ratio in Pn103 using autotuning without a host reference. Check that the machine's movement direction, travel distance, and movement speed agree with the references from the host controller.	Pn103 (Moment of Inertia Ratio)	Host controller
3	Check the external encoder. Items to Check Is the signal from the external encoder received correctly?	Set the parameters related to fully-closed loop control and move the machine with your hand without turning ON the power supply to the Servomotor. Check the following status with the Digital Operator or SigmaWin+. • Does the fully-closed feedback pulse counter count up when the Servomotor moves in the forward direction? • Is the travel distance of the machine visually about the same as the amount counted by the fully-closed feedback pulse counter? Note: The unit for the fully-closed feedback pulse counter is pulses, which is equivalent to the external encoder sine wave pitch.	Pn002 = n.X□□□ (External Encoder Usage) Pn20A (Number of External Scale Pitches) Position reference unit (position user unit (2701h)) Pn281 (Encoder Output Resolution) Pn51B (Motor-Load Position Deviation Overflow Detection Level) Pn522 (Positioning Completed Width) Pn52A (Multiplier per Fully-closed Rotation)	_

Continued on next page.

Continued from previous page.

Step	Description	Operation	Required Parameter and Object Settings	Con- trolling Device
4	Perform a program jogging operation. Items to Check Does the fully-closed system operate correctly for the SERVOPACK without a load?	Perform a program jogging operation and confirm that the travel distance is the same as the reference value in Pn531. When you perform program jogging, start from a low speed and gradually increase the speed.	Pn530 to Pn536 (program jogging-related parameters)	SERVO- PACK
5	Operate the SERVO-PACK. Items to Check Does the fully-closed system operate correctly, including the host controller?	Input a position reference and confirm that the SERVOPACK operates correctly. Start from a low speed and gradually increase the speed.	-	Host controller

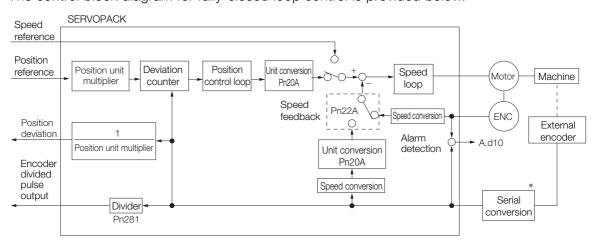
10.3 Parameter and Object Settings for Fully-closed Loop Control

This section describes the parameter settings that are related to fully-closed loop control.

Parameter and Object to Set	Setting	Position Control	Speed Control	Torque Control	Reference
Pn000 (2000h) = n.□□□X	Motor direction √ √ √		V	page 10-6	
Pn002 (2002h) = n.X□□□	External encoder usage method	V	V	V	page 10-0
Pn20A (220Ah)	Number of external scale pitches	√	√	$\sqrt{}$	page 10-7
Pn281 (2281h)	Encoder divided pulse output signals (PAO, PBO, and PCO) from the SERVO-PACK	V	V	√	page 10-7
-	External absolute encoder data reception sequence	V	√	V	page 6-41
Position User Unit (2701h)	Electronic gear ratio	V	_	_	page 5-43
Pn51B (251Bh)	Excessive deviation level between Servo- motor and load positions	V	-	_	page 10-8
Pn52A (252Ah)	252Ah) Multiplier for one fully-closed rotation		_	_	
Pn006 (2006h)/ Pn007 (2007h)	Analog monitor signal	V	V	V	page 10-9
Pn22A (222Ah) = 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.□1□□ (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 both $Pn000 = n.\square\square\square\square X$ (Rotation Direction Selection) and $Pn002 = n.X\square\square\square$ (External Encoder Usage).

	Parameter			Pn002 (2002h) = n.X□□□ (External Encoder Usage)			
	Faramet	51	n.1□	100	n.3□	100	
		Reference direction	Forward reference	Reverse reference	Forward reference	Reverse reference	
Pn000	n.□□□0	Motor direction	CCW	CW	CCW	CW	
(2000h) =n.□□□X		External encoder	Forward movement	Reverse movement	Reverse movement	Forward movement	
(Rotation Direction	n.□□□1	Reference direction	Forward reference	Reverse reference	Forward reference	Reverse reference	
Selection)		Motor direction	CW	CCW	CW	CCW	
		External encoder	Reverse movement	Forward movement	Forward movement	Reverse movement	

- Phase B leads in the divided pulses for a forward reference regardless of the setting of Pn000
 = n.□□□□X.
- Forward direction: The direction in which the pulses are counted up.
- Reverse direction: The direction in which the pulses are counted down.

Related Parameters

\bullet Pn000 = n. $\Box\Box\Box$ X

Refer to the following section for details.

5.4 Motor Direction Setting on page 5-15

◆ Pn002 = n.X□□□

When you perform fully-closed loop control, set Pn002 to n.1 \(\square\) or n.3 \(\square\)

Parameter		Name	Meaning	When Enabled	Classifi- cation
	n.0□□□ (default set- ting)		Do not use an external encoder.		Setup
Pn002	n.1□□□	External	External encoder moves in forward direction for CCW motor rotation.	After restart	
(2002h)	n.2□□□	Encoder Usage	Reserved parameter (Do not change.)		
	n.3□□□		External encoder moves in reverse direction for CCW motor rotation.		
	n.4□□□		Reserved parameter (Do not change.)		

Information

Determine the setting of Pn002 = $n.X\square\square\square$ as described below.

- Set Pn000 to n.□□□□ (Use the direction in which the linear encoder counts up as the forward direction) and set Pn002 to n.1□□□ (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

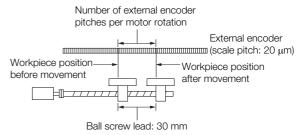
Set the number of external encoder scale pitches per Servomotor rotation in Pn20A.

Setting Example

Specifications

External encoder scale pitch: 20 μm

Ball screw lead: 30 mm



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 Externa	l Scale Pitches	Position		
Pn20A	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
(220Ah)	4 to 1,048,576	1 scale pitch/revo- 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

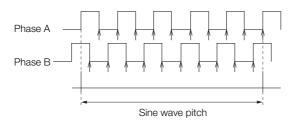
External encoder scale pitch: 20 μm

Ball screw lead: 30 mm Speed:1,600 mm/s

If a single pulse (multiplied by 4) is output for 1 μm, the setting would be 20.

If a single pulse (multiplied by 4) is output for 0.5 μ 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 External Absolute Encoder Data Reception Sequence

Example

If the setting is 20 and the speed is 1,600 mm/s, the output frequency would be 1.6 Mpps

 $\frac{1000 \text{ Him}/3}{0.001 \text{ mm}} = 1,600,000 = 1.6 \text{ Mpps}$

Because 1.6 Mpps is less than 6.4 Mpps, this setting can be used.

Related Parameters

Pn281 (2281h)	Encoder Output Re	solution	Position		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 4,096	1 edge/pitch	20	After restart	Setup

Note: 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 5-46.

10.3.5 External Absolute Encoder Data Reception Sequence

Refer to the following section for details.

6.9.4 Reading the Position Data from the Absolute Linear Encoder on page 6-41

With fully-closed loop control, the same sequence as for a Linear Servomotor is used.

10.3.6 Setting Unit Systems

Refer to the following section for details.

5.14 Setting Unit Systems on page 5-43

With fully-closed loop control, the same setting as for a Linear Servomotor is used.

10.3.7 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	on Deviation Overflo	Position		
Pn51B (251Bh)	Setting Range	Setting Unit	Default Setting	When Enabled	Classifica- tion
(231611)	0 to 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.

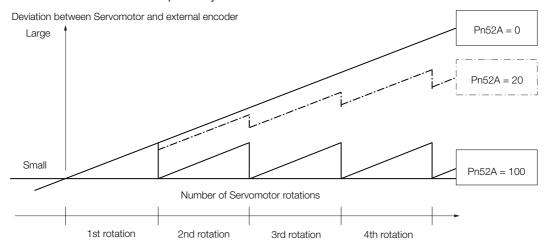
This setting can be used to prevent the Servomotor from running out of control due to damage to the external encoder or to detect belt slippage.

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

Pn52A (252Ah)	Multiplier per Fully-	closed Rotation	Position		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	1%	20	Immediately	Setup

10.3.8 Analog Monitor Signal Settings

You can monitor the position deviation between the Servomotor and load with an analog monitor.

Parameter Name		Name	Meaning	When Enabled	Classifi- cation
Pn006 (2006h)	n.□□07	Analog Monitor 1 Signal Selection	Position deviation between motor and load (output unit: 0.01 V/reference unit).	Immedi-	Setup
Pn007 (2007h)	n.□□07	Analog Monitor 2 Signal Selection	Position deviation between motor and load (output unit: 0.01 V/reference unit).	ately	Setup

10.3.9 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 Enabled	Classification
Pn22A (222Ah)	n.0□□□ (default set- ting)	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 \(\sigma \sigma \) (Do not use external encoder).

10.4.1 Option Module Required for Monitoring

10.4

Monitoring an External Encoder

You can monitor the current value of an external encoder attached to a machine without creating a fully-closed loop.

A dual encoder system with an encoder in the Rotary Servomotor and an external encoder attached to the machine is used, but only the encoder in the Rotary Servomotor is used in the control loop.

The external encoder is used only to monitor the current position of the machine. You can also use a touch probe to latch the current position of an external encoder.

10.4.1 Option Module Required for Monitoring

A Fully-closed Module (SGDV-OFA01A) is required to use this function.

Refer to the following manual for detailed information on installation.

Σ-V-Series/Σ-V-Series for Large-Capacity Models/Σ-7-Series Installation Guide Fully-closed Module (Manual No.: TOBP C720829 03)

Note: You cannot use a Safety Module (SGDV-OSA01A) if you install a Fully-closed Module.

10.4.2 Related Parameters

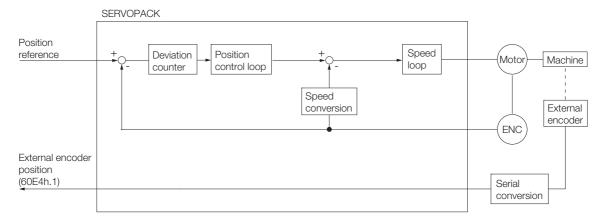
The parameter that is used to monitor the external encoder as the current value of the machine is given below.

Par	ameter	Meaning	When Enabled	Classification
(de tin	n.0□□□ (default set- ting)	Do not use the external encoder monitor.	encoder monitor.	
	n.1000	Use CCW as the forward direction.	A.C	
(200Eh)	n.2000	Reserved setting (Do not use.)	After startup	Setup
	n.3□□□	Use CW as the forward direction. (Reverse Rotation Mode)		
	n.4000	Reserved setting (Do not use.)		

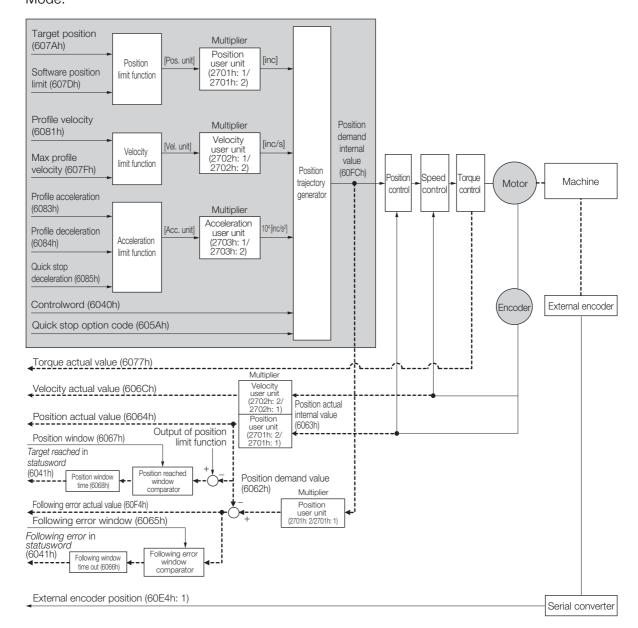
Set Pn002 to n.0 \(\sigma\) (Do not use external encoder) if you will not use fully-closed loop control.

10.4.3 Block Diagrams

A simple block diagram is given below to provide an overall image of monitoring an external encoder.



The following block diagram shows monitoring an external encoder in the Profile Position Mode.



Safety Functions

This chapter provides detailed information on the safety functions of the SERVOPACK.

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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.

The SERVOPACK provides the following four safety functions for functional safety standards.

		SERVO-	Safety Module Function		
Function	Description	PACK Built- in Function		Active Mode Function*1	
Hard Wire Base Block (HWBB and SBB)	This safety function is equivalent to the Safety Torque OFF function defined in IEC 61800-5-2.	Yes (HWBB)	Yes (SBB*2)	_	
Safety Base Block with Delay (SBB-D)*2	This safety function is equivalent to the Safety Stop 1 function defined in IEC 61800-5-2.	-	Yes	Yes	
Safe Position Monitor with Delay (SPM-D)*2	This safety function is equivalent to the Safety Stop 2 function defined in IEC 61800-5-2.	-	Yes	Yes	
Safe Speed Limit with Delay (SLS-D)*2	This safety function is equivalent to the Safely-Limited Speed function defined in IEC 61800-5-2.	_	Yes	_	

^{*1.} The Active Mode Function stops the motor according to the speed reference that is preset in a parameter in the SERVOPACK when the safety request input signal turns OFF during SBB-D or SPM-D.

The Active Mode Function is not a safety function in the applicable standards. Keep this in mind when you

design the system.

Refer to the following section for details.

11.7.4 Active Mode Function on page 11-19

Σ-V-Series/Σ-V-Series for Large-Capacity Models/Σ-7-Series User's Manual Safety Module (Manual No.: SIEP C720829 06)

Refer to the following section for information on the safety function and safety parameters. *Compliance with UL Standards, EU Directives, and Other Safety Standards* on page xxv



Products that display the TÜV mark on the nameplate have met the safety standards.

Ш

^{*2.} A Safety Module (optional) must be connected to use this function. Refer to the following manual for application procedures.

11.1.2 Precautions for Safety Functions

MARNING

- 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 Hard Wire Base Block (HWBB and SBB)

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.

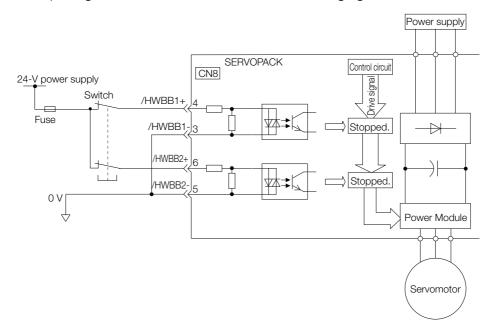
This is opposite to other signals described in this manual.

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, and Other Safety Standards on page xxv

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.

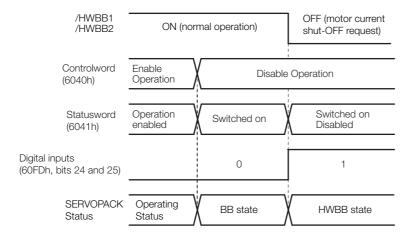
11.2.2 Hard Wire Base Block (HWBB) State

- 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)
 - 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.

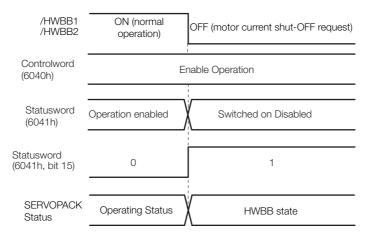
11.2.2 Hard Wire Base Block (HWBB) State

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)

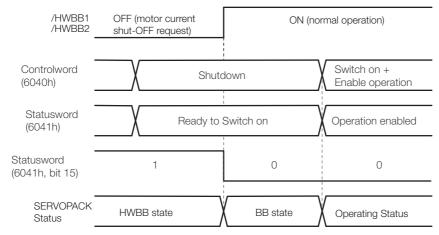


• When HWBB Operates While Power Is Supplied to Servomotor



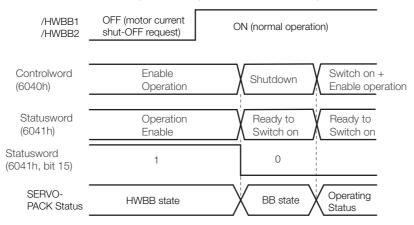
11.2.3 Resetting the HWBB State

Normally, after the Shutdown 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 Operation command).



If the /HWBB1 and /HWBB2 signals are OFF and the Servo ON command (Enable Operation command) is received, the HWBB state will be maintained even after the /HWBB1 and /HWBB2 signals are turned ON.

Send the Shutdown command to place the SERVOPACK in the BB state and then send the Servo ON command (Enable Operation command).



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 Shutdown command is received.

11.2.4 Recovery Method

Recovery Conditions

All of the following conditions must be met.

- · All safety request inputs are ON.
- The Servo ON command (Enable Operation command) was not sent.
- None of the following utility functions have been executed. (These functions execute the Servo ON command (Enable Operation command).)

The following utility functions execute the Servo ON command (Enable Operation command).

Utility Function No.	Function Name
Fn002	Jog
Fn003	Origin Search
Fn004	Jog Program
Fn00E	Autotune Motor Current Detection Signal Offset
Fn080	Polarity Detection
Fn201	Advanced Autotuning without Reference
Fn206	Easy FFT

Note: If any of the above utility functions was executed, the utility function must be ended. Perform the operation to return to the Main Menu for the utility functions on the Digital Operator. Refer to the following manual for operating procedures.

Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)

Recovery Procedure

- 1. Specify Shutdown in controlword (6040h, bits 0 to 3) to reset the Servo Drive.
- 2. Specify Switch ON and the Servo ON command (Enable Operation command) in *controlword* (6040h, bits 0 to 3).

Power will be supplied to the motor.

11.2.5 Detecting Errors in HWBB Signal

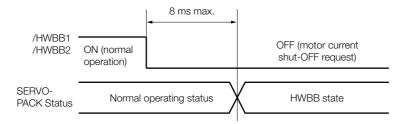
If only the /HWBB1 or the /HWBB2 signal is input, an A.Eb1 alarm (Safety Function Signal Input Timing Error) will occur unless the other signal is input within 10 seconds. This makes it possible to detect failures, such as disconnection of an HWBB signal.



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.

11.2.6 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. Refer to the following section for details.
 - 9.2.3 I/O Signal Monitor on page 9-5

11.2.7 Operation without a Host Controller

The HWBB will operate even for operation without a host controller.

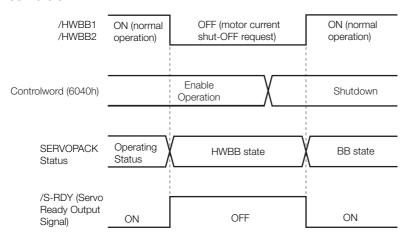
However, if the HWBB operates during execution of the following functions, leave the execution mode for the function and then enter it again to restart operation. Operation will not be restarted simply by turning OFF the /HWBB1 and /HWBB2 signals.

Applicable Functions	Resetting the HWBB State				
Jogging Origin search	After you turn ON the /HWBB1 and /HWBB2 signals, leave the execution mode for the function and then enter it again.				
Program joggingAutomatic adjustment without host reference	execution execution mode execution mode status Function execution mode execution mode OFF (motor current Not function execution mode execution mode				
Easy FFTAdjustment of motor current detection signal offset	/HWBB1 ON (normal shut-OFF request) ON (normal operation)				
	SERVOPACK Operating HWBB state BB state Operating Status				

11.2.8 /S-RDY (Servo Ready Output) Signal

The Servo ON command (Enable Operation command) will not be acknowledged in the HWBB state. Therefore, the Servo Ready Output Signal will turn OFF. The Servo Ready Output Signal will turn ON if both the /HWBB1 and /HWBB2 signals are ON and the servo is turned OFF (BB state).

An example is provided below for when the main circuit power supply is ON when there is no servo alarm.



11.2.9 /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.

M CAUTION

• 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.

Safety Functio

11.2.10 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 = $n.\Box\Box\Box\Box$ X). However, if the dynamic brake is enabled (Pn001 = $n.\Box\Box\Box\Box$ 0 or $n.\Box\Box\Box\Box$ 1), observe the following precautions.

M CAUTION

- 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.

11.2.11 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.

Information

Safety Module Monitor (2720h)

You can also use *safety module monitor* (2720h) in the EtherCAT communications object dictionary to monitor the Safety Module. Refer to the following sections for details on monitoring the Safety Module.

Safety Module Monitor (2720h) on page 14-21

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.

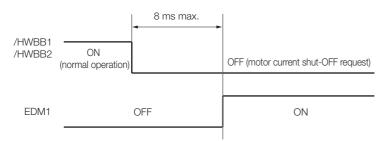
Signal	Logic				
/HWBB1	ON	ON	OFF	OFF	
/HWBB2	ON	OFF	ON	OFF	
EDM1	OFF	OFF	OFF	ON	

MARNING

• 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.

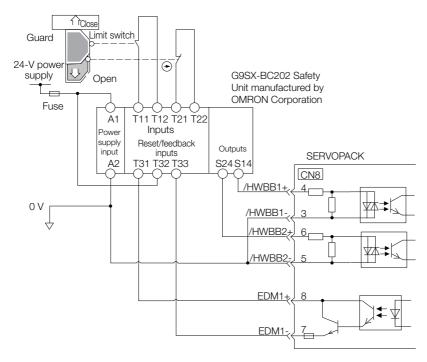


11.4 Applications Examples for Safety Functions

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.

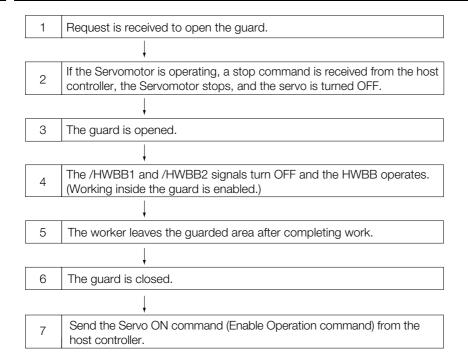
Note: The EDM1 signal is used as a source output. Connect the EDM1 so that the current flows from EMD1+ to EMD1-.

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



11.5 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 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.

Refer to the following sections for details on the monitor.

§ 9.2.3 I/O Signal Monitor on page 9-5

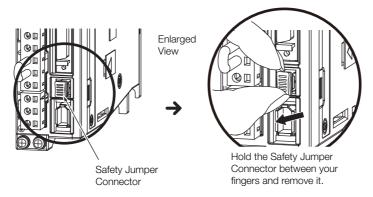
• Confirm that the EDM1 signal is OFF while in normal operation by using the feedback circuit input display of the connected device.

11.6

Connecting a Safety Function Device

Use the following procedure to connect a safety function device.

 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.

11.7 Safety Module Safety Functions

This section describes the safety functions provided by the Safety Module.

11.7.1 Safety Base Block with Delay (SBB-D)

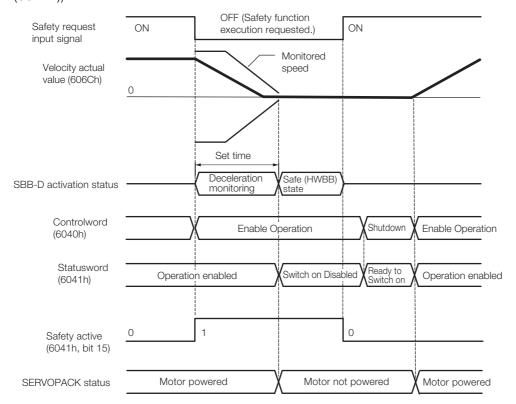
The Safety Base Block with Delay (SBB-D) function operates according to the Safe Stop 1 (SS1) function defined in IEC 61800-5-2. The deceleration operation of the motor is monitored (deceleration monitoring) until the time set in a parameter elapses in response to the safety request input status. The HWBB in the SERVOPACK is then executed to shut OFF the power supply to the motor.

Note: Refer to the following manual for the application procedures for the SBB-D function.

Σ-V-Series/Σ-V-Series for Large-Capacity Models/Σ-7-Series User's Manual Safety Module (Manual No.: SIEP C720829 06)

Operation Example for SBB-D

When the safety monitor time expires, the safe state (HWBB) is entered and then the power supply to the motor is shut OFF. The Drive enters the Switch ON Disabled state (*statusword* (6041h)).



Recovery Method

When the safety request input signal turns ON, normal operation will be enabled.

The recovery method after deceleration monitoring is completed and the safe (HWBB) state is entered in the same as for the HWBB function. Refer to the following section for details.

11.2.4 Recovery Method on page 11-8

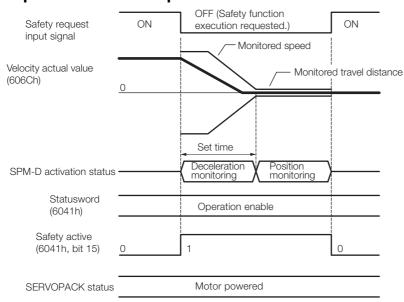
11.7.2 Safe Position Monitor with Delay (SPM-D)

The Safe Position Monitor with Delay (SPM-D) function operates according to the Safe Stop 2 (SS2) function defined in IEC 61800-5-2. The deceleration operation of the motor is monitored (deceleration monitoring) until the time set in a parameter elapses in response to the safety request input status. Position monitoring is then performed to see if the motor travel distance is within the allowable range.

Note: Refer to the following manual for the application procedures for the SPM-D function.

Σ-V-Series/Σ-V-Series for Large-Capacity Models/Σ-7-Series User's Manual Safety Module (Manual No.: SIEP C720829 06)

Operation Example for SPM-D



Recovery Method

When the safety request input signal turns ON, normal operation will be enabled.

The recovery method after deceleration monitoring is completed and the safe (HWBB) state is entered in the same as for the HWBB function. Refer to the following section for details.

11.2.4 Recovery Method on page 11-8

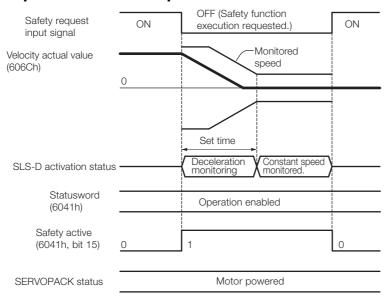
11.7.3 Safe Speed Limit with Delay (SLS-D)

The Safe Speed Limit with Delay (SLS-D) function operates according to the Safely-Limited Speed (SLS) function defined in IEC 61800-5-2. The deceleration operation of the motor is monitored (deceleration monitoring) until the time set in a parameter elapses in response to the safety request input status. The motor speed is then monitored to see if it is within the allowable range (within range for a constant speed).

Note: Refer to the following manual for the application procedures for the SLS-D function.

Σ-V-Series/Σ-V-Series for Large-Capacity Models/Σ-7-Series User's Manual Safety Module (Manual No.: SIEP C720829 06)

Operation Example for SLS-D



Recovery Method

When the safety request input signal turns ON, normal operation will be enabled.

The recovery method after deceleration monitoring is completed and the safe (HWBB) state is entered in the same as for the HWBB function. Refer to the following section for details.

11.2.4 Recovery Method on page 11-8

11.7.4 Active Mode Function

The Active Mode Function stops the motor according to the deceleration reference that is preset in a parameter in the SERVOPACK when the safety request input signal turns OFF during SBB-D or SPM-D.

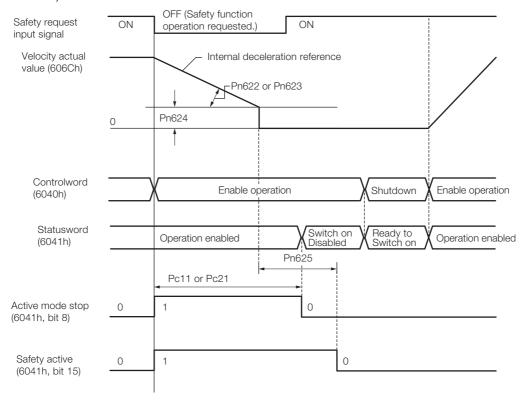
Active Mode Function Operation Example

If Profile Torque Mode or Cyclic Synchronous Torque Mode is set in *controlword* (6040h, bits 4 to 9), the servo will be turned OFF and the motor will be stopped as soon as the safety request input signal turns OFF.

11.7.4 Active Mode Function

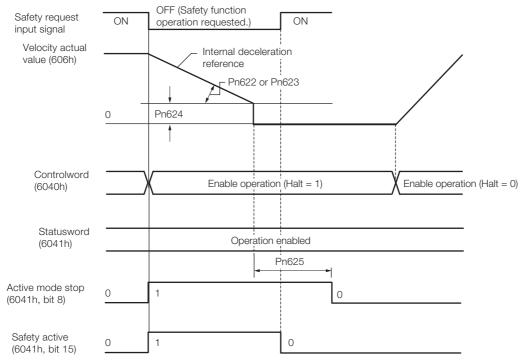
♦ When Using the SBB-D Function (Position or Speed Control)

The motor is stopped at the set deceleration rate (Pn622 or Pn623). After the deceleration monitor time (Pc11 or Pc21) elapses, the servo is turned OFF (Switch ON Disable state is entered).



◆ When Using the SPM-D Function (Position or Speed Control)

The motor is stopped at the set deceleration rate (Pn622 or Pn623) and then the servo is locked (Operation Enabled state).



Operation by Operation Mode When Stopped for the Active Mode Function

Operation Mode	Operation
Profile position mode	Profile position operation is canceled and <i>statusword</i> (6041h) changes as given below. Bit 08 = 1: Active Mode Function operating. Bit 12 = 0: Previous set-point already processed, waiting for new set-point. Bit 15 = 1: Safety function operating.
Homing mode	Homing operation is canceled and <i>statusword</i> (6041h) changes as given below. Bit 08 = 1: Active Mode Function operating. Bit 13 = 1: Homing error. Bit 15 = 1: Safety function operating.
Cyclic synchronous position/velocity/torque mode	Cyclic synchronous position, velocity, or torque operation is canceled and <i>statusword</i> (6041h) changes as given below. Bit 08 = 1: Active Mode Function operating. Bit 12 = 0: Target value (position/velocity/torque) ignored. Bit 15 = 1: Safety function operating.
Interpolated position mode	Interpolated position operation is canceled and <i>statusword</i> (6041h) changes as given below. Bit 08 = 1: Active Mode Function operating. Bit 12 = 0: Interpolation operation disabled. Bit 15 = 1: Safety function operating.
Profile velocity/torque mode	Profile velocity or torque operation is canceled and <i>statusword</i> (6041h) changes as given below. Bit 08 = 1: Active Mode Function operating. Bit 15 = 1: Safety function operating.

Recovery Method

Recovery Conditions

If the Active Mode Function operates and the motor is stopped, the Active Mode Function will be reset and normal operation will be enabled when all of the following conditions are met.

- All relevant safety request input signals must be ON.
- A period of time equal to or greater than the value set as the Active Mode Hold Time (Pn625) must have elapsed.
- The following command must have been sent from the Controller.
- Interpolated Position Mode: Bit 8 in *controlword* (6040h) = 1 (stop axis according to *halt option code* (605Dh)) or bit 4 = 0 (disable interpolation).
- Cyclic Synchronous Position/Velocity Mode or Profile Velocity Mode: Bit 8 in *controlword* (6040h) = 1 (Halt).
- Profile Torque or Cyclic Synchronous Torque Mode: Bits 1 and 2 in *controlword* (6040h) = 1 (Shutdown).
- Homing Mode or Profile Position Mode: No condition.

Note: If the HWBB function has turned OFF the servo, normal operation will be enabled when the corresponding safety request input signal turns ON.

◆ Recovery Procedure

- 1. After detecting that bit 8 in *statusword* (6041h) is 1 (Active Mode Function operating) or that bit 15 is 1 (safety function operating), set bit 8 in *controlword* (6040h) to 1 (stop axis according to *halt option code* (605Dh)).
- 2. After detecting that the safety request input signal turned ON, confirm that bit 8 in *statusword* (6041h) is 0 (Active Mode Function operation completed) and that bit 15 is 0 (safety function operation completed), and then specify the Servo ON command (Enable Operation command) in *controlword* (6040h).
- 3. Specify a new motion command.

EtherCAT Communications

This chapter provides basic information on EtherCAT communications.

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	12.4.1 Setting Procedure for PDO Mappings 12-7 12.4.2 Default PDO Mappings

12.1

EtherCAT Slave Information

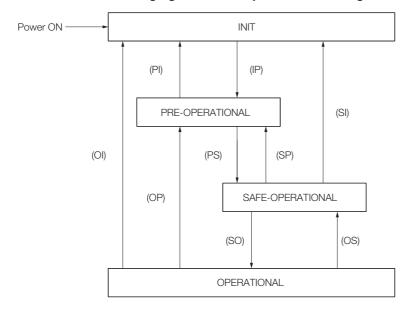
You can use an EtherCAT slave information file (ESI) to configure the EtherCAT master. The ESI file contains general information on EtherCAT communications settings that are related to the SERVOPACK settings.

The following file is provided for the SERVOPACK.

SERVOPACK	File Name
SGD7S-□□□□A0□	Yaskawa_SGD7S-xxxxA0x_CoE_rev□□□□.□□.xml

12.2 EtherCAT State Machine

The EtherCAT state machine is used to manage the communications states between the master and slave applications when EtherCAT communications are started and during operation, as shown in the following figure. Normally, the state changes for requests from the master.



State	Description				
INIT	 Mailbox communications are not possible. Process data communications are not possible.				
INIT => PRE-OP	 The master sets the DL address and Sync Manager channels for mailbox communications. The master initializes DC clock synchronization. The master requests the Pre-Operational state. The master sets the AL control register. The slaves check whether the mailbox was initialized correctly. 				
PRE-OPERATIONAL (PREOP)	Mailbox communications are possible.Process data communications are not possible.				
PREOP => SAFEOP	 The master sets the Sync Manager channels and FMMU channels for process data. The master uses SDOs to set the PDO mappings and the Sync Manager PDO Assignment parameters. The master requests the Safe-Operational state. The slaves check whether the Sync Manager channels for process data communications and, if required, the distributed clock settings are correct. 				
SAFE-OPERA- TIONAL (SAFEOP)	 Mailbox communications are possible. Process data communications are possible. However, only the input data is valid. The output data is still not valid. 				
SAFEOP => OP	The master sends valid output data.The master requests the Operational state.				
OPERATIONAL (OP)	Mailbox communications are possible.Process data communications are possible.				

Information

- The SERVOPACK does not support EtherCAT Read/Write commands (APRW, FPRW, BRW, and LRW).
 For SDO and PDO communications through the EtherCAT data link layer, the FMMUs and Sync Managers must be set as follows:

• Sync Manager Settings

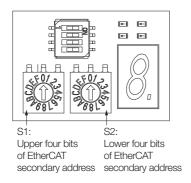
Sync Manager	Assignment (Fixed)	Size	Start Address (Fixed)	
Sync Manager 0	Assigned to Receive Mailbox	128 bytes (fixed)	0x1000	
Sync Manager 1	Assigned to Transmit Mailbox	128 bytes (fixed)	0x1080	
Sync Manager 2	Assigned to Receive PDOs	0 to 256 bytes	0x1100	
Sync Manager 3	Assigned to Transmit PDOs	0 to 256 bytes	0x1400	

• FMMU Settings

FMMU	Setting
FMMU 0	Mapped in receive PDO (RxPDO) area.
FMMU 1	Mapped in transmit PDO (TxPDO) area.
FMMU 2	Mapped to the mailbox status.

12.3 EtherCAT (CoE) Communications Settings

You can use EtherCAT secondary addresses (station aliases) to identify devices or to specify addresses.



12.3.1 Normal Device Recognition Process at Startup

When communications are started, the master uses auto-increment addressing to detect the slaves. The Identity objects read from the slaves are compared with the master configuration information (set in advance with an EtherCAT configuration tool). Therefore, the slaves must normally be connected in the network in the same order as they appear in the master configuration. However, you can define station aliases to enable using other network topologies.

12.3.2 Application Example

With a machining center, there may be two identical drives for operation in the X and Y directions. When a device is replaced, there is a chance that the cable may be connected in the wrong order. To prevent the drives from receiving incorrect process data, you can use station aliases to use explicit addresses for the drives.

12.3.3 Device Recognition with Station Aliases

The master uses auto-increment addressing to read the station aliases. It then compares the detected station aliases with the master configuration to get the topology that was set as the network topology.

Station Alias Register (0x0012)

The station alias is set in the ESC Configured Station Alias register when the power supply is turned ON.

The value of the register can be read as follows:

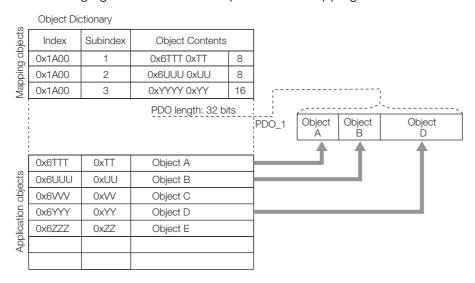
Configured station alias = $(S1 \text{ set value}) \times 16 + (S2 \text{ set value})$

12.4

PDO Mappings

The process data that is used in process data communications is defined in the PDO mappings. PDO mappings are definitions of the applications objects that are sent with PDOs. The PDO mapping tables are in indexes 1600h to 1603h for the RxPDOs and indexes 1A00h to 1A03h for the TxPDOs in the object dictionary.

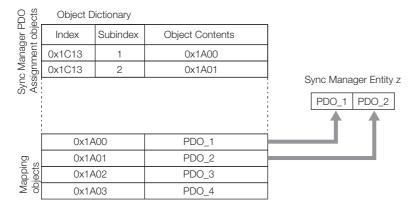
The following figure shows an example of PDO mappings.



In addition to the above PDO mappings, PDOs have to be assigned to the Sync Managers to exchange EtherCAT process data.

The Sync Manager PDO assignment objects (1C12h and 1C13h) establish the relationship between these PDOs and the Sync Managers.

The following figure shows an example of a Sync Manager and the PDO mappings.



M CAUTION

 The PDO mapping objects (indexes 1600h to 1603h and 1A00h to 1A03h) and the Sync Manager PDO assignment objects (index 1C12h and 1C13h) can be written only in Pre-Operational state.

12.4.1 Setting Procedure for PDO Mappings

- 1. Disable the assignments between the Sync Manager and PDOs. (Set subindex 0 of objects 1C12h to 1C13h to 0.)
- 2. Set all of the mapping entries for the PDO mapping objects. (Set objects 1600h to 1603h and 1A00h to 1A03h.)
- 3. Set the number of mapping entries for the PDO mapping objects. (Set subindex 0 of objects 1600h to 1603h and 1A00h to 1A03h.)
- 4. Set the assignments between the Sync Manager and PDOs. (Set subindex 1 of objects 1C12h to 1C13h.)
- 5. Enable the assignments between the Sync Manager and PDOs. (Set subindex 0 of objects 1C12h to 1C13h to 1.)

12.4.2 Default PDO Mappings

The following table shows the default PDO mappings for the SERVOPACK. The defaults are defined in the EtherCAT slave information file (ESI).

• 1st PDO Mapping (Position, Velocity, Torque, Torque Limit, and Touch Probe)

RxPDO (1600h)	Controlword (6040h)	Target position (607Ah)	Target velocity (60FFh)	Target torque (6071h)	Maxtorque (6072h)	Mode of operation (6060h)	Padding (8 bits)	Touch probe function (60B8h)
TxPDO (1A00h)	Statusword (6041h)	Position actual value (6064h)	Torque actual value (6077h)	Following error actual value (60F4h)	Modes of operation display (6061h)	Padding (8 bits)	Touch probe status (60B9h)	Touch probe value (60BAh)

• 2nd PDO Mapping (Cyclic Synchronous Position): Default PDO Assignments

RxPDO (1601h)	Controlword (6040h)	Target position (607Ah)	
TxPDO (1A01h)	Statusword (6041h)	Position actual value (6064h)	

• 3rd PDO Mapping (Cyclic Synchronous Velocity)

RxPDO	Controlword	Target velocity
(1602h)	(6040h)	(60FFh)
TxPDO (1A02h)	Statusword (6041h)	Position actual value (6064h)

4th PDO Mapping (Cyclic Synchronous Torque)

RxPDO (1603h)	Controlword (6040h)	Target torque (6071h)	-
TxPDO (1A03h)	Statusword (6041h)	Position actual value (6064h)	Torque actual value (6077h)

12.5

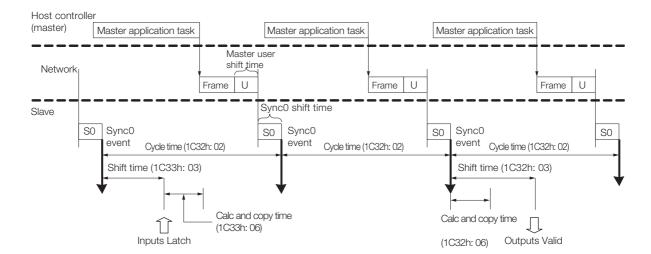
Synchronization with Distributed Clocks

The synchronization of EtherCAT communications is based on a mechanism called a distributed clock. With the distributed clock, all devices are synchronized with each other by sharing the same reference clock. The slave devices synchronize the internal applications to the Sync0 events that are generated according to the reference clock.

You can use the following synchronization modes with EtherCAT (CoE). You can change the synchronization mode in the Sync Control registers (ESC registers 0x980 and 0x981).

- Free-Run (ESC register 0x980 = 0x0000) In Free-Run mode, the local cycle is independent from the communications cycle and master cycle.
- DC Mode (ESC register 0x980 = 0x0300)
 In this mode, the SERVOPACK is synchronized with the host controller (master) on the Sync0 event.

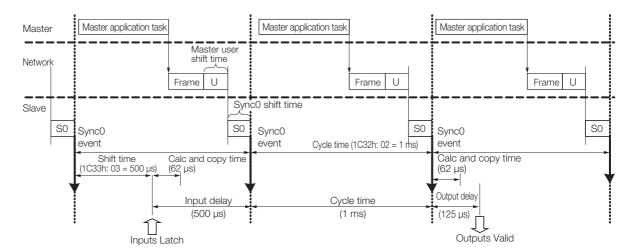
The following figure gives a timing chart for DC synchronization.



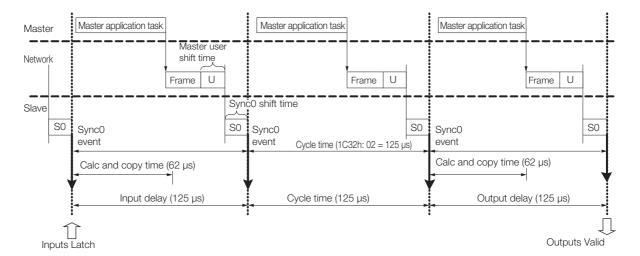
Index	Sub- index	Name	Access	PDO Map- ping	Data Type	Description	
	Sync Manager channel 2 (process data output) synchronization						
	1	Synchronization type	RO	No	UINT	Ourrent status of DC mode 0: Free-run 2: DC mode (synchronous with Sync0)	
	2	Cycle time	RO	No	UDINT	Sync0 event cycle [ns] (The value is set by the master via an ESC register.) Range: 125,000 × n (n = 1 to 32) [ns]	
1C32h	3	Shift time	RO	No	UDINT	125,000 [ns] (fixed) The time between the Sync0 event and Outputs Valid (i.e., the time from Sync0 until the output data is input to the SER-VOPACK).	
	6	Calc and copy time	RO	No	UDINT	62,500 [ns] (fixed) The time from the Sync0 event until the output data from Sync Manager 2 is read.	
	Sync	Manager channel 3 (pr	ocess data	a input) s	synchronizat	ion	
1C33h	3	Shift time	RW	No	UDINT	125,000 × n (n = 1 to 32) [ns] Range: 0 to (Sync0 event cycle - 125,000) [ns] The time between the Sync0 event and Inputs Latch (i.e., when the input data is obtained from the SERVOPACK).	
	6	Calc and copy time	RO	No	UDINT	62,500 [ns] (fixed) The time for copying the input process data to the Sync Manager 3 area.	

Example of PDO Data Exchange Timing in DC Mode

• DC Cycle Time = 1 ms, Input Shift Time = 500 μs



• DC Cycle Time = 125 μ s, Input Shift Time = 0 μ s



12.6 Emergency Messages

Emergency messages are triggered by alarms and warnings detected within the SERVOPACK. They are sent via the mailbox interface.

An emergency message consists of eight bytes of data as shown in the following table.

Byte	0	1	2	3	4	5	6	7	
	_		Error reg-		Manufacturer-specific error field				
Descrip- tion	Emerger code (F		ister (object 1001h)	Reserved.	SERVOPA warning	CK alarm/ g code ^{*2}	Reserved.		

^{*1.} The manufacturer-specific error code is always FF00h.

15.2.2 Troubleshooting Alarms on page 15-11

15.3.2 Troubleshooting Warnings on page 15-47

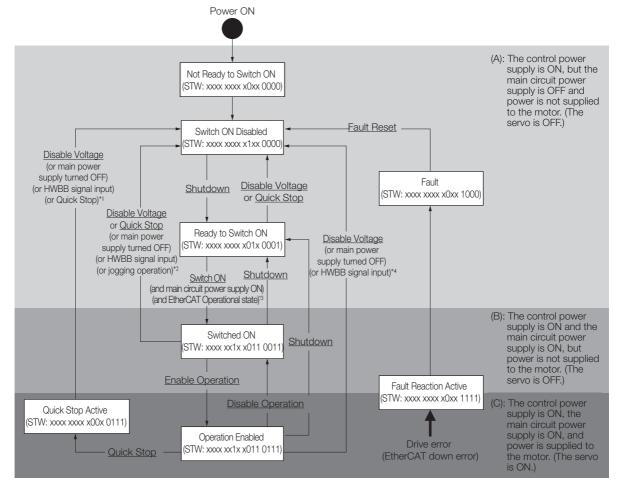
^{*2.} For details on SERVOPACK alarms and warnings, refer to the following sections.

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13.1 Device Control

You use the *controlword* (6040h) to execute device control for the Servo Drive according to the following state transitions. You can use the *statusword* (6041h) to monitor the device status of the Servo Drive.



- *1. In the Quick Stop Active state, the SERVOPACK automatically moves to the Switch ON Disabled state in the following cases:
 - The main power supply was turned OFF.
 - The HWBB signal was input.
 - The motor was stopped.
- *2. In the Switched ON state, the SERVOPACK automatically moves to the Switch ON Disabled state in the following cases:
 - The main power supply was turned OFF.
 - The HWBB signal was input.
 - Motor operation was already enabled by the Digital Operator or the SigmaWin+.
- *3. In the Ready to Switch ON state, the SERVOPACK moves to the next state in the following cases:
 - The main circuit power supply is ON.
 - The EtherCAT state machine (ESM) is in the Operational state.
 - The Servomotor is not being operated by the Digital Operator or the SigmaWin+.
- *4. In the Operation Enabled state, the SERVOPACK automatically moves to the Switch ON Disabled state in the following cases:
 - The main power supply was turned OFF.
 - The HWBB signal was input.
- Note: 1. ____: The states are shown in white boxes.
 - 2. STW indicates the statusword (6041h).
 - 3. _____: Underlines indicate control commands in the controlword (6040h).

13.1.1 State Machine Control Commands

Command	Bits in Controlword (6040h)						
Command	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0		
Shutdown	0	_	1	1	0		
Switch ON	0	0	1	1	1		
Switch ON + Enable Operation	0	1	1	1	1		
Disable Voltage	0	_	_	0	_		
Quick Stop	0	_	0	1	_		
Disable Operation	0	0	1	1	1		
Enable Operation	0	1	1	1	1		
Fault Reset	0 → 1	_	_	_	_		

13.1.2 Bits in Statusword (6041h)

Bit	Data Description	Remarks
0	Ready to Switch ON	
1	Switched ON	
2	Operation Enabled	
3	Fault	
4	Voltage Enabled	
5	Quick Stop	
6	Switch ON Disabled	
7	Warning	Refer to the following section for details.
8	Active Mode Stop	☐ 14.6 Device Control on page 14-22
9	Remote	
10	Target Reached	
11	Internal Limit Active	
12	Operation Made Specific	
13	Operation Mode Specific	
14	Torque Limit Active	
15	Safety Active	

13.1.3 Related Objects

Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
6040h	0	Controlword	RW	Yes	_	UINT
6041h	0	Statusword	RO	Yes	_	UINT
605Ah	0	Quick stop option code	RW	No	_	INT
605Bh	0	Shutdown option code	RW	No	_	INT
605Ch	0	Disable operation option code	RW	No	_	INT
605Dh	0	Halt option code	RW	No	_	INT
605Eh	0	Fault reaction option code	RW	No	_	INT

13.2 Modes of Operation

The SERVOPACK supports the following modes of operation.

- Profile Position Mode
- · Homing Mode
- Interpolated Position Mode
- Profile Velocity Mode
- Torque Profile Velocity Mode
- Cyclic Sync Position Mode
- Cyclic Sync Velocity Mode
- Cyclic Sync Torque Mode

13.2.1 Related Objects

Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
6060h	0	Modes of operation	RW	Yes	-	SINT
6061h	0	Modes of operation display	RO	Yes	_	SINT
6502h	0	Supported drive modes	RO	No	_	UDINT

13.2.2 Dynamic Mode Changes

You can change the operation mode with *modes of operation* (6060h). The master must update all operation mode-specific process data objects at the same time when it changes the operation mode during motor operation. If the master selects a new operation mode, the SERVO-PACK will change to the new operation mode immediately. The following table describes operation when the operation mode is changed to a new mode.

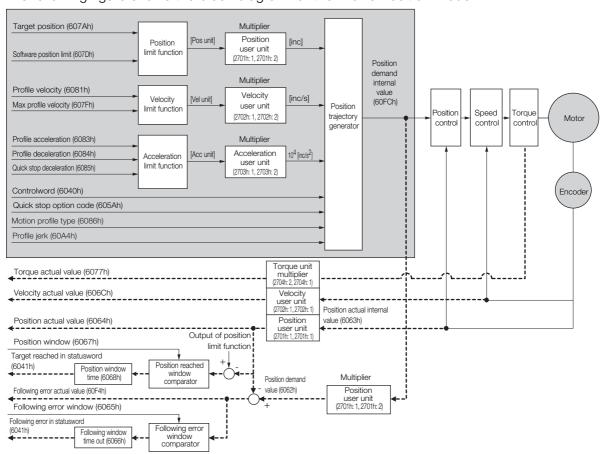
New Operation Mode	Operation When Operation Mode Is Changed
Profile Position Mode	Controlword bit 4 = 0: The motor is stopped in the current position control mode. Controlword bit 4 = 1: A new positioning operation is started immediately.
Homing Mode	Controlword bit 4 = 0: The motor is stopped in the current position control mode. Controlword bit 4 = 1: Homing is started immediately.
Interpolated Position Mode	Controlword bit 4 = 0: The motor is stopped in the current position control mode. Controlword bit 4 = 1: A new positioning operation is started immediately.
Profile Velocity Mode	The new operation mode is started immediately.
Torque Profile Velocity Mode	The new operation mode is started immediately.
Cyclic Sync Position Mode	The new operation mode is started immediately.
Cyclic Sync Velocity Mode	The new operation mode is started immediately.
Cyclic Sync Torque Mode	The new operation mode is started immediately.

13.3 Position Control Modes

13.3.1 Profile Position Mode

The Profile Position Mode is used to position to the Target Position at the Profile Velocity and the Profile Acceleration.

The following figure shows the block diagram for the Profile Position Mode.

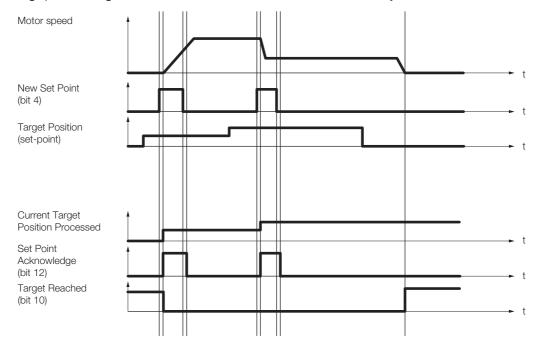


Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
6040h	0	Controlword	RW	Yes	_	UINT
6041h	0	Statusword	RO	Yes	_	UINT
607Ah	0	Target position	RW	Yes	Pos. unit	DINT
	Software position limit					<u>. </u>
607Dh	1	Min position limit	RW	No	Pos. unit	DINT
	2	Max position limit	RW	No	Pos. unit	DINT
607Fh	0	Max profile velocity	RW	Yes	Vel. unit	UDINT
6081h	0	Profile velocity	RW	Yes	Vel. unit	UDINT
6083h	0	Profile acceleration	RW	Yes	Acc. unit	UDINT
6084h	0	Profile deceleration	RW	Yes	Acc. unit	UDINT
6085h	0	Quick stop deceleration	RW	Yes	Acc. unit	UDINT
6086h	_	Motion profile type	RW	Yes	_	INT
60A4h	Profile jerk		•			
	1	Profile jerk 1	RW	No	%	UDINT

In the Profile Position Mode, the following two methods can be used to start positioning.

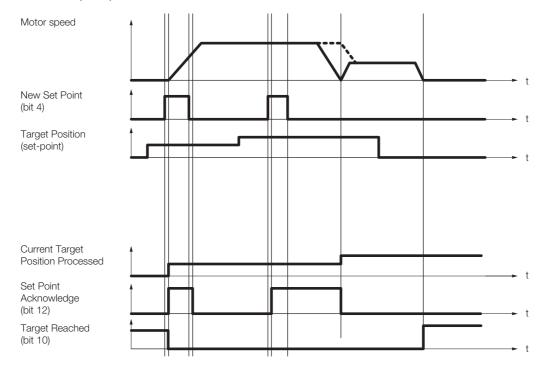
Single Set Point (When Change Set Immediately Bit (Bit 5) in Controlword Is 1)

When a new command is input to the New Set Point Bit (bit 4) in *controlword* during positioning, positioning for the new command is started immediately.



Set of Set Points (When Change Set Immediately Bit (Bit 5) in Controlword Is 0)

When a new command is input in the New Set Point Bit (bit 4) in *controlword* during positioning, positioning for the new command is started as soon as the current positioning operation is completed. The dotted line in the following figure shows the actual speed if the Change of Set Point Bit (bit 9) is set to 1.

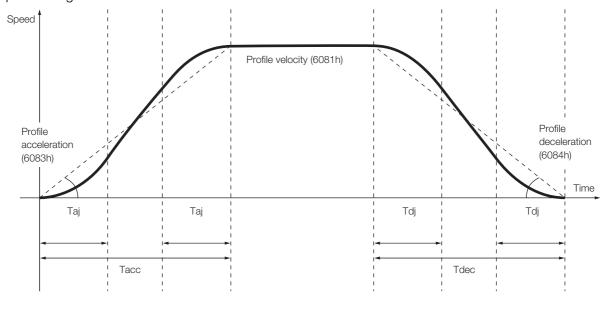


13.3.1 Profile Position Mode

◆ SPOSING (S-curve Acceleration/Deceleration Positioning)

If you set *Motion profile type* to 2, S-curve acceleration/deceleration will be used for positioning to *Target position*.

SERVOPACKs with software version 0023 or higher support S-curve acceleration/deceleration positioning.



Acceleration time: Tacc = Profile velocity (6081h)

S-curve acceleration time: Taj = Tacc × Profile jerk (60A4h)

/Profile acceleration (6083h)

Deceleration time: Tdec = Profile velocity (6081h)

/Profile deceleration (6084h)

S-curve deceleration time: Tdj = Tdec × Profile jerk (60A4h)



1. If you change the *Target position* (607Ah), *Profile velocity* (6081h), *Profile acceleration* (6083h), or *Profile deceleration* (6084h), do so either while positioning is stopped or while positioning at a constant speed.

2. Set the S-curve acceleration/deceleration time in *Profile jerk* (60A4h).

13.3.2 Interpolated Position Mode

The Interpolated Position Mode is used to control multiple coordinated axes or to control a single axis that requires time interpolation of the set point data. There are the following two submodes for the Interpolated Position Mode.

Interpolation submode select (60C0h) is used to change the submode. Refer to the following section for details.

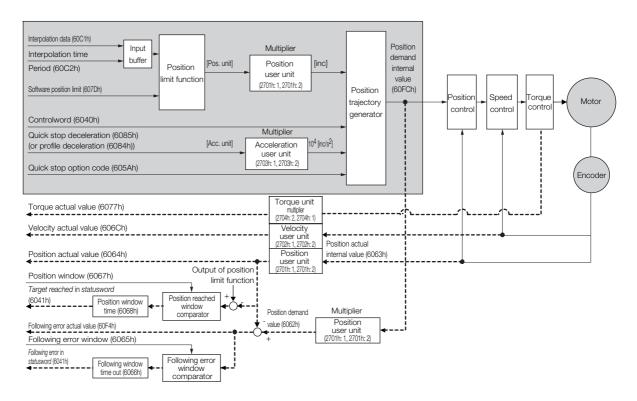
14.10 Interpolated Position Mode on page 14-36

Inter	polated Position Mode	Number of Data	Number of Profiles	
Mode 1	No position reference filter	1	4	
Mode 1	Position reference filter		ı	
Mode 2	No position reference filter	1 to 254	0	
Mode 2	Position reference filter	1 10 254	2	

Mode 1

This submode normally uses a time (communications) synchronization mechanism to synchronize the Servo Drives. The Interpolation Time Period defines the update cycle of the Interpolation Data (i.e., the interpolation position). The interpolation processing in the SERVOPACK is based on this setting. The Interpolation Data is interpreted as an absolute value.

The following figure shows the block diagram for mode 1.



◆ Related Objects

Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
6040h	0	Controlword	RW	Yes	_	UINT
6041h	0	Statusword	RO	Yes	_	UINT
60C1h	1	Interpolation data record	RW	Yes	Pos. unit	DINT

Continued on next page.

13.3.2 Interpolated Position Mode

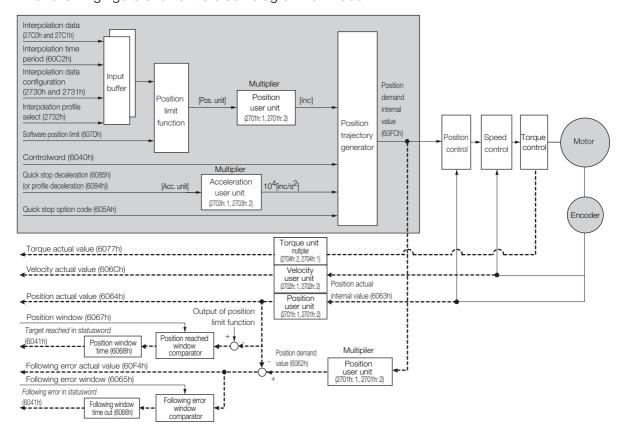
~			
Continued	trom	nravious	naga
OUTILITIES	11 0111	previous	page.

Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type	
	Interpolation ti	me period			•		
60C2h	1	Interpolation time period value	RO	No	_	USINT	
	2	Interpolation time index	RO	No	_	SINT	
	Software position limit						
607Dh	1	Min position limit	RW	No	Pos. unit	DINT	
	2	Max position limit	RW	No	Pos. unit	DINT	
6084h	0	Profile deceleration	RW	Yes	Acc. unit	UDINT	
6085h	0	Quick stop deceleration	RW	Yes	Acc. unit	UDINT	

Mode 2

This submode is used to perform interpolation feeding control for an individual axis. Unlike mode 1, mode 2 has reference input buffers (interpolation data record for 1st profile and interpolation data record for 2nd profile) that you can set to different interpolation positions (interpolation data record). The interpolation positions that are set in the reference input buffers are read each interpolation time period to perform interpolation processing.

The following figure shows the block diagram for mode 2.



Related Objects

Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
6040h	0	Controlword	RW	Yes	_	UINT
6041h	0	Statusword	RO	Yes	_	UINT
	Interpolation ti	me period				
60C2h	1	Interpolation time period value	RW	No	_	USINT
	2	Interpolation time index	RW	No	_	SINT

Continued on next page.

Continued from previous page.

Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
	Interpolation	data configuration for 1st profile				
	1	Maximum buffer size	RO	No	_	UDINT
	2	Actual buffer size	RW	No	_	UDINT
	3	Buffer organization	RW	No	_	USINT
	4	Buffer position	RW	Yes	-	UINT
2730h	5	Size of data record	WO	No	_	USINT
	6	Buffer clear	WO	No	_	USINT
	7	Position data definition	RW	Yes	_	USINT
	8	Position data polarity	RW	Yes	_	USINT
	9	Behavior after reaching buffer position	RW	Yes	-	USINT
	Interpolation	data configuration for 2nd profile		1		
	1	Maximum buffer size	RO	No	_	UDINT
	2	Actual buffer size	RW	No	_	UDINT
	3	Buffer organization	RW	No	_	USINT
	4	Buffer position	RW	Yes	_	UINT
2731h	5	Size of data record	WO	No	_	USINT
	6	Buffer clear	WO	No	_	USINT
	7	Position data definition	RW	Yes	_	USINT
	8	Position data polarity	RW	Yes	_	USINT
	9	Behavior after reaching buffer position	RW	Yes	-	USINT
2732h	0	Interpolation profile select	RW	Yes	_	USINT
27C0h	1-254	Interpolation data record for 1 st profile	RW	No	Pos. unit	DINT
27C1h	1-254	Interpolation data record for 2 nd profile	RW	No	Pos. unit	DINT
	Interpolation	data read/write pointer position r	nonitor			
2741h	1	Interpolation data read pointer position	RO	Yes	-	UINT
	2	Interpolation data write pointer position	RO	Yes	_	UINT
	Software pos	ition limit			· <u> </u>	
607Dh	1	Min position limit	RW	No	Pos. unit	DINT
	2	Max position limit	RW	No	Pos. unit	DINT
	1					

RW

RW

Yes

Yes

Acc. unit

Acc. unit

UDINT

UDINT

6084h

6085h

0

0

Profile deceleration

Quick stop deceleration

13.3.3 Cyclic Synchronous Position Mode

◆ Object Setting Procedure

The recommended object setting procedure to use mode 2 is given in the following table.

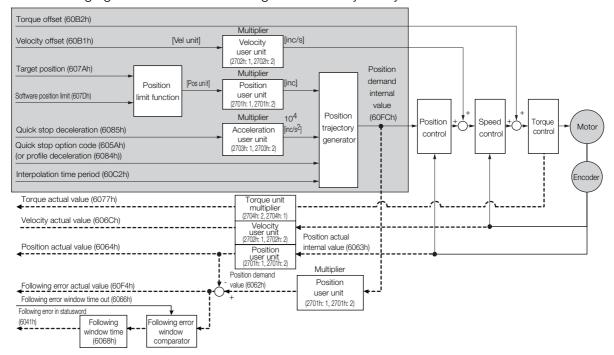
Step	Description
1	Set interpolation submode select (60C0h).
2	Set interpolation profile select (2732h).
3	Set interpolation data configuration for 1st profile (2730h) and interpolation data configuration for 2nd profile (2731h).
4	Set interpolation data record for 1st profile (27C0h) and interpolation data record for 2nd profile (27C1h).
5	Set mode of operation (6060h).
6	Set enable interpolation (6060h bit 4).

13.3.3 Cyclic Synchronous Position Mode

The Cyclic Synchronous Position Mode is used for the interpolated positioning in the same way as the Interpolated Position Mode. In this mode, speed and torque compensations can be specified by the master to enable speed and torque feedforward.

The *interpolation time period* defines the interval at which the Target Position is updated. Interpolation is performed in the SERVOPACK according to this setting. The target position is interpreted as an absolute value.

The following figure shows the block diagram for the Cyclic Synchronous Position Mode.



Related Objects

Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
607Ah	0	Target position	RW	Yes	Pos. unit	DINT
	Software posit	ion limit				
607Dh	1	Min position limit	RW	No	Pos. unit	DINT
	2	Max position limit	RW	No	Pos. unit	DINT
6084h	0	Profile deceleration	RW	Yes	Acc. unit	UDINT
6085h	0	Quick stop deceleration	RW	Yes	Acc. unit	UDINT
60B1h	0	Velocity offset	RW	Yes	Vel. unit	DINT

Continued on next page.

13.3.3 Cyclic Synchronous Position Mode

Continued from previous page.

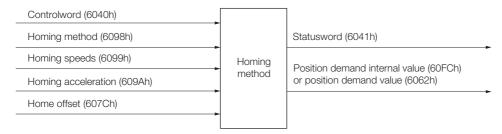
Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
60B2h	0	Torque offset	RW	Yes	Trq. unit	INT
	Interpolation ti	me period	•	•		
60C2h	1	Interpolation time period value	RO	No	ı	USINT
	2	Interpolation time index	RO	No	_	SINT

13.4.1 Related Objects

13.4

Homing

The following figure shows the relationship between the input objects and the output objects in the Homing Mode. You can specify the speeds, acceleration rate, and homing method. You can also use *home offset* to offset zero in the user coordinate system from the home position.



13.4.1 Related Objects

Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
6040h	0	Controlword	RW	Yes	_	UINT
6041h	0	Statusword	RO	Yes	_	UINT
607Ch	0	Home offset	RW	No	Pos. unit	DINT
6098h	0	Homing method	RW	Yes	_	SINT
	Homing speed	ds		•		
6099h	1	Speed during search for switch	RW	Yes	Vel. unit	UDINT
	2	Speed during search for zero	RW	Yes	Vel. unit	UDINT
609Ah	0	Homing acceleration	RW	Yes	Acc. unit	UDINT

13.4.2 Homing Method (6098h)

Value	Definition	Description
0	_	No homing (default setting)
		With this method, homing starts in the negative direction if the negative limit switch is inactive. The home position is the first index pulse that is detected after the negative limit switch becomes inactive.
1	Homing with the negative limit switch and index pulse	Index pulse Negative limit switch (N-OT)

Note: The index pulse is the encoder's zero signal (phase C).

Continued on next page.

Continued from previous page.

Value	Definition	Description Description
		With this method, homing starts in the positive direction if the positive limit switch is inactive. The home position is the first index pulse that is detected after the positive limit switch becomes inactive.
2	Homing with the positive limit switch and index pulse	+2
		Index pulse
		Positive limit switch (P-OT)
7 to 10	Homing with the home switch input (/Home) signal and index pulse and starting in the positive direction	With methods 7 to 10, homing starts in the positive direction. However, if the /Home signal is already active when homing is started, the initial homing direction depends on the required edge. The home position will be the index pulse on either the rising or falling edge side of the /Home signal. If the initial movement direction is away from the /Home signal, the motor will reverse direction when the limit switch in the movement direction is input.
11 to 14	Homing with the home switch input (/Home) signal and index pulse and starting in the negative direction	These methods are similar to methods 7 to 10 except that homing starts in the negative direction. Index pulse /Home signal Negative limit switch (N-OT)

Continued on next page.

13.4.2 Homing Method (6098h)

Continued from previous page.

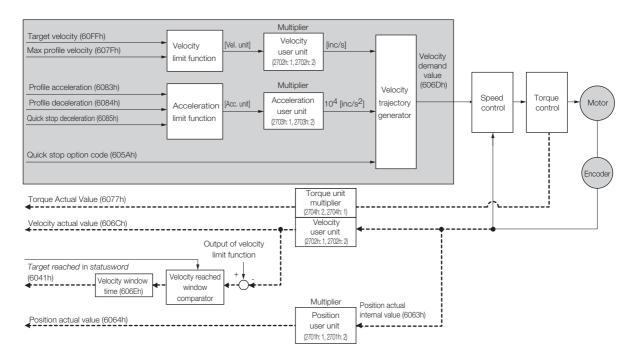
		Continued from previous page.			
Value	Definition	Description			
		This method is same as method 8 except that the home position does not depend on the index pulse. Here, it depends only on changes in the relevant /Home signal or limit switch.			
24	Homing with the home switch input (/Home) signal and starting in the positive direction	/Home signal Positive limit switch			
		(P-OT)			
28	Homing with the home switch input (/Home) signal and starting in the negative direction	This method is same as method 12 except that the home position does not depend on the index pulse. Here, it depends only on changes in the relevant /Home signal or limit switch.			
		/Home signal			
33, 34	Homing with the index pulse	Index pulse			
35	Homing with the cur- rent position	With this method, the current position is defined as the home position. You can execute this method even if the Servo Drive is not in the Operation Enabled state.			

13.5 Velocity Control Modes

13.5.1 **Profile Velocity Mode**

In the Profile Velocity Mode, the speed is output according to the profile acceleration and profile deceleration until it reaches the target velocity.

The following figure shows the block diagram for the Profile Velocity Mode.

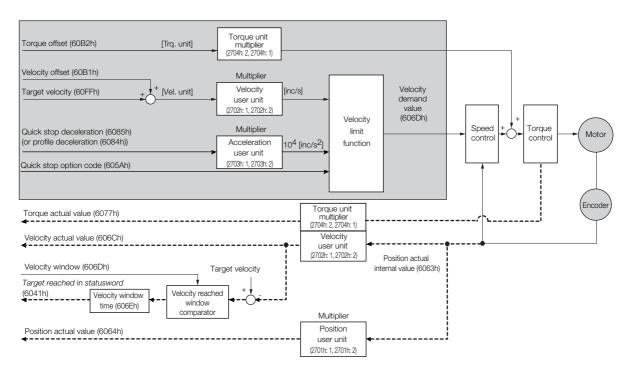


Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
60FFh	0	Target velocity	RW	Yes	Vel. unit	DINT
607Fh	0	Max profile velocity	RW	Yes	Vel. unit	UDINT
6083h	0	Profile acceleration	RW	Yes	Acc. unit	UDINT
6084h	0	Profile deceleration	RW	Yes	Acc. unit	UDINT
6085h	0	Quick stop deceleration	RW	Yes	Acc. unit	UDINT
606Bh	0	Velocity demand value	RO	Yes	Vel. unit	DINT
606Ch	0	Velocity actual value	RO	Yes	Vel. unit	DINT
606Dh	0	Velocity window	RW	No	Vel. unit	UINT
606Eh	0	Velocity window time	RW	No	ms	UINT

13.5.2 Cyclic Synchronous Velocity Mode

In the Cyclic Synchronous Velocity Mode, the master provides the target speed to the Servo Drive, which performs speed control. In this mode, a torque compensation can be specified by the master to enable torque feedforward.

The following figure shows the block diagram for the Cyclic Synchronous Velocity Mode.



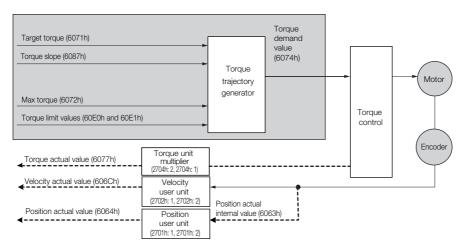
Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
60FFh	0	Target velocity	RW	Yes	Vel. unit	DINT
60B1h	0	Velocity offset	RW	Yes	Vel. unit	DINT
60B2h	0	Torque offset	RW	Yes	Trq. unit	INT
6084h	0	Profile deceleration	RW	Yes	Acc. unit	UDINT
6085h	0	Quick stop deceleration	RW	Yes	Acc. unit	UDINT
606Bh	0	Velocity demand value	RO	Yes	Vel. unit	DINT
606Ch	0	Velocity actual value	RO	Yes	Vel. unit	DINT
606Dh	0	Velocity window	RW	No	Vel. unit	UINT
606Eh	0	Velocity window time	RW	No	ms	UINT

13.6 Torque Control Modes

13.6.1 Profile Torque Mode

In the Profile Torque Mode, the torque is output up to the *target torque* according to the *torque* slope setting.

The following figure shows the block diagram for the Profile Torque Mode.



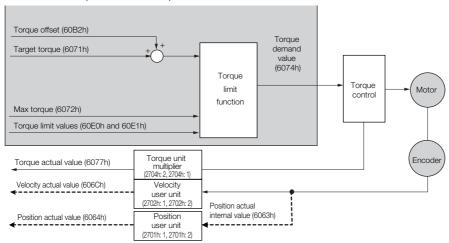
Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
6071h	0	Target torque	RW	Yes	Trq. unit *	INT
6087h	0	Torque slope	RW	Yes	Trq. unit/s *	UDINT
6074h	0	Torque demand value	RO	Yes	Trq. unit *	INT
6077h	0	Torque actual value	RO	Yes	Trq. unit *	INT
6072h	0	Max torque	RW	Yes	Trq. unit *	UINT
60E0h	0	Positive torque limit value	RW	Yes	Trq. unit *	UINT
60E1h	0	Negative torque limit value	RW	Yes	Trq. unit *	UINT

^{*} Refer to the following section for details.

^{14.14} Torque Limit Function on page 14-44

13.6.2 Cyclic Sync Torque Mode

In the Cyclic Synchronous Torque Mode, the master provides the *target torque* to the Servo Drive, which performs torque control.



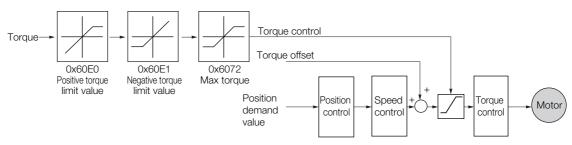
Index	Subindex	Name Access PDO Mapping Unit		Unit	Data Type	
6071h	0	Target torque	RW	Yes	Trq. unit *	INT
6074h	0	Torque demand value	RO	Yes	Trq. unit *	INT
6077h	0	Torque actual value	RO	Yes	Trq. unit *	INT
60B2h	0	Torque offset	RW	Yes	Trq. unit *	INT
6072h	0	Max torque	RW	Yes	Trq. unit *	UINT
60E0h	0	Positive torque limit value	RW	Yes	Trq. unit *	UINT
60E1h	0	Negative torque limit value	RW	Yes	Trq. unit *	UINT

 $[\]boldsymbol{*}$ Refer to the following section for details.

^{14.14} Torque Limit Function on page 14-44

13.7 Torque Limits

The following figure shows the block diagram for the torque limits. The torque is limited by the lowest limit value.



Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
6072h	0	Max torque	RW	Yes	Trq. unit *	UINT
60E0h	0	Positive torque limit value	RW	Yes	Trq. unit *	UINT
60E1h	0	Negative torque limit value	RW	Yes	Trq. unit *	UINT

^{*} Refer to the following section for details.

^{14.14} Torque Limit Function on page 14-44

13.8 Digital I/O Signals

The digital inputs and digital outputs are used to control the I/O signals of the CN1 connector on the SERVOPACK.

Index	Subindex	Name	Access	PDO Mapping	Unit	Data Type
60FDh	0	Digital inputs	RO	Yes	1	UDINT
	Digital outputs	3				
60FEh	1	Physical outputs	RW	Yes	ı	UDINT
	2	Bit mask	RW	No	-	UDINT

13.9 Touch Probe

You can latch the feedback position with the following trigger events.

- Trigger with probe 1 input (Probe 1 Latch Input (/Probe1) signal)
- Trigger with probe 2 input (Probe 2 Latch Input (/Probe2) signal)
- Trigger with encoder zero signal (phase C)

The following two touch probe latches can be used at the same time.

■ Touch Probe 1 Latch

- Latch control object: 60B8h (bits 0 to 7)
- Latch status object: 60B9h (bits 0 to 7)
- The latched position is always stored in touch probe 1 position value (60BAh).
- Trigger signal: Encoder zero signal or /Probe1 signal

■ Touch Probe 2 Latch

- Latch control object: 60B8h (bits 8 to 15)
- Latch status object: 60B9h (bits 8 to 15)
- The latched position is always stored in touch probe 2 position value (60BCh).
- Trigger signal: /Probe2 signal

You can change the connector pin assignments and the /Probe1 and /Probe2 signal logic in the Probe 1 Latch Input Signal parameter (Pn511 = $\square\square$ X \square) and the Probe 2 Latch Input Signal parameter (Pn511 = \square X \square D).

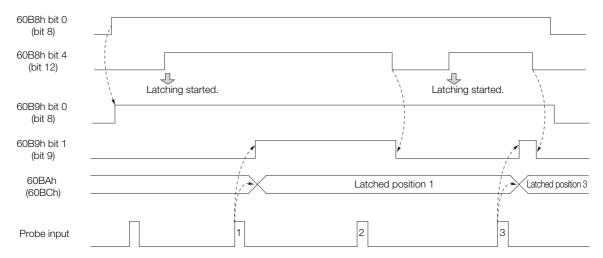
Note: Touch probe 1 cannot be used during homing. If touch probe 1 was already active, it will be switched OFF.

13.9.1 Related Objects

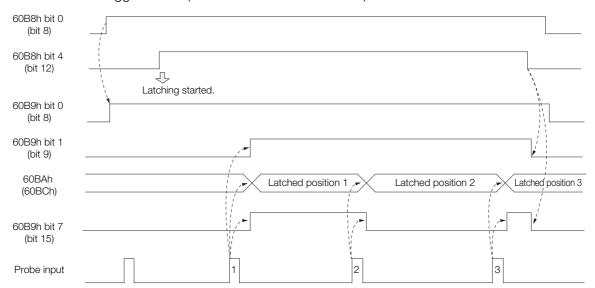
Index	Subindex	Name Access		PDO Mapping	Unit	Data Type
60B8h	0	Touch probe function	RW	Yes	-	UINT
60B9h	0	Touch probe status	RO	Yes	-	UINT
60BAh	0	Touch probe 1 position value	RO	Yes	Pos. unit	DINT
60BCh	0	Touch probe 2 position value	RO	Yes	Pos. unit	DINT

13.9.2 Example of Execution Procedure for a Touch Probe

• Single Trigger Mode (60B8h bit 1 = 0 or bit 9 = 0)

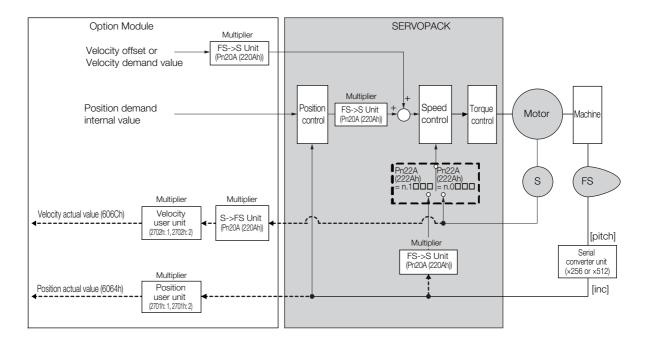


• Continuous Trigger Mode (60B8h bit 1 = 1 or bit 9 = 1)



13.10 Fully-Closed Loop Control

The following figure shows the block diagram for the fully-closed loop control.



The basic setting procedure for the related parameters is given in the following table.

Step	Description	Parameter Setting
1	Set the speed feedback method to use during fully-closed loop control.	Fully-closed Control Selections (Pn22A (222Ah))
2	Set the motor rotation direction.	Rotation Direction Selection (Pn000 (2000h) = n.□□□X) External Encoder Usage (Pn002 (2002h) = n.X□□□)
3	Set the number of pitches (cycles) of the sine wave for the external encoder.	Number of External Scale Pitches (Pn20A (220Ah))
4	Set the position reference unit (electronic gear).	Position user unit (2701h)
5	Set the alarm detection level for the external encoder.	Motor-Load Position Deviation Overflow Detection Level (Pn51B (251Bh)) Multiplier per Fully-closed Rotation (Pn52A (252Ah))

Object Dictionary

This chapter provides tables of the objects that are supported by an EtherCAT SERVOPACK. Each object is described.

14.1	Object Dictionary List14-3
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14.3	PDO Mapping Objects14-9
14.4	Sync Manager Communications Objects14-13
14.5	Manufacturer-Specific Objects14-17
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14.7	Profile Position Mode14-30
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14.1 Object Dictionary List

The following table lists the dictionary objects.

Functional Classification	Object Name	Index	Refer to
	Device type	(1000h)	14.2
	Error register	(1001h)	14.2
	Manufacturer device name	(1008h)	14.2
General Objects	Manufacturer software version	(100Ah)	14.2
	Store parameters	(1010h)	14.2
	Restore default parameters	(1011h)	14.2
	Identity object	(1018h)	14.2
PDO Mapping Objects	Receive PDO mapping	(1600h to 1603h)	14.3
FDO Mapping Objects	Transmit PDO mapping	(1A00h to 1A03h)	14.3
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14.2 General Objects

Device Type (1000h)

This object contains the device type and functionality.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
1000h	0	Device type	UDINT	RO	No	0x00020192	No

◆ Data Description

Bit 3	1	16	15	0
	Additional Information		Device profile number	

Additional information: 0002 (Servo Drive) Device profile number: 0192 (DS402)

Error Register (1001h)

This object contains the error status of the device. The value of this object is stored as part of an emergency message.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
1001h	0	Error register	USINT	RO	No	0x00	No

Data Description

Bit	Data	Description
0	Generic error	0: No error, 1: Error
1 to 7	Reserved.	0: Always 0

Manufacturer Device Name (1008h)

This object contains the SERVOPACK model name.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
1008h	0	Manufacturer device name	STRING	RO	No	-	No

Manufacturer Software Version (100Ah)

This object contains the software version of the SERVOPACK.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
100Ah	0	Manufacturer software version	STRING	RO	No	-	No

Data Description

The following string is saved.

"XXXX.****"

xxxx.***: Software version of EtherCAT (CoE)

Store Parameters (1010h)

You can use this object to save the parameter settings in non-volatile memory.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
1010h	0	Largest subindex supported	USINT	RO	No	4	No
	1	Save all parameters	UDINT	RW	No	0x00000000 to 0xFFFFFFF (default: 0x00000001)	No
	2	Save communication parameters	UDINT	RW	No	0x00000000 to 0xFFFFFFF (default: 0x00000001)	No
	3	Save application parameters	UDINT	RW	No	0x00000000 to 0xFFFFFFF (default: 0x00000001)	No
	4	Save manufacturer defined parameters	UDINT	RW	No	0x00000000 to 0xFFFFFFF (default: 0x00000001)	No

If you read the object entry data, a value will be returned that tells whether the SERVOPACK can save the parameters.

Bit	Value	Meaning
1	0	The SERVOPACK does not save the parameters autonomously.
0	0	The SERVOPACK does not save the parameters for a command.
U	1	The SERVOPACK saves the parameters for a command.

To prevent saving parameters by mistake, they are saved only when a specific signature is written to the appropriate subindex. The signature is "save."

Signature N	MSB LS					
ASCII	е	٧	а	s		
h	65h	76h	61h	73h		

If you write "save" to subindex 1, all parameters are saved.

If you write "save" to subindex 2, the communications parameters (objects 1000h to 1FFFh) are saved.

If you write "save" to subindex 3, the application parameters (objects 27□□h and 6□□□h) are saved.

If you write "save" to subindex 4, the SERVOPACK parameters (objects 2000h to 26FFh) are saved.

Note: 1. If an incorrect signature is written, the SERVOPACK refuses to save the parameters and returns an SDO abort code.

- 2. If you read the object entry data while parameters are being saved, 0 will be returned.
- 3. Subindex 1 and subindex 4 can be written only in the Switch ON Disabled state (servo OFF).
- 4. After storing parameters with subindex 1 or subindex 4, you must turn the power supply OFF and ON again to move to the Operation Enabled state.

Restore Default Parameters (1011h)

You can use this object to restore the parameters to the default values.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
1011h	0	Largest subindex supported	USINT	RO	No	4	No
	1	Restore all default parameters	UDINT	RW	No	0x00000000 to 0xFFFFFFF (default: 0x00000001)	No
	2	Restore communication default parameters	UDINT	RW	No	0x00000000 to 0xFFFFFFF (default: 0x00000001)	No
	3	Restore application default parameters	UDINT	RW	No	0x00000000 to 0xFFFFFFF (default: 0x00000001)	No
	4	Restore manufacturer defined default parameters	UDINT	RW	No	0x00000000 to 0xFFFFFFF (default: 0x00000001)	No

If you read the object entry data, a value will be returned that tells whether the SERVOPACK can initialize the parameters.

Bit	Value	Description				
	0	The SERVOPACK does not restore the parameters to the default values.				
U	1	The SERVOPACK restores the parameters to the default values.				

To prevent restoring the parameters to the default values by mistake, the parameters are restored to the default values only when a specific signature is written to the appropriate subindex. The signature is "load."

Signature	MSB	LSB			
ASCII	d	а	0	Ι	
h	64h	61h	6Fh	6Ch	

If you write "load" to subindex 1, all parameters are restored to the default values.

If you write "load" to subindex 2, the communications parameters (objects $1\Box\Box\Box$ h) are restored to the default values.

If you write "load" to subindex 3, the application parameters (objects $27\square\square$ h and $6\square\square\square$ h) are restored to the default values.

If you write "load" to subindex 4, the SERVOPACK parameters (objects 2000h to 26FFh) are restored to the default values.

Note: 1. If an incorrect signature is written, the SERVOPACK refuses to restore the default values and returns an SDO abort code.

- 2. Subindex 1 and subindex 4 can be written only in the Switch ON Disabled state (servo OFF).
- 3. If you read this object while the default values are being restored, 0 will be returned.
- 4. The default values are enabled after the SERVOPACK is reset or after the power supply to the SERVO-PACK is turned OFF and ON again.

Identity Object (1018h)

This object contains general information on the device.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	USINT	RO	No	4	No
	1	Vendor ID	UDINT	RO	No	0x00000539	No
1018h	2	Product code	UDINT	RO	No	0x02200301	No
	3	Revision number *1	UDINT	RO	No	-	No
	4	Serial number *2	UDINT	RO	No	0x00000000	No

^{*1.} The revision number is saved as follows:

Bit 31		16	15	0
	Major version		Minor version	

The major version identifies the operating specifications of EtherCAT (CoE). If the CoE functionality is expanded, the major version has to be increased. The minor version number identifies different versions with the same operating specifications.

*2. Serial Number is not used. (It is always 0.)

14.3 PDO Mapping Objects

The CANopen over EtherCAT protocol allows the user to map objects to process data objects (PDOs) in order to use the PDOs for realtime data transfer.

The PDO mappings define which objects will be included in the PDOs.

A mapping entry (subindexes 1 to 8) is defined as shown below.

Bit 31	16	15 8	7	0
	Object index	Subindex	Length	

Bits 0 to 7: The length of the mapped object in bits. (If there is a gap in the PDOs, the bit length of the gap is given.)

Bits 8 to 15: The subindex of the mapped object (0 if there is a gap in the PDOs).

Bits 16 to 31: The index of the mapped object (0 if there is a gap in the PDOs).

Information

The objects mapped to PDOs can be changed only when the EtherCAT (CoE) Network Module is in the Pre-Operational state.

Set the mapping entries (subindexes 1 to 8) only after you write 0 to subindex 0.

Receive PDO Mapping (1600h to 1603h)

◆ 1st Receive PDO Mapping

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of objects in this PDO	USINT	RW	No	0 to 8 (default: 8)	Yes
	1	Mapping entry 1	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60400010)	Yes
	2	Mapping entry 2	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x607A0020)	Yes
	3	Mapping entry 3	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60FF0020)	Yes
1600h	4	Mapping entry 4	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60710010)	Yes
	5	Mapping entry 5	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60720010)	Yes
	6	Mapping entry 6	UDINT	RW	No	0 0xFFFFFFF (default: 0x60600008)	Yes
	7	Mapping entry 7	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x00000008)	Yes
	8	Mapping entry 8	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60B80010)	Yes

◆ 2nd Receive PDO Mapping

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
1601h	0	Number of objects in this PDO	USINT	RW	No	0 to 8 (default: 2)	Yes
	1	Mapping entry 1	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60400010)	Yes
	2	Mapping entry 2	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x607A0020)	Yes
	3 to 8	Mapping entry 3 to Mapping entry 8	UDINT	RW	No	0 to 0xFFFFFFF (default: 0)	Yes

◆ 3rd Receive PDO Mapping

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
1602h	0	Number of objects in this PDO	USINT	RW	No	0 to 8 (default: 2)	Yes
	1	Mapping entry 1	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60400010)	Yes
	2	Mapping entry 2	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60FF0020)	Yes
	3 to 8	Mapping entry 3 to Mapping entry 8	UDINT	RW	No	0 to 0xFFFFFFF (default: 0)	Yes

◆ 4th Receive PDO Mapping

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
1603h	0	Number of objects in this PDO	USINT	RW	No	0 to 8 (default: 2)	Yes
	1	Mapping entry 1	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60400010)	Yes
	2	Mapping entry 2	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60710010)	Yes
	3 to 8	Mapping entry 3 to Mapping entry 8	UDINT	RW	No	0 to 0xFFFFFFF (default: 0)	Yes

Transmit PDO Mapping (1A00h to 1A03h)

◆ 1st Transmit PDO Mapping

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of objects in this PDO	USINT	RW	No	0 to 8 (default: 8)	Yes
	1	Mapping entry 1	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60410010)	Yes
	2	Mapping entry 2	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60640020)	Yes
	3	Mapping entry 3	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60770010)	Yes
1A00h	4	Mapping entry 4	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60F40020)	Yes
	5	Mapping entry 5	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60610008)	Yes
	6	Mapping entry 6	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x00000008)	Yes
	7	Mapping entry 7	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60B90010)	Yes
	8	Mapping entry 8	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60BA0020)	Yes

◆ 2nd Transmit PDO Mapping

	11 3									
Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM			
1A01h	0	Number of objects in this PDO	USINT	RW	No	0 to 8 (default: 2)	Yes			
	1	Mapping entry 1	UDINT	RW	No	0 to 0xFFFFFFFF (default: 0x60410010)	Yes			
	2	Mapping entry 2	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60640020)	Yes			
	3 to 8	Mapping entry 3 to Mapping entry 8	UDINT	RW	No	0 to 0xFFFFFFF (default: 0)	Yes			

♦ 3rd Transmit PDO Mapping

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
1A02h	0	Number of objects in this PDO	USINT	RW	No	0 to 8 (default: 2)	Yes
	1	Mapping entry 1	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60410010)	Yes
	2	Mapping entry 2	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60640020)	Yes
	3 to 8	Mapping entry 3 to Mapping entry 8	UDINT	RW	No	0 to 0xFFFFFFF (default: 0)	Yes

♦ 4th Transmit PDO Mapping

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of objects in this PDO	USINT	RW	No	0 to 8 (default: 3)	Yes
1A03h	1	Mapping entry 1	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60410010)	Yes
	2	Mapping entry 2	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60640020)	Yes
	3	Mapping entry 3	UDINT	RW	No	0 to 0xFFFFFFF (default: 0x60770010)	Yes
	4 to 8	Mapping entry 4 to Mapping entry 8	UDINT	RW	No	0 to 0xFFFFFFF (default: 0)	Yes

14.4 Sync Manager Communications Objects

Sync Manager Communications Type (1C00h)

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of used Sync Manager channels	USINT	RO	No	4	No
	1	Communication type sync manager 0	USINT	RO	No	1: Mailbox reception (master to slave)	No
1C00h	2	Communication type sync manager 1	USINT	RO	No	2: Mailbox send (slave to master)	No
	3	Communication type sync manager 2	USINT	RO	No	3: Process data output (master to slave)	No
	4	Communication type sync manager 3	USINT	RO	No	4: Process data input (slave to master)	No

Sync Manager PDO Assignment (1C10h to 1C13h)

This object defines which PDOs will be transferred in the process data communications.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
1C10h	0	Sync manager PDO assignment 0	USINT	RO	No	0	No
1C11h	0	Sync manager PDO assignment 1	USINT	RO	No	0	No
	0	Number of assigned PDOs	USINT	RW	No	0 to 2 (default: 1)	Yes
1C12h	1	Index of assigned RxPDO 1	UINT	RW	No	1600h to 1603h (default: 1601h)	Yes
	2	Index of assigned RxPDO 2	UINT	RW	No	1600h to 1603h (default: 1600h)	Yes
	0	Number of assigned PDOs	USINT	RW	No	0 to 2 (default: 1)	Yes
1C13h	1	Index of assigned TxPDO 1	UINT	RW	No	1A00h to 1A03h (default: 1A01h)	Yes
	2	Index of assigned TxPDO 2	UINT	RW	No	1A00h to 1A03h (default: 1A00h)	Yes

Objects 1C12h and 1C13h can be changed when the EtherCAT (CoE) Network Module is in the Pre-Operational state. Set subindex 1 or 2 only after you write 0 to subindex 0.

Sync Manager Synchronization (1C32h and 1C33h)

◆ Sync Manager 2 (Process Data Output) Synchronization

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of synchroni- zation parameters	USINT	RO	No	10	No
	1	Synchronization type	UINT	RO	No	0: Free-Run (DC not used) 2: DC Sync0 (DC used)	No
	2	Cycle time	UDINT	RO	No	Sync0 event cycle [ns]	No
	3	Shift time	UDINT	RO	No	125,000 [ns]	No
1C32h	4	Synchronization types supported	UINT	RO	No	Bit 0 = 1: Free-Run supported Bits 2 to 4 = 001: DC Sync0 supported Bits 5 and 6 = 00: Output shift not supported.	No
	5	Minimum cycle time	UDINT	RO	No	62,500 [ns]	No
	6	Calc and copy time	UDINT	RO	No	62,500 [ns]	No
	7	Reserved	UDINT	RO	No	_	No
	8	Reserved	UINT	RO	No	_	No
	9	Delay time	UDINT	RO	No	0 [ns]	No
	10	Sync0 cycle time	UDINT	RO	No	Same as 1C32h: 02.	No
	11	Reserved	UDINT	RO	No	_	No
	12	SM2 event miss count	UDINT	RO	No		No

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◆ Sync Manager 3 (Process Data Input) Synchronization

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of synchroni- zation parameters	USINT	RO	No	10	No
	1	Synchronization type	UINT	RO	No	Same as 1C32h: 01.	No
	2	Cycle time	UDINT	RO	No	Same as 1C32h: 02.	No
	3	Shift time	UDINT	RW	No	125,000 × n [ns] (n = 1, 2, 3) Range: 0 to (Sync0 event cycle -125,000)	Yes
1C33h	4	Synchronization types supported	UINT	RO	No	Bit 0 = 1: Free-Run supported. Bits 2 to 4 = 001: DC Sync0 supported Bits 5 and 6 = 01: Input shift with local timer supported.	No
	5	Minimum cycle time	UDINT	RO	No	Same as 1C32h: 05.	No
	6	Calc and copy time	UDINT	RO	No	62,500 [ns]	No
	7	Reserved	UDINT	RO	No	_	No
	8	Reserved	UINT	RO	No	_	No
	9	Delay time	UDINT	RO	No	0	No
	10	Sync0 cycle time	UDINT	RO	No	Same as 1C32h: 10.	No

Sync Error Settings (10F1h)

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	USINT	RO	No	2	No
10F1h	1	Reserved	UDINT	RO	No	0	No
	2	Sync error count limit	UDINT	RW	No	0 to 15 (default: 9)	Yes

◆ 0x10F1h: 2 Sync Error Counter Limit

This object defines the allowable number of failures when receiving process data. If the value of the internal error counter in the SERVOPACK exceeds the value of this object, the SERVOPACK will detect an EtherCAT Output Data Synchronization Error (A12h) and change the ESM state to SAFEOP.

The SERVOPACK increments the internal error counter by 3 if the process output data is not updated (i.e., if a reception event does not occur) when the synchronization event (SyncO) occurs. When the process output data is updated normally, the internal error counter is decremented by 1. The internal error counter is reset when the EtherCAT communications state changes from SAFEOP to OP.

An example of internal error counter operation is shown below.

Reception (SM2) event	1	0	1	0	1	0	1	0	1	0	1
SERVOPACK internal error counter (Error Counter Limit = 9)	0	3	2	5	4	7	6	9 (Error)	9	9	9

In this example, a failure in receiving the process data occurs every other DC (Sync0) cycle. After eight DC cycles, the internal error count reaches the Sync Error Count Limit, and an error occurs.

No alarm will be detected if the DC mode is disabled or when the Sync Error Count Limit is set to 0.

If an A12h (EtherCAT Output Data Synchronization Error) alarm occurs, check 1C32h:12(SM2 event miss count) for an estimate of the frequency of reception failures. Use it as reference in setting the *sync error count limit*.

The number of reception failures for process data is given in 1C32h: 12. (This is not an internal error count. The counter is incremented each time there is a failure for one reception.)



- 1. Set a suitable cycle time for updating the process data according to the requirements of the application.
- 2. Determine if the default setting of the Sync Error Counter Limit is suitable for the requirements of the application. With the default value of 9, network frames will be lost (SM2 reception events will not occur) three times consecutively before an alarm occurs in the SERVOPACK. If the setting of the Sync Error Counter Limit is too small, alarms will occur even when there is no problem in the application.
- 3. Noise may cause communications errors. Check the wiring of the SERVOPACK to minimize the affects of noise. Refer to the following sections for details on countermeasures.

4.1.2 Countermeasures against Noise on page 4-6

14.5 Manufacturer-Specific Objects

SERVOPACK Parameters (2000h to 26FFh)

Objects 2000h to 26FFh are mapped to SERVOPACK parameters (PnDDD).

Object index 2DDDh corresponds to PnDDD in the SERVOPACK parameters (e.g., object 2100h is the same as Pn100).

User Parameter Configuration (2700h)

This object enables all user parameter settings and initializes all of the position data.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
2700h	0	User parameter configuration	UDINT	RW	No	0 to 0xFFFFFFF (default: 0)	No

If you change any of the following objects and restart operation without turning the power supply OFF and then ON again, you must execute this object to enable the new settings.

- Objects 2701h, 2702h, and 2703h
- SERVOPACK parameters that require that the power supply be turned OFF and ON again to enable changes to the parameter settings

Procedure

- 1. Change the SERVOPACK to the Switch ON Disabled state.
- 2. Set the new parameter settings.
- 3. Set user parameter configuration (2700h) to 1. The parameter settings will be enabled. After execution, object 2700h will automatically be reset to 0.

Position User Unit (2701h)

This object sets the user-defined position reference unit (Pos. unit).

The user-defined position reference unit is calculated with the following formula.

1 [Pos. unit] = (Numerator/Denominator) [inc]

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	USINT	RO	No	2	No
2701h	1	Numerator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes
	2	Denominator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes

Setting range: 1/4,096 < Numerator/Denominator < 65,536

(Alarm A.A20 will be detected if the setting exceeds the setting range.)

Velocity User Unit (2702h)

This object sets the user-defined speed reference unit (Vel. unit).

The user-defined speed reference unit is calculated with the following formula.

1 [Vel. unit] = (Numerator/Denominator) [inc/sec]

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	USINT	RO	No	2	No
2702h	1	Numerator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes
	2	Denominator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes

Setting range: 1/128 ≤ Numerator/Denominator ≤ 8,388,608

(Alarm A.A20 will be detected if the setting exceeds the setting range.)

Acceleration User Unit (2703h)

This object sets the user-defined acceleration reference unit (Acc. unit).

The user-defined acceleration reference unit is calculated with the following formula.

1 [Acc. unit] = (Numerator/Denominator) \times 10⁴ [inc/sec²]

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	USINT	RO	No	2	No
2703h	1	Numerator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes
	2	Denominator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes

Setting range: 1/128 ≤ Numerator/Denominator ≤ 262,144

(Alarm A.A20 will be detected if the setting exceeds the setting range.)

Torque User Unit (2704h)

This object sets the user-defined torque reference unit (Torque unit).

The user-defined torque reference unit is calculated with the following formula.

1 [Trq. unit] = (Numerator/Denominator) [%]

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	USINT	RO	No	2	No
2704h	1	Numerator	UDINT	RW	No	1 to 1,073,741,823 (default: 1)	Yes
	2	Denominator	UDINT	RW	No	1 to 1,073,741,823 (default: 10)	Yes

Setting range: 1/256 ≤ Numerator/Denominator ≤ 1

(Alarm A.A20 will be detected if the setting exceeds the setting range.)

The objects that are related to user-defined torque reference unit settings are given in the following table. The reference units for the following objects are 0.1%.

EtherCAT(CoE) Communications Object	Data Type
Target torque (6071h)	INT
Torque demand (6074h)	INT
Torque slope (6087h)	UDINT
Torque actual value (6077h)	INT
Max torque (6072h)	UINT
Positive torque limit (60E0h)	UINT
Negative torque limit (60E1h)	UINT
Torque offset (60B2h)	INT

Encoder Selection (2705h)

This object is used to select the encoder resolution.

Index	Subin- dex	Name	Data Type	Access	PDO Mappings	Value	Saving to EEPROM
2705h	0	Encoder Selection	USINT	RW	No	0000h (20 bits), 0001h (24 bits) (default: 0000h)	Yes

SERVOPACK Adjusting Command (2710h)

This object is used for SERVOPACK adjustment services (e.g., encoder setup or multiturn reset). Write data to subindex 1 to start command execution. Also, read the subindex 3 to obtain the response. If you cannot obtain the response by reading subindex 3, the first byte of the response data will give information about the progress of execution.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	USINT	RO	No	3	No
	1	Command	STRING	RW	No	Bytes 0 to n: Service Request Data The command is executed when command data is written.	No
2710h	2	Status	USINT	RO	No	O: Command completed, no errors, and no response data 1: Command completed, no errors, and response data provided 2: Command completed, error, and no response data 3: Command completed, error, response data provided 255: Command is being executed	No
	3	Reply	STRING	RO	No	Byte 0: Subindex 2 Byte 1: Not used 2 to n: Service response data	No

◆ Command/Response Data Format

Com	Command Data (Service Request Data)			
Byte	yte Description			
0	Reserved.			
1	Reserved.			
2	CCMD (command code) 00: Read request 01: Write request			
3	CSIZE (CDATA data byte size)			
4 to 7	CADDRESS (address)			
8 to 15*1	CDATA (writing data)			

^{*1.} This is the size set with CSIZE.

Resp	Response Data (Service Response Data)				
Byte	Description				
0	Status (Same data as subindex 2)				
1	Reserved.				
2	RCMD (echoback of CCMD)				
3	RSIZE (R_DATA data byte size)				
4 to 7	RADDRESS (echoback of CADDRESS)				
8 to 15*2	R_DATA (read data)/ERROCODE				

^{*2.} This is the size set with RSIZE.

◆ Executable Adjustment Services

Adjustment Service	Request Code	Preparation before Execution	Processing Time	Execution Conditions
Absolute Encoder Reset	1008h	Required	5 s max.	If an incremental encoder is used, it is not possible to reset the encoder while the servo is ON.
Autotune Motor Current Detection Signal Offset	100Eh	Not required	5 s max.	Adjustment is disabled in the following cases. • While the main circuit power supply is OFF • While the servo is ON • While the Servomotor is running
Multiturn Limit Setting	1013h	Required	5 s max.	If an incremental encoder is used, the setting is disabled unless a Multiturn Limit Disagreement alarm has occurred.

How to Send a Command for Adjustment

1. Send the following data and set the request code for the adjustment service to execute.

CCMD = 01h

CSIZE = 02h

CADDRESS = 00002000h

CDATA = Request code of the adjustment service to execute*

* Select the request code from the table in *◆ Executable Adjustment Services*.

If the slave station receives the command normally, the status field will be set to 1.

If an error occurs, perform step 4 to stop execution.

2. For an adjustment that requires preparations, send the following data. If preparations before execution are not required, perform step 3.

 $C\dot{C}M\dot{D} = 01h$

CSIZE = 02h

CADDRESS = 00002001h

CDATA = 0002h

If the slave station receives the command normally, the status field will be set to 1.

If an error occurs, perform step 4 to stop execution.

3. Send the following data to execute the adjustment service.

CCMD = 01h

CSIZE = 02h

CADDRESS = 00002001h

CDATA = 0001h

If the slave station receives the command normally, the status field will be set to 1.

If an error occurs, perform step 4 to stop execution.

4. Send the following data to stop execution.

CCMD = 01h

CSIZE = 02h

CADDRESS = 00002000h

CDATA = 0000h

If the slave station receives the command normally, the status field will be set to 1.

Note: If no command is received within 10 seconds after step 1, the adjustment service will be automatically stopped.

Safety Module Monitor (2720h)

This object shows the operating status of the Safety Module.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
2720h	0	Safety module monitor	UDINT	RO	Yes	_	No

◆ Details

Bit	Signal	Description
	Safety Request Input Sig-	0: Safety Request Input Signal A1 is ON. (Operation is normal.)
0	nal A1	1: Safety Request Input Signal A1 is OFF. (Safety Function A is active.)
	Safety Request Input Sig-	0: Safety Request Input Signal A2 is ON. (Operation is normal.)
1	nal A2	1: Safety Request Input Signal A2 is OFF. (Safety Function A is active.)
	Safety Request Input Sig-	0: Safety Request Input Signal B1 is ON. (Operation is normal.)
2	nal B1	1: Safety Request Input Signal B1 is OFF. (Safety Function B is active.)
	Safety Request Input Sig-	0: Safety Request Input Signal B2 is ON. (Operation is normal.)
3	nal B2	1: Safety Request Input Signal B2 is OFF. (Safety Function B is active.)
4	External Device Monitor	0: External Device Monitor Output Signal A is OFF. (Operation is normal or a malfunction occurred in Safety Function A.)
4	Signal A	1: External Device Monitor Output Signal A is ON. (Safety Function A is active.)
5	External Device Monitor	0: External Device Monitor Output Signal B is OFF. (Operation is normal or a malfunction occurred in Safety Function B.)
5	Signal B	1: External Device Monitor Output Signal B is ON. (Safety Function B is active.)
6 and 7	Reserved.	-
8	Safety Function Monitor-	0: –
	ing	1: Monitoring is in progress.
9	Safety Function Safe	0: –
	Odicty i dilotion odic	1: Safe state
10	Safety Function HWBB	0: –
	-	1: Safety BB is active.
12 to 15	Reserved.	-
16	Active Mode State	0: Standby or not selected.
		1: Operating
17 to 31	Reserved.	-

14.6 Device Control

Error Code (603Fh)

This object provides the SERVOPACK alarm/warning code of the last error that occurred.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
603Fh	0	Error code	UINT	RO	Yes	0	No

Controlword (6040h)

This object controls the device and operation mode.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6040h	0	Controlword	UINT	RW	Yes	0 to 0xFFFF (default: 0)	No

Controlword Bits

Bit	Function	Description		
0	Switch on			
1	Enable voltage	Refer to ■ Details on Bits 0 to 3.		
2	Quick stop	neiel to Details off bits of to 5.		
3	Enable operation			
4 to 6	Operation mode specific	Refer to ■ Details on Bits 4 to 9.		
7	Fault reset	0 → 1: Alarm/warning reset.		
8	Halt	Refer to ■ Details on Bits 4 to 9.		
9	Operation mode specific			
10	- (Reserved)	-		
11	Positive torque limit	0: Disables torque limit parameter (object 2404h). 1: Enables torque limit parameter (object 2404h).		
12	Negative torque limit	0: Disables torque limit parameter (object 2405h). 1: Enables torque limit parameter (object 2405h).		
13 to 15	- (Reserved)	-		

■ Details on Bits 0 to 3

• Bits 0 to 3: These bits function as the control command for the Servo Drive's state.

Command	Controlword Bits							
Command	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0			
Shutdown	0	X	1	1	0			
Switch on	0	0	1	1	1			
Switch on + Enable operation	0	1	1	1	1			
Disable voltage	0	X	X	0	X			
Quick stop	0	X	0	1	X			
Disable operation	0	0	1	1	1			
Enable operation	0	1	1	1	1			

■ Details on Bits 4 to 9

• Bits 4, 5, and 9: Profile Position Mode

Bit 9 func- tion: Change Of Set Point.	Bit 5 func- tion: Change Set Immedi- ately.	Bit 4 func- tion: New set- point.	Description		
0	0	0 → 1	Starts the next positioning operation after the current positioning operation is completed (i.e., after the target is reached).		
X	1	0 → 1	Starts the next positioning operation immediately.		
1	0	0 → 1	Continues positioning with the current profile speed up to the current target position and then start the next positioning operation.		

• Bits 6 and 8: Profile Position Mode

Bit	Function	Value	Description	
		0	Treats the target position as an absolute value.	
6	Abs/rel	1	Treats the target position as a relative value. (Treats it as the movement distance from the current target position.)	
0	Halt	0	Executes or continues positioning.	
0	Пан	Пан	1	Stops axis according to halt option code (605Dh).

• Bits 4, 5, 6, 8, and 9: Homing Mode

Bit	Function	Value	Description		
	Homing	0	Does not start homing.		
4	operation start	1	Starts or continues homing.		
5	_	0	Reserved.		
6	_	0	Reserved.		
8	Halt	0	Enables bit 4.		
0	Пан	1	Stops the axis according to halt option code (605Dh).		
9	_	0	Reserved.		

• Bits 4, 5, 6, 8, and 9: Cyclic Synchronous Position, Velocity, or Torque Mode

Bit	Function	Value	Description
4	_	0	Reserved.
5	_	0	Reserved.
6	_	0	Reserved.
8	Halt	0	Executes or continues operation.
0	o nail	1	Stops axis according to halt option code (605Dh).
9	_	0	Reserved.

• Bits 4, 5, 6, 8, and 9: Interpolated Position Mode

Bit	Function	Value	Description		
4	Enable	0	Disables interpolation.		
4	interpolation	1	Enables interpolation.		
5	_	0	Reserved.		
6	_	0	Reserved.		
0	Halt	0	Executes specification for bit 4.		
8	пан	1	Stops the axis according to halt option code (605Dh).		
9	_	0	Reserved.		

• Bits 4, 5, 6, 8, and 9: Profile Velocity/Torque Mode

Bit	Function	Value	Description		
4	_	0	Reserved.		
5	_	0	Reserved.		
6	_	0	Reserved.		
8	Halt	0	Executes or continues operation.		
0	Пан	1	Stops the axis according to halt option code (605Dh).		
9	_	0	Reserved.		

Statusword (6041h)

Statusword contains the bits that give the current state of the Servo Drive and the operating state of the operation mode.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6041h	0	Statusword	UINT	RO	Yes	0	No

◆ Statusword Bits

Bit	State	Description			
0	Ready to switch on				
1	Switched on				
2	Operation enabled				
3	Fault	Refer to ■ Details on Bits 0 to 7.			
4	Voltage enabled	nelei to Details on bits o to 7.			
5	Quick stop				
6	Switch on disabled				
7	Warning				
8	Active mode stop	1: Active mode function execution is in progress.			
9	Remote	Controlword (6040h) is being processed			
10	Operation mode specific	Refer to ■ Details on Bits 10, 12, and 13.			
11	Internal limit active	Refer to ■ Details on Bit 11.			
12, 13	Operation mode specific	Refer to ■ Details on Bits 10, 12, and 13.			
14	Torque limit active	0: Torque limit is disabled. 1: Torque limit is enabled.			
15	Safety active	1: Safety function is active.			

■ Details on Bits 0 to 7

• Bits 0 to 7: Current State of Servo Drive

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Servo Drive State
X	0	X	X	0	0	0	0	Not ready to switch on
X	1	X	Х	0	0	0	0	Switch on disabled
X	0	1	Х	0	0	0	1	Ready to switch on
X	0	1	Х	0	0	1	1	Switched on
X	0	1	Х	0	1	1	1	Operation enabled
X	0	0	Х	0	1	1	1	Quick stop active
X	0	Х	Х	1	1	1	1	Fault reaction active
X	0	X	X	1	0	0	0	Fault
X	Х	Х	1	Х	Х	Х	X	Main power on
1	Х	Х	Х	Х	Х	X	X	Warning occurred

■ Details on Bit 11

• Bit 11: Internal limit active

The internal limit is activated in the following cases:

- The target position was limited by a software limit.
- The N-OT or P-OT signal was activated.
- The interpolation speed was exceeded in Interpolated Position Mode or Cyclic Position Mode.

If the interpolated reference speed exceeds the following speed range, the target position will be ignored.

(Target position – position demand value) × (2701h: 01)/(2701h: 02) < 4,194,304 [inc/ms]

■ Details on Bits 10, 12, and 13

• Bits 10, 12, and 13: Profile Position Mode

Bit	Meaning	Value	Description
10	10 Target reached	0	Halt (bit 8 in controlword) = 0: The target position has not been reached. Halt (bit 8 in controlword) = 1: The axis is decelerating.
		1	Halt (bit 8 in controlword) = 0: The target position was reached. Halt (bit 8 in controlword) = 1: The axis is stopped.
10	12 Set-point acknowledge	0	Processing of previous set point (reference) was completed and Servo Drive is waiting for a new set point.
12		1	Processing the previous set point is still in process or a set point was acknowledged.
10	Following orror	0	No following error has occurred.
13	13 Following error	1	A following error occurred.

• Bits 10, 12, and 13: Homing Mode

Bit 13	Bit 12	Bit 10	
Homing error	Homing attained	Target reached	Description
0	0	0	Homing is in progress.
0	0	1	Homing was interrupted or has not yet started.
0	1	0	Home has been defined, but the operation is still in progress.
0	1	1	Homing was completed normally.
1	0	0	A homing error occurred and the speed is not 0.
1	0	1	A homing error occurred and the speed is 0.

• Bits 10, 12, and 13: Cyclic Synchronous Position, Velocity, or Torque Mode

Bit	State	Value	Description
10	10 Target reached	0	The target (position, speed, or torque) has not been reached (always 0 in Cyclic Torque Mode).
		1	The target (position, speed, or torque) was reached.
	12 Target value ignored	0	The target value (position, speed, or torque) was ignored.
12		1	The target value will be used as the input to the (position, speed, or torque) control loop.
13	13 Following error	0	There is no following error (always 0 in Cyclic Velocity or Torque Mode).
		1	A following error occurred.

• Bits 10, 12, and 13: Interpolated Position Mode

Bit	State	Value	Description
10	Target reached	0	Halt (bit 8 in controlword) = 0: The target position has not been reached. Halt (bit 8 in controlword) = 1: The axis is decelerating.
	-	1	Halt (bit 8 in controlword) = 0: The target position was reached. Halt (bit 8 in controlword) = 1: The axis is stopped.
12	Ip mode	0	Interpolation is disabled.
12	active	1	Interpolation is enabled.
13	_	0	Reserved.

• Bits 10, 12, and 13: Profile Velocity Mode

Bit	State	Value	Description
10	Target reached	0	Halt (bit 8 in controlword) = 0: The target speed has not been reached. Halt (bit 8 in controlword) = 1: The axis is decelerating.
10	10 Target reached	1	Halt (bit 8 in controlword) = 0: The target speed was reached. Halt (bit 8 in controlword) = 1: The axis is stopped.
12	12 Speed		The speed is equal to or exceeds the rotation detection level (2502h).
		1	The speed is below the rotation detection level (2502h).
13	_	0	Reserved.

• Bits 10, 12, and 13: Profile Torque Mode

Bit	State	Value	Description
10	Target reached	0	Halt (bit 8 in controlword) = 0: The target torque has not been reached. Halt (bit 8 in controlword) = 1: The axis is decelerating.
		1	Halt (bit 8 in controlword) = 0: The target torque was reached. Halt (bit 8 in controlword) = 1: The axis is stopped.
12	_	0	Reserved.
13	_	0	Reserved.

Quick Stop Option Code (605Ah)

This object determines what operation will be performed if a Quick Stop is executed.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
605Ah	0	Quick stop option code	INT	RW	No	0 to 3 (default: 2)	Yes

Data Description

Value	Description
0	Disables the Servo Drive (moves to the Switch ON Disabled state).
1	Decelerates at the deceleration rate for decelerating to a stop and moves to the Switch ON Disabled state.*1,*2
2	Decelerates at the deceleration rate for a quick stop and moves to the Switch ON Disabled state.*1,*3
3	Decelerates at the torque limit and moves to the Switch ON Disabled state.*1

^{*1.} The motor is always stopped according to option code 0 (servo OFF stop) in Profile Torque Mode or Cyclic Torque Mode.

• Profile Position, Interpolated Position, Cyclic Position, or Cyclic Velocity Mode: 6084h

^{*2.} The deceleration rate for decelerating to a stop is defined in the following object.

[•] Homing Mode: 609Ah

^{*3.} Quick stop deceleration (6085h) is the deceleration rate for a quick stop.

Shutdown Option Code (605Bh)

This object defines the operation that is performed if there is a move from Operation Enable state to Ready to Switch ON state.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
605Bh	0	Shutdown option code	INT	RW	No	0 to 1 (default: 0)	Yes

◆ Data Description

Value	Description
0	Disables the Servo Drive (moves to the Switch ON Disabled state).
1	Decelerates at the deceleration rate for decelerating to a stop and moves to the Switch ON Disabled state. *1, *2

^{*1.} The motor is always stopped according to option code 0 (servo OFF stop) in Profile Torque Mode or Cyclic Torque Mode.

Profile Position, Interpolated Position, Cyclic Position, or Cyclic Velocity Mode: 6084h

Disable Operation Option Code (605Ch)

This object defines the operation that is performed if there is a move from Operation Enable state to Switched ON state.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
605Ch	0	Disable operation option code	INT	RW	No	0 to 1 (default: 1)	Yes

◆ Data Description

Value	Description
0	Disables the Servo Drive (moves to the Switch ON Disabled state).
1	Decelerates at the deceleration rate for decelerating to a stop and moves to the Switch ON Disabled state.*1,*2

^{*1.} The motor is always stopped according to option code 0 (servo OFF stop) in Profile Torque Mode or Cyclic Torque Mode.

• Profile Position, Interpolated Position, Cyclic Position, or Cyclic Velocity Mode: 6084h

Halt Option Code (605Dh)

This object defines the operation that is performed if bit 8 (Halt) in controlword is active.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
605Dh	0	Halt option code	INT	RW	No	0 to 3 (default: 1)	Yes

◆ Data Description

Value	Description
1	Decelerates at the deceleration rate for decelerating to a stop and moves to the Operation Enabled state.*1,*2
2	Decelerates at the deceleration rate for a quick stop and moves to the Operation Enabled state.*1,*3
3	Decelerates at the torque limit and moves to the Operation Enabled state.*1

^{*1.} If bit 8 (Halt) is 1 in Profile Torque Mode or Cyclic Torque Mode, the torque reference value is reduced to zero.

Profile Position, Interpolated Position, Cyclic Position, or Cyclic Velocity Mode: 6084h

^{*2.} The deceleration rate for decelerating to a stop is defined in the following object.

[·] Homing Mode: 609Ah

^{*2.} The deceleration rate for decelerating to a stop is defined in the following object.

Homing Mode: 609Ah

^{*2.} The deceleration rate for decelerating to a stop is defined in the following object.

[•] Homing Mode: 609Ah

^{*3.} Quick stop deceleration (6085h) is the deceleration rate for a quick stop.

Fault Reaction Option Code (605Eh)

This object defines the operation that is performed when an alarm is detected in the Servo Drive system.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
605Eh	0	Fault reaction option code	INT	RW	No	0	Yes

◆ Data Description

Value	Description
0	Disables the Servo Drive. (Turns OFF the servo.)

Modes of Operation (6060h)

This object is used to select the operation mode. The Servo Drive gives the actual operation mode in the *modes of operation display* object.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6060h	0	Modes of operation	SINT	RW	Yes	0 to 10 (default: 0)	Yes

◆ Data Description

Value	Description
0	There is no mode change or no mode assigned.
1	Profile Position Mode
2	Reserved (continue previous mode).
3	Profile Velocity Mode
4	Torque Profile mode
6	Homing Mode
7	Interpolated Position Mode
8	Cyclic Sync Position Mode
9	Cyclic Sync Velocity Mode
10	Cyclic Sync Torque Mode
Other value	Reserved (continue previous mode).

Modes of Operation Display (6061h)

This object gives the current mode of operation.

The values that are returned are the same as the object codes for modes of operation (6060h).

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6061h	0	Modes of operation display	SINT	RO	Yes	-	No

Supported Drive Modes (6502h)

This object gives the operation modes that are supported by the device.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6502h	0	Supported drive modes	UDINT	RO	No	03EDh	No

◆ Data Description

Bit	Applicable Mode	Definition
0	Pp (Profile position mode)	1: Supported.
1	VI (Velocity mode)	0: Not supported.
2	Pv (Profile velocity mode)	1: Supported.
3	Tq (Torque profile mode)	1: Supported.
4	Reserved.	0
5	Hm (Homing mode)	1: Supported.
6	Ip (Interpolated position mode)	1: Supported.
7	Csp (Cyclic sync position mode)	1: Supported.
8	Csv (Cyclic sync velocity mode)	1: Supported.
9	Cst (Cyclic sync torque mode)	1: Supported.
10 to 31	Reserved.	0

4.7 Profile Position Mode

Target Position (607Ah)

This object contains the target position for the Profile Position Mode or Cyclic Synchronous Position Mode.

In Profile Position Mode, the value of this object is interpreted as either an absolute or relative value depending on the Abs/Rel Flag in controlword. In Cyclic Synchronous Position Mode, the value is always interpreted as an absolute value.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
607Ah	0	Target position	DINT	RW	Yes	-2,147,483,648 to 2,147,483,647 (default: 0) [Pos. unit]	No

Software Position Limits (607Dh)

This object defines the absolute positions of the limits to the target position (position demand value). Every target position is checked against these limits.

The limit positions are specified in user-defined position reference units, the same as for target positions, and are always relative to the machine home position.

The limit values are corrected internally for the home offset as given below. The target positions are compared with the corrected values.

- Corrected minimum position limit = Min position limit Home offset (607Ch)
- Corrected maximum position limit = Max position limit Home offset (607Ch)

The software position limits are enabled at the following times:

- When homing is completed
- · When an absolute encoder is connected

The software limits are disabled if they are set as follows:

Min position limit ≥ Max position limit

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
607Dh	0	Number of entries	USINT	RO	No	2	No
	1	Min position limit	DINT	RW	No	-536,870,912 to 536,870,911 (default: 0) [Pos. unit]	Yes
	2	Max position limit	DINT	RW	No	-536,870,912 to 536,870,911 (default: 0) [Pos. unit]	Yes

Max Profile Velocity (607Fh)

This object contains the maximum speed during a Profile Mode operation.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
607Fh	0	Max profile velocity	UDINT	RW	Yes	0 to 4,294,967,295 (default: 2,147,483,647) [Vel. unit]	Yes

Profile Velocity (6081h)

This object contains the final movement speed at the end of acceleration for a Profile Mode operation.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6081h	0	Profile velocity	UDINT	RW	Yes	0 to 4,294,967,295 (default: 0) [Vel. unit]	Yes

Profile Acceleration (6083h)

This object specifies the acceleration rate for Profile Mode operations.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6083h	0	Profile acceleration	UDINT	RW	Yes	0 to 4,294,967,295 (default: 1,000) [Acc. unit]	Yes

Profile Deceleration (6084h)

This object specifies the deceleration rate for Profile Mode operations.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6084h	0	Profile deceleration	UDINT	RW	Yes	0 to 4,294,967,295 (default: 1,000) [Acc. unit]	Yes

Quick Stop Deceleration (6085h)

This object contains the deceleration rate that is used to stop the motor if the *quick stop option* code (605Ah) is set to 2 and the Quick Stop command is given.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6085h	0	Quick stop deceleration	UDINT	RW	Yes	0 to 4,294,967,295 (default: 1,000) [Acc. unit]	Yes

4.8 Homing Mode

Home Offset (607Ch)

This object contains the offset between the zero position for the application and the machine home position (found during homing).

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
607Ch	0	Home offset	DINT	RW	No	-536,870,912 to 536,870,911 (default: 0) [Pos. unit]	Yes

Incremental Encoder

The machine home position is found during homing. After homing is completed, the zero position is offset from the home position by adding the home offset to the home position.

Absolute Encoder

If an absolute encoder is connected to the SERVOPACK, the home offset is added to the encoder absolute position when the power supply to the SERVOPACK is turned ON.



Homing Method (6098h)

This object specifies the homing method. Refer to the following section for details on the operations that are performed.

13.4 Homing on page 13-14

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6098h	0	Homing method	SINT	RW	Yes	0 to 35 (default: 35)	No

Data Description

Value (Method)	Description
0	Homing is disabled.
1	Homing with the negative limit switch and index pulse
2	Homing with the positive limit switch and index pulse
7 to 14	Homing with the home switch and index pulse
24	Homing with the home switch
28	Homing with the home switch
33 or 34	Homing with the index pulse
35	Homing with the current position

Homing Speeds (6099h)

This object defines the speeds that are used during homing. The speeds are given in user speed reference units.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6099h	0	Number of entries	USINT	RO	No	2	No
	1	Speed during search for switch	UDINT	RW	Yes	0 to 4,294,967,295 (default: 500,000) [Vel. unit]	Yes
	2	Speed during search for zero	UDINT	RW	Yes	0 to 4,294,967,295 (default: 100,000) [Vel. unit]	Yes

Homing Acceleration (609Ah)

This object defines the acceleration that is used during homing. The rate is given in user acceleration reference units.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
609Ah	0	Homing acceleration	UDINT	RW	Yes	0 to 4,294,967,295 (default: 1,000) [Acc. unit]	Yes

14.9

Position Control Function

Position Demand Value (6062h)

This object specifies the current reference position in user position reference units.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6062h	0	Position demand value	DINT	RO	Yes	- [Pos. unit]	No

Position Actual Internal Value (6063h)

This object gives the current feedback position in encoder pulse units.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6063h	0	Position actual internal value	DINT	RO	Yes	- [inc]	No

Position Actual Value (6064h)

This object gives the current feedback position in user position reference units.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6064h	0	Position actual value	DINT	RO	Yes	- [Pos. unit]	No

Position Demand Internal Value (60FCh)

This object gives the output of the trajectory generator during position control (the position that is input to the position loop). The value is given in encoder pulses.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60FCh	0	Position demand internal value	DINT	RO	Yes	- [inc]	No

Following Error Window (6065h)

This object defines the detection range for the following error (bit 13 of statusword).

If the position deviation exceeds the *following error window* for the *following error time out* (6066h), bit 13 in *statusword* changes to 1 to indicate following error. A following error can occur when the Servo Drive is blocked, when the profile speed is too high, or when the gain settings are not correct.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6065h	0	Following error window	UDINT	RW	No	0 to 1,073,741,823 (default: 5,242,880) [Pos. unit]	Yes

Following Error Time Out (6066h)

If the position deviation exceeds the *following error window* for the time specified in this object, bit 13 in *statusword* changes to 1 to indicate following error.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6066h	0	Following error time out	UINT	RW	No	0 to 65,535 (default: 0) [ms]	Yes

Following Error Actual Value (60F4h)

This object provides the current following error.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60F4h	0	Following error actual value	DINT	RO	Yes	- [Pos. unit]	No

Position Window (6067h)

This object defines the positioning completed width for the target position. When the Servo Drive has completed outputting the reference to the target position and the time specified in *position window time* (6068h) has passed after the distance between the target position and the *position actual value* is within the value of this object, bit 10 (*target reached*) in *statusword* changes to 1.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6067h	0	Position window	UDINT	RW	No	0 to 1,073,741,823 (default: 30) [Pos. unit]	Yes

Position Window Time (6068h)

When the Servo Drive has completed outputting the reference to the target position and the time specified in this object has passed after the distance between the target position and the position actual value is within the position window (6067h), bit 10 (target reached) in statusword changes to 1.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6068h	0	Position window time	UINT	RW	No	0 to 65,535 (default: 0) [ms]	Yes

14.10 Interpolated Position Mode

Interpolation Submode Select (60C0h) (Object Shared by Mode 1 and Mode 2)

This object is used to select the submode for the Interpolated Position Mode. To use Interpolated Position Mode, set this object first.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60C0h	0	Interpolation sub mode select	INT	RW	No	-3 to 0 (default: 0)	No

Data Description

Value (Method)	Des	scription	
0	Selects mode 1 with no position reference filter.	Interpolation data record (60C1h) is used as	
-1	Selects mode 1 with a position reference filter.*	the interpolation position reference.	
-2	Selects mode 2 with no position reference filter.	Interpolation data record for 1st profile (27C0h) and interpolation data record for 2nd	
-3	Selects mode 2 with a position reference filter.*	profile (27C1h) are used as the interpolation position references.	

^{*} If a reference filter is used, the moving average of the interpolation position over the interpolation time period (60C2h) is used.

Interpolation Data Record (60C1h) (Object Shared by Mode 1 and Mode 2)

This object gives the interpolation position reference for Interpolated Position Mode.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	USINT	RO	No	1	No
60C1h	1	Interpolation data record	DINT	RW	Yes	-2,147,483,648 to 2,147,483,647 (default: 0) [Pos. unit]	No

Interpolation Time Period (60C2h) (Object Shared by Mode 1 and Mode 2)

This object defines the interpolated position reference period for Interpolation Position Mode. If DC Sync0 Mode is selected, the interpolation time period is automatically stored as the Sync0 Cycle Time. If DC Free-Run Mode is selected, set the object manually.

In	dex	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60C2h	0	Number of entries	USINT	RO	No	2	No	
	1	Interpolation time period	USINT	RW	No	1 to 250 (default:125)	No	
	2	Interpolation time index	SINT	RW	No	-6 to -3 (default: -3)	No	

Interpolation time = (Interpolation time period (60C2h: 01)) × 10^{Interpolation time index (60C2h: 02)} [s]

Note: You can change this object only under the following conditions.

• When DC Sync0 Mode Is Selected:

EtherCAT (CoE) is in the Switch ON Disable state.

• When DC Free-run Mode Is Selected:

EtherCAT (CoE) is in the Switch ON Disable state.

Or, EtherCAT (CoE) is in Interpolated Position Mode and enable interpolation equals 0.

Manufacturer Interpolation Data Configuration for 1st Profile (2730h) (Mode 2 Object)

This object sets how to use the interpolation position reference in *interpolation data record for 1st profile* (27C0h).

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	USINT	RO	No	9	No
	1	Maximum buffer size	UDINT	RO	No	254	No
	2	Actual buffer size	UDINT	RW	No	254	No
	3	Buffer organization	USINT	RW	No	0 or 1 (default: 0)	No
	4	Buffer position	UINT	RW	Yes	1 to 255 (default: 1)	No
	5	Size of data record	USINT	WO	No	1	No
2730h	6	Buffer clear	USINT	WO	No	0 or 1 (default: 0)	No
	7	Position data definition	USINT	RW	Yes	0 or 1 (default: 1)	No
	8	Position data polarity	USINT	RW	Yes	0 or 1 (default: 0)	No
	9	Behavior after reaching buffer position	USINT	RW	Yes	0 or 1 (default: 0)	No

◆ 2730h: 3 Buffer Organization

Value (Method)	Description
0	Uses the reference input buffer as a FIFO buffer.
1	Uses the reference input buffer is as a ring buffer.

Note: Do not change this value while enable interpolation (6040h bit 4) is 1.

2730h: 4 Buffer Position

The object contains the entry point for the available area in the reference input buffer.

Note: Do not change this value while enable interpolation (6040h bit 4) is 1.

◆ 2730h: 6 Buffer Clear

Value (Method)	Description
0	Disables the reference input buffer.
1	Enables the reference input buffer.

◆ 2730h: 7 Position Data Definition

Value (Method)	Description
0	Uses the value in the reference input buffer as an absolute value.
1	Uses the value in the reference input buffer as a relative value.

To enable changing this value, set the write pointer (2741h: 2) and the read pointer (2741h: 1) to the same value.

◆ 2730h: 8 Position Data Polarity

Value (Method)	Description
0	Multiplies the value in the reference input buffer by 1.
1	Multiplies the value in the reference input buffer by -1.

This value is valid when position data definition (2730h: 7) is 1.

To enable changing this value, set the write pointer (2741h: 2) and the read pointer (2741h: 1) to the same value.

◆ 2730h: 9 Behavior after Reaching Buffer Position

Value (Method)	Description					
0	Holds the value of the read pointer (2741h: 1) when the read pointer (2741h: 1) equals the write pointer (2741h: 2) and <i>enable interpolation</i> is 0.					
1	Initializes the value of the read pointer (2741h: 1) when the read pointer (2741h: 1) equals the write pointer (2741h: 2) and <i>enable interpolation</i> is 0.					

This value is valid when buffer organization (2731h: 3) is 0.

Manufacturer Interpolation Data Configuration for 2nd Profile (2731h) (Mode 2 Object)

This object sets how to use the interpolation position reference in *interpolation data record for 2nd profile* (27C1h).

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	USINT	RO	No	9	No
	1	Maximum buffer size	UDINT	RO	No	254	No
	2	Actual buffer size	UDINT	RW	No	254	No
	3	Buffer organization	USINT	RW	No	0 or 1 (default: 0)	No
	4	Buffer position	UINT	RW	Yes	1 to 255 (default: 1)	No
	5	Size of data record	USINT	WO	No	1	No
2731h	6	Buffer clear	USINT	WO	No	0 or 1 (default: 0)	No
	7	Position data definition	USINT	RW	Yes	0 or 1 (default: 0)	No
	8	Position data polarity	USINT	RW	Yes	0 or 1 (default: 0)	No
	9	Behavior after reaching buffer position	USINT	RW	Yes	0 or 1 (default: 0)	No

◆ 2731h: 3 Buffer Organization

Value (Method)	Description
0	Uses the reference input buffer as a FIFO buffer.
1	Uses the reference input buffer is as a ring buffer.

Note: Do not change this value while enable interpolation (6040h bit 4) is 1.

◆ 2731h: 4 Buffer Position

This object contains the entry point for the available area in the reference input buffer.

Note: Do not change this value while enable interpolation (6040h bit 4) is 1.

◆ 2731h: 6 Buffer Clear

Value (Method)	Description
0	Disables the reference input buffer.
1	Enables the reference input buffer.

◆ 2731h: 7 Position Data Definition

Value (Method)	Description
0	Uses the value in the reference input buffer as an absolute value.
1	Uses the value in the reference input buffer as a relative value.

To enable changing this value, set the write pointer (2741h: 2) and the read pointer (2741h: 1) to the same value.

◆ 2731h: 8 Position Data Polarity

Value (Method)	Description
0	Multiplies the value in the reference input buffer by 1.
1	Multiplies the value in the reference input buffer by -1.

This value is valid when position data definition (2731h: 7) is 1.

To enable changing this value, set the write pointer (2741h: 2) and the read pointer (2741h: 1) to the same value.

◆ 2731h: 9 Behavior after Reaching Buffer Position

Value (Method)	Description
0	Holds the value of the read pointer (2741h: 1) when the read pointer (2741h: 1) equals the write pointer (2741h: 2) and <i>enable interpolation</i> is 0.
1	Initializes the value of the read pointer (2741h: 1) when the read pointer (2741h: 1) equals the write pointer (2741h: 2) and <i>enable interpolation</i> is 0.

This value is valid when buffer organization (2731h: 3) is 0.

Interpolation Profile Select (2732h) (Mode 2 Object)

This object is used to select the type of interpolation profile to use.

Change the interpolation profile only after execution of the current profile has been completed. You can change the object when *enable interpolation* (6040h bit 4) is 0.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
2732h	0	Interpolation profile select	USINT	RW	Yes	0 or 1 (default: 0)	No

Data Description

Value (Method)	Description
0	Uses the 1st profile. (interpolation data record for 1st profile (27C0h) and manufacturer interpolation data configuration for 1st profile (2730h) are enabled.)
1	Uses the 2nd profile. (interpolation data record for 2nd profile (27C1h) and manufacturer interpolation data configuration for 2nd profile (2731h) are enabled.)

Note: Do not change this value while enable interpolation (6040h bit 4) is 1.

Interpolation Data Record for 1st Profile (27C0h) (Mode 2 Object)

This object is used to set the interpolation position reference for the 1st profile in Buffer Strategies for the Interpolated Position Mode.

Set this object only after setting all of the items in *manufacturer interpolation data configuration* for 1st profile (2730h).

After you set this object, set enable interpolation (6040h bit 4) to 1.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	DINT	RO	No	254	No
27C0h	1 to 254	1st set point to 254th set point	DINT	RW	No	-2,147,483,648 to 2,147,483,647 (default:0)	No

Interpolation Data Record for 2nd Profile (27C1h) (Mode 2 Object)

This object is used to set the interpolation position reference for the 2nd profile in Buffer Strategies for the Interpolated Position Mode.

Set this object only after setting all of the items in *manufacturer interpolation data configuration* for 2nd profile (2731h).

After you set this object, set enable interpolation (6040h bit 4) to 1.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	DINT	RO	No	254	No
27C1h	1 to 254	1st set point to 254th set point	DINT	RW	No	-2,147,483,648 to 2,147,483,647 (default:0)	No

Interpolation Data Read/Write Pointer Position Monitor (2741h) (Mode 2 Object)

This object gives the current values of the read and write pointers for the reference input buffers in the EtherCAT (CoE) Network Module.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
2741h	0	Number of entries	UINT	RO	No	2	No
	1	Interpolation data read pointer position	UINT	RO	Yes	1 to 254	No
	2	Interpolation data write pointer position	UINT	RO	Yes	1 to 254	No

◆ 2741h: 1 Interpolation Data Read Pointer Position

This object gives the current value of the read pointer for the reference input buffer in the Ether-CAT (CoE) Network Module.

◆ 2741h: 2 Interpolation Data Write Pointer Position

This object gives the current value of the write pointer for the reference input buffer in the EtherCAT (CoE) Network Module.

14.11

Cyclic Synchronous Position Mode

Velocity Offset (60B1h)

In Cyclic Synchronous Position Mode, this object contains the speed feedforward value.

In Cyclic Synchronous Velocity Mode, this object contains the offset value to add to the speed reference.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60B1h	0	Velocity offset	DINT	RW	Yes	-2,147,483,648 to 2,147,483,647 (default: 0) [Vel. unit]	No

Torque Offset (60B2h)

In Cyclic Synchronous Position Mode or Cyclic Synchronous Velocity Mode, this object contains the torque feedforward value. In Cyclic Synchronous Torque Mode, this object contains the offset value to add to the torque reference.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60B2h	0	Torque offset	INT	RW	Yes	-32,768 to 32,767 (default: 0) [Trq. unit]	No

14.12 Profile Velocity/Cyclic Synchronous Velocity Mode

Velocity Demand Value (606Bh)

This object contains the output value from the velocity trajectory generator or the output value from the position control function (i.e., the input reference for the speed loop).

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
606Bh	0	Velocity demand value	DINT	RO	Yes	– [Vel. unit]	No

Velocity Actual Value (606Ch)

This object contains the motor speed.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
606Ch	0	Velocity actual value	DINT	RO	Yes	– [Vel. unit]	No

Velocity Window (606Dh)

This object sets the speed coincidence detection width.

When the time specified in velocity window time (606Eh) has passed after the difference between the target speed (target velocity) and the velocity actual value is within the setting of the velocity window, bit 10 (target reached) in statusword is set to 1.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
606Dh	0	Velocity window	UINT	RW	No	0 to 65,535 (default: 20,000) [Vel. unit]	Yes

Velocity Window Time (606Eh)

When the time specified in velocity window time (606Eh) has passed after the difference between the target speed (target velocity) and the velocity actual value is within the setting of the velocity window, bit 10 (target reached) in statusword is set to 1.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
606Eh	0	Velocity window time	UINT	RW	No	0 to 65,535 (default: 0) [ms]	Yes

Target Velocity (60FFh)

This object specifies the target speed for Profile Velocity Mode or Cyclic Synchronous Velocity Mode in user defined speed reference units.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60FFh	0	Target velocity	DINT	RW	Yes	-2,147,483,648 to 2,147,483,647 (default: 0) [Vel. unit]	No

14.13 Profile Torque/Cyclic Synchronous Torque Mode

Target Torque (6071h)

This object specifies the input torque reference value for Torque Control Mode in user-defined torque reference units.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6071h	0	Target torque	INT	RW	Yes	-32,768 to 32,767 (default: 0) [Trq. unit]	No

Torque Demand Value (6074h)

This object gives the currently output torque reference value in user-defined torque reference units.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6074h	0	Torque demand value	INT	RO	Yes	– [Trq. unit]	No

Torque Slope (6087h)

This object sets the torque output slope to use in Profile Torque Mode. Set the value as the rate of change per second in user-defined torque reference units per second.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6087h	0	Torque slope	UDINT	RW	Yes	0 to 4,294,967,295 (default:1,000) [Trq. unit/s]	Yes

Motor Rated Torque (6076h)

This object gives the motor rated torque (rated force for a Linear Servomotor). The value is given in m Nm for a Rotary Servomotor, and in m N for a Linear Servomotor.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6076h	0	Motor rated torque	UDINT	RO	No	– [mNm] or [mN]	No

Torque Actual Value (6077h)

For a SERVOPACK, this object contains the same value as the torque reference output value.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6077h	0	Torque actual value	INT	RO	Yes	– [Trq. unit]	No

14.14 Torque Limit Function

Max Torque (6072h)

This object sets the maximum output torque for the motor in user-defined torque reference

The maximum motor torque is automatically set in this object in units of 0.1% of the motor rated torque when the power is turned ON.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
6072h	0	Max torque	UINT	RW	Yes	0 to 65,535 (default: maximum motor torque) [Trq. unit]	No

Positive Torque Limit Value (60E0h)

This object sets the positive torque limit in user-defined torque reference units.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60E0h	0	Positive torque limit value	UINT	RW	Yes	0 to 65,535 (default: 8,000) [Trq. unit]	Yes

Negative Torque Limit Value (60E1h)

This object sets the negative torque limit in user-defined torque reference units.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	EEPROM
60E1h	0	Negative torque limit value	UINT	RW	Yes	0 to 65,535 (default: 8,000) [Trq. unit]	Yes

14.15 Touch Probe Function

Touch Probe Function (60B8h)

This object sets the touch probes.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60B8h	0	Touch probe function	UINT	RW	Yes	0 to 0xFFFF (default: 0)	No

Data Description

Bit	Value	Description
0	0	Disables touch probe 1.
U	1	Enables touch probe 1.
	0	Single Trigger Mode (Latches the position at the first trigger event.)
1	1	Continuous Trigger Mode (Latches the position every trigger event.)
2	0	Triggers on probe 1 input (SERVOPACK CN1/Probe 1 (SI4) signal).
2	1	Triggers on encoder zero signal (phase C).
3	-	Reserved.
4	0	Stops sampling at touch probe 1.
4	1	Starts sampling at touch probe 1
5 to 7	-	Reserved.
8	0	Disables touch probe 2.
0	1	Enables touch probe 2.
9	0	Single Trigger Mode (Latches the position at the first trigger event.)
9	1	Continuous Trigger Mode (Latches the position every trigger event.)
10	0	Triggers on probe 2 input (SERVOPACK CN1/Probe 2 (SI5) signal).
10	1	Reserved.
11	_	Reserved.
12	0	Stops sampling at touch probe 2.
12	1	Starts sampling at touch probe 2
13 to 15	_	Reserved.

Note: 1. Bits 0 to 7: For touch probe 1. Bits 8 to 15: For touch probe 2.

Touch Probe Status (60B9h)

This object gives the status of the touch probes.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60B9h	0	Touch probe status	UINT	RO	Yes	_	No

^{2.} Touch probe 1 cannot be used during execution of homing. If touch probe 1 was already enabled, it will be disabled when homing is started.

^{3.} If 1 is specified for bit 1 (i.e., if Continuous Trigger Mode is set), the setting of bit 2 (Trigger Selection Signal) will be read each time the latch is started. To continuously latch with the same trigger signal, do not change the status of bit 2.

◆ Data Description

Bit	Value	Description					
0	0	Touch probe 1 is disabled.					
U	1	Touch probe 1 is enabled.					
	0	No latched position is stored for touch probe 1.					
ı	1	A latch position is stored for touch probe 1.					
2 to 6	-	Reserved.					
7	0 or 1	Saving the latched position for Continuous Trigger Mode for touch probe 1 was completed. * (Status toggles every time a position is latched.)					
8	0	Touch probe 2 is disabled.					
0	1	Touch probe 2 is enabled.					
9	0	No latched position is stored for touch probe 2.					
9	1	A latch position is stored for touch probe 2.					
10 to 14	-	Reserved.					
15	1	Saving the latched position for Continuous Trigger Mode for touch probe 2 was completed.* (Status toggles every time a position is latched.)					

^{*} If the continuous latch is enabled (60B8h bit 1 = 1 or bit 9 = 1), bit 7 or bit 15 of object 60B9h is toggled every time the latched position is updated.

Touch Probe 1 Position Value (60BAh)

This object gives the latched position for touch probe 1. The value is given in user position units (Pos. unit).

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60BAh	0	Touch probe 1 position value	DINT	RO	Yes	– [Pos. unit]	No

Touch Probe 2 Position Value (60BCh)

This object gives the latched position for touch probe 2. The value is given in user position units (Pos. unit).

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60BCh	0	Touch probe 2 position value	DINT	RO	Yes	- [Pos. unit]	No

14.16 Digital Inputs/Outputs

Digital Inputs (60FDh)

This object gives the status of the digital inputs to CN1 on the SERVOPACK.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60FDh	0	Digital inputs	UDINT	RO	Yes	_	No

◆ Data Description

Bit	Signal	Description
0	N-OT: Negative limit switch	0: OFF, 1: ON
1	P-OT: Positive limit switch	0: OFF, 1: ON
2	Home switch	0: OFF, 1: ON
3 to 15	-	Reserved.
16	SIO	0: OFF (open), 1: ON (closed)
17	SI1	0: OFF (open), 1: ON (closed)
18	SI2	0: OFF (open), 1: ON (closed)
19	SI3	0: OFF (open), 1: ON (closed)
20	SI4	0: OFF (open), 1: ON (closed)
21	SI5	0: OFF (open), 1: ON (closed)
22	SI6	0: OFF (open), 1: ON (closed)
23	-	Reserved.
24	HWBB1	Hardwired base block signal input 1 (0: Open, 1: Closed)
25	HWBB2	Hardwired base block signal input 2 (0: Open, 1: Closed)
26 to 31	_	Reserved.

Digital Outputs (60FEh)

This object controls the status of the general-purpose output signals (SO1 to SO3) from CN1 on the SERVOPACK.

Subindex 1 is used to control the status of the output signals. Subindex 2 determines which output signals in subindex 1 are enabled.

If SERVOPACK status outputs are assigned in objects 250Eh, 250Fh, and 2510h, the status will be output using ORs with the settings in this object. If any of these signals (SO1 to SO3) are assigned to functions that are enabled with objects 250Eh, 250Fh, or 2510h, use the Bit Masks in subindex 2 to disable the corresponding signals so that the signals are not duplicated.

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
60FEh	0	Number of entries	USINT	RO	No	2	No
	1	Physical outputs*1	UDINT	RW	Yes	0 to 0xFFFFFFF (default: 0)	No
	2	Bit mask*2	UDINT	RW	No	0 to 0xFFFFFFFF (default: 0x000C0000)	Yes

^{*1.} Data Description of Physical Outputs:

Bit	Signal	Description
0 to 16	_	Reserved.
17	SO1	0: OFF, 1: ON
18	SO2	0: OFF, 1: ON
19	SO3	0: OFF, 1: ON
20 to 31	-	Reserved.

*2. Data Description of Bit Masks:

Bit	Signal	Description
0 to 16	-	Reserved.
17	SO1	0: Disables physical output. 1: Enables physical output.
18	SO2	0: Disables physical output. 1: Enables physical output.
19	SO3	0: Disables physical output. 1: Enables physical output.
20 to 31	-	Reserved.

14.17 Dual Encoder Feedback

You can monitor the position of the external encoder in dual encoder feedback (60E4h).

Index	Subin- dex	Name	Data Type	Access	PDO Mapping	Value	Saving to EEPROM
	0	Number of entries	USINT	RO	No	1	No
60E4h	1	External encoder position	DINT	RO	Yes	(Default: 0)	Yes

Maintenance

This chapter provides information on the meaning of, causes of, and corrections for alarms and warnings. In this chapter, the object index number ($2\square\square\square$ h) for EtherCAT communications is given after the SERVOPACK parameter number ($Pn\square\square\square$)

15.1	Inspe	ctions and Part Replacement 15-2
	15.1.1 15.1.2 15.1.3	Inspections
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	15.2.1 15.2.2 15.2.3 15.2.4 15.2.5 15.2.6	List of Alarms
15.3	Warni	ng Displays 15-46
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15.4	Troublesho	pooting Based on the Operation and Conditions of the Servomotor 15-53

15.1.1 Inspections

15.1 Inspections and Part Replacement

This section describes inspections and part replacement for SERVOPACKs.

15.1.1 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	A414	Check for dust, dirt, and oil on the surfaces.	Clean with compressed air or a cloth.
Loose Screws	At least once a year	Check for loose terminal block and connector screws and for other loose parts.	Tighten any loose screws or other loose parts.

15.1.2 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.
 9.4 Monitoring Product Life on page 9-13
- Use the following table.

Part	Standard Replace- ment Period	Remarks
Cooling Fan	4 to 5 years	The standard replacement periods given on the left are for
Electrolytic Capacitor	10 years	 the following operating conditions. Surrounding air temperature: Annual average of 30°C Load factor: 80% max. Operation rate: 20 hours/day max.
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.

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15.1.3 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 Replacement Procedure on page 15-3

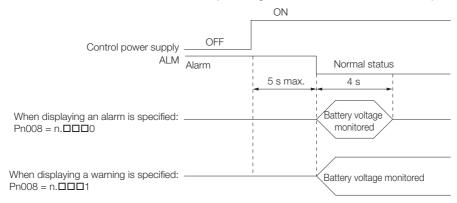
Battery Alarm/Warning Selection

Whether to display an alarm or a warning is determined by the setting of $Pn008 = n.\Box\Box\Box X$ (Low Battery Voltage Alarm/Warning Selection).

Parameter		Meaning	When Enabled	Classification
Pn008 (2008h)	n.□□□0 (default setting)	Output alarm (A.830) for low battery voltage.	After restart	Setup
(200611)	n.□□□1	Output warning (A.930) for low battery voltage.		

- $Pn008 = n. \square \square \square \square 0$
- 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.

15.1.3 Replacing the Battery

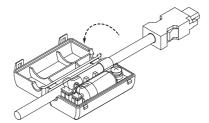
◆ When Using an Encoder Cable with a Battery Case

1. Turn ON only the control power supply to the SERVOPACK.

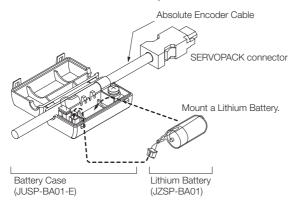


If you remove the Battery or disconnect the Encoder Cable while the control power supply to the SERVOPACK is OFF, the absolute encoder data will be lost.

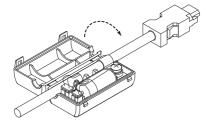
2. Open the cover of the Battery Case.



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.

15

15.2 Alarm Displays

If an error occurs in the SERVOPACK, an alarm number will be displayed on the panel display. However, if □□-□□ appears on the panel display, the display will indicate a SERVOPACK system error. Replace the SERVOPACK.

Panel display on SERVOPACK	If there is an alarm, the code will be displayed one character at a time, as shown below. Example: Alarm A.020 Status display Not lit.
Digital Operator	The alarm code will be displayed.
Statusword (6041h)	Bit 3 (<i>fault</i>) in the <i>statusword</i> will change to 1. (Bit 3 is 0 during normal operation.)
Error Code (603Fh)	A current alarm code is stored in object 603Fh.
Emergency message	The Controller is notified of any alarm that occurs. (Notification may not be possible if EtherCAT communications are unstable.)

This section provides a list of the alarms that may occur and the causes of and corrections for those alarms.

15.2.1 **List of Alarms**

The following alarm tables gives the alarm name, alarm meaning, alarm stopping method, and alarm reset possibility in order of the alarm codes.

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 5-39

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 Code	Alarm Name	Alarm Meaning	Servo- motor Stop- ping Method	Alarm Reset Possi- ble?
020h	Parameter Checksum Error	There is an error in the parameter data in the SERVOPACK.	Gr.1	No
021h	Parameter Format Error	There is an error in the parameter data format in the SERVOPACK.	Gr.1	No
022h	System Checksum Error	There is an error in the parameter data in the SERVOPACK.	Gr.1	No
024h	System Alarm	An internal program error occurred in the SER-VOPACK.	Gr.1	No
025h	System Alarm	An internal program error occurred in the SER-VOPACK.	Gr.1	No

15.2.1 List of Alarms

Continued from previous page.

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Alarm Code	Alarm Name	Alarm Meaning	Servo- motor Stop- ping Method	Alarm Reset Possi- ble?
030h	Main Circuit Detector Error	There is an error in the detection data for the main circuit.	Gr.1	Yes
040h	Parameter Setting Error	A parameter setting is outside of the setting range.	Gr.1	No
041h	Encoder Output Pulse Setting Error	The setting of Pn212 (2212h) (Encoder Output Pulses) or Pn281 (2281h) (Encoder Output Resolution) is outside of the setting range or does not satisfy the setting conditions.	Gr.1	No
042h	Parameter Combination Error	The combination of some parameters exceeds the setting range.	Gr.1	No
044h	Semi-Closed/Fully-Closed Loop Control Parameter Setting Error	The settings of the Option Module and Pn002 = n.X□□□ (External Encoder Usage) do not match.	Gr.1	No
050h	Combination Error	The capacities of the SERVOPACK and Servomotor do not match.	Gr.1	Yes
051h	Unsupported Device Alarm	An unsupported device was connected.	Gr.1	No
070h	Motor Type Change Detected	The connected motor is a different type of motor from the previously connected motor.	Gr.1	No
080h	Linear Encoder Pitch Setting Error	The setting of Pn282 (2282h) (Linear Encoder Pitch) has not been changed from the default setting.	Gr.1	No
0b0h	Invalid Servo ON Command Alarm	The Servo ON command (Enable Operation command) was sent from the host controller after a utility function that turns ON the Servomotor was executed.	Gr.1	Yes
100h	Overcurrent Detected	An overcurrent flowed through the power transformer or the heat sink overheated.	Gr.1	No
101h	Motor Overcurrent Detected	The current to the motor exceeded the allowable current.	Gr.1	No
300h	Regeneration Error	There is an error related to regeneration.	Gr.1	Yes
320h	Regenerative Overload	A regenerative overload occurred.	Gr.2	Yes
330h	Main Circuit Power Supply Wiring Error	 The AC power supply input setting or DC power supply input setting is not correct. The power supply wiring is not correct. 	Gr.1	Yes
400h	Overvoltage	The main circuit DC voltage is too high.	Gr.1	Yes
410h	Undervoltage	The main circuit DC voltage is too low.	Gr.2	Yes
510h	Overspeed	The motor exceeded the maximum speed.	Gr.1	Yes
511h	Encoder Output Pulse Overspeed	 Rotary Servomotor: The pulse output speed for the setting of Pn212 (2212h) (Encoder Output Pulses) was exceeded. Linear Servomotor: The motor speed upper limit for the setting of Pn281 (2281h) (Encoder Output Resolution) was exceeded. 	Gr.1	Yes
520h	Vibration Alarm	Abnormal oscillation was detected in the motor speed.	Gr.1	Yes
521h	Autotuning Alarm	Vibration was detected during autotuning for the tuning-less function.	Gr.1	Yes
550h	Maximum Speed Setting Error	The setting of Pn385 (2385h) (Maximum Motor Speed) is greater than the maximum motor speed.	Gr.1	Yes
710h	Instantaneous Overload	The Servomotor was operating for several seconds to several tens of seconds under a torque that largely exceeded the rating.	Gr.2	Yes

Continued from previous page.

Alarm Code	Alarm Name	Alarm Meaning	Servo- motor Stop- ping Method	Alarm Reset Possi- ble?
720h	Continuous Overload	The Servomotor was operating continuously under a torque that exceeded the rating.	Gr.1	Yes
730h 731h	- Dynamic Brake Overload	When the dynamic brake was applied, the rotational or linear kinetic energy exceeded the capacity of the dynamic brake resistor.	Gr.1	Yes
740h	Inrush Current Limiting Resistor Overload	The main circuit power supply was frequently turned ON and OFF.	Gr.1	Yes
7A1h	Internal Temperature Error 1 (Control Board Tempera- ture Error)	The surrounding temperature of the control PCB is abnormal.	Gr.2	Yes
7A2h	Internal Temperature Error 2 (Power Board Tempera- ture Error)	The surrounding temperature of the power PCB is abnormal.	Gr.2	Yes
7A3h	Internal Temperature Sensor Error	An error occurred in the temperature sensor circuit.	Gr.2	No
7Abh	SERVOPACK Built-in Fan Stopped	The fan inside the SERVOPACK stopped.	Gr.1	Yes
810h	Encoder Backup Alarm	The power supplies to the encoder all failed and the position data was lost.	Gr.1	No
820h	Encoder Checksum Alarm	There is an error in the checksum results for encoder memory.	Gr.1	No
830h	Encoder Battery Alarm	The battery voltage was lower than the specified level after the control power supply was turned ON.	Gr.1	Yes
840h	Encoder Data Alarm	There is an internal data error in the encoder.	Gr.1	No
850h	Encoder Overspeed	The encoder was operating at high speed when the power was turned ON.	Gr.1	No
860h	Encoder Overheated	The internal temperature of encoder is too high.	Gr.1	No
861h	Motor Overheated	The internal temperature of motor is too high.	Gr.1	No
862h	Overheat Alarm	The input voltage (temperature) for the overheat protection input (TH) signal exceeded the setting of Pn61B (261Bh) (Overheat Alarm Level).	Gr.1	Yes
890h	Encoder Scale Error	A failure occurred in the linear encoder.	Gr.1	No
891h	Encoder Module Error	An error occurred in the linear encoder.	Gr.1	No
8A0h	External Encoder Error	An error occurred in the external encoder.	Gr.1	Yes
8A1h	External Encoder Module Error	An error occurred in the Serial Converter Unit.	Gr.1	Yes
8A2h	External Incremental Encoder Sensor Error	An error occurred in the external encoder.	Gr.1	Yes
8A3h	External Absolute Encoder Position Error	An error occurred in the position data of the external encoder.	Gr.1	Yes
8A5h	External Encoder Over- speed	An overspeed error occurred in the external encoder.	Gr.1	Yes
8A6h	External Encoder Over- heated	An overheating error occurred in the external encoder.	Gr.1	Yes
A10h	EtherCAT DC Synchronization Error *1	The SERVOPACK and Sync0 events cannot be synchronized.	Gr.2*2	Yes
A11h	EtherCAT State Error	The EtherCAT AL does not move to the Operational state when the DS402 drive is in Operation Enabled state.	Gr.2*2	Yes

15.2.1 List of Alarms

Continued from previous page.

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Alarm Code	Alarm Name	Alarm Meaning	Servo- motor Stop- ping Method	Alarm Reset Possi- ble?
A12h	EtherCAT Output Data Synchronization Error *1	The process data reception events and Sync0 events cannot be synchronized. (Process data communications failed.)	Gr.2	Yes
A20h	Parameter Setting Error	A parameter setting exceeds the setting range.	Gr.1	No
A40h	System Initialization Error	Initialization failed when the power supply was turned ON.	Gr.1	No
A41h	Communication Device Initialization Error	An error occurred during ESC initialization.	Gr.1	No
A47h	Loading Servo Information Error	Loading SERVOPACK information failed.	Gr.1	No
A48h	EEPROM Parameter Data Error	A checksum error occurred in the EEPROM.	Gr.1	No
b33h	Current Detection Error 3	An error occurred in the current detection circuit.	Gr.1	No
bF0h	System Alarm 0	Internal program error 0 occurred in the SERVO-PACK.	Gr.1	No
bF1h	System Alarm 1	Internal program error 1 occurred in the SERVO-PACK.	Gr.1	No
bF2h	System Alarm 2	Internal program error 2 occurred in the SERVO-PACK.	Gr.1	No
bF3h	System Alarm 3	Internal program error 3 occurred in the SERVO-PACK.	Gr.1	No
bF4h	System Alarm 4	Internal program error 4 occurred in the SERVO-PACK.	Gr.1	No
bF5h	System Alarm 5	Internal program error 5 occurred in the SERVO-PACK.	Gr.1	No
bF6h	System Alarm 6	Internal program error 6 occurred in the SERVO-PACK.	Gr.1	No
bF7h	System Alarm 7	Internal program error 7 occurred in the SERVO-PACK.	Gr.1	No
bF8h	System Alarm 8	Internal program error 8 occurred in the SERVO-PACK.	Gr.1	No
C10h	Servomotor Out of Control	The Servomotor ran out of control.	Gr.1	Yes
C20h	Phase Detection Error	The detection of the phase is not correct.	Gr.1	No
C21h	Polarity Sensor Error	An error occurred in the polarity sensor.	Gr.1	No
C22h	Phase Information Disagreement	The phase information does not match.	Gr.1	No
C50h	Polarity Detection Failure	The polarity detection failed.	Gr.1	No
C51h	Overtravel Detected during Polarity Detection	The overtravel signal was detected during polarity detection.	Gr.1	Yes
C52h	Polarity Detection Not Completed	The servo was turned ON before the polarity was detected.	Gr.1	Yes
C53h	Out of Range of Motion for Polarity Detection	The travel distance exceeded the setting of Pn48E (248Eh) (Polarity Detection Range).	Gr.1	No
C54h	Polarity Detection Failure 2	The polarity detection failed.	Gr.1	No
C80h	Encoder Clear Error or Multiturn Limit Setting Error	The multiturn data for the absolute encoder was not correctly cleared or set.	Gr.1	No
C90h	Encoder Communications Error	Communications between the encoder and SER-VOPACK is not possible.	Gr.1	No

Continued from previous page.

Alarm Code	Alarm Name	Alarm Meaning	Servo- motor Stop- ping Method	Alarm Reset Possi- ble?
C91h	Encoder Communications Position Data Acceleration Rate Error	An error occurred in calculating the position data of the encoder.	Gr.1	No
C92h	Encoder Communications Timer Error	An error occurred in the communications timer between the encoder and SERVOPACK.	Gr.1	No
CA0h	Encoder Parameter Error	The parameters in the encoder are corrupted.	Gr.1	No
Cb0h	Encoder Echoback Error	The contents of communications with the encoder are incorrect.	Gr.1	No
CC0h	Multiturn Limit Disagree- ment	Different multiturn limits have been set in the encoder and the SERVOPACK.	Gr.1	No
CF1h	Reception Failed Error in Feedback Option Module Communications	Receiving data from the Feedback Option Module failed.	Gr.1	No
CF2h	Timer Stopped Error in Feedback Option Module Communications	An error occurred in the timer for communications with the Feedback Option Module.	Gr.1	No
d00h	Position Deviation Over- flow	The setting of Pn520 (2520h) (Position Deviation Overflow Alarm Level) was exceeded by the position deviation while the servo was ON.	Gr.1	Yes
d01h	Position Deviation Over- flow Alarm at Servo ON	The servo was turned ON after the position deviation exceeded the setting of Pn526 (2526h) (Position Deviation Overflow Alarm Level at Servo ON) while the servo was OFF.	Gr.1	Yes
d02h	Position Deviation Over- flow Alarm for Speed Limit at Servo ON	If position deviation remains in the deviation counter, the setting of Pn529 (2529h) or Pn584 (2584h) (Speed Limit Level at Servo ON) will limit the speed when the servo is turned ON. This alarm occurs if a position reference is input and the setting of Pn520 (2520h) (Position Deviation Overflow Alarm Level) is exceeded before the limit is cleared.	Gr.2	Yes
d10h	Motor-Load Position Deviation Overflow	There was too much position deviation between the motor and load during fully-closed loop control.	Gr.2	Yes
d30h	Position Data Overflow	The position feedback data exceeded ±1,879,048,192 [Linear encoder pulse units].	Gr.1	No
E00h	EtherCAT Module Inter- face Initialization Timeout Error	Communications initialization failed between the SERVOPACK and the EtherCAT Module.	Gr.2	Yes
E02h	EtherCAT Internal Syn- chronization Error 1	A synchronization error occurred during Ether-CAT communications with the SERVOPACK.	Gr.1	Yes
E03h	EtherCAT Module Inter- face Communications Data Error	There is an error in the communications data between the SERVOPACK and the EtherCAT Module.	Gr.1	Yes
E71h	Safety Option Module Detection Failure	Detection of the Safety Option Module failed.	Gr.1	No
E72h	Feedback Option Module Detection Failure	Detection of the Feedback Option Module failed.	Gr.1	No
E74h	Unsupported Safety Option Module Alarm	An unsupported Safety Option Module was connected. Refer to the following manual for investigative and corrective actions. AC Servo Drive Σ-V Series/Σ-V Series for Large-Capacity Models/Σ-7 Series User's Manual Safety Module (Manual No.: SIEP C720829 06)	Gr.1	No

15.2.1 List of Alarms

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Alarm Code	Alarm Name	Alarm Meaning	Servo- motor Stop- ping Method	Alarm Reset Possi- ble?
E75h*2	Unsupported Feedback Option Module Alarm	An unsupported Feedback Option Module was connected.	Gr.1	No
EA0h	Command-Option IF Servo Unit Initial Error	Communications could not be initialized between the SERVOPACK and EtherCAT (CoE) Network Module within 10 seconds.	Gr.1	No
EA1h	Command-Option IF Memory Check Error	An error occurred in communications memory between the SERVOPACK and EtherCAT (CoE) Network Module.	Gr.1	No
EA2h	Command-Option IF Servo Synchronization Error *1	Communications could not be synchronized between the SERVOPACK and EtherCAT (CoE) Network Module.	Gr.1	Yes
EA3h	Command-Option IF Servo Data Error *1	An error occurred in communications data between the SERVOPACK and EtherCAT (CoE) Network Module.	Gr.1	Yes
Eb1h	Safety Function Signal Input Timing Error	An error occurred in the input timing of the safety function signal.	Gr.1	No
Ed1h	Command Execution Timeout	A timeout error occurred for a EtherCAT command.	Gr.2	Yes
F10h	Power Supply Line Open 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*3				
FL-2*3				
FL-3*3	Cyatam Alarm	An internal program error occurred in the SER-		No
FL-4*3	- System Alarm	VOPACK.	_	No
FL-5*3				
FL-6*3				
CPF00	Digital Operator Communications Error 1	Communications were not possible between the Digital Operator (model: JUSP-OP05A-1-E) and	_	No
CPF01	Digital Operator Communications Error 2	the SERVOPACK (e.g., a CPU error occurred).		INO

^{*1.} The EtherCAT communications state moved to SAFEOP after an alarm was detected.

Note: The Eb0h, Eb2h to Eb9h, and EC0h to EC2h alarms can occur when a Safety Module is connected. Refer to the following manual for details.

Σ-V-Series/Σ-V-Series for Large-Capacity Models/Σ-7-Series User's Manual Safety Module (Manual No.: SIEP C720829 06)

^{*2.} This alarm can occur when a Fully-Close Option Module is mounted.

^{*3.} 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 Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The power supply voltage suddenly dropped.	Measure the power supply voltage.	Set the power supply voltage within the specified range, and initialize the parameter settings.	page 5-10
	The power supply was shut OFF while writing parameter settings.	Check the timing of shutting OFF the power supply.	Initialize the parameter settings and then set the parameters again.	page o lo
020h: Parameter	The number of times that parameters were written exceeded the limit.	Check to see if the parameters were frequently changed from the host controller.	The SERVOPACK may be faulty. Replace the SER-VOPACK. Reconsider the method for writing the parameters.	-
Checksum Error (There is an error in the parameter data in the SER- VOPACK.)	A malfunction was caused by noise from the AC power supply, ground, static electricity, or other source.	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, noise may be the cause.	Implement countermeasures against noise.	page 4-6
	Gas, water drops, or cutting oil entered the SERVOPACK and caused failure of the internal components.	Check the installation conditions.	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-
	A failure occurred in the SERVOPACK.	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may have failed.	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-
021h: Parameter Format Error (There is an error in the parameter	The software version of the SERVOPACK that caused the alarm is older than the software version of the parameters specified to write.	Read the product information to see if the software versions are the same. If they are different, it could be the cause of the alarm.	Write the parameters from another SERVOPACK with the same model and the same software version, and then turn the power 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-VOPACK.	-
022h: System Check- sum Error (There is an error in the parameter data in the SER- VOPACK.)	The power supply voltage suddenly dropped.	Measure the power supply voltage.	The SERVOPACK may be faulty. Replace the SER-VOPACK.	_
	The power supply was shut OFF while setting a utility function.	Check the timing of shutting OFF the power supply.	The SERVOPACK may be faulty. Replace the SER-VOPACK.	_
	A failure occurred in the SERVOPACK.	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may have failed.	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-

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Alarm Code:	Continued from previous page			
Alarm Name	Possible Cause	Confirmation	Correction	Reference
O24h: System Alarm (An internal pro- gram error occurred in the SERVOPACK.)	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-
O25h: System Alarm (An internal program error occurred in the SERVOPACK.)	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-
030h: Main Circuit Detector Error	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-
	The SERVOPACK and Servomotor capacities do not match each other.	Check the combination of the SERVOPACK and Servomotor capacities.	Select a proper combination of SERVOPACK and Servomotor capacities.	page 1-13
040h: Parameter Setting Error (A parameter setting is outside of	The motor parameter file was not written to the linear encoder. (This applies only when not using a Serial Converter Unit.)	Check to see if the motor parameter file was written to the linear encoder.	Write the motor parameter file to the linear encoder.	page 5-17
the setting range.)	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-
	A parameter setting is outside of the setting range.	Check the setting ranges of the parameters that have been changed.	Set the parameters to values within the setting ranges.	-
041h: Encoder Output Pulse Setting Error	The setting of Pn212 (2212h) (Encoder Output Pulses) or Pn281 (2281h) (Encoder Output Resolution) is outside of the setting range or does not satisfy the setting conditions.	Check the setting of Pn212 (2212h) or Pn281 (2281h).	Set Pn212 (2212h) or Pn281 (2281h) to an appropriate value.	page 6-22
042h: Parameter Com- bination Error	The speed of program jogging went below the setting range when Pn533 (2533h) or Pn585 (2585h) (Program Jogging Movement Speed) was changed.	Check to see if the detection conditions*1 are satisfied.	Increase the setting of Pn533 (2533h) or Pn585 (2585h).	page 7-13
044h: Semi-Closed/ Fully-Closed Loop Control Parameter Setting Error	The setting of the Fully-closed Module does not match the setting of Pn002 (2002h) = n.X□□□ (External Encoder Usage).	Check the setting of Pn002 (2002h) = n.X□□□.	Make sure that the setting of the Fully-closed Module agrees with the setting of Pn002 (2002h) = n.X□□□.	page 10-6

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
050h: Combination Error	The SERVOPACK and Servomotor capacities do not match each other.	Confirm that the following condition is met: 1/4 ≤ (Servomotor capacity/SERVOPACK capacity) ≤ 4	Select a proper combination of the SERVOPACK and Servomotor capacities.	page 1-13
(The capacities of the SERVOPACK and Servomotor	A failure occurred in the encoder.	Replace the encoder and check to see if the alarm still occurs.	Replace the Servomotor or encoder.	-
do not match.)	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-
051h:	The motor parameter file was not written to the linear encoder. (This applies only when not using a Serial Converter Unit.)	Check to see if the motor parameter file was written to the linear encoder.	Write the motor parameter file to the linear encoder.	page 5-17
Unsupported Device Alarm	An unsupported Serial Converter Unit or encoder (e.g., an external encoder) is connected to the SERVOPACK.	Check the product combination specifications.	Change to a correct combination of models.	-
070h: Motor Type Change Detected (The connected motor is a differ-	A Rotary Servomotor was removed and a Linear Servomotor was connected.	_	Set the parameters for a Linear Servomotor and reset the motor type alarm. Then, turn the power supply to the SER- VOPACK OFF and ON again.	page 15-45
ent type of motor from the previ- ously connected motor.)	A Linear Servomotor was removed and a Rotary Servomotor was connected.	-	Set the parameters for a Rotary Servomotor and reset the motor type alarm. Then, turn the power supply to the SER- VOPACK OFF and ON again.	page 15-45
080h: Linear Encoder Pitch Setting Error	The setting of Pn282 (2282h) (Linear Encoder Pitch) has not been changed from the default setting.	Check the setting of Pn282 (2282h).	Correct the setting of Pn282 (2282h).	page 5-16
0b0h: Invalid Servo ON Command Alarm	The Servo ON command (Enable Operation command) was sent from the host controller after a utility function that turns ON the Servomotor was executed.	_	Turn the power supply to the SERVOPACK OFF and ON again. Or, execute a software reset.	page 6-43

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Continued from processing Correction	Reference
	The Main Circuit Cable is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	
	There is a short-circuit or ground fault in a Main Circuit Cable.	Check for short-circuits across Servomotor phases U, V, and W, or between the ground and Servomotor phases U, V, and W.	The cable may be short-circuited. Replace the cable.	
	There is a short-circuit or ground fault inside the Servomotor.	Check for short-circuits across Servomotor phases U, V, and W, or between the ground and Servomotor phases U, V, or W.	The Servomotor may be faulty. Replace the Servomotor.	page 4-27
	There is a short-circuit or ground fault inside the SERVOPACK.	Check for short-circuits across the Servomotor connection terminals U, V, and W on the SER-VOPACK, or between the ground and terminals U, V, or W.	The SERVOPACK may be faulty. Replace the SER-VOPACK.	
100h: Overcurrent Detected (An overcurrent	The regenerative resistor is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	page 4-24
flowed through the power trans- former or the heat sink overheated.)	The dynamic brake (DB, emergency stop executed from the SERVOPACK) was frequently activated, or a DB overload alarm occurred.	Check the power consumed by the DB resistor to see how frequently the DB is being used. Or, check the alarm display to see if a DB overload alarm (A.730 or A.731) has occurred.	Change the SERVOPACK model, operating methods, or the mechanisms so that the dynamic brake does not need to be used so frequently.	-
	The regenerative processing capacity was exceeded.	Check the regenerative load ratio in the SigmaWin+ Motion Monitor Tab Page to see how frequently the regenerative resistor is being used.	Recheck the operating conditions and load.	*2
	The SERVOPACK regenerative resistance is too small.	Check the regenerative load ratio in the SigmaWin+ Motion Monitor Tab Page to see how frequently the regenerative resistor is being used.	Change the regenerative resistance to a value larger than the SERVO-PACK minimum allowable resistance.	-
	A heavy load was applied while the Servomotor was stopped or running at a low speed.	Check to see if the operating conditions exceed Servo Drive specifications.	Reduce the load applied to the Servomotor. Or, increase the operating speed.	_

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
100h: Overcurrent Detected (An overcurrent	A malfunction was caused by noise.	Improve the noise environment, e.g. by improving the wiring or installation conditions, and check to see if the alarm still occurs.	Implement countermeasures against noise, such as correct wiring of the FG. Use an FG wire size equivalent to the SERVO-PACK's main circuit wire size.	-
flowed through the power trans- former or the heat sink overheated.)	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
	The Main Circuit Cable is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	
	There is a short-circuit or ground fault in a Main Circuit Cable.	Check for short-circuits across cable phases U, V, and W, or between the ground and cable phases U, V, and W.	The cable may be short-circuited. Replace the cable.	
	There is a short-circuit or ground fault inside the Servomotor.	Check for short-circuits across Servomotor phases U, V, and W, or between the ground and Servomotor phases U, V, or W.	The Servomotor may be faulty. Replace the Servomotor.	page 4-27
101h: Motor Overcur- rent Detected (The current to the motor exceeded the	There is a short-circuit or ground fault inside the SERVOPACK.	Check for short-circuits across the Servomotor connection terminals U, V, and W on the SER-VOPACK, or between the ground and terminals U, V, or W.	The SERVOPACK may be faulty. Replace the SER-VOPACK.	
allowable current.)	A heavy load was applied while the Ser- vomotor was stopped or running at a low speed.	Check to see if the operating conditions exceed Servo Drive specifications.	Reduce the load applied to the Servomotor. Or, increase the operating speed.	-
	A malfunction was caused by noise.	Improve the noise environment, e.g. by improving the wiring or installation conditions, and check to see if the alarm still occurs.	Implement countermeasures against noise, such as correct wiring of the FG. Use an FG wire size equivalent to the SERVO-PACK's main circuit wire size.	-
	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	When using the built-in regenerative resistor, the jumper between the regenerative resistor terminals (B2 and B3) was removed from one of the following SERVO-PACKs: SGD7S-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, or -330A.	Check to see if the jumper is connected between power supply terminals B2 and B3.*3	Correctly connect a jumper.	page 4-24
	The External Regenerative Resistor or Regenerative Resistor tor Unit is not wired correctly, or was removed or disconnected.	Check the wiring of the External Regenerative Resistor or Regenerative Resistor Unit.*3	Correct the wiring of the External Regenerative Resistor or Regenerative Resistor Unit.	
300h: Regeneration Error	Pn600 (2600h)) (Regenerative Resistor Capacity) is set to a value other than 0 (setting unit: 10 W) even though a Regenerative Resistor is not connected to one of the following SERVOPACKS: SGD7S-R70A, -R90A, -1R6A, -2R8A, -R70F, -R90F, -2R1F, or -2R8F.	Check to see if an External Regenerative Resistor is connected and check the setting of Pn600 (2600h).	Connect an External Regenerative Resistor, or if a Regenerative Resistor is not required, set Pn600 (2600h) to 0.	page 5-57
	A Regenerative Resistor is not connected to one of the following SERVOPACKs: SGD7S-470A, -550A, -590A, or -780A.	Check to see if an External Regenerative Resistor or a Regenerative Resistor Unit is connected and check the setting of Pn600 (2600h) (Regenerative Resistor Capacity).	Connect an External Regenerative Resistor and set Pn600 (2600h) to an appropriate value, or con- nect a Regenerative Resistor Unit and set Pn600 (2600h) to 0 (set- ting unit: 10 W).	
	A failure occurred in the SERVOPACK.	_	While the main circuit power supply is OFF, turn the control power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	_

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The power supply voltage exceeded the specified range.	Measure the power supply voltage.	Set the power supply voltage within the specified range.	-
	The external regenerative resistance value or regenerative resistor capacity is too small, or there has been a continuous regeneration state.	Check the operating conditions or the capacity using the SigmaJunmaSize+ Capacity Selection Software or other means.	Change the regenerative resistance value or capacity. Reconsider the operating conditions using the SigmaJunmaSize+ Capacity Selection Software or other means.	*2
	There was a continuous regeneration state because a negative load was continuously applied.	Check the load applied to the Servomotor during operation.	Reconsider the system including the servo, machine, and operating conditions.	-
320h: Regenerative Overload	The setting of Pn600 (2600h) (Regenerative Resistor Capacity) is smaller than the capacity of the External Regenerative Resistor.	Check to see if a Regenerative Resistor is connected and check the setting of Pn600 (2600h).	Correct the setting of Pn600 (2600h).	page 5-57
	The setting of Pn603 (2603h) (Regenerative Resistance) is smaller than the capacity of the External Regenerative Resistor.	Check to see if a Regenerative Resistor is connected and check the setting of Pn603 (2603h).	Correct the setting of Pn603 (2603h).	page 5-57
	The external regenerative resistance is too high.	Check the regenerative resistance.	Change the regenerative resistance to a correct value or use an External Regenerative Resistor of an appropriate capacity.	*2
_	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SER-VOPACK.	_

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The regenerative resistor was disconnected when the SERVOPACK power supply voltage was high.	Measure the resistance of the regenerative resistor using a measuring instrument.	If you are using the regenerative resistor built into the SERVOPACK, replace the SERVOPACK. If you are using an External Regenerative Resistor, replace the External Regenerative Resistor.	-
	DC power was supplied when an AC power supply input was specified in the settings.	Check the power supply to see if it is a DC power supply.	Correct the power supply setting to match the actual power supply.	page 5-12
330h: Main Circuit Power Supply Wiring Error (Detected when the main circuit power supply is turned ON.)	AC power was supplied when a DC power supply input was specified in the settings.	Check the power supply to see if it is an AC power supply.	Correct the power supply setting to match the actual power supply.	
	Pn600 (2600h) (Regenerative Resistor Capacity) (setting unit: 10 W) is not set to 0 and an External Regenerative Resistor is not connected to one of the following SERVOPACKs: SGD7S-R70A, -R90A, -1R6A, -2R8A, -R70F, -R90F, -2R1F, or -2R8F.	Check to see if an External Regenerative Resistor is connected and check the setting of Pn600 (2600h).	Connect an External Regenerative Resistor, or if an External Regenera- tive Resistor is not required, set Pn600 (2600h) to 0.	page 4-24, page 5-57
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SER-VOPACK.	_

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Alarm Code: 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 not stable or was influenced by a lightning surge.	Measure the power supply voltage.	Improve the power supply conditions, install a surge absorber, and then turn the power supply OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
400h: Overvoltage (Detected in the	The voltage for AC power supply was too high during acceleration or deceleration.	Check the power supply voltage and the speed and torque during operation.	Set the AC power supply voltage within the specified range.	-
main circuit power supply section of the SERVOPACK.)	The external regenerative resistance is too high for the operating conditions.	Check the operating conditions and the regenerative resistance.	Select a regenerative resistance value that is appropriate for the operating conditions and load.	*2
	The moment of inertia ratio or mass ratio exceeded the allowable value.	Check to see if the moment of inertia ratio or mass ratio is within the allowable range.	Increase the deceleration time, or reduce the load.	-
	A failure occurred in the SERVOPACK.	_	While the main circuit power supply is OFF, turn the control power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	_
	The power supply voltage went below the specified range.	Measure the power supply voltage.	Set the power supply voltage within the specified range.	-
	The power supply voltage dropped during operation.	Measure the power supply voltage.	Increase the power supply capacity.	_
410h: Undervoltage (Detected in the main circuit power supply	A momentary power interruption occurred.	Measure the power supply voltage.	If you have changed the setting of Pn509 (2509h) (Momentary Power Interruption Hold Time), decrease the setting.	page 6-13
section of the SERVOPACK.)	The SERVOPACK fuse is blown out.	_	Replace the SERVO- PACK and connect a reactor to the DC reactor terminals (⊝1 and ⊝2) on the SERVOPACK.	-
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The order of phases U, V, and W in the motor wiring is not correct.	Check the wiring of the Servomotor.	Make sure that the Servo- motor is correctly wired.	-
510h: Overspeed (The motor	A reference value that exceeded the over- speed detection level was input.	Check the input reference.	Reduce the reference value. Or, adjust the gain.	
exceeded the maximum speed.)	The motor exceeded the maximum speed.	Check the waveform of the motor speed.	Reduce the speed reference input gain and adjust the servo gain. Or, reconsider the operating conditions.	_
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-
511h:	The encoder output pulse frequency exceeded the limit.	Check the encoder output pulse setting.	Decrease the setting of Pn212 (2212h) (Encoder Output Pulses) or Pn281 (2281h) (Encoder Output Resolution).	page 6-22
Encoder Output Pulse Overspeed	The encoder output pulse frequency exceeded the limit because the motor speed was too high.	Check the encoder output pulse setting and the motor speed.	Reduce the motor speed.	-
	Abnormal oscillation was detected in the motor speed.	Check for abnormal motor noise, and check the speed and torque waveforms during operation.	Reduce the motor speed. Or, reduce the setting of Pn100 (2100h) (Speed Loop Gain).	page 8-78
520h: Vibration Alarm	The setting of Pn103 (2103h) (Moment of Inertia Ratio) is greater than the actual moment of inertia or was greatly changed.	Check the moment of inertia ratio or mass ratio.	Correct the setting of Pn103 (2103h).	page 8-16
	The vibration detection level (Pn312 or Pn384) is not suitable.	Check that the vibration detection level (Pn312 or Pn384) is suitable.	Set a suitable vibration detection level (Pn312 or Pn384).	page 6-45
521h: Autotuning Alarm (Vibration was detected while executing the custom tuning, Easy FFT, or the tuning-less func- tion.)	The Servomotor vibrated considerably while performing the tuning-less function.	Check the waveform of the motor speed.	Reduce the load so that the moment of inertia ratio is within the allowable value. Or increase the load level or reduce the rigidity level in the tuning- less level settings.	page 8-13
	The Servomotor vibrated considerably while performing custom tuning or Easy FFT.	Check the waveform of the motor speed.	Check the operating procedure of corresponding function and implement corrections.	page 8-41, page 8-94
550h: Maximum Speed Setting Error	The setting of Pn385 (2385h) (Maximum Motor Speed) is greater than the maximum speed.	Check the setting of Pn385 (2385h), and the upper limits of the maxi- mum motor speed set- ting and the encoder output resolution set- ting.	Set Pn385 (2385h) to a value that does not exceed the maximum motor speed.	page 6-16

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The wiring is not correct or there is a faulty connection in the motor or encoder wiring.	Check the wiring.	Make sure that the Servo- motor and encoder are correctly wired.	page 4-27
	Operation was performed that exceeded the overload protection characteristics.	Check the motor over- load characteristics and Run command.	Reconsider the load and operating conditions. Or, increase the motor capacity.	-
710h: Instantaneous Overload 720h: Continuous	An excessive load was applied during operation because the Servomotor was not driven due to mechanical problems.	Check the operation reference and motor speed.	Correct the mechanical problem.	-
Overload	There is an error in the setting of Pn282 (2282h) (Linear Encoder Pitch).	Check the setting of Pn282 (2282h).	Correct the setting of Pn282 (2282h).	page 5-16
	There is an error in the setting of Pn080 (2080h) = n.□□X□ (Motor Phase Selection).	Check the setting of Pn080 (2080h) = n.□□X□.	Set Pn080 (2080h) = n.□□X□ to an appropriate value.	page 5-21
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-
720h and	The Servomotor was rotated by an external force.	Check the operation status.	Implement measures to ensure that the motor will not be rotated by an external force.	-
730h and 731h: Dynamic Brake Overload (An excessive power consump- tion by the dynamic brake was detected.)	When the Servomotor was stopped with the dynamic brake, the rotational or linear kinetic energy exceeded the capacity of the dynamic brake resistor.	Check the power consumed by the DB resistor to see how frequently the DB is being used.	Reconsider the following: Reduce the Servomotor command speed. Decrease the moment of inertia ratio or mass ratio. Reduce the frequency of stopping with the dynamic brake.	-
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-
740h: Inrush Current Limiting Resistor Overload (The main circuit power supply was frequently turned ON and OFF.)	The allowable frequency of the inrush current limiting resistor was exceeded when the main circuit power supply was turned ON and OFF.	_	Reduce the frequency of turning the main circuit power supply ON and OFF.	-
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The surrounding temperature is too high.	Check the surrounding temperature using a thermometer. Or, check the operating status with the SERVOPACK installation environment monitor.	Decrease the surrounding temperature by improving the SERVO-PACK installation conditions.	page 3-6
7A1h:	An overload alarm was reset by turning OFF the power supply too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	-
Internal Tempera- ture Error 1 (Control Board Temperature Error)	There was an excessive load or operation was performed that exceeded the regenerative processing capacity.	Use the accumulated load ratio to check the load during operation, and use the regenerative load ratio to check the regenerative processing capacity.	Reconsider the load and operating conditions.	-
	The SERVOPACK installation orientation is not correct or there is insufficient space around the SERVOPACK.	Check the SERVOPACK installation conditions.	Install the SERVOPACK according to specifications.	page 3-3, page 3-5
	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-
	The surrounding temperature is too high.	Check the surrounding temperature using a thermometer. Or, check the operating status with the SERVOPACK installation environment monitor.	Decrease the surrounding temperature by improving the SERVO-PACK installation conditions.	page 3-6
7 4 2h.	An overload alarm was reset by turning OFF the power supply too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	-
7A2h: Internal Temperature Error 2 (Power Board Temperature Error)	There was an excessive load or operation was performed that exceeded the regenerative processing capacity.	Use the accumulated load ratio to check the load during operation, and use the regenerative load ratio to check the regenerative processing capacity.	Reconsider the load and operating conditions.	-
	The SERVOPACK installation orientation is not correct or there is insufficient space around the SERVOPACK.	Check the SERVOPACK installation conditions.	Install the SERVOPACK according to specifications.	page 3-3, page 3-5
	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SER-VOPACK.	_
7A3h: Internal Temperature Sensor Error (An error occurred in the temperature sensor circuit.)	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
7Abh: SERVOPACK Built-in Fan Stopped	The fan inside the SERVOPACK stopped.	Check for foreign matter inside the SERVOPACK.	Remove foreign matter from the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SER-VOPACK.	-
	The power to the absolute encoder was turned ON for the first time.	Check to see if the power supply was turned ON for the first time.	Set up the encoder.	
810h:	The Encoder Cable was disconnected and then connected again.	Check to see if the power supply was turned ON for the first time.	Check the encoder connection and set up the encoder.	page 5-51
Encoder Backup Alarm (Detected at the encoder, but only when an abso- lute encoder is used.)	Power is not being supplied both from the control power supply (+5 V) from the SERVOPACK and from the battery power supply.	Check the encoder connector battery and the connector status.	Replace the battery or implement similar measures to supply power to the encoder, and set up the encoder.	
	A failure occurred in the absolute encoder.	_	If the alarm still occurs after setting up the encoder again, replace the Servomotor.	-
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SER-VOPACK.	-
820h: Encoder Check- sum Alarm (Detected at the encoder.)	A failure occurred in the encoder.	_	■ When Using an Absolute Encoder Set up the encoder again. If the alarm still occurs, the Servomotor may be faulty. Replace the Servomotor. ■ When Using a Singleturn Absolute Encoder or Incremental Encoder • The Servomotor may be faulty. Replace the Servomotor. • The linear encoder may be faulty. Replace the linear encoder.	page 5-51
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SER-VOPACK.	_
830h: Encoder Battery Alarm (The absolute encoder battery voltage was lower than the speci- fied level.)	The battery connection is faulty or a battery is not connected.	Check the battery connection.	Correct the battery connection.	page 4-28
	The battery voltage is lower than the specified value (2.7 V).	Measure the battery voltage.	Replace the battery.	page 15-3
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SER-VOPACK.	_

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Alarm Code: Day 14 Continued from previous pag				
Alarm Name	Possible Cause	Confirmation	Correction	Reference
840h: Encoder Data Alarm (Detected at the encoder.)	The encoder malfunctioned.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the Servomotor or linear encoder may be faulty. Replace the Servo- motor or linear encoder.	-
	An error occurred in reading data from the linear encoder.	-	The linear encoder is not mounted within an appropriate tolerance. Correct the mounting of the linear encoder.	-
	Excessive speed occurred in the linear encoder.	_	Control the motor speed within the range specified by the linear encoder manufacturer and then turn ON the control power supply.	-
	The encoder malfunctioned due to noise.	_	Correct the wiring around the encoder by separating the Encoder Cable from the Servomotor Main Cir- cuit Cable or by ground- 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 sensor.	_
850h: Encoder Over- speed (Detected at the encoder when the control power supply is turned ON.)	Rotary Servomotor: The Servomotor speed was 200 min ⁻¹ or higher when the control power supply was turned ON.	Check the motor speed when the power supply is turned ON.	Reduce the Servomotor speed to a value less than 200 min ⁻¹ , and turn ON the control power supply.	-
	Linear Servomotor: The Servomotor exceeded the speci- fied speed when the control power supply was turned ON.	Check the motor speed when the power supply is turned ON.	Control the motor speed within the range specified by the linear encoder manufacturer and then turn ON the control power supply.	-
	A failure occurred in the encoder.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the Servomotor or linear encoder may be faulty. Replace the Servo- motor or linear encoder.	-
	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
860h: Encoder Overheated (Detected when a Rotary Servomotor, Absolute Linear Encoder, or Direct Drive Servomotor is connected. However, this alarm is not detected for SGMCS Servomotor with Incremental Encoders.) (Detected at the encoder.)	The surrounding air temperature around the Servomotor is too high.	Measure the surrounding air temperature around the Servomotor.	Reduce the surrounding air temperature of the Servomotor to 40°C or less.	-
	The Servomotor load is greater than the rated load.	Use the accumulated load ratio to check the load.	Operate the Servo Drive so that the motor load remains within the specified range.	page 9-3
	A failure occurred in the encoder.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the Servomotor or absolute linear encoder may be faulty. Replace the Servomotor or absolute linear encoder.	-
	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
861h: Motor Over- heated	The surrounding temperature around the Servomotor is too high.	Measure the surrounding temperature around 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 accumulated load ratio on the Motion Monitor Tab Page on the SigmaWin+.	Operate the Servo Drive so that the motor load remains within the specified range.	page 9-3
	A failure occurred in the Serial Converter Unit.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the Serial Con- verter Unit may be faulty. Replace the Serial Con- verter Unit.	-
	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The surrounding temperature is too high.	Check the surrounding temperature using a thermometer.	Lower the surrounding temperature by improving the installation conditions of the Linear Servomotor or the machine.	-
	The overheat protection input signal line is disconnected or short-circuited.	Check the input voltage with the overheat protection input information on the Motion Monitor Tab Page on the SigmaWin+.	Repair the line for the overheat protection input signal.	-
862h:	An overload alarm was reset by turning OFF the power supply too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	-
Overheat Alarm	Operation was performed under an 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 detection circuit in the Linear Servomotor is faulty or the sensor attached to the machine is faulty.	_	The temperature detection circuit in the Linear Servomotor may be faulty or the sensor attached to the machine may be faulty. Replace the Linear Servomotor or repair the sensor attached to the machine.	-
890h: Encoder Scale Error	A failure occurred in the linear encoder.	-	The linear encoder may be faulty. Replace the linear encoder.	-
891h: Encoder Module Error	A failure occurred in the linear encoder.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the linear encoder may be faulty. Replace the linear encoder.	-
8A0h: External Encoder Error	Setting the origin of the absolute linear encoder failed because the motor moved.	Before you set the origin, use the fully-closed feedback pulse counter to confirm that the motor is not moving.	The motor must be stopped while setting the origin position.	page 5-54
	A failure occurred in the external encoder.	_	Replace the external encoder.	_
8A1h:	A failure occurred in the external encoder.	_	Replace the external encoder.	_
External Encoder Module Error	A failure occurred in the Serial Converter Unit.	-	Replace the Serial Converter Unit.	-
8A2h: External Incre- mental Encoder Sensor Error	A failure occurred in the external encoder.	_	Replace the external encoder.	-
8A3h: External Absolute Encoder Position Error	A failure occurred in the external absolute encoder.	-	The external absolute encoder may be faulty. Refer to the encoder manufacturer's instruction manual for corrections.	-

Continued from previous page.

Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
8A5h: External Encoder Overspeed	An overspeed error was detected in the external encoder.	Check the maximum speed of the external encoder.	Keep the external encoder below its maximum speed.	-
8A6h: External Encoder Overheated	An overheating error was detected in the external encoder.	_	Replace the external encoder.	-
A10h: EtherCAT DC Synchronization Error	The synchronization timing (Sync0) for EtherCAT communications fluctuated.	_	Turn the power supply OFF and ON again and reestablish communications.	-
A11h: EtherCAT State Error	The EtherCAT communications state left the Operational state during motor operation.	_	Reset the alarm and then re-establish communications.	-
	Noise caused an error in EtherCAT communications.	_	Check the EtherCAT wiring and implement noise countermeasures.	_
A12h: EtherCAT Output Data Synchroni- zation Error	The controller did not update the process data during the fixed period.	Check the process data specified by the controller.	Correct the controller so that the process data is updated during the fixed period.	-
	The EtherCAT Communications Cable or connector wiring is faulty.	Check the EtherCAT Communications Cable and connector wiring.	Wire the connections correctly.	-
A20h: Parameter Set- ting Error	The position unit is outside of the setting range.	Make sure it is within the following range. 1/4,096 < Numerator (2701h: 1)/Denomina- tor (2701h: 2) < 65,536	Correct the setting of position user unit (2701h).	-
	The speed unit is outside of the setting range.	Make sure it is within the following range. 1/128 ≤ Numerator (2702h: 1)/Denominator (2702h: 2) ≤ 8,388,608	Correct the setting of velocity user unit (2702h).	-
	The acceleration unit is outside of the setting range.	Make sure it is within the following range. 1/128 ≤ Numerator (2703h: 1)/Denominator (2703h: 2) ≤ 262,144	Correct the setting of acceleration user unit (2703h).	-
A40h: System Initializa- tion Error	A failure occurred in the SERVOPACK.	_	Replace the SERVO-PACK.	-
A41h: Communications Device Initializa- tion Error	A failure occurred in the SERVOPACK.	_	Replace the SERVO-PACK.	_

Continued from previous page.

Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A47h: Loading Servo Information Error	User parameter configuration (2700h) was executed while a utility function (Fn□□□) was being executed from the Digital Operator or SigmaWin+.	-	Turn the power supply OFF and ON again.	-
	The power supply was turned ON or user parameter configuration (2700h) was executed when an encoder was not connected.	Check the wiring of the encoder.	Turn OFF the power supply, correct the encoder connection, and then turn the power supply back ON.	-
	The power supply was turned ON or user parameter configuration (2700h) was executed when there was a Parameter Setting Error (alarm 040h).	Check the parameter settings.	Correct the parameter settings and turn the power supply OFF and ON again.	-
	A failure occurred in the SERVOPACK.	_	Replace the SERVO- PACK.	_
	The power supply was shut OFF while writing parameter settings.	Check the timing of shutting OFF the power supply.	Initialize the parameter settings (restore default parameters (1011h)) and then set the parameters again.	-
A48h: EEPROM Param-	The number of times that parameters were written exceeded the limit.	_	Repair or replace the SERVOPACK. Reconsider the method for writing the parameters.	-
eter Data Error	The power supply voltage suddenly dropped.	Measure the power supply voltage.	Set the power supply voltage within the specified range, and initialize the parameter settings (restore default parameters (1011h)).	-
	A failure occurred in the SERVOPACK.	_	Replace the SERVO-PACK.	_
b33h: Current Detection Error 3	A failure occurred in the current detection circuit.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
bF0h: System Alarm 0	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
bF1h: System Alarm 1	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
bF2h: System Alarm 2	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
bF3h: System Alarm 3	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
bF4h: System Alarm 4	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
bF5h: System Alarm 5	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
bF6h: System Alarm 6	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
bF7h: System Alarm 7	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	_
bF8h: System Alarm 8	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
C10h: Servomotor Out of Control (Detected when the servo is turned ON.)	The order of phases U, V, and W in the motor wiring is not correct.	Check the Servomotor wiring.	Make sure that the Servo- motor is correctly wired.	-
	There is an error in the setting of Pn080 (2080h) = n.□□X□ (Motor Phase Selection).	Check the setting of Pn080 (2080h) = n.□□X□.	Set Pn080 (2080h) = n.□□X□ to an appropriate value.	page 5-21
	A failure occurred in the encoder.	_	If the motor wiring is correct and the alarm still occurs after turning the power supply OFF and ON again, the Servomotor or linear encoder may be faulty. Replace the Servomotor or linear encoder.	-
	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
C20h: Phase Detection Error	The linear encoder signal level is too low.	Check the voltage of the linear encoder signal.	Fine-tune the mounting of the scale head. Or, replace the linear encoder.	-
	The count-up direction of the linear encoder does not match the forward direction of the Moving Coil in the motor.	Check the setting of Pn080 (2080h) = n.□□X□ (Motor Phase Selection). Check the installation orientation for the linear encoder and Moving Coil.	Change the setting of Pn080 (2080h) = n.□□X□. Correctly reinstall the linear encoder or Moving Coil.	page 5-21
	The polarity sensor signal is being affected by noise.	_	Correct the FG wiring. Implement countermea- sures against noise for the polarity sensor wiring.	-
	The setting of Pn282 (2282h) (Linear Encoder Pitch) is not correct.	Check the setting of Pn282 (2282h) (Linear Encoder Pitch).	Check the specifications of the linear encoder and set a correct value.	page 5-16
C21h: Polarity Sensor Error	The polarity sensor is protruding from the Magnetic Way of the motor.	Check the polarity sensor.	Correctly reinstall the Moving Coil or Magnetic 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 sensor.	-
C22h: Phase Informa- tion Disagree- ment	The SERVOPACK phase information is different from the linear encoder phase information.	_	Perform polarity detection.	page 5-26

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference	
, admirtume	The parameter settings are not correct.	Check the linear encoder specifications and feedback signal status.	The settings of Pn282 (2282h) (Linear Encoder Pitch) and Pn080 (2080h) = n.□□X□ (Motor Phase Selection) may not match the installation. Set the parameters to correct values.	page 5-16, page 5-21	
C50h: Polarity Detection Failure	There is noise on the scale signal.	Check to make sure that the frame grounds of the Serial Converter Unit and Servomotor are connected to the FG terminal on the SER-VOPACK and that the FG terminal on the SER-VOPACK is connected to the frame ground on the power supply. And, confirm that the shield is properly processed on the Linear Encoder Cable. Check to see if the detection reference is repeatedly output in one direction.	Implement appropriate countermeasures against noise for the Linear Encoder Cable.	_	
	An external force was applied to the Moving Coil of the motor.	_	The polarity cannot be properly detected if the detection reference is 0 and the speed feedback is not 0 because of an external force, such as cable tension, applied to the Moving Coil. Implement measures to reduce the external force so that the speed feedback goes to 0. If the external force cannot be reduced, increase the setting of Pn481 (2481h) (Polarity Detection Speed Loop Gain).	_	
C50h: Polarity Detection Failure	The linear encoder resolution is too low.	Check the linear encoder scale pitch to see if it is within 100 µm.	If the linear encoder scale pitch is 100 µm or higher, the SERVOPACK cannot detect the correct speed feedback. Use a linear encoder scale pitch with higher resolution. (We recommend a pitch of 40 µm or less.) Or, increase the setting of Pn485 (2485h) (Polarity Detection Reference Speed). However, increasing the setting of Pn485 (2485h) will increase the Servomotor movement range that is required for polarity detection.	_	

15.2.2 Troubleshooting Alarms

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Alarm Code:	Possible Cause Confirmation			Reference
C51h: Overtravel Detected during Polarity Detection	The overtravel signal was detected during polarity detection.	Check the overtravel position.	Correction Wire the overtravel signals. Execute polarity detection at a position where an overtravel signal would not be detected.	page 4-38
C52h: Polarity Detection Not Completed	The servo was turned ON when using an absolute linear encoder, Pn587 (2587h) was set to n.□□□0 (Do not detect polarity), and the polarity had not been detected.	_	When using an absolute linear encoder, set Pn587 (2587h) to n. \$\square\$ (Detect polarity)	-
C53h: Out of Range of Motion for Polarity Detection	The travel distance exceeded the setting of Pn48E (248Eh) (Polarity Detection Range) in the middle of detection.	_	Increase the setting of Pn48E (248Eh) (Polarity Detection Range). Or, increase the setting of Pn481 (2481h) (Polarity Detection Speed Loop Gain).	-
C54h: Polarity Detection Failure 2	An external force was applied to the Servomotor.	_	Increase the setting of Pn495 (2495h) (Polarity Detection Confirmation Force Reference). Increase the setting of Pn498 (2498h) (Polarity Detection Allowable Error Range). Increasing the allowable error will also increase the motor temperature.	-
C80h: Encoder Clear Error or Multiturn	A failure occurred in the encoder.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the Servomotor or linear encoder may be faulty. Replace the Servo- motor or linear encoder.	-
Limit Setting Error	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	There is a faulty contact in the connector or the connector is not wired correctly for the encoder.	Check the condition of the encoder connector.	Reconnect the encoder connector and check the encoder wiring.	page 4-27
	There is a cable disconnection or short-circuit in the encoder. Or, the cable impedance is outside the specified values.	Check the condition of the Encoder Cable.	Use the Encoder Cable within the specifications.	-
C90h: Encoder Commu- nications Error	One of the following has occurred: corrosion caused by improper temperature, humidity, or gas, a short-circuit caused by entry of water drops or cutting oil, or faulty contact in connector caused by vibration.	Check the operating environment.	Improve the operating environment, and replace the cable. If the alarm still occurs, replace the SER-VOPACK.	page 3-2
	A malfunction was caused by noise.	_	Correct the wiring around the encoder by separating the Encoder Cable from the Servomotor Main Circuit Cable or by grounding the encoder.	page 4-6
	A failure occurred in the SERVOPACK.	_	Connect the Servomotor to another SERVOPACK, and turn ON the control power supply. If no alarm occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
	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
C91h: Encoder Communications Position Data Acceleration Rate	The Encoder Cable is bundled with a high-current line or installed near a high-current line.	Check the installation condition of the Encoder Cable.	Confirm that there is no surge voltage on the Encoder Cable.	-
Error	There is variation in the FG potential because of the influ- ence of machines on the Servomotor side, such as a welder.	Check the installation condition of the Encoder Cable.	Properly ground the machine to separate it from the FG of the encoder.	-

15.2.2 Troubleshooting Alarms

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	Noise entered on the signal line from the encoder.	_	Implement countermeasures against noise for the encoder wiring.	page 4-6
	Excessive vibration or shock was applied to the encoder.	Check the operating conditions.	Reduce machine vibration. Correctly install the Servomotor or linear encoder.	-
C92h: Encoder Communications Timer Error	A failure occurred in the encoder.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the Servomotor or linear encoder may be faulty. Replace the Servo- motor or linear encoder.	-
	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
CA0h: Encoder Parame-	A failure occurred in the encoder.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the Servomotor or linear encoder may be faulty. Replace the Servo- motor or linear encoder.	-
ter Error	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	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 4-27
	The specifications of the Encoder Cable are not correct and noise entered on it.	_	Use a shielded twisted-pair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm ² .	-
	The Encoder Cable is too long and noise entered on it.	_	Rotary Servomotors: The Encoder Cable wiring distance must be 50 m max. Linear Servomotors: The Encoder Cable wiring distance must be 20 m max.	-
Cb0h: Encoder Echo- back Error	There is variation in the FG potential because of the influ- ence of machines on the Servomotor side, such as a welder.	Check the condition of the Encoder Cable and 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 vibration. Correctly install the Servomotor or linear encoder.	-
	A failure occurred in the encoder.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the Servomotor or linear encoder may be faulty. Replace the Servo- motor or linear encoder.	-
	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
	When using a Direct Drive Servomotor, the setting of Pn205 (2205h) (Multiturn Limit) does not agree with the encoder.	Check the setting of Pn205 (2205h).	Correct the setting of Pn205 (2205h) (0 to 65,535).	page 6-36
CC0h: Multiturn Limit Disagreement	The multiturn limit of the encoder is different from that of the SERVOPACK. Or, the multiturn limit of the SERVOPACK has been changed.	Check the setting of Pn205 (2205h) (Multiturn Limit).	Change the setting if the alarm occurs.	page 6-36
	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The cable between the Serial Converter Unit and SERVOPACK is not wired correctly or there is a faulty contact.	Check the wiring of the external encoder.	Correctly wire the cable between the Serial Converter Unit and SERVO-PACK.	page 4-29
CF1h: Reception Failed Error in Feed- back Option	A specified cable is not being used between Serial Con- verter Unit and SER- VOPACK.	Check the wiring specifications of the external encoder.	Use a specified cable.	-
Module Communications	The cable between the Serial Converter Unit and SERVOPACK is too long.	Measure the length of the cable that connects the Serial Converter Unit.	The length of the cable between the Serial Converter Unit and SERVO-PACK must be 20 m or less.	-
	The sheath on cable between the Serial Converter Unit and SERVOPACK is broken.	Check the cable that connects the Serial Converter Unit.	Replace the cable between the Serial Converter Unit and SERVO-PACK.	-
CF2h: Timer Stopped Error in Feed- back Option Module Commu- nications	Noise entered the cable between the Serial Converter Unit and SERVOPACK.	_	Correct the wiring around the Serial Converter Unit, e.g., separate I/O signal lines from the Main Circuit Cables or ground.	-
	A failure occurred in the Serial Converter Unit.	-	Replace the Serial Converter Unit.	-
	A failure occurred in the SERVOPACK.	_	Replace the SERVO- PACK.	_
	The Servomotor U, V, and W wiring is not correct.	Check the wiring of the Servomotor's Main Circuit Cables.	Make sure that there are no faulty contacts in the wiring for the Servomotor and encoder.	-
d00h: Position Deviation Overflow (The setting of Pn520 (2520h) (Excessive Position Excessive Position Position Position Position Deviation Deviation Position Deviation Position	The position command speed is too fast.	Reduce the position command speed and try operating the SER-VOPACK.	Reduce the position reference speed or the reference acceleration rate, or reconsider the electronic gear ratio.	page 5-44
	The acceleration of the position reference is too high.	Reduce the reference acceleration and try operating the SERVO-PACK.	Reduce the acceleration of the position reference using an EtherCAT command.	-
tion Error Alarm Level) was exceeded by the position devia- tion while the servo was ON.)	The setting of Pn520 (2520h) (Position Deviation Overflow Alarm Level) is too low for the operating conditions.	Check the setting of Pn520 (2520h) to see if it is appropriate.	Optimize the setting of Pn520 (2520h).	page 8-8
	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
d01h: Position Deviation Overflow Alarm at Servo ON	The servo was turned ON after the position deviation exceeded the setting of Pn526 (2526h) (Position Deviation Overflow Alarm Level at Servo ON) while the servo was OFF.	Check the position deviation while the servo is OFF.	Optimize the setting of Pn526 (2526h).	
d02h: Position Deviation Overflow Alarm for Speed Limit at Servo ON	If position deviation remains in the deviation counter, the setting of Pn529 (2529h) or Pn584 (2584h) (Speed Limit Level at Servo ON) will limit the speed when the servo is turned ON. This alarm occurs if a position reference is input and the setting of Pn520 (2520h) (Position Deviation Overflow Alarm Level) is exceeded.	_	Optimize the setting of Pn520 (2520h). Or, set Pn529 (2529h) or Pn584 (2584h) to an appropriate value.	page 8-8
d10h: Motor-Load Position Deviation	The motor direction and external encoder installation orientation are backward.	Check the motor direction and the external encoder installation orientation.	Install the external encoder in the opposite direction, or change the setting of Pn002 (2002h) = n.X□□□ (External Encoder Usage) to 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.	-
d30h: Position Data Overflow	The position data exceeded ±1,879,048,192.	Check the input reference pulse counter.	Reconsider the operating specifications.	-
E00h: EtherCAT Module Interface Initializa- tion Timeout Error	A failure occurred in the SERVOPACK.	_	Replace the SERVO-PACK.	_
E02h:	The EtherCAT transmission cycle fluctuated.	_	Remove the cause of transmission cycle fluctuation at the host controller.	-
EtherCAT Internal Synchronization Error 1	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
E03h: EtherCAT Mod- ule Interface Communications	Noise caused an error in communications between the SERVO-PACK and EtherCAT Network Module.	-	Implement countermea- sures against noise.	-
Data Error	A failure occurred in the SERVOPACK.	_	Replace the SERVO- PACK.	n novt nago

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Possible Cause	Confirmation	Correction	Reference
There is a faulty connection between the SERVOPACK and the Safety Option Module.	Check the connection between the SERVO- PACK and the Safety Option Module.	Correctly connect the Safety Option Module.	-
The Safety Option Module was discon- nected.	_	Execute Fn014 (Reset Option Module Configuration Error) from the Digital Operator or SigmaWin+ and then turn the power supply OFF and ON again.	page 15-43
A failure occurred in the Safety Option Module.	_	Replace the Safety Option Module.	_
A failure occurred in the SERVOPACK.	_	Replace the SERVO- PACK.	_
There is a faulty con- nection between the SERVOPACK and the Feedback Option Module.	Check the connection between the SERVO- PACK and the Feed- back Option Module.	Correctly connect the Feedback Option Module.	-
The Feedback Option Module was discon- nected.	_	Reset the Option Module configuration error and turn the power supply to the SERVOPACK OFF and ON again.	page 15-43
A failure occurred in the Feedback Option Module.	_	Replace the Feedback Option Module.	_
A failure occurred in the SERVOPACK.	_	Replace the SERVO-PACK.	_
A failure occurred in the Safety Option Module.	_	Replace the Safety Option Module.	-
An unsupported Safety Option Module was connected.	Refer to the manual for the connected Safety Option Module.	Connect a supported Safety Option Module.	-
A failure occurred in the Feedback Option Module.	_	Replace the Safety Option Module.	-
An unsupported Feedback Option Module was con- nected.	Refer to the catalog for the connected Feed- back Option Module or the SERVOPACK man- ual.	Connect a supported Feedback Option Module.	_
A failure occurred in the SERVOPACK.	_	Replace the SERVO- PACK.	_
A failure occurred in the SERVOPACK.	_	Replace the SERVO- PACK.	_
	There is a faulty connection between the SERVOPACK and the Safety Option Module. The Safety Option Module. The Safety Option Module was disconnected. A failure occurred in the SERVOPACK. There is a faulty connection between the SERVOPACK and the Feedback Option Module. The Feedback Option Module was disconnected. A failure occurred in the Feedback Option Module. A failure occurred in the SERVOPACK. A failure occurred in the SERVOPACK. A failure occurred in the SERVOPACK. A failure occurred in the Safety Option Module. An unsupported Safety Option Module was connected. A failure occurred in the Feedback Option Module. An unsupported Safety Option Module was connected. A failure occurred in the Feedback Option Module. An unsupported Feedback Option Module was connected. A failure occurred in the SERVOPACK.	There is a faulty connection between the SERVOPACK and the Safety Option Module. The Safety Option Module. A failure occurred in the SERVOPACK. There is a faulty connection between the SERVOPACK. There is a faulty connection between the SERVOPACK and the Feedback Option Module. The Feedback Option Module. The Feedback Option Module was disconnected. A failure occurred in the Feedback Option Module was disconnected. A failure occurred in the SERVOPACK. A failure occurred in the SERVOPACK. A failure occurred in the Servopack. A failure occurred in the Safety Option Module. An unsupported Safety Option Module was connected. A failure occurred in the Feedback Option Module. An unsupported Safety Option Module. A failure occurred in the Feedback Option Module. A failure occurred in the Servopack. A failure occurred in the Seedback Option Module. An unsupported Feedback Option Module was connected. A failure occurred in the Servopack Module or the Servopack manual. A failure occurred in the Servopack. A failure occurred in the Servopack manual. A failure occurred in the Servopack.	There is a faulty connection between the SERVOPACK and the Safety Option Module. The Safety Option Module. The Safety Option Module. The Safety Option Module. A failure occurred in the SERVOPACK. There is a faulty connection between the SERVOPACK. There is a faulty connection between the SERVOPACK. There is a faulty connection between the SERVOPACK and the Feedback Option Module. A failure occurred in the SERVOPACK. A failure occurred in the SERVOPACK. A failure occurred in the SERVOPACK. A failure occurred in the Sefety Option Module. A replace the Sefety Option Module. A failure occurred in the Feedback Option Module. A failure occurred in the Sefety Option Module. An unsupported Sefety Option Module. An unsupported Feedback Option Module. A failure occurred in the Feedback Option Module. A failure occurred in the Sefety Option Module. A failu

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Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
EA2h: Command- Option IF Servo Synchronization Error	Fluctuation in the EtherCAT communications synchronization timing (Sync0) caused the synchronization timing in the SERVO-PACK to fluctuate.	_	Turn the power supply OFF and ON again and reestablish communications.	_
	A failure occurred in the SERVOPACK.	_	Repair or replace the SERVOPACK.	_
EA3h: Command- Option IF Servo	Noise caused an error in communications in the SERVOPACK.	_	Implement countermeasures against noise.	-
Data Error	A failure occurred in the SERVOPACK.	_	Replace the SERVO-PACK.	_
Eb1h: Safety Function Signal Input Tim- ing Error	The delay between activation of the /HWBB1 and /HWBB2 input signals for the HWBB was ten second or longer. The delay between activation of the /HWBB1 and /HWBB1 and /HWBB2 signals. Measure the time delay between the /HWBB1 and /HWBB2 signals.		The output signal circuits or devices for /HWBB1 and /HWBB2 or the SER-VOPACK input signal circuits may be faulty. Alternatively, the input signal cables may be disconnected. Check to see if any of these items are faulty or have been disconnected.	_
	A failure occurred in the SERVOPACK.	_	Replace the SERVO-PACK.	_
EC8h: Gate Drive Error 1 (An error occurred in the gate drive circuit.) EC9h: Gate Drive Error 2 (An error occurred in the gate drive circuit.)	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	_
Ed1h: Command Exe- cution Timeout	A timeout error occurred for an Ether-CAT command.	Check the motor status when the command is executed.	Execute the Servo ON command (Enable Operation command) only when the motor is not operating.	-
	The three-phase power supply wiring is not correct.	Check the power supply wiring.	Make sure that the power supply is correctly wired.	page 4-12
F10h: Power Supply	The three-phase power supply is unbalanced.	Measure the voltage for each phase of the three-phase power supply.	Balance the power supply by changing phases.	-
Line Open Phase (The voltage was low for more than one second for phase R, S, or T when the main power supply	A single-phase power supply was input without specifying a single-phase AC power supply input (Pn00B (200Bh) = n.□1□□).	Check the power supply and the parameter setting.	Match the parameter setting to the power supply.	page 4-12
was ON.)	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

15.2.2 Troubleshooting Alarms

Continued from previous page.

Alarm Code: Alarm Name	Possible Cause	Confirmation	Correction	Reference
FL-1: System Alarm*4 FL-2: System Alarm*4 FL-3: System Alarm*4 FL-4: System Alarm*4 FL-5: System Alarm*4 FL-6: System Alarm*4	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	_
CPF00: Digital Operator Communications	There is a faulty connection between the Digital Operator and the SERVOPACK.	Check the connector contact.	Disconnect the connector and insert it again. Or, replace the cable.	_
Error 1	A malfunction was caused by noise.	_	Keep the Digital Operator or the cable away from sources of noise.	-
CPF01: Digital Operator Communications	A failure occurred in the Digital Operator.	_	Disconnect the Digital Operator and then con- nect it again. If the alarm still occurs, the Digital Operator may be faulty. Replace the Digital Oper- ator.	_
Error 2	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	_

^{*1.} Detection Conditions

Rotary Servomotor

If either of the following conditions is detected, an alarm will occur.

• Pn533 [min⁻¹]
$$\times \frac{\text{Encoder resolution}}{6 \times 10^5} \leq 1$$

• Maximum motor speed [min⁻¹]
$$\times$$
 Encoder resolution
Approx. 3.66 \times 10¹² \ge 1

Linear Servomotor

If either of the following conditions is detected, an alarm will occur.

Pn585 [mm/s]		Resolution of Serial Converter Unit	< 1
Linear encoder pitch [μm]	^	10	21
 Pn385 [100 mm/s]		Resolution of Serial Converter Unit	> 1
Linear encoder pitch [um]	^	Approx 6.10 x10 ⁵	_

^{*2.} Refer to the following manual for details.

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

^{*3.} 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.

^{*4.} These alarms are not stored in the alarm history. They are only displayed on the panel display.

15.2.3 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.



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.

Clearing Alarms and Warnings with the Fault Reset Command

Execute the Fault Reset command to clear alarms or warnings.

Refer to the following section for details on the Fault Reset command.

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.

Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)

15.2.4 Displaying the Alarm History

The alarm history displays up to the last ten alarms that have occurred in the SERVOPACK.

Note: The following alarms are not displayed in the alarm history: A.E50 (EtherCAT Synchronization Error), A.E60 (Reception Error in EtherCAT Communications), and FL-1 to FL-6.

Preparations

No preparations are required.

Applicable Tools

The following table lists the tools that you can use to display the alarm history and the applicable tool functions.

Tool	Function	Reference
Digital Operator	Fn000	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Alarm – Display Alarm	Operating Procedure on page 15-42

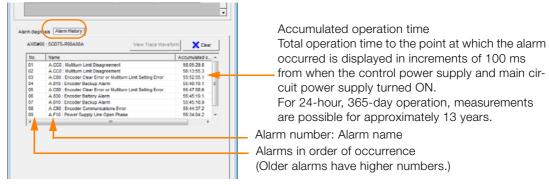
15.2.5 Clearing the Alarm History

Operating Procedure

Use the following procedure to display the alarm history.

- 1. Click the 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.

15.2.5 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 and the applicable tool functions.

Tool	Function	Reference
Digital Operator	Fn006	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Alarm – Display Alarm	Operating Procedure on page 15-43

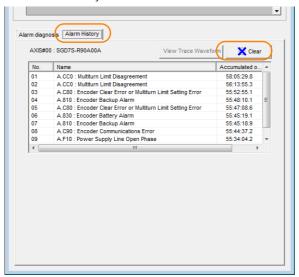
15

Operating Procedure

Use the following procedure to reset the alarm history.

- 1. Click the 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.
- 4. Click the Clear Button.

The alarm history will be cleared.



This concludes the procedure to reset the alarm history.

15.2.6 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.



- 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 and the applicable tool functions.

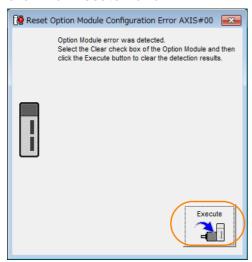
Tool	Function	Reference
Digital Operator	Fn014	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup – Reset Configuration Error of Option Module	Operating Procedure on page 15-44

15.2.6 Resetting Alarms Detected in Option Modules

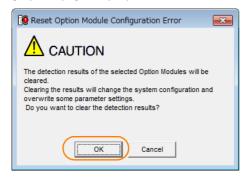
Operating Procedure

Use the following procedure to reset alarms detected in Option Modules.

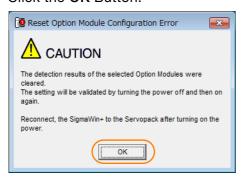
- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Reset Option Module Configuration Error in the Menu Dialog Box. The Reset Option Module Configuration Error Dialog Box will be displayed.
- 3. Select the Clear Check Box for the Option Modules from which to clear alarms and the click the Execute Button.



4. Click the OK Button.



5. Click the OK Button.



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

This concludes the procedure to reset alarms detected in Option Modules.

15.2.7 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.



- 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 clear 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 and the applicable tool functions.

Tool	Function	Reference
Digital Operator	Fn021	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Alarm – Reset Motor Type Alarm	Operating Procedure on page 15-45

Operating Procedure

Use the following procedure to reset Motor Type alarm.

- 1. Click the 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 Clear Button. The alarm will be cleared.

This concludes the procedure to reset Motor Type alarms.

15.3 Warning Displays

To check a warning that occurs in the SERVOPACK, use one of the following methods. Warnings are displayed to warn you before an alarm occurs.

	If there is a warning, the code will be displayed one character at a time, as shown
Panel display on SERVOPACK	below. Example: Alarm A.E60
	Status of the s
Digital Operator	The warning code is displayed.
Statusword (6041h)	Bit 7 (warning) in the statusword will change to 1. (Bit 7 is 0 during normal operation.)
Error code (603Fh)	A current warning code is stored in error code (603Fh).
Emergency message	The Controller is notified of any warning that occurs. (Notification may not be possible if EtherCAT communications are unstable.)

This next section provides a list of warnings and the causes of and corrections for warnings.

15.3.1 List of Warnings

The warning table gives the warning name and warning meaning in order of the warning codes.

Warning Code	Warning Name	Meaning
900h	Position Deviation Overflow	The position deviation exceeded the percentage set with the following formula: (Pn520 (2520h) × Pn51E (251Eh/100)
901h	Position Deviation Overflow Alarm at Servo ON	The position deviation when the servo was turned ON exceeded the percentage set with the following formula: (Pn526 (2526h) × Pn528 (2528h)/100)
910h	Overload	This warning occurs before an overload alarm (A.710 or A.720) occurs. If the warning is ignored and operation is continued, an alarm may occur.
911h	Vibration	Abnormal vibration was detected during motor operation. The detection level is the same as A.520. Set whether to output an alarm or a warning by setting Pn310 (2310h) (Vibration Detection Selections).
912h	Internal Temperature Warning 1 (Control Board Temperature Error)	The surrounding temperature of the control PCB is abnormal.
913h	Internal Temperature Warning 2 (Power Board Temperature Error)	The surrounding temperature of the power PCB is abnormal.
920h	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.
921h	Dynamic Brake Over- load	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.
923h	SERVOPACK Built-in Fan Stopped	The fan inside the SERVOPACK stopped.
930h	Absolute Encoder Bat- tery Error	This warning occurs when the voltage of absolute encoder's battery is low.
93Bh	Overheat Warning	The input voltage (temperature) for the overheat protection input (TH) signal exceeded the setting of Pn61C (261Ch) (Overheat Warning Level).

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Continued from previous page.

Warning Code	Warning Name	Meaning
942h	Speed Ripple Com- pensation Information Disagreement	The speed ripple compensation information stored in the encoder does not agree with the speed ripple compensation information stored in the SERVOPACK.
971h	Undervoltage	This warning occurs before an A.410 alarm (Undervoltage) occurs. If the warning is ignored and operation is continued, an alarm may occur.
9A0h	Overtravel	Overtravel was detected while the servo was ON.
9b0h	Preventative Mainte- nance Warning	One of the consumable parts has reached the end of its service life.

Note: Use Pn008 (2008h) = n.□X□□ (Warning Detection Selection) to control warning detection. However, the following warnings are not affected by the setting of Pn008 (2008h) = n.□X□□.

Warning	Parameters That Must Be Set to Select Warning Detection	Reference
971h	Pn008 (2008h) = n.□□X□ (Function Selection for Undervoltage)	page 6-14
9A0h	Pn00D (200Dh) = n.X□□□ (Overtravel Warning Detection Selection)	page 5-30

In addition to Pn008 (2008h) = $n.\Box X\Box \Box$, the following parameters must also be set.

Warning	Parameters That Must Be Set to Select Warning Detection	Reference
911h	Pn310 (2310h) = n.□□□X (Vibration Detection Selections)	page 6-45
930h	Pn008 (2008h) = n.□□□X (Low Battery Voltage Alarm/Warning Selection)	page 15-3
942h	Pn423 (2423h) = n.□□X□ (Speed Ripple Compensation Information Disagreement Warning Detection Selection)	page 8-59
9b0h	Pn00F (200Fh) = n.□□□X (Preventative Maintenance Warning Selection)	page 9-15

15.3.2 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 Code: Warning Name	Possible Cause	Confirmation	Correction	Reference
	The Servomotor U, V, and W wiring is not correct.	Check the wiring of the Servomotor's Main Circuit 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- PACK gains.	Increase the servo gain, e.g., by using autotuning without a host reference.	page 8-23
	The acceleration of the position reference is too high.	Reduce the reference acceleration and try operating the SERVO-PACK.	Reduce the acceleration of the position reference using an EtherCAT command.	-
900h: Position Deviation Overflow	The excessive position deviation alarm level (Pn520 (2520h) × Pn51E (251Eh)/100) is too low for the operating conditions.	Check excessive position deviation alarm level (Pn520 (2520h) × Pn51E (251Eh)/100) to see if it is set to an appropriate value.	Optimize the settings of Pn520 (2520h) and Pn51E (251Eh).	page 8-8
	A failure occurred in the SERVO-PACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

15.3.2 Troubleshooting Warnings

Continued from previous page.

Warning Code:	Donaible Cause	Confirmation	Continued from pre	1 0
Warning Name	Possible Cause	Confirmation	Correction	Reference
901h: Position Deviation Overflow Alarm at Servo ON	The position deviation when the servo was turned ON exceeded the percentage set with the following formula: (Pn526 (2526h) × Pn528 (2528h)/100)	_	Optimize the setting of Pn528 (2528h) (Position Deviation Overflow Warning Level at Servo ON).	-
	The wiring is not correct or there is a faulty connection in the motor or encoder wiring.	Check the wiring.	Make sure that the Servo- motor and encoder are cor- rectly wired.	-
	Operation was performed that exceeded the overload protection characteristics.	Check the motor over- load characteristics and Run command.	Reconsider the load and operating conditions. Or, increase the motor capacity.	-
910h: Overload (warning before an A.710 or A.720 alarm occurs)	An excessive load was applied during operation because the Servomotor was not driven because of mechanical problems.	Check the operation reference and motor speed.	Remove the mechanical problem.	-
	The overload warning level (Pn52B (252Bh)) is not suitable.	Check that the overload warning level (Pn52B (252Bh)) is suitable.	Set a suitable overload warning level (Pn52B (252Bh)).	page 5-41
	A failure occurred in the SERVO-PACK.	_	The SERVOPACK may be faulty. Replace the SERVO-PACK.	_
	Abnormal vibration was detected during motor operation.	Check for abnormal motor noise, and check the speed and torque waveforms during operation.	Reduce the motor speed. Or, reduce the servo gain with custom tuning.	page 8-41
911h: Vibration	The setting of Pn103 (2103h) (Moment of Inertia Ratio) is greater than the actual moment of inertia or was greatly changed.	Check the moment of inertia ratio or mass ratio.	Correct the setting of Pn103 (2103h).	page 8-16
	The vibration detection level (Pn312 (2312h) or Pn384 (2384h)) is not suitable.	Check that the vibration detection level (Pn312 (2312h) or Pn384 (2384h)) is suitable.	Set a suitable vibration detection level (Pn312 (2312h) or Pn384 (2384h)).	page 6-45

Continued from previous page.

Warning Code:	Possible Cause	Confirmation	Continued from pre	Reference
Warning Name	. 222,510 34400	Check the surrounding	20.700.011	
	The surrounding temperature is too high.	temperature using a thermometer. Or, check the operating status with the SERVOPACK installation environment monitor.	Decrease the surrounding temperature by improving the SERVOPACK installation conditions.	page 3-6
	An overload alarm was reset by turning OFF the power supply too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	-
912h: Internal Tempera- ture Warning 1 (Control Board Tem- perature Error)	There was an excessive load or operation was performed that exceeded the regenerative processing capacity.	Use the accumulated load ratio to check the load during operation, and use the regenerative load ratio to check the regenerative processing capacity.	Reconsider the load and operating conditions.	-
	The SERVOPACK installation orientation is not correct or there is insufficient space around the SERVOPACK.	Check the SERVO- PACK installation con- ditions.	Install the SERVOPACK according to specifications.	page 3-3, page 3-5
	A failure occurred in the SERVO-PACK.	-	The SERVOPACK may be faulty. Replace the SERVO-PACK.	_
	The surrounding temperature is too high.	Check the surrounding temperature using a thermometer. Or, check the operating status with the SERVOPACK installation environment monitor.	Decrease the surrounding temperature by improving the SERVOPACK installation conditions.	page 3-6
	An overload alarm was reset by turning OFF the power supply too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	-
913h: Internal Temperature Warning 2 (Power Board Temperature Error)	There was an excessive load or operation was performed that exceeded the regenerative processing capacity.	Use the accumulated load ratio to check the load during operation, and use the regenerative load ratio to check the regenerative processing capacity.	Reconsider the load and operating conditions.	-
	The SERVOPACK installation orientation is not correct or there is insufficient space around the SERVOPACK.	Check the SERVO- PACK installation con- ditions.	Install the SERVOPACK according to specifications.	page 3-3, page 3-5
	A failure occurred in the SERVO-PACK.	_	The SERVOPACK may be faulty. Replace the SERVO-PACK.	-

15.3.2 Troubleshooting Warnings

Continued from previous page.

Marning Cada			Continued from pre	vious page.
Warning Code: Warning Name	Possible Cause	Confirmation	Correction	Reference
920h: Regenerative Overload (warning before an A.320 alarm occurs)	The power supply voltage exceeded the specified range.	Measure the power supply voltage.	Set the power supply voltage within the specified range.	-
	There is insufficient external regenerative resistance, regenerative resistor capacity, or SER-VOPACK capacity, or there has been a continuous regeneration state.	Check the operating conditions or the capacity using the SigmaJunmaSize+ Capacity Selection Software or another means.	Change the regenerative resistance value, regenerative resistance capacity, or SERVOPACK capacity. Reconsider the operating conditions using the Sigma-JunmaSize+ Capacity Selection Software or other means.	
	There was a continuous regeneration state because a negative load was continuously applied.	Check the load applied to the Servomotor during operation.	Reconsider the system including the servo, machine, and operating conditions.	-
	The Servomotor was rotated by an external force.	Check the operation status.	Implement measures to ensure that the motor will not be rotated by an external force.	-
921h: Dynamic Brake Overload (warning before an A.731 alarm occurs)	When the Servo- motor was stopped with the dynamic brake, the rotational or linear kinetic energy exceeded the capacity of the dynamic brake resistor.	Check the power consumed by the DB resistor to see how frequently the DB is being used.	Reconsider the following: Reduce the Servomotor command speed. Decrease the moment of inertia or mass. Reduce the frequency of stopping with the dynamic brake.	-
7	A failure occurred in the SERVO-PACK.	-	The SERVOPACK may be faulty. Replace the SERVO-PACK.	-
923h: SERVOPACK Built- in Fan Stopped	The fan inside the SERVOPACK stopped.	Check for foreign matter inside the SERVO-PACK.	Remove foreign matter from the SERVOPACK. If the alarm still occurs, the SER- VOPACK may be faulty. Replace the SERVOPACK.	-
930h: Absolute Encoder Battery Error (The absolute encoder battery voltage was lower than the spec- ified level.) (Detected only when an abso- lute encoder is con- nected.)	The battery con- nection is faulty or a battery is not connected.	Check the battery connection.	Correct the battery connection.	page 4-28
	The battery voltage is lower than the specified value (2.7 V).	Measure the battery voltage.	Replace the battery.	page 15-3
	A failure occurred in the SERVO-PACK.	_	The SERVOPACK may be faulty. Replace the SERVO-PACK.	_

Continued from previous page.				
Warning Code: Warning Name	Possible Cause	Confirmation	Correction	Reference
	The surrounding temperature is too high.	Check the surrounding temperature using a thermometer.	Lower the surrounding temperature by improving the installation conditions of the Linear Servomotor or the machine.	-
	Operation was performed under an excessive load.	Use the accumulated load ratio to check the load during operation.	Reconsider the load and operating conditions.	_
93Bh: Overheat Warning	A failure occurred in the SERVO-PACK.	_	The SERVOPACK may be faulty. Replace the SERVO-PACK.	_
	The temperature detection circuit in the Linear Servomotor is faulty or the sensor attached to the machine is faulty.	_	The temperature detection circuit in the Linear Servomotor may be faulty or the sensor attached to the machine may be faulty. Replace the Linear Servomotor or repair the sensor attached to the machine.	-
	The speed ripple	-	Reset the speed ripple compensation value on the SigmaWin+.	page 8-59
942h: Speed Ripple Compensation Informa-	compensation information stored in the encoder does not agree with the speed	-	Set Pn423 (2423h) to n. \$\square\$ 10 not detect A.942 alarms). However, changing the setting may increase the speed ripple.	page 8-59
tion Disagreement	ripple compensa- tion information stored in the SER- VOPACK.	_	Set Pn423 (2423h) to n. \$\square\$ (Disable torque ripple compensation). However, changing the setting may increase the speed ripple.	page 8-59
	For a 200-V SER- VOPACK, the AC power supply volt- age dropped below 140 V.	Measure the power supply voltage.	Set the power supply voltage within the specified range.	-
	For a 100-V SER- VOPACK, the AC power supply volt- age dropped below 60 V.	Measure the power supply voltage.	Set the power supply voltage within the specified range.	-
971h: Undervoltage	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 setting of Pn509 (2509h) (Momentary Power Interruption Hold Time), decrease the setting.	page 6-13
	The SERVOPACK fuse is blown out.	_	Replace the SERVOPACK and connect a reactor.	page 4-26
	A failure occurred in the SERVO-PACK.	_	The SERVOPACK may be faulty. Replace the SERVO-PACK.	_

15.3.2 Troubleshooting Warnings

Continued from previous page.

Warning Code: Warning Name	Possible Cause	Confirmation	Correction	Reference
9A0h: Overtravel (Over- travel status was detected.)	Overtravel was detected while the servo was ON.	Check the status of the overtravel signals on the input signal monitor.	Even if an overtravel signal is not shown by the input signal monitor, momentary overtravel may have been detected. Take the following precautions. • Do not specify movements that would cause overtravel from the host controller. • Check the wiring of the overtravel signals. • Implement countermeasures against noise.	page 5-30
9b0h: Preventative Mainte- nance Warning	One of the consumable parts has reached the end of its service life.	_	Replace the part. Contact your Yaskawa representative for replacement.	page 9-14

15.4

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 between control power supply terminals.	Turn OFF the power supply to the servo system. Correct the wiring so that the control power supply is turned ON.	-
	The main circuit power supply is not turned ON.	Measure the voltage across the main circuit power input terminals.	Turn OFF the power supply to the servo system. Correct the wiring so that the main circuit power supply is turned ON.	-
	The I/O signal connector (CN1) pins are not wired correctly or are disconnected.	Turn OFF the power supply to the servo system. Check the wiring condition of the I/O signal connector (CN1) pins.	Correct the wiring of the I/O signal connector (CN1) pins.	page 4-35, page 9-5
	The wiring for the Servomotor Main Circuit Cables or Encoder Cable is disconnected.	Check the wiring conditions.	Turn OFF the power supply to the servo system. Wire the cable correctly.	-
Servomotor Does Not Start	There is an overload on the Servomotor.	Operate the Servomotor with no load and check the load status.	Turn OFF the power supply to the servo system. Reduce the load or replace the Servomotor with a Servomotor with a larger capacity.	-
	The type of encoder that is being used does not agree with the setting of Pn002 (2002h) = n.□X□□ (Encoder Usage).	Check the type of the encoder that is being used and the setting of Pn002 (2002h) = n.□X□□.	Set Pn002 (2002h) = n.□X□□ according to the type of the encoder that is being used.	page 6-30
	There is a mistake in the input signal allocations (Pn50A (250Ah), Pn50B (250Bh), Pn511 (2511h), and Pn516 (2516h)).	Check the input signal allocations (Pn50A (250Ah), Pn50B (250Bh), Pn511 (2511h), Pn516 (2516h)).	Correctly allocate the input signals (Pn50A (250Ah), Pn50B (250Bh), Pn511 (2511h), Pn516 (2516h)).	page 6-3, page 9-5
	The Servo ON command (Enable Operation command) was not sent.	Make sure the Servo ON command (Enable Operation command) is set to Operation Enabled.	Set the correct value for the Servo ON com- mand (Enable Opera- tion command).	-
	The torque limit reference is too small.	Check the torque limit reference.	Increase the torque limit reference.	_
	The operation mode is not set.	Check to see if modes of operation (6060h) is set.	Set modes of operation (6060h) correctly.	_
	A software limit is active.	Check to see if the target position exceeds a software limit.	Specify a target position that is within the software limits.	_
	EtherCAT communications are not established.	Check to see if the Ether- CAT indicator shows the Operational state.	Place the EtherCAT communications in the Operational state.	_

			Continued from pre	
Problem	Possible Cause	Confirmation	Correction	Reference
	The P-OT (Forward Drive Prohibit) or N-OT (Reverse Drive Prohibit) signal is still OFF.	Check the P-OT and N-OT signals.	Turn ON the P-OT and N-OT signals.	page 9-5
	The safety input signals (/HWBB1 or /HWBB2) were not turned ON.	Check the /HWBB1 and /HWBB2 input signals.	Turn ON the /HWBB1 and /HWBB2 input signals. If you are not using the safety function, connect the Safety Jumper Connector (provided as an accessory) to CN8.	page 9-5
Servomotor Does Not	The FSTP (Forced Stop Input) signal is still OFF.	Check the FSTP signal.	Turn ON the FSTP signal. If you will not use the function to force the motor to stop, set Pn516 (2516h) = n.□□□X (FSTP (Forced Stop Input) Signal Allocation) to disable the signal.	page 9-5
Start	A failure occurred in the SER-VOPACK.	_	Turn OFF the power supply to the servo system. Replace the SERVO-PACK.	-
		Check the setting of Pn080 (2080h) =n.□□□X (Polarity Sensor Selection).	Correct the parameter setting.	page 5-23
	The polarity detection was not executed.	Check the inputs to the Servo ON command (Enable Operation command).	If you are using an incremental linear encoder, send the Servo ON command (Enable Operation command) from the host controller. If you are using an absolute linear encoder, execute polarity detection.	page 5-24
	There is a mistake in the Servomotor wiring.	Turn OFF the power supply to the servo system. Check the wiring.	Wire the Servomotor correctly.	_
	There is a mistake in the wiring of the encoder or Serial Converter Unit.	Turn OFF the power supply to the servo system. Check the wiring.	Wire the Serial Converter Unit correctly.	_
Servomotor Moves Instanta- neously, and Then Stops	There is a mistake in the linear encoder wiring.	Turn OFF the power supply to the servo system. Check the wiring.	Wire the cable correctly.	_
	The setting of Pn282 (2282h) (Linear Encoder Pitch) is not correct.	Check the setting of Pn282 (2282h).	Correct the setting of Pn282 (2282h).	page 5-16
·	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 Pn080 (2080h) = n.□□X□ (Motor Phase Selection). Match the linear encoder direction and motor direction.	page 5-21

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Continued from previous page.

Problem	Possible Cause	Confirmation	Continued from pre	Reference
Servomotor Moves Instanta- neously, and Then Stops	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 the polarity detection-related parameters.	-
Servomotor Speed Is Unstable	There is a faulty connection in the Servomotor wiring.	The connector connections for the power line (U, V, and W phases) and the encoder or Serial Converter Unit may be unstable. Turn OFF the power supply to the servo system. Check the wiring.	Tighten any loose terminals or connectors and correct the wiring.	-
	A failure occurred in the SER-VOPACK.	_	Turn OFF the power supply to the servo system. Replace the SERVO-PACK.	_
Servomotor Moves with- out a Refer- 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 Pn080 (2080h) = n.□□X□ (Motor Phase Selection). Match the linear encoder direction and Servomotor direction.	page 5-21
	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 the polarity detection-related parameters.	-
Dynamic Brake Does Not Operate	The setting of Pn001 (2001h) = n.□□□X (Motor Stopping Method for Servo OFF and Group 1 Alarms, Overtravel Stopping Method) is not suitable.	Check the setting of Pn001 (2001h) = n.□□□X.	Set Pn001 (2001h) = n.□□□X correctly.	_
	The dynamic brake resistor is disconnected.	Check the moment of inertia, motor speed, and dynamic brake frequency of use. If the moment of inertia, motor speed, or dynamic brake frequency of use is excessive, the dynamic brake resistance may be disconnected.	Turn OFF the power supply to the servo system. Replace the SERVO-PACK. To prevent disconnection, reduce the load.	-
	There was a failure in the dynamic brake drive circuit.	_	There is a defective component in the dynamic brake circuit. Turn OFF the power supply to the servo system. Replace the SERVO-PACK.	-

D 1:	D 11.0	0 " "	Continued from pre	
Problem	Possible Cause	Confirmation	Correction	Reference
	The Servomotor vibrated considerably while performing the tuning-less function with the default settings.	Check the waveform of the motor speed.	Reduce the load so that the moment of inertia ratio or mass ratio is within the allowable value, or increase the load level or reduce the rigidity level in the tuning-less level settings. If the situation is not improved, disable the tuning-less function (i.e., set Pn170 (2170h) to n.□□□0) and execute autotuning either with or without a host reference.	page 8-12
	The machine mounting is not secure.	Turn OFF the power supply to the servo system. Check to see if there are any loose mounting screws.	Tighten the mounting screws.	-
	The machine mounting is not secure.	Turn OFF the power supply to the servo system. Check to see if there is misalignment in the coupling.	Align the coupling.	-
Abnormal Noise from Servomotor	Secure.	Turn OFF the power supply to the servo system. Check to see if the coupling is balanced.	Balance the coupling.	_
	The bearings are defective.	Turn OFF the power supply to the servo system. Check for noise and vibration around the bearings.	Replace the Servomotor.	-
	There is a vibration source at the driven machine.	Turn OFF the power supply to the servo system. Check for any foreign matter, damage, or deformation in the machine's moving parts.	Consult with the machine manufacturer.	-
	Noise interference occurred because of incorrect I/O signal cable specifications.	Turn OFF the power supply to the servo system. Check the I/O signal cables to see if they satisfy specifications. Use shielded twisted-pair wire cables or screened twisted-pair cables with conductors of at least 0.12 mm ² .	Use cables that satisfy the specifications.	-
	Noise interference occurred because an I/O signal cable is too long.	Turn OFF the power supply to the servo system. Check the lengths of the I/O signal cables.	The I/O signal cables must be no longer than 3 m.	_

Problem	Possible Cause	Confirmation	Correction	Reference
	Noise interference occurred because of incorrect Encoder Cable specifications.	Turn OFF the power supply to the servo system. Make sure that the rotary or Linear Encoder Cable satisfies the specifications. Use a shielded twisted-pair wire cable or a screened twisted-pair cable with a conductors of at least 0.12 mm ² .	Use cables that satisfy the specifications.	-
	Noise interference occurred because the Encoder Cable is too long.	Turn OFF the power supply to the servo system. Check the length of the Encoder Cable.	Rotary Servomotors: The Encoder Cable length must be 50 m max. Linear Servomotors: Make sure that the Serial Converter Unit cable is no longer than 20 m and that the Linear Encoder Cable and the Sensor Cable are no longer than 15 m each.	-
	Noise interference occurred because the Encoder Cable is damaged.	Turn OFF the power supply to the servo system. Check the Encoder Cable to see if it is pinched or the sheath is damaged.	Replace the Encoder Cable and correct the cable installation envi- ronment.	-
Abnormal Noise from Servomotor	The Encoder Cable was subjected to excessive noise interference.	Turn OFF the power supply to the servo system. Check to see if the Encoder Cable is bundled with a high-current line or installed near a high-current line.	Correct the cable lay- out so that no surge is applied by high-current lines.	-
	There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder.	Turn OFF the power supply to the servo system. Check to see if the machines are correctly 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 noise interference on the signal line from the encoder.	Turn OFF the power supply to the servo system. Implement countermeasures against noise for the encoder wiring.	-
	The encoder was subjected to excessive vibration or shock.	Turn OFF the power supply to the servo system. Check to see if vibration from the machine occurred. Check the Servomotor installation (mounting surface precision, securing state, and alignment). Check the linear encoder installation (mounting surface precision and securing method).	Reduce machine vibration. Improve the mounting state of the Servomotor or linear encoder.	-
	A failure occurred in the encoder.	_	Turn OFF the power supply to the servo system. Replace the Servomotor.	-

Problem	Possible Cause	Confirmation	Continued from pre	Reference
Abnormal	A failure occurred in the Serial Converter Unit.	-	Turn OFF the power supply to the servo system. Replace the Serial Converter Unit.	-
Noise from Servomotor	A failure occurred in the linear encoder.	_	Turn OFF the power supply to the servo system. Replace the linear encoder.	_
	The servo gains are not balanced.	Check to see if the servo gains have been correctly tuned.	Perform autotuning without a host reference.	page 8-23
Servomotor	The setting of Pn100 (2100h) (Speed Loop Gain) is too high.	Check the setting of Pn100 (2100h). The default setting is Kv = 40.0 Hz.	Set Pn100 (2100h) to an appropriate value.	_
Vibrates at Frequency of Approx. 200 to 400	The setting of Pn102 (2102h) (Position Loop Gain) is too high.	Check the setting of Pn102 (2102h). The default setting is Kp = 40.0/s.	Set Pn102 (2102h) to an appropriate value.	_
Hz.	The setting of Pn101 (2101h) (Speed Loop Integral Time Constant) is not appropriate.	Check the setting of Pn101 (2101h). The default setting is Ti = 20.0 ms.	Set Pn101 (2101h) to an appropriate value.	_
	The setting of Pn103 (2103h) (Moment of Inertia Ratio or Mass Ratio) is not appropriate.	Check the setting of Pn103 (2103h).	Set Pn103 (2103h) to an appropriate value.	_
	The servo gains are not balanced.	Check to see if the servo gains have been correctly tuned.	Perform autotuning without a host reference.	page 8-23
	The setting of Pn100 (2100h) (Speed Loop Gain) is too high.	Check the setting of Pn100 (2100h). The default setting is Kv = 40.0 Hz.	Set Pn100 (2100h) to an appropriate value.	-
Large Motor	The setting of Pn102 (2102h) (Position Loop Gain) is too high.	Check the setting of Pn102 (2102h). The default setting is Kp = 40.0/s.	Set Pn102 (2102h) to an appropriate value.	_
Speed Overshoot on Starting and Stop- ping	The setting of Pn101 (2101h) (Speed Loop Integral Time Constant) is not appropriate.	Check the setting of Pn101 (2101h). The default setting is Ti = 20.0 ms.	Set Pn101 (2101h) to an appropriate value.	_
	The setting of Pn103 (2103h) (Moment of Inertia Ratio or Mass Ratio) is not appropriate.	Check the setting of Pn103 (2103h).	Set Pn103 (2103h) to an appropriate value.	_
	The torque reference is saturated.	Check the waveform of the torque reference.	Use the mode switch.	
	The force limits (Pn483 (2483h) and Pn484 (2484h)) are set to the default values.	The default values of the force limits and Pn483 (2483h) = 30% and Pn484 (2484h) = 30%.	Set Pn483 (2483h) and Pn484 (2484h) to appropriate values.	page 6-25

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Problem	Possible Cause	Confirmation	Correction	Reference
Absolute Encoder Position Deviation Error (The position that was saved in the host con- troller when the power was turned OFF is dif- ferent from the posi- tion when the power was next turned ON.)	Noise interference occurred because of incorrect Encoder Cable specifications.	Turn OFF the power supply to the servo system. Check the Encoder Cable to see if it satisfies specifications. Use a shielded twistedpair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm ² .	Use cables that satisfy the specifications.	-
	Noise interference occurred because the Encoder Cable is too long.	Turn OFF the power supply to the servo system. Check the length of the Encoder Cable.	Rotary Servomotors: The Encoder Cable length must be 50 m max. Linear Servomotors: Make sure that the Serial Converter Unit cable is no longer than 20 m and that the Linear Encoder Cable and the Sensor Cable are no longer than 15 m each.	_
	Noise interference occurred because the Encoder Cable is damaged.	Turn OFF the power supply to the servo system. Check the Encoder Cable to see if it is pinched or the sheath is damaged.	Replace the Encoder Cable and correct the cable installation envi- ronment.	-
	The Encoder Cable was subject to excessive noise interference.	Turn OFF the power supply to the servo system. Check to see if the Encoder Cable is bundled with a high-current line or installed near a high-current line.	Correct the cable lay- out so that no surge is applied by high-current lines.	-
	There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder.	Turn OFF the power supply to the servo system. Check to see if the machines are correctly 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 supply to the servo system. Check to see if there is noise interference on the I/O signal line from the encoder or Serial Converter Unit.	Implement counter- measures against noise for the encoder or Serial Converter Unit wiring.	-

Problem	Possible Cause	Confirmation	Correction	Reference
Absolute Encoder Position Deviation Error (The position that was saved in the host con-	The encoder was subjected to excessive vibration or shock.	Turn OFF the power supply to the servo system. Check to see if vibration from the machine occurred. Check the Servomotor installation (mounting surface precision, securing state, and alignment). Check the linear encoder installation (mounting surface precision and securing method).	Reduce machine vibration. Improve the mounting state of the Servomotor or linear encoder.	-
	A failure occurred in the encoder.	_	Turn OFF the power supply to the servo system. Replace the Servomotor or linear encoder.	-
troller when the power was turned OFF is dif- ferent from	A failure occurred in the SER-VOPACK.	_	Turn OFF the power supply to the servo system. Replace the SERVO-PACK.	-
the posi- tion when the power		Check the error detection section of the host controller.	Correct the error detection section of the host controller.	-
was next turned ON.)	Host Controller Multiturn Data or Absolute Encoder Position Data Reading Error	Check to see if the host controller is executing data parity checks.	Perform parity checks for the multiturn data or absolute encoder posi- tion data.	-
		Check for noise interference in the cable between the SERVO-PACK and the host controller.	Implement counter- measures against noise and then perform parity checks again for the multiturn data or abso- lute encoder position data.	-

Problem	Possible Cause	Confirmation	Continued from pre	Reference
		Check the external power supply (+24 V) voltage for the input signals.	Correct the external power supply (+24 V) voltage for the input signals.	-
	The P-OT/N-OT (Forward Drive Prohibit or Reverse	Check the operating condition of the overtravel limit switches.	Make sure that the overtravel limit switches operate correctly.	-
	Drive Prohibit) signal was input.	Check the wiring of the overtravel limit switches.	Correct the wiring of the overtravel limit switches.	page 5-27
		Check the settings of the overtravel input signal allocations (Pn50A/Pn50B).	Set the parameters to correct values.	page 5-27
	The P-OT/N-OT (Forward Drive Prohibit or Reverse Drive Prohibit) signal malfunctioned.	Check for fluctuation in the external power supply (+24 V) voltage for the input signals.	Eliminate fluctuation from the external power supply (+24 V) voltage for the input signals.	-
		Check to see if the operation of the overtravel limit switches is unstable.	Stabilize the operating condition of the over-travel limit switches.	-
Overtravel Occurred		Check the wiring of the overtravel limit switches (e.g., check for cable damage and loose screws).	Correct the wiring of the overtravel limit switches.	-
	There is a mistake in the allocation of the P-OT or N-OT (Forward Drive Prohibit or Reverse Drive Prohibit) signal in Pn50A (250Ah) = n.X□□□ or Pn50B (250Bh) = n.□□□X.	Check to see if the P-OT signal is allocated in Pn50A (250Ah) = n.X□□□.	If another signal is allocated in Pn50A (250Ah) =n.XDDD, allocate the P-OT signal instead.	
		Check to see if the N-OT signal is allocated in Pn50B (250Bh) = n.□□□X.	If another signal is allocated in Pn50B (250Bh) =n.□□□X, allocate the N-OT signal instead.	page 5-27
	The selection of the Servo- motor stopping method is not correct.	Check the servo OFF stopping method set in Pn001 (2001h) = n.□□□X or Pn001 (2001h) = n.□□X□.	Select a Servomotor stopping method other than coasting to a stop.	5.00
		Check the torque control stopping method set in Pn001 (2001h) = n.□□□X or Pn001 (2001h) = n.□□X□.	Select a Servomotor stopping method other than coasting to a stop.	page 5-28
Improper Stop Posi-	The limit switch position and dog length are not appropriate.	_	Install the limit switch at the appropriate position.	_
tion for Overtravel (OT) Signal	The overtravel limit switch position is too close for the coasting distance.	_	Install the overtravel limit switch at the appropriate position.	_

Problem	Possible Cause	Confirmation	Correction	Reference
Position Deviation (without Alarm)	Noise interference occurred because of incorrect Encoder Cable specifications.	Turn OFF the power supply to the servo system. Check the Encoder Cable to see if is satisfies specifications. Use a shielded twisted-pair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm ² .	Use cables that satisfy the specifications.	-
	Noise interference occurred because the Encoder Cable is too long.	Turn OFF the power supply to the servo system. Check the length of the Encoder Cable.	Rotary Servomotors: The Encoder Cable length must be 50 m max. Linear Servomotors: Make sure that the Serial Converter Unit cable is no longer than 20 m and that the Linear Encoder Cable and the Sensor Cable are no longer than 15 m each.	-
	Noise interference occurred because the Encoder Cable is damaged.	Turn OFF the power supply to the servo system. Check the Encoder Cable to see if it is pinched or the sheath is damaged.	Replace the Encoder Cable and correct the cable installation envi- ronment.	-
	The Encoder Cable was subjected to excessive noise interference.	Turn OFF the power supply to the servo system. Check to see if the Encoder Cable is bundled with a high-current line or installed near a high-current line.	Correct the cable lay- out so that no surge is applied by high-current lines.	-
	There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder.	Turn OFF the power supply to the servo system. Check to see if the machines are correctly 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 supply to the servo system. Check to see if there is noise interference on the I/O signal line from the encoder or Serial Converter Unit.	Implement counter- measures against noise for the encoder wiring or Serial Converter Unit wiring.	-

Continued from previous page

			Continued from pre		
Problem	Possible Cause	Confirmation	Correction	Reference	
Position Deviation (without Alarm)	The encoder was subjected to excessive vibration or shock.	Turn OFF the power supply to the servo system. Check to see if vibration from the machine occurred. Check the Servomotor installation (mounting surface precision, securing state, and alignment). Check the linear encoder installation (mounting surface precision and securing method).	Reduce machine vibration. Improve the mounting state of the Servomotor or linear encoder.	-	
	The coupling between the machine and Servomotor is not suitable.	Turn OFF the power supply to the servo system. Check to see if position offset occurs at the coupling between machine and Servomotor.	Correctly secure the coupling between the machine and Servomotor.	-	
	Noise interference occurred because of incorrect I/O signal cable specifications.	Turn OFF the power supply to the servo system. Check the I/O signal cables to see if they satisfy specifications. Use a shielded twisted-pair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm ² .	Use cables that satisfy the specifications.	-	
	Noise interference occurred because an I/O signal cable is too long.	Turn OFF the power supply to the servo system. Check the lengths of the I/O signal cables.	The I/O signal cables must be no longer than 3 m.	-	
	An encoder fault occurred. (The pulse count does not change.)	_	Turn OFF the power supply to the servo system. Replace the Servomotor or linear encoder.	-	
	A failure occurred in the SER-VOPACK.	_	Turn OFF the power supply to the servo system. Replace the SERVO-PACK.	-	
Servomotor Overheated	The surrounding air temperature is too high.	Measure the surrounding air temperature around the Servomotor.	Reduce the surrounding air temperature to 40°C or less.	-	
	The surface of the Servomotor is dirty.	Turn OFF the power supply to the servo system. Visually check the surface for dirt.	Clean dirt, dust, and oil from the surface.	_	
	There is an overload on the Servomotor.	Check the load status with a monitor.	If the Servomotor is overloaded, reduce the load or replace the Servo Drive with a SERVOPACK and Ser- vomotor with larger 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 the polarity detection-related parameters.	_	

Parameter and Object Lists

This chapter provides information on parameters and objects.

16.1	List of Parameters
	16.1.1 Interpreting the Parameter Lists16-216.1.2 List of Parameters16-3
16.2	Object List
16.3	SDO Abort Code List 16-36
16.4	Parameter Recording Table 16-37

Pn000 (2000h)

16.1 L

List of Parameters

16.1.1 Interpreting the Parameter Lists

The types of Servomotors to which the parameter applies.

- All: The parameter is used for both Rotary Servomotors and Linear Servomotors.
- Rotary: The parameter is used for only Rotary Servomotors.
- · Linear: The parameter is used for only Linear Servomotors.

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.

◆ Differences in Terms for Rotary Servomotors and Linear Servomotors on page x

Indicates when a change to the parameter will be effective.

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	Applica- ble Motors	When Enabled	Classi- fication	Refer- ence
	2	Basic Function Selections 0	0000h to 10B1h	_	0000h	All	After restart	Setup	-

If there are differences in the parameters for Rotary Servomotor and Linear Servomotor, information is provided for both.

- Top row: For Rotary Servomotors
- Bottom row: For Linear Servomotors

There are the following two classifications.

- · Setup
- Tuning

Refer to the following section for details.

5.1.1 Classifications of SERVOPACK Parameters on page 5-3

	J. (10111110VV. 1	of Efficient Solvernotors				
		/_/				
	Rotation	Rotation Direction S/vection				
	Moveme	Movement Direction Selection				
		Use CCW as the forward direction.				
n.□□□X	0	Use the direction in which the linear encoder counts up as the forward direction.	- page 5-15			
		Use CW as the forward direction. (Reverse Rotation Mode)				
	1	Use the direction in which the linear encoder counts down as the forward direction. (Reverse Movement Mode)				
n.□□X□	Reserve	d parameter (Do not change.)				
n.□X□□	Reserve	d parameter (Do not change.)				
	Rotary/L	inear Servomotor Startup Selection When Encoder Is Not Connected	Reference			
n.X□□□	When an encoder is not connected, start as SERVOPACK for Rotary Servomotor.		2000 F 14			
	1	When an encoder is not connected, start as SERVOPACK for Linear Servomotor	page 5-14			

List of Parameters 16.1.2

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

No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer		
Pn000 (2000h)	2	Basic Fund tions 0	ction Selec-	0000h to 10B1h	-	0000h	All	After restart	Setup	_		
	Ī			Direction Selection					Refere	ence		
				Jse CCW as the f		ection.						
		n.□□□X	0 (Use the direction in ward direction.			coder counts	up as the fo		page 5-15		
				Jse CW as the for		١				5-15		
				Use the direction is orward direction.				down as the	;			
		n.□□X□	Reserved	parameter (Do no	t change.)						
		n.□X□□	Reserved	parameter (Do no	t change.)						
			Rotary/Lin	ear Servomotor S	Startup Se	election W	hen Encoder	Is Not Con-	Refere	Reference		
		n.X□□□		When an encoder Rotary Servomoto		nected, st	art as SERVO	PACK for	page 5	5-14		
				When an encoder ear Servomotor.	is not con	nected, st	art as SERVO	PACK for Lin	- Pago (
	2	Application Selections	n Function 1	0000h to 1142h	-	0000h	All	After restart	Setup	_		
	Motor Stopping Method for Servo OFF and Group 1 Alarms							Refere	nce			
				Stop the motor by			•		Ticicic	71100		
		n.□□□X		Stop the motor by he dynamic brake		ing dynam	ic brake and t	then release	page 5	page 5-38		
			2 (Coast the motor to	o a stop w	ithout the	dynamic brak	e.				
	li		Overtravel	Stopping Metho	d				Refere	ence		
			0 8	Apply the dynamic stopping method s	set in Pn00	01 (2001h)	$= n.\Box\Box\BoxX).$					
Pn001 (2001h)		n.□□X□		Decelerate the mo he maximum torq								
				Decelerate the mo				in Pn406 as	page 5	5-28		
				Decelerate the mo Pn30A and then s			ne deceleratio	n time set in				
				Decelerate the mo Pn30A and then le			ne deceleratio	on time set in				
				it Power Supply	AC/DC In	put Select	ion		Refere	ence		
			Main Circu	iit i owei Suppiy								
		n ПУПП	0 1	nput AC power as and L3 terminals (the main	circuit pow		ng the L1, L2	,			
		n.ロXロロ	0 I 1 1 2	nput AC power as	the main do not use the main or the B1	circuit powe shared concircuit power and ⊖ 2	onverter). ver supply usi	ing the B1/⊕		5-12		

Continued from previous page.

Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
	2	Application Selections		0000h to 4213h	-	0001h	-	After restart	Setup	-
			EtherCAT (C Selection	oE) Module Tor	que Limit	Command	d Usage	Applicable Motors	Refere	ence
			0 Re	eserved setting (Do not us	э.)				
		n.□□□X	1 (C	able torque limi oE). utomatically set				All	_	
			2 Re	eserved setting (Do not us	э.)				
			3 Re	eserved setting (
		n.□□X□	EtherCAT (C Selection	oE) Module Sp	eed Limit	Command	l Usage	Applicable Motors	Refere	ence
				sable speed limi oE) during torqu	herCAT	All	_			
Pn002			1 Re	eserved setting (
(2002h)		n.□X□□	Encoder Usage					Applicable Motors	Refere	ence
			1 ()	se the encoder ans.	specifica-	All				
			1 Us	e the encoder a	ıs an incre	mental end	coder.		page 6	3-30
				e the encoder a coder.	lute	Rotary				
			External En	coder Usage				Applicable Motors	Refere	ence
			0 Do	not use an ext	ernal enco	der.				
		n.X□□□		e external enco n for CCW moto			ward direc-			
			2 Re	eserved setting (Do not us	э.)		Rotary	page 1	10-6
				e external enco n for CCW moto			erse direc-			
			4 Re	eserved setting (Do not us	э.)				

Continued from previous page.

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
	2	Application Function Selections 6	0000h to 105Fh	-	0002h	All	Immedi- ately	Setup	page 9-9

		Analog Mo	onitor 1 Signal Selection
		00	Motor speed (1 V/1,000 min ⁻¹)
		00	Motor speed (1 V/1,000 mm/s)
		0.1	Speed reference (1 V/1,000 min ⁻¹)
		01	Speed reference (1 V/1,000 mm/s)
		00	Torque reference (1 V/100% rated torque)
		02	Force reference (1 V/100% rated force)
		03	Position deviation (0.05 V/reference unit)
			Position amplifier deviation (after electronic gear) (0.05 V/encoder pulse unit)
		04	Position amplifier deviation (after electronic gear) (0.05 V/linear encoder pulse unit)
		05	Position reference speed (1 V/1,000 min ⁻¹)
		05	Position reference speed (1 V/1,000 mm/s)
		06	Reserved setting (Do not use.)
n006	n.□□XX	07	Load-motor position deviation (0.01 V/reference unit)
2006h)		08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)
		09	Speed feedforward (1 V/1,000 min ⁻¹)
		09	Speed feedforward (1 V/1,000 mm/s)
		0A	Torque feedforward (1 V/100% rated torque)
		UA	Force feedforward (1 V/100% rated force)
		0B	Active gain (1st gain: 1 V, 2nd gain: 2 V)
		0C	Completion of position reference distribution (completed: 5 V, not completed: 0 V)
		0D	External encoder speed (1 V/1,000 min ⁻¹ : value at the motor shaft)
		0E	Reserved setting (Do not use.)
		0F	Reserved setting (Do not use.)
		10	Main circuit DC voltage
		11 to 5F	Reserved settings (Do not use.)
	n.□X□□	Reserved	parameter (Do not change.)
	n.X□□□	Reserved	parameter (Do not change.)

Continued from previous page.

Parameter No.	Size	N	lame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence		
	2	Application Selections		0000h to 105Fh	_	0000h	All	Immedi- ately	Setup	page 9-9		
	2		7		V/1,000 m V/1,000 m e (1 V/1,00 e (1 V/1,00 e (1 V/100 (1 V/100% on (0.05 V/ er deviation	nin ⁻¹) nm/s) 00 min ⁻¹) 00 mm/s) % rated to 6 rated fore freference n (after elect	rque) ce) unit) ctronic gear) (ately 0.05 V/enco	der pulse	9-9		
		n.□□XX	05	Position reference	<u>'</u>							
			06	Reserved setting (Do not use.)								
Pn007		n.□□XX	07	Load-motor position deviation (0.01 V/reference unit)								
(2007h)			08	Positioning completed: 0 V)	pletion (po	ositioning o	ompleted: 5	V, positioning	g not com-	-		
			09	Speed feedforw Speed feedforw	•	· · · · · · · · · · · · · · · · · · ·						
				Torque feedforw	•		<u> </u>					
			0A	Force feedforwa	•							
			0B	Active gain (1st								
			0C	Completion of p				pleted: 5 V,	not com-			
			0D	External encode	r speed (1	V/1.000 r	nin ⁻¹ : value at	the motor s	haft)			
			0E	Reserved setting					- ,			
			0F	Reserved setting								
			10	Main circuit DC	voltage							
			11 to 5F	Reserved setting	gs (Do not	use.)						
		n.□X□□	Reserved	oarameter (Do no	ot change.)						
		n.X000	Reserved	oarameter (Do no	ot change.	.)						
								Cantinus				

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							C	Continued fro	m previou	ıs page
Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
140.	2	Application		0000h to 7121h	-	4000h	Rotary	After restart	Setup	-
			Low Battery	Voltage Alarm	/Warning S	Selection			Refere	ence
		n.□□□X		utput alarm (A.8	30) for low	battery vo	oltage.		page 1	15-2
			1 O	utput warning (A	930) for l	ow battery	voltage.		10 11 9 1	
			Function Se	election for Und	ervoltage				Refere	ence
Pn008			0 Do	o not detect und	lervoltage.					
(2008h)		n.□□X□	1 De	etect undervolta	ge warnin	g and limit	torque at hos	t controller.	page 6	3-14
				Detect undervoltage warning and limit torque with Pn424 (2424h and Pn425 (2425h) (i.e., only in the SERVOPACK).)	
			Warning De	tection Selection	n				Reference	
		n.□X□□	0 De	etect warnings.					page	15-
			1 Do not detect warnings except for A.971.							
		n.XDDD	Reserved parameter (Do not change.)							
			1100011001	(·/				
	2	Application Selections		0000h to 0121h	_	0010h	All	After restart	Tuning	_
		n.□□□X	Reserved p	arameter (Do no	ot change.	.)				
			Current Cor	ntrol Mode Sele	ction				Refere	ence
			0 U:	se current contro	ol mode 1.					
Pn009 (2009h)		n.□□X□	1 .	SERVOPACK Mo -3R8A, -5R5A, a SERVOPACK Mo -470A, -550A, -	and -7R6A odels SGD	: Use curre 7S-120A,	ent control mo -180A, -200A	ode 1. ., -330A,	page 8	3-71
			2 Us	se current contro	ol mode 2.					
			Speed Dete	ction Method S	election				Refere	ence
		n.□X□□	0 Use speed detection 1.				page 9	2 70		
			1 U:	se speed detect	ion 2.				page 8	D-12

Reserved parameter (Do not change.)

n.X□□□

Continued from previous page.

Parameter No.	Size	Name			Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence	
140.	2	Application Selections			0000h to	-	0001h	All	After	Setup	-	
		Selections	A		104411				restart			
			Matax Ct	i	na Mathad fa	и Сиотъ 0	Alarma			Refere	222	
			0	App	ng Method fo bly the dynamic	c brake or	coast the			Refere	ence	
			0		oping method celerate the mo		,	, ,				
			1	(24)	06h) as the ma .□□□X for the	ximum tor	que. Use t	he setting of F		h)		
		n.□□□X	2		celerate the mo 06h) as the ma					page	5-39	
			3	Pn3	celerate the mo 30A (230Ah). U status after st	lse the set						
			4		celerate the mo 30A (230Ah) ar				on time set ir	n		
Pn00A (200Ah)			Stopping	Me	thod for Force	ed Stops				Refere	ence	
			0		oly the dynamic oping method							
			1	(240	celerate the mo 06h) as the ma .000X for the	ximum tor	que. Use t	he setting of F		h)		
		n.□□X□	2		celerate the mo					page	6-53	
			3	Pn3	celerate the mo 30A (230Ah). U status after st							
			4	Dec	celerate the mo	otor to a s			on time set in	n		
		n.□X□□	Reserved	erved parameter (Do not change.)								
		n.X□□□	Reserved	d par	ameter (Do no	ot change	.)					
	2	Application Selections			0000h to 1121h	-	0000h	All	After restart	Setup	-	
		-	•		meter Display					Refere	nce	
	1	n.□□□X		•	lay only setup lay all paramet	•	rs.			page 5	5-3	
							A !			D (
		L		•	the motor by	•		ference to Ω		Refere	nce	
Pn00B (200Bh)	1	n.□□X□	1	Appl	ly the dynamic	brake or	coast the r	motor to a sto	p (use the	page 5	-39	
(200211)		_			ping method s the stopping m				ППХ	Pago o	00	
					election for Th		`	•		Dofores	200	
			·		a three-phase	•				Refere	100	
		n.□X□□	, (Use	a three-phase er supply input	power su			le-phase	page 5	-13	
	ı	n.X000	Reserved	para	ımeter (Do no	t change.)	1					
									Cantinus	برم مر مر م		

Parameter No.	Size				Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence		
	2	Application Selection	on Functio is C	n	0000h to 0131h	-	0000h	_	After restart	Setup	page 7-22		
										Applica	ble		
		n.□□□X	Functio	n Sele	ection for Test	without a	Motor			Motor			
		11.000	0		able tests with					All			
			1	Ena	ble tests witho	ut a moto	r.						
			Encode	r Reso	olution for Tes	ts without	a Motor			Applical Motor			
Pn00C		n.□□X□	0		13 bits.								
(200Ch)		11.00/0	1		20 bits.					Rotary			
			2		22 bits.								
			3	Use	24 bits.								
			Encode	r Type	Selection for	Tests with	nout a Mo	tor		Applical Motor			
		n.□X□□	0										
			1	Use	an absolute e	ncoder.				All			
		n.X□□□ Reserved parameter (Do not change.)											
	2	Application Selection	on Functio	n	0000h to 1001h	-	0000h	All	After restart	Setup	page 5-30		
	1												
		n.□□□X	Reserve	ed par	ameter (Do no	it change.)						
Pn00D (200Dh)	n.□□X□ Reserved parameter (Do not change.)												
(200011)		n.□X□□	Reserve	Reserved parameter (Do not change.)									
			Overtra	vel Wa	arning Detection	on Selecti	on						
		n.X□□□	0	Do	not detect ove	rtravel wai	nings.						
			1	Det	ect overtravel v	warnings.							
	2	Application Selection	on Functio s F	n	0000h to 2011h	-	0000h	All	After restart	Setup	-		
					aintenance Wa					Referer	nce		
Pn00F	n	.000X	0		ot detect preve					page 9-	15		
(200Fh)			ı	Detec	t preventative	mamtenar	ice warnin	gs.					
	n	.00X0	Reserved	para	meter (Do not	change.)							
	n.□X□□ Reserved parameter (Do not change.)												
	n.X□□□ Reserved parameter (Do not change.)												
Pn021 (2021h)	2	Reserved not chan	l paramete	r (Do	_	_	0000h	All	_	_	_		
(202111)		not onan	99.1					1	0	1	<u> </u>		

Continued from previous page.

								Continued fro	m previou	ıs page.			
Parameter No.	Size	1	Name	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence			
	2	Applications Selections	on Function s 22	0000h to 0011h	-	0000h	All	After restart	Setup	_			
		I.		1	I.				I.				
			Overtravel Re	elease Method	Selection				Refere	nce			
			0 Ove	ertravel exists w	hile the P-	OT or N-C	T signal is be	ing input.					
Pn022 (2022h)	n	.000X	1 cur	ertravel exists w rent position of or N-OT signal.	the workp				page 5	5-31			
	n	.00X0	Reserved par	rameter (Do not	t change.)								
	n	.DXDD	Reserved par	ameter (Do not	t change.)								
	n	.X000	Reserved par	rameter (Do not	t change.)								
Pn040 (2040h)	2	Reserved not change	parameter (Do	_	_	0000h	_	_	_	_			
(204011)	2		n Function	0000h to	_	0000h	Linear	After restart	Setup	_			
		OCICCION	3 00	111111				TOStart					
	_												
	_	.000X	Polarity Sens	or Selection polarity sensor					Refere	nce			
	- 11	.⊔⊔⊔∧		not use polarity					page 5	5-23			
			Motor Phase	Sequence Sele	ection				Refere	nce			
Pn080	n	.00X0	0 Set	a phase-A lead	l as a phas	se sequen	ce of U, V, and	d W.	page 5	 5-21			
(2080h)			1 Set	a phase-B lead	l as a pha	se sequen	ce of U, V, and	d W.	page 3)- <u>Z</u> I			
	n	.0X00	Reserved par	rameter (Do not	t change.)								
			Calculation N	Calculation Method for Maximum Speed or Encoder Output Pulses									
	n	.X000		O Calculate the encoder output pulse setting for a fixed maximum speed.									
				Calculate the maximum speed for a fixed encoder output pulse setting.									
	_								I.				
	2	Applications Selections	on Function s 81	0000h to 1111h	-	0000h	All	After restart	Setup	page 6-19			
			Phase-C Pu	se Output Sele	ection								
	r	n.000X		tput phase-C p		in the forv	vard direction						
Pn081			1 Ou	tput phase-C p	ulses in bo	oth the for	ward and reve	erse direction	ıs.				
(2081h)	r	n.00X0	Reserved pa	rameter (Do no	t change.)							
	r	n.□X□□	Reserved pa	ırameter (Do no	t change.)							
	r	n.X000	Reserved pa	rameter (Do no	t change.)							
Pn100 (2100h)	2	Speed Lo	oop Gain	10 to 20,000	0.1 Hz	400	All	Immedi- ately	Tuning	page 8-78			
Pn101 (2101h)	2	Speed Lo Time Con	oop Integral Istant	15 to 51,200	0.01 ms	2000	All	Immedi- ately	Tuning	page 8-78			
Pn102		2 Position Loop Gain		10 to 20,000	0.1/s	400	All	Immedi- ately	Tuning	page 8-78			
(2102h)	2	Position L	Loop Gain	10 10 20,000				alely	J	0-70			
(2102h) Pn103 (2103h)	2		Loop Gain Of Inertia Ratio	0 to 20,000	1%	100	All	Immedi- ately	Tuning	page 8-78			
Pn103		Moment of				100	All	Immedi-					

						C	Continued fro	m previou	ıs page.
Parameter	ze	Name	Setting	Setting	Default	Applicable	When	Classi-	Refer-
No.	is	IName	Range	Unit	Setting	Motors	Enabled	fication	ence
Pn105	2	Second Speed Loop	15 to 51 200	0.01 ms	2000	ΔII	Immedi-	Tuning	page

No. Pn105 Tuning (2105h) 15 to 51,200 | 0.01 ms | Integral Time Constant ately 8-65 Pn106 Second Position Loop Gain Immedi-ately page 8-65 10 to 20,000 400 0.1/s ΑII Tuning (2106h) Pn109 (2109h) Pn10A (210Ah)

		Use the internal torque reference as the condition (level setting: Pn10C (210Ch)).													
		Mode Sv	ing Selection	When Enabled	Refere	nce									
2	Gain Applications	cation Sele	ec-	0000h to 5334h	_	0000h	All	-	Setup	_					
2	Feedforwa Constant	ard Filter Time		0 to 6,400	0.01 ms	0	All	Immedi- ately	Tuning	page 8-88					
2	Feedforwa			rd		rd		0 to 100	1%	0	All	Immedi- ately	Tuning	page 8-88	

Pn10B (210Bh)

		Mode Sv	vitching Selection	When Enabled	Reference
	0	Use the internal torque reference as the condition (level setting: Pn10C (210Ch)).			
		4	Use the speed reference as the condition (level setting: Pn10D (210Dh)).		
n. 🗆 🗆 🖸	⊐X	l	Use the speed reference as the condition (level setting: Pn181 (2181h)).		
		2	Use the acceleration reference as the condition (level setting: Pn10E (210Eh)).	Immedi- ately	page 8-89
		2	Use the acceleration reference as the condition (level setting: Pn182 (2182h)).		
	3	Use the position deviation as the condition (level setting: Pn10F (210Fh)).			
			Do not use mode switching.		

	Speed L	pop Control Method	When Enabled	Reference
n.□□X□	0	PI control		
	1	I-P control	After restart	page 8-84
	2 and 3	Reserved settings (Do not use.)	1001011	

n.□X□□	Reserved parameter (Do not change.)
n.X□□□	Reserved parameter (Do not change.)

Pn10C (210Ch)	2	Mode Switching Level for Torque Reference	0 to 800	1%	200	All	Immedi- ately	Tuning	page 8-89
Pn10D (210Dh)	2	Mode Switching Level for Speed Reference	0 to 10,000	1 min ⁻¹	0	Rotary	Immedi- ately	Tuning	page 8-89
Pn10E (210Eh)	2	Mode Switching Level for Acceleration	0 to 30,000	1 min ⁻¹ /	0	Rotary	Immedi- ately	Tuning	page 8-89
Pn10F (210Fh)	2	Mode Switching Level for Position Deviation	0 to 10,000	1 refer- ence unit	0	All	Immedi- ately	Tuning	page 8-89
Pn11F (211Fh)	2	Position Integral Time Constant	0 to 50,000	0.1 ms	0	All	Immedi- ately	Tuning	page 8-91
Pn121 (2121h)	2	Friction Compensation Gain	10 to 1,000	1%	100	All	Immedi- ately	Tuning	page 8-65, page 8-68
Pn122 (2122h)	2	Second Friction Compensation Gain	10 to 1,000	1%	100	All	Immedi- ately	Tuning	page 8-65, page 8-68
Pn123 (2123h)	2	Friction Compensation Coefficient	0 to 100	1%	0	All	Immedi- ately	Tuning	page 8-68
Pn124 (2124h)	2	Friction Compensation Frequency Correction	-10,000 to 10,000	0.1 Hz	0	All	Immedi- ately	Tuning	page 8-68
Pn125 (2125h)	2	Friction Compensation Gain Correction	1 to 1,000	1%	100	All	Immedi- ately	Tuning	page 8-68
							O 11		

Continued from previous page.

Parameter No.	Size	N	lame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence			
Pn131 (2131h)	2	Gain Switch	ching Time 1	0 to 65,535	1 ms	0	All	Immedi- ately	Tuning	page 8-65			
Pn132 (2132h)	2	Gain Swite	ching Time 2	0 to 65,535	1 ms	0	All	Immedi- ately	Tuning	page 8-65			
Pn135 (2135h)	2	Gain Swite Time 1	ching Waiting	0 to 65,535	1 ms	0	All	Immedi- ately	Tuning	page 8-65			
Pn136 (2136h)	2	Gain Swite Time 2	ching Waiting	0 to 65,535	1 ms	0	All	Immedi- ately	Tuning	page 8-65			
	2	Automatic ing Select	Gain Switch	n- 0000h to 0052h	_	0000h	All	Immedi- ately	Tuning	page 8-65			
	_												
				ching Selection									
				Disable automatic									
		n.□□□X		Reserved setting (Do not use.)									
			2 3	Jse automatic gain is switch switching condition second gain to the second gain gain gain gain gain gain gain gain	ed automa n A is sati	atically fron sfied. The	n the first gain gain is switch	ed automatic	ally from				
Pn139			Gain Switch	ching Condition A	4								
(2139h)			0 /	COIN (Positioning	g Completi	ion Output	signal turns	ON.					
			1 /										
		n.□□X□	2 /	, , , ,									
			3 /	/NEAR (Near Output) signal turns OFF. Position reference filter output is 0 and position reference input is OFF.									
			4 F	Position reference	filter outp	ut is 0 and	position refe	rence input is	OFF.				
			5 Position reference input is ON.										
		n.□X□□											
		n.X□□□	Reserved	parameter (Do no	ot change.)							
Pn13D (213Dh)	2	Current G	ain Level	100 to 2,000	1%	2000	All	Immedi- ately	Tuning	page 8-71			
	2		lowing Con- ed Selections	0000h to 1121h	_	0100h	All	Immedi- ately	Tuning	-			
			Model Follo	owing Control Se	lection				Refere	ence			
	n	n.□□□X		o not use model t		ontrol.			page 8	3-85			
			1 U	1 Use model following control.									
			Vibration S	uppression Selec	tion				Refere	ence			
				o not perform vib		pression.							
	n	1.□□X□	1 P	erform vibration s	uppressio	n for a spe	cific frequenc	y.	page 8	3-85			
			2 P	erform vibration s	uppressio	n for two s	pecific freque	ncies.					
Pn140 (2140h)			Vibration S	uppression Adjus	stment Se	lection			Refere	ence			
	n	ı.0X00	O tio	o not adjust vibra on of autotuning v eference, and cus	vithout a h	ost referen			– page 8	3-31			
			1 ai	djust vibration suputotuning without nce, and custom	a host ref	automatica erence, au	ally during exe totuning with	ecution of a host refer-	pago				
			Speed Feed	dforward (VFF)/To	orque Fee	dforward (TFF) Selection	n	Refere	ence			
	n	n.X000	0 D	o not use model f ogether.	•				_ page 8	3-32,			
				se model followin ogether.	g control a	and speed	torque feedfo	orward	page 8	3-58 			

Continued from	om previous	page.

				0.17				Continued fro		
Parameter No.	Size	N	lame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
Pn141 (2141h)	2	Model Foll trol Gain	owing Con-	10 to 20,000	0.1/s	500	All	Immedi- ately	Tuning	page 8-85
Pn142 (2142h)	2	Model Foll trol Gain C	owing Con- Correction	500 to 2,000	0.1%	1000	All	Immedi- ately	Tuning	page 8-65
Pn143 (2143h)	2		owing Con- the Forward	0 to 10,000	0.1%	1000	All	Immedi- ately	Tuning	page 8-85
Pn144 (2144h)	2		owing Con- the Reverse	0 to 10,000	0.1%	1000	All	Immedi- ately	Tuning	page 8-85
Pn145 (2145h)	2	Vibration S Frequency	Suppression 1	10 to 2,500	0.1 Hz	500	All	Immedi- ately	Tuning	page 8-58
Pn146 (2146h)	2	Vibration S Frequency	Suppression 1	10 to 2,500	0.1 Hz	700	All	Immedi- ately	Tuning	page 8-58
Pn147 (2147h)	2		owing Con- Feedforward ation	0 to 10,000	0.1%	1000	All	Immedi- ately	Tuning	page 8-85
Pn148 (2148h)	2	Second M ing Contro	odel Follow- I Gain	10 to 20,000	0.1/s	500	All	Immedi- ately	Tuning	page 8-65
Pn149 (2149h)	2		odel Follow- I Gain Correc-	500 to 2,000	0.1%	1000	All	Immedi- ately	Tuning	page 8-65
Pn14A (214Ah)	2	Vibration S Frequency	Suppression 2	10 to 2,000	0.1 Hz	800	All	Immedi- ately	Tuning	page 8-58
Pn14B (214Bh)	2		Vibration Suppression 2 Correction Control-Related Selec-		1%	100	All	Immedi- ately	Tuning	page 8-58
	2	Control-Retions	elated Selec-	0000h to 0021h	-	0021h	All	After restart	Tuning	_
Pn14F (214Fh)		n.□□□X	1 Use	0 71						3-88 ence
		n.□□X□	1 Use	1 Use tuning-less type 2. page 8-13						
	n.□X□□ Reserved parameter (Do not change.)									
		n.X□□□	Reserved par	ameter (Do no	t change.)				
	2		nance Con- ed Selections	0000h to 0011h	_	0010h	All	Immedi- ately	Tuning	-
				nce Control Se					Refere	ence
		n.□□□X		not use anti-re: anti-resonanc		control.			page 8	3-50
Pn160 (2160h)		n.□□X□	0 tion refe Adju	Anti-Resonance Control Adjustment Selection Do not adjust anti-resonance control automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning. Adjust anti-resonance control automatically during execution of						ence 3-31
		n.□X□□	Reserved par	ameter (Do no	t change.)				
		n.X□□□	Reserved par	ameter (Do no	t change.)				

Parameter

No.

Pn161

(2161h)

Pn162

(2162h) Pn163

(2163h)

Size

2

2

2

Name

Anti-Resonance Fre-

Anti-Resonance Gain Correction

Anti-Resonance Damp-

quency

ing Gain

Continued from previous page.

Classi-

fication

Tuning

Tuning

Tuning

Refer-

ence

page 8-50

page 8-50

page 8-50

When

Enabled

Immedi-

ately

Immedi-

ately

Immedi-

Applicable

Motors

ΑII

All

ΑII

(2 10311)		ing dain							atory		0 00		
Pn164 (2164h)	2	Anti-Resor Time Cons rection			-1,000 to 1,000	0.01 ms	0	All	Immedi- ately	Tuning	page 8-50		
Pn165 (2165h)	rection 1,000 ately									Tuning	page 8-50		
Pn166 (2166h)	2 ing Gain 2 0 to 1,000 1% 0 All ately							Tuning	page 8-53				
	2	Tuning-less Related Se	s Function elections	-	0000h to 2711h	_	1401h	All	_	Setup	page 8-12		
	n.□□□X Tuning-less Selection 0 Disable tuning-less function. 1 Enable tuning-less function.								Whe Enabl Afte	led er			
Pn170 (2170h)	1	n.□□X□	Speed C	ontro Use	ol Method for speed con	I Method for speed control. for speed control and use host controller for position control.							
	1	n.□X□□		igidity Level O to 7 Set the rigidity level.							en led edi-		
	Ī		Tuning-le	ss L	oad Level					Whe	en		
	1	n.X000	0 to 2	Set	the load level t	for the tuni	ing-less fui	nction.		Imme atel			
Pn181 (2181h)	1) Mode of Miching Love () to 1() ()() 1 mm/s () Inear minodi								Tuning	page 8-89			
		Mada Cwit	china Lev	el	0 to 30 000	1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1							
Pn182 (2182h)	2	for Acceler	ation		0 10 00,000	S ⁻			ately		page 8-89		
	2	for Acceler	ration		0 to 65,535	1 rev	65535	Rotary	After restart	Setup	8-89 page 6-35		

Setting

Range

10 to 20,000

1 to 1,000

0 to 300

Setting

Unit

0.1 Hz

1%

1%

Default

Setting

1000

100

0

10	
-	

Parameter No.	Size	N	lame		Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer	
	2	Position C tion Select		D-	0000h to 2210h	-	0010h	All	After restart	Setup	-	
		n.□□□X	Reserved	l par	rameter (Do no	t change.)					
		n.□□X□	Reserved	l par	rameter (Do no	t change.)					
		n.□X□□	Reserved	l par	rameter (Do no	t change.)					
Pn207			/COIN (P	ositi	tioning Completion Output) Signal Output Timing						Refer- ence	
(2207h)			0	san	put when the and the contract that the contract	-						
		n.X□□□	1	Output when the absolute value of the position error is the same or less than the setting of Pn522 (2522h) (Positioning Completed Width) and the reference after the position reference filter is 0.							6-10	
			2	or l	put when the a ess than the se oth) and the refe	tting of Pr	n522 (2522	position error 2h) (Positionin	is the same g Completed			
Pn20A (220Ah)	4	Number of Encoder S		es	4 to 1,048,576	1 scale pitch/ revolu- tion	32768	Rotary	After restart	Setup	page 10-	
Pn20E (220Eh)	4	Electronic (Numerato	nic Gear Ratio		1 to 1,073,741,824	1	16	All	After restart	Setup	_	
Pn210 (2210h)	4				1 to 1,073,741,824	1	1	All	After restart	Setup	-	
Pn212 (2212h)	4		Number of Encoder Output Pulses		16 to 1,073,741,824	1 P/Rev	2048	Rotary	After restart	Setup	pag 6-2	
	2	2 Fully-closed Control 0000h to Selections 1003h - 0000h Rotary After restart								Setup	pag 10-9	
		n.□□□X	.□□□X Reserved parameter (Do not change.)									
Pn22A		n.□□X□	Reserved parameter (Do not change.)									
(222Ah)	•	n.□X□□	Reserved	l par	rameter (Do no	t change.)					
		n.X□□□	Fully-clos 0 1	Use	Control Speed e motor encode e external enco	r speed.		n				
	2	Position C sion Funct	ontrol Expa ion Selecti	an- ons	0000h to 0001h	-	0000h	All	After restart	Setup	pag 8-73	
Pn230		n.□□□X	Backlash 0	Cor	mpensation Dia mpensate forwa mpensate rever	ard referen						
(2230h)	,	n.□□X□	Reserved	l par	rameter (Do no	t change.)					
		n.□X□□	Reserved	l par	rameter (Do no	t change.)					
		n.X□□□	Reserved	l par	rameter (Do no	t change.)					
	1											

Parameter

No.

Size

Name

Continued	from	nrevious	nage

Classi-

fication

Refer-

ence

When

Enabled

140.	0,		riarige	Offic	Octimig	MOLOIS	Lilabica	lication	CITCC
Pn233 (2233h)	2	Backlash Compensa- tion Time Constant	0 to 65,535	0.01 ms	0	All	Immedi- ately	Setup	page 8-74
Pn281 (2281h)	2	Encoder Output Resolution	1 to 4,096	1 edge/ pitch	20	All	After restart	Setup	page 6-23
Pn282 (2282h)	4	Linear Encoder Scale Pitch	0 to 6,553,600	0.01 μm	0	Linear	After restart	Setup	page 5-16
Pn304 (2304h)	4h) 2 Jogging Speed		0 to 10,000	Rotary: 1 min ⁻¹ Direct Drive: 0.1 min ⁻¹	500	Rotary	Immedi- ately	Setup	page 7-7
Pn305 (2305h)	2	Soft Start Acceleration Time	0 to 10,000	1 ms	0	All	Immedi- ately	Setup	-
Pn306 (2306h)	2	Soft Start Deceleration Time	0 to 10,000	1 ms	0	All	Immedi- ately	Setup	_
Pn308 (2308h)	2	Speed Feedback Filter Time Constant	0 to 65,535	0.01 ms	0	All	Immedi- ately	Setup	page 8-84
Pn30A (230Ah)	2	Deceleration Time for Servo OFF and Forced Stops	0 to 10,000	1 ms	0	All	Immedi- ately	Setup	page 5-29
Pn30C (230Ch)	2	Speed Feedforward Average Movement Time	0 to 5,100	0.1 ms	0	All	Immedi- ately	Setup	_
	2	Vibration Detection Selections	0000h to 0002h	-	0000h	All	Immedi- ately	Setup	page 6-45
(2310h)	r	n.□□X□ Reserved par	rameter (Do no ramete	ot change.)				
Pn311 (2311h)	2	Vibration Detection Sensitivity	50 to 500	1%	100	All	Immedi- ately	Tuning	page 6-45
Pn312 (2312h)	2	Vibration Detection Level	0 to 5,000	1 min ⁻¹	50	Rotary	Immedi- ately	Tuning	page 6-45
Pn316 (2316h)	2	Maximum Motor Speed	0 to 65,535	1 min ⁻¹	10000	Rotary	After restart	Setup	page 6-16
Pn324 (2324h)	2	Moment of Inertia Cal-	0 to 20,000	4.0/			lancar a al!	1	
Pn383		culation Starting Level	0 10 20,000	1%	300	All	Immedi- ately	Setup	page 8-30
(2383h)	2	culation Starting Level Jogging Speed	0 to 10,000	1 mm/s	300 50	All Linear		Setup Setup	page 8-30 page 7-7
(2383h) Pn384 (2384h)	2		·				ately Immedi-	·	
Pn384		Jogging Speed Vibration Detection Level Maximum Motor Speed	0 to 10,000	1 mm/s	50	Linear	ately Immediately Immediately	Setup	page 7-7
Pn384 (2384h) Pn385 (2385h) Pn401 (2401h)	2	Jogging Speed Vibration Detection Level	0 to 10,000 0 to 5,000	1 mm/s 1 mm/s	50	Linear Linear	ately Immediately Immediately After	Setup Tuning	page 7-7 page 6-45
Pn384 (2384h) Pn385 (2385h) Pn401	2 2	Jogging Speed Vibration Detection Level Maximum Motor Speed First Stage First Torque Reference Filter Time	0 to 10,000 0 to 5,000 1 to 100	1 mm/s 1 mm/s 100 mm/s	50 10 50	Linear Linear	ately Immediately Immediately After restart Immediately	Setup Tuning Setup	page 7-7 page 6-45 page 6-16
Pn384 (2384h) Pn385 (2385h) Pn401 (2401h) Pn402	2 2 2	Jogging Speed Vibration Detection Level Maximum Motor Speed First Stage First Torque Reference Filter Time Constant	0 to 10,000 0 to 5,000 1 to 100 0 to 65,535	1 mm/s 1 mm/s 100 mm/s 0.01 ms	50 10 50 100	Linear Linear All	ately Immediately Immediately After restart Immediately Immediately	Setup Tuning Setup Tuning	page 7-7 page 6-45 page 6-16 page 8-81
Pn384 (2384h) Pn385 (2385h) Pn401 (2401h) Pn402 (2402h) Pn403	2 2 2 2	Jogging Speed Vibration Detection Level Maximum Motor Speed First Stage First Torque Reference Filter Time Constant Forward Torque Limit	0 to 10,000 0 to 5,000 1 to 100 0 to 65,535 0 to 800	1 mm/s 1 mm/s 100 mm/s 0.01 ms 1%*1	50 10 50 100 800	Linear Linear All Rotary	ately Immediately Immediately After restart Immediately Immediately Immediately Immediately	Setup Tuning Setup Tuning Setup Setup Setup	page 7-7 page 6-45 page 6-16 page 8-81 page 6-25 page 6-25 page 6-25

Setting

Unit

Setting

Range

Default

Setting

Applicable

Motors

						C	Jonanaea ma	iii bieviot	is page.
Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
Pn405 (2405h)	2	Reverse External Torque Limit	0 to 800	1%*1	100	All	Immedi- ately	Setup	page 6-26
Pn406 (2406h)	2	Emergency Stop Torque	0 to 800	1%*1	800	All	Immedi- ately	Setup	page 5-29
Pn407 (2407h)	2	Speed Limit during Torque Control	0 to 10,000	1 min ⁻¹	10000	Rotary	Immedi- ately	Setup	page 6-12
	2	Torque-Related Func-	0000h to	-	0000h	All	-	Setup	-

	2	Torque-Re tion Select		0-	0000h to 1111h	-	0000h	All	-	Setup	_
	I		Notch Fi	Iter S	Selection 1				When Enabled	Refere	nce
		n.□□□X	0	Disa	able first stage	notch filte	r.		Immedi-	page 8	0.01
			1	Ena	ble first stage	notch filter	:		ately	page c	-01
			Speed L	imit \$	Selection				When Enabled	Refere	nce
			0		the smaller of ing of Pn407 (
		n.□□X□			the smaller of ing of Pn480 (
Pn408 (2408h)			1		the smaller of ed and the set t.		After restart	page 6	6-12		
			'		the smaller of ed and the set t.						
	Ī		Notch Fi	Iter S	Selection 2	When Enabled	Refere	Reference			
		n.□X□□	0	Disa	able second st	age notch	Immedi-	page 8	R-81		
			1	Ena	ble second sta	age notch	filter.		ately	pago	
			Friction	Com	pensation Fun	ction Sele	ection		When Enabled	Refere	nce
		n.X□□□	0	Disable friction compensation.						page 8	 R-68
			1	Ena	ble friction cor	npensatior	n.		ately	pago	
Pn409	_	First Stage	Notch Fi	lter			5000		Immedi-	- .	nage
(2409h)	2	Frequency	,		50 to 5,000	1 Hz	5000	All	ately	Tuning	page 8-81
Pn40A (240Ah)	2	First Stage Q Value	Notch Fil	lter	50 to 1,000	0.01	70	All	Immedi- ately	Tuning	page 8-81
Pn40B (240Bh)	2	First Stage Depth	Notch Fil	lter	0 to 1,000	0.001	0	All	Immedi- ately	Tuning	page 8-81
Pn40C (240Ch)	2	Second St ter Freque		n Fil-	50 to 5,000	1 Hz	5000	All	Immedi- ately	Tuning	page 8-81
Pn40D (240Dh)	2	Second St ter Q Value	age Notch	n Fil-	50 to 1,000	0.01	70	All	Immedi- ately	Tuning	page 8-81
Pn40E (240Eh)	2	Second St ter Depth	age Notch	n Fil-	0 to 1,000	0.001	0	All	Immedi- ately	Tuning	page 8-81
Pn40F (240Fh)	2	Second St Torque Re Frequency	ference Fi	lter	100 to 5,000	1 Hz	5000	All	Immedi- ately	Tuning	page 8-81
Pn410 (2410h)	2	Second St Torque Rei Q Value	age Seco ference Fi	nd Iter	50 to 100	0.01	50	All	Immedi- ately	Tuning	page 8-81
Pn412 (2412h)	2	First Stage Torque Ret Time Cons	ference Fi	lter	0 to 65,535	0.01 ms	100	All	Immedi- ately	Tuning	page 8-65

Continued from previous page.

								Continued fro				
Parameter No.	Size	N	lame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence		
	2	Torque-Re tion Select	lated Func- ions 2	0000h to 1111h	_	0000h	All	Immedi- ately	Setup	page 8-83		
			Notch Filte	er Selection 3								
		n.□□□X	0 [Disable third stage	e notch filt	er.						
			1 E	Enable third stage	notch filte	er.						
D : 440	İ		Notch Filte	er Selection 4								
Pn416 (2416h)		n.□□X□	0 0	Disable fourth stag	sable fourth stage notch filter.							
, ,			1 E	able fourth stage notch filter.								
	İ		Notch Filte	er Selection 5	Selection 5							
		n.□X□□	0 [Disable fifth stage	notch filte	er.						
			1 E	Enable fifth stage	notch filte	r.						
		n.X□□□	Reserved	parameter (Do no	ot change	.)						
Pn417 (2417h)	2	Third Stag Frequency	e Notch Filte	50 to 5,000	1 Hz	5000	All	Immedi- ately	Tuning	page 8-83		
Pn418 (2418h)	2	Third Stag Q Value	e Notch Filte	50 to 1,000	0.01	70	All	Immedi- ately	Tuning	page 8-83		
Pn419 (2419h)	2	Third Stag Depth	e Notch Filte	0 to 1,000	0.001	0	All	Immedi- ately	Tuning	page 8-83		
Pn41A (241Ah)	2	Fourth Sta ter Freque	ge Notch Fi ncy	50 to 5,000	1 Hz	5000	All	Immedi- ately	Tuning	page 8-83		
Pn41B (241Bh)	2	Fourth Sta ter Q Value	ge Notch Fi	50 to 1,000	0.01	70	All	Immedi- ately	Tuning	page 8-83		
Pn41C (241Ch)	2	Fourth Sta ter Depth	ge Notch Fi	0 to 1,000	0.001	0	All	Immedi- ately	Tuning	page 8-83		
Pn41D (241Dh)	2	Fifth Stage Frequency	Notch Filte	r 50 to 5,000	1 Hz	5000	All	Immedi- ately	Tuning	page 8-83		
Pn41E (241Eh)	2	Fifth Stage Q Value	Notch Filte	f 50 to 1,000	0.01	70	All	Immedi- ately	Tuning	page 8-83		
Pn41F (241Fh)	2	Depth	Notch Filte	0 to 1,000	0.001	0	All	Immedi- ately	Tuning	page 8-82		
	2	Speed Rip sation Sele	ple Comper ections	n- 0000h to 1111h	-	0000h	Rotary	-	Setup	page 8-63		
			I									
			Speed Rip	ple Compensation	on Function	n Selectio	n		Whe Enab			
		n.□□□X	0 0	Disable speed ripp	ole compe	nsation.			Imme	edi-		
			1 E	Enable speed ripp	le compe	nsation.			ate	y		
Pn423			Speed Rip	ple Compensatio	on Informa	ation Disag	greement War	ning Detec-	Whe Enab			
(2423h)		n.□□X□	0 0	Detect A.942 aları	ms.				Afte			
			1 [Do not detect A.9	42 alarms				resta	art 		
			Speed Rip	ple Compensatio	n Fnable	Condition	Selection		Whe			
		n.□X□□		Speed reference		,			Enab			
				Motor speed					Afte			
				·	1 -1-	`						
		n.X□□□	Reserved	parameter (Do no	ot change	.)						
Pn424	2	Torque Lin	nit at Main C	ir- 0 to 100	1%*1	50	All	Immedi-	Setup	page 6-15		
(2424h)		cuit voitag	e nioh		_			ately	d on nov			

16

							C	Continued fro	m previou	ıs page.		
Parameter No.	Size	N	lame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence		
Pn425 (2425h)	2	Release Ti Limit at Ma Voltage Dr		0 to 1,000	1 ms	100	All	Immedi- ately	Setup	page 6-15		
Pn426 (2426h)	2	Torque Fee Average M Time	edforward lovement	0 to 5,100	0.1 ms	0	All	Immedi- ately	Setup	_		
Pn427 (2427h)	2	Speed Rip sation Ena	ple Compen- ble Speed	0 to 10,000	1 min ⁻¹	0	Rotary Ser- vomotor	Immedi- ately	Tuning	page 8-63		
Pn456 (2456h)	2	Sweep Tor ence Amp	rque Refer- litude	1 to 800	1%	15	All	Immedi- ately	Tuning	page 8-97		
	2	Notch Filte Selections	er Adjustment 1	0000h to 0101h	_	0101h	All	Immedi- ately	Tuning	page 8-15, page 8-31		
			l 									
				Adjustment Se		notoh filtor	· automatically	, during over	oution of a	uto		
	ı	n.□□□X		ing without a h								
				ust the first sta nout a host refe								
Pn460 (2460h)	1	n.00X0	Reserved par	rameter (Do no	t change.)						
		Notch Filter Adjustment Selection 2										
	1	n.□X□□	0 fun	Do not 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. Adjust the second stage notch filter automatically when the tuning-less func-								
			1 tion	ust the second is enabled or otuning with a	during exe	ecution of a	autotuning wit	hout a host	ng-less fur reference,	nc-		
	1	n.X000	Reserved par	rameter (Do no	t change.)						
	2	Gravity Co Related Se	mpensation- elections	0000h to 0001h	_	0000h	All	After restart	Setup	page 8-70		
	_		0 " 0	0.1								
	ľ	n.□□□X		ensation Selec		n						
Pn475				able gravity con	<u>'</u>							
(2475h)	-	1.00X0	Reserved para	ameter (Do not	change.)							
	1	n.□X□□	Reserved para	ameter (Do not	change.)							
	-	1.X000	Reserved para	ameter (Do not	change.)							
	_				-							
Pn476 (2476h)	2	Gravity Co Torque	mpensation	-1,000 to 1,000	0.1%	0	All	Immedi- ately	Tuning	page 8-70		
Pn480 (2480h)	2	Speed Lim Force Con	nit during trol	0 to 10,000	1 mm/s	10000	Linear	Immedi- ately	Setup	page 6-12		
Pn481 (2481h)	2	Polarity De Speed Loc	etection op Gain	10 to 20,000	0.1 Hz	400	Linear	Immedi- ately	Tuning	-		
Pn482 (2482h)	2	Polarity De Speed Loc Time Cons	op Integral	15 to 51,200	0.01 ms	3000	Linear	Immedi- ately	Tuning	-		
Pn483 (2483h)	2	Forward F	orce Limit	0 to 800	1%*1	30	Linear	Immedi- ately	Setup	page 6-25		
Pn484 (2484h)	2	Reverse F	orce Limit	0 to 800	1%*1	30	Linear	Immedi- ately	Setup	page 6-25		
D:: 40E		D 1 11 D	: D.				İ					

Polarity Detection Reference Speed

0 to 100

20

Linear

1 mm/s

Pn485

(2485h)

2

Continued on next page.

Tuning

Immediately

Continued from previous page.

Parameter	a)		Setting	Setting	Default	Applicable	When	Classi-	Refer-
No.	Size	Name	Range	Unit	Setting	Motors	Enabled	fication	ence
Pn486 (2486h)	2	Polarity Detection Reference Acceleration/ Deceleration Time	0 to 100	1 ms	25	Linear	Immedi- ately	Tuning	_
Pn487 (2487h)	2	Polarity Detection Constant Speed Time	0 to 300	1 ms	0	Linear	Immedi- ately	Tuning	_
Pn488 (2488h)	2	Polarity Detection Reference Waiting Time	50 to 500	1 ms	100	Linear	Immedi- ately	Tuning	_
Pn48E (248Eh)	2	Polarity Detection Range	1 to 65,535	1 mm	10	Linear	Immedi- ately	Tuning	_
Pn490 (2490h)	2	Polarity Detection Load Level	0 to 20,000	1%	100	Linear	Immedi- ately	Tuning	_
Pn495 (2495h)	2	Polarity Detection Con- firmation Force Refer- ence	0 to 200	1%	100	Linear	Immedi- ately	Tuning	_
Pn498 (2498h)	2	Polarity Detection Allow- able Error Range	0 to 30	1 deg	10	Linear	Immedi- ately	Tuning	_
Pn49F (249Fh)	2	Speed Ripple Compensation Enable Speed	0 to 10,000	1 mm/s	0	Linear	Immedi- ately	Tuning	page 8-63
Pn502 (2502h)	2	Rotation Detection Level	1 to 10,000	1 min ⁻¹	20	Rotary	Immedi- ately	Setup	page 6-7
Pn503 (2503h)	2	Speed Coincidence Detection Signal Output Width	0 to 100	1 min ⁻¹	10	Rotary	Immedi- ately	Setup	page 6-8
Pn506 (2506h)	2	Brake Reference-Servo OFF Delay Time	0 to 50	10 ms	0	All	Immedi- ately	Setup	page 5-33
Pn507 (2507h)	2	Brake Reference Output Speed Level	0 to 10,000	1 min ⁻¹	100	Rotary	Immedi- ately	Setup	page 5-33
Pn508 (2508h)	2	Servo OFF-Brake Com- mand Waiting Time	10 to 100	10 ms	50	All	Immedi- ately	Setup	page 5-33
Pn509 (2509h)	2	Momentary Power Inter- ruption Hold Time	20 to 50,000	1 ms	20	All	Immedi- ately	Setup	page 6-13
	2	Input Signal Selections	0000h to FFF2h	_	1881h	All	After restart	Setup	-

	n.□□□X	Rese	rved parameter (Do not change.)	
	n.□□X□	Rese	rved parameter (Do not change.)	
	n.□X□□	Rese	rved parameter (Do not change.)	
		P-OT	(Forward Drive Prohibit) Signal Allocation	Reference
		0	Enable forward drive when CN1-13 input signal is ON (closed).	
		1	Enable forward drive when CN1-7 input signal is ON (closed).	
		2	Enable forward drive when CN1-8 input signal is ON (closed).	
Pn50A		3	Enable forward drive when CN1-9 input signal is ON (closed).	
(250Ah)		4	Enable forward drive when CN1-10 input signal is ON (closed).	
250AN)		5	Enable forward drive when CN1-11 input signal is ON (closed).	
		6	Enable forward drive when CN1-12 input signal is ON (closed).	
	n.X□□□	7	Set the signal to always prohibit forward drive.	page 5-28
		8	Set the signal to always enable forward drive.	page 5-26
		9	Enable forward drive when CN1-13 input signal is OFF (open).	
		А	Enable forward drive when CN1-7 input signal is OFF (open).	
		В	Enable forward drive when CN1-8 input signal is OFF (open).	
		С	Enable forward drive when CN1-9 input signal is OFF (open).	
		D	Enable forward drive when CN1-10 input signal is OFF (open).	
		Е	Enable forward drive when CN1-11 input signal is OFF (open).	
		F	Enable forward drive when CN1-12 input signal is OFF (open).	

Parameter No.	Size	N	lame		Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
	2	Input Signa	al Selectio	ns	0000h to FFFFh	-	8882h	All	After restart	Setup	_
											•
			N-OT (Re	evers	e Drive Prohib	oit) Signal	Allocation			Refere	ence
			0	Ena	ble reverse dri	ve when C	N1-13 inp	ut signal is O	N (closed).		
			1	Ena	ble reverse dri	ve when C	N1-7 inpu	t signal is ON	(closed).		
			2	Ena	ble reverse dri	ve when C	N1-8 inpu	t signal is ON	(closed).		
			3	Ena	ble reverse dri	ve when C	N1-9 inpu	t signal is ON	(closed).		
			4	Ena	ble reverse dri	ve when C	N1-10 inp	ut signal is O	N (closed).		
			5		ble reverse dri				, ,		
			6		ble reverse dri		·		N (closed).		
		n.□□□X	7		the signal to a					page 5	5-28
			8		the signal to a						
			9		ble reverse dri						
			A	Enable reverse drive when CN1-7 input signal is OFF (open). Enable reverse drive when CN1-8 input signal is OFF (open).							
			В								
			С		ble reverse dri				,		
	1100B	D		ble reverse dri		·					
			E F		ble reverse dri		<u> </u>		· · · ·		
		Г	LIIA	ble reverse dri	ve when c	/NT-12 IIIP	ut signal is O	гг (ореп).			
Pn50B		Reserved	d par	ameter (Do no	t change.)					
(250Bh)	l		/P-CL (Fo	orwa	rd External To	rque Limit	Input) Sig	nal Allocatio	n	Refere	ence
			0		ve when CN1-						
			1	Acti	ve when CN1-	7 input sig	nal is ON	(closed).			
			2	Acti	ve when CN1-	8 input sig	gnal is ON	(closed).			
			3	Acti	ve when CN1-	9 input sig	gnal is ON	(closed).			
			4	Acti	ve when CN1-	10 input s	ignal is ON	l (closed).			
			5	Acti	ve when CN1-	11 input s	ignal is ON	l (closed).			
			6	Acti	ve when CN1-	12 input s	ignal is ON	l (closed).			
		n.□X□□	7	The	signal is alway	ys active.				page 6	3-26
			8	The	signal is alway	ys inactive				page	7 20
			9	Acti	ve when CN1-	13 input s	ignal is OF	F (open).			
			А		ve when CN1-						
			В	Acti	ve when CN1-	8 input sig	gnal is OFF	(open).			
			С	Acti	ve when CN1-	9 input sig	gnal is OFF	(open).			
			D		ve when CN1-	•	0	,			
			Е		ve when CN1-						
			F	Acti	ve when CN1-	12 input s	ignal is OF	F (open).			
			/N-CL (R	lever	se External To	rque Limit	t Input) Siç	gnal Allocatio	n	Refere	ence
		n.X□□□	0 to F		allocations are			-CL (Forward	External	page 6	6-26
	_									•	

Continued from previous page.

Parameter No.	Size	N	Name		Setting	Setting	Default	Applicable Motors	When	Classi- fication	Refer-
INO.	2	Output Sig	gnal Selec-		Range 0000h to	Unit _	Setting 0000h	All	Enabled After	Setup	ence _
		tions 1			6666h				restart		
			(OOIN (D		.' 0	0 1.	1) 0:1	Alleretter		Defe	
			<u> </u>		oning Comple bled (the abov	•	, ,			Refere	nce
					out the signal		•		erminal		
		n.□□□X			out the signal t					page	6-9
					out the signal			· ·		pago	0 0
					erved setting (
Pn50E			01 ON 1D 10		10:::::	. D.I	0	\ O' All	. 17	Defe	
(250Eh)		n.□□X□	· ·	•	d Coincidenc		•	, ,		Refere	nce
					allocations are signal allocati		e as the /C	OIN (Position	ing Compie-	page	6-8
		/TGON (Rotation Detection Output) Signal Allocation						Refere	nce		
		n.□X□□ 0 to 6 The allocations are the same as the /COIN (Positioning 0 tion) signal allocations.								page	6-7
			/S-RDY (S	/S-RDY (Servo Ready) Signal Allocation							ence
	n.X□□□			allocations are signal allocati		e as the /C	OIN (Position	ing Comple-	page	6-7	
	2	Output Signations 2	gnal Selec-		0000h to 6666h	_	0100h	All	After restart	Setup	-
			/CLT (Torc	que L	imit Detectio	n Output)	Signal All	ocation		Refere	nce
			0	Disal	bled (the abov	/e signal o	utput is no	ot used).			
		n.□□□X	1 (Outp	out the signal t	from the C	N1-1 or C	N1-2 output t	erminal.		
			2	Outp	out the signal	from the C	N1-23 or	CN1-24 outpu	ut terminal.	page 6	3-29
					out the signal			CN1-26 outpu	ut terminal.		
			4 to 6	Rese	erved setting (Do not us	e.)				
Pn50F (250Fh)			/VLT (Spe	ed L	imit Detection	n) Signal A	Allocation			Refere	nce
(230111)		n.□□X□			allocations are out) signal allo		e as the /C	LT (Torque Lir	mit Detection	page 6	 3-11
			/BK (Brak	<u>م</u>	ıtput) Signal A	Allocation				Refere	nce
		n.□X□□	0 to 6	The	allocations are out) signal allo	the same	e as the /C	LT (Torque Lir	mit Detection		
			/WARN (W	Varni	ing Output) S	ignal Alloc	cation			Refere	ence
		n.X□□□	0 to 6	The	allocations are out) signal allo	the same		LT (Torque Lir	mit Detection		
	1141713										

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Continued	from	previous	page.

Parameter	(I)			Setting	Setting	Default	Applicable	When	Classi-	Refer-				
No.	Size	N	ame	Range	Unit	Setting	Motors	Enabled	fication	ence				
	2	Output Sig tions 3	ınal Selec-	0000h to 0666h	-	0000h	All	After restart	Setup	_				
	i		(1) [1]						Б.					
			/NEAR (N	lear Output) Signa Disabled (the above			ot used)		Refere	ence				
			1	Output the signal				terminal.						
		n.□□□X	2	Output the signal					page 6	6-10				
Pn510 (2510h)			3	Output the signal	from the C	N1-25 or	CN1-26 outp	ut terminal.						
(20.0)			4 to 6	Reserved setting (Do not us	e.)								
		n.□□X□	Reserved	I parameter (Do no	ot change.)								
		n.□X□□	X□□ Reserved parameter (Do not change.)											
		n.X□□□	Reserved	I parameter (Do no	ot change.)								
		Innut Cian	al Calcation	0000h to				Aftor		2000				
	2	Input Signa 5	ai Selection	ns 0000h to FFFFh	_	6543h	All	After restart	Setup	page 6-3				
		n.□□□X	Reserved	I parameter (Do no	ot change.)								
			/Probe1 (Probe 1 Latch Input) Signal Allocation											
			4	Active when CN1-	· ·									
			5	Active when CN1-			,							
		n.□□X□	6 7	Active when CN1- The signal is alway			l (closed).							
D 544			8	The signal is alway										
Pn511 (2511h)			D	Active when CN1-			F (open).							
,			Е	Active when CN1-		_								
		F Active when CN1-12 input signal is OFF (open).												
		/Probe2 (Probe 2 Latch Input) Signal Allocation												
		n.X□□□	0 to F The allocations are the same as the /Probe1 (Probe 1 Latch Input) signal allocations.											
			/Home (H	lome Switch Input) Signal A	llocation								
		n.X□□□	0 to F	The allocations are cations.	e the same	e as the /P	robe1 (Probe	1 Latch Inpu	ut) signal a	allo-				
				Cations.										
	2	Output Sig Settings	ınal Inverse	0000h to	-	0000h	All	After restart	Setup	page 6-4				
		- DDDV		ignal Inversion for		nd CN1-2	Terminals							
		n.□□□X	0	The signal is not in The signal is inver										
	l.						4 Taurain ala							
		n.□□X□	Output S	ignal Inversion for The signal is not in		and CN1-2	4 rerminais							
Pn512				-										
Pn512 (2512h)		11.0000	1	The signal is inver										
		11.0000				and CN1-2	6 Terminals							
		n.0X00		The signal is inverignal Inversion for The signal is not in	CN1-25 a	and CN1-2	6 Terminals							
			Output S	ignal Inversion for	CN1-25 a	and CN1-2	6 Terminals							

Parameter So			Continued from previous p							ıs page.		
Pn514 (2514h) Pn514 (2516h) Pn515 (2516h) Pn516 (2516h) Pn516 (2516h) Pn517 Pn518 (2516h) Pn518 Pn5		Size		Name		•	•		7 7			
Ph514 (2514t) Ph Ph Ph Preventative Maintenance Cutput) Signal Allocation Reference		2	Output S tions 4	ignal Selec-			_	0000h	All		Setup	_
Ph514 (2514t) Ph Ph Ph Preventative Maintenance Cutput) Signal Allocation Reference		_		Posonyo	l nar	amotor (Do no	t change	\				
Ph. Ph.						,		,				
Disabled (the above signal output is not used)						•		,	Allogation		Dofore	
1	-			_ `			•	, 0			neiere	ence
Description Property Proper	(2514h)					`	-			erminal		
3		r	n.□X□□			·					page 9	9-15
						·			•			
Pn516 (2516h) Pn518*4 Position Input Signal Selections O000h to FFFFh - B888h All After restart Setup -				4 to 6					·			
PR516 (2516h) PSTP (Forced Stop Input) Signal Allocation O Enable drive when CN1-13 input signal is ON (closed). 1 Enable drive when CN1-8 input signal is ON (closed). 2 Enable drive when CN1-9 input signal is ON (closed). 3 Enable drive when CN1-9 input signal is ON (closed). 3 Enable drive when CN1-9 input signal is ON (closed). 4 Enable drive when CN1-10 input signal is ON (closed). 5 Enable drive when CN1-11 input signal is ON (closed). 6 Enable drive when CN1-11 input signal is ON (closed). 7 Set the signal to always prohibit drive (always force the motor to stop). 8 Enable drive when CN1-13 input signal is OFF (open). A Enable drive when CN1-13 input signal is OFF (open). B Enable drive when CN1-8 input signal is OFF (open). C Enable drive when CN1-9 input signal is OFF (open). E Enable drive when CN1-10 input signal is OFF (open). E Enable drive when CN1-11 input signal is OFF (open). E Enable drive when CN1-11 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN		r	n.X000	Reserved	eserved parameter (Do not change.)							
PR516 (2516h) PSTP (Forced Stop Input) Signal Allocation O Enable drive when CN1-13 input signal is ON (closed). 1 Enable drive when CN1-8 input signal is ON (closed). 2 Enable drive when CN1-9 input signal is ON (closed). 3 Enable drive when CN1-9 input signal is ON (closed). 3 Enable drive when CN1-9 input signal is ON (closed). 4 Enable drive when CN1-10 input signal is ON (closed). 5 Enable drive when CN1-11 input signal is ON (closed). 6 Enable drive when CN1-11 input signal is ON (closed). 7 Set the signal to always prohibit drive (always force the motor to stop). 8 Enable drive when CN1-13 input signal is OFF (open). A Enable drive when CN1-13 input signal is OFF (open). B Enable drive when CN1-8 input signal is OFF (open). C Enable drive when CN1-9 input signal is OFF (open). E Enable drive when CN1-10 input signal is OFF (open). E Enable drive when CN1-11 input signal is OFF (open). E Enable drive when CN1-11 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN1-12 input signal is OFF (open). E Enable drive when CN			Input Sig	nal Salaatia	ne	0000h to				Aftor		
Desition Deviation Pn518 Pn520 Pn518 Pn520 Pn520 Pn520 Pn520 Pn520 Pn522		2	7	nai Selectio	115		-	8888h	All		Setup	-
Desition Deviation Pn518 Pn520 Pn518 Pn520 Pn520 Pn520 Pn520 Pn520 Pn522				FCTD /Fox	d	Ctan Innut\ Ci	anal Allaa	ation			Dofor	222
1							_		al ic ON (close)d)	Refere	ence
2								·	•			
Reserved parameter (Do not change.) Reserved parameter (Do not cha								·	`	<u>, </u>		
A												
Pn516 (2516h) Pn516 (2516h) Pn516 (2516h) Pn518 Pn520 Pn5								·	` `	·		
Pn516 (2516h) Set the signal to always prohibit drive (always force the motor to stop).								·	•			
Pn516 (2516h)				6	Ena	able drive when	CN1-12	input signa	al is ON (close	ed).		
Set the signal to always enable drive (always disable forcing the motor to stop).		n.	X	7			ılways pro	hibit drive	(always force	the motor to		0.50
Pn518*4 (2518h) Composition Deviation Overflow Detection Level (252ch) Position Deviation Overflow (252ch) Position Deviation Overflow (252ch) Position Deviation Overflow (252ch) Position Deviation Overflow (252ch) Position Deviation Overflow (252ch) Position Deviation Overflow (252ch) Position Deviation Overflow (252ch) Position Deviation Completed (252ch) Position Deviation Completed (252ch) Position Deviation Completed (252ch) Position Deviation Completed (252ch) Position Deviation Completed (252ch) Position Deviation Completed (252ch) Position				8			lways ena	able drive (a	always disable	e forcing the	page	6-53
B Enable drive when CN1-8 input signal is OFF (open). C Enable drive when CN1-9 input signal is OFF (open). D Enable drive when CN1-10 input signal is OFF (open). E Enable drive when CN1-11 input signal is OFF (open). F Enable drive when CN1-11 input signal is OFF (open). F Enable drive when CN1-12 input signal is OFF (open). Reserved parameter (Do not change.)	(20.0)			9	Enable drive when CN1-13 input signal is OFF (open).							
C Enable drive when CN1-9 input signal is OFF (open). D Enable drive when CN1-10 input signal is OFF (open). E Enable drive when CN1-11 input signal is OFF (open). F Enable drive when CN1-12 input signal is OFF (open). Reserved parameter (Do not change.) n.DXD Reserved parameter (Do not change.) n.XDD Reserved parameter (Do not change.) NXDD Reserved parameter (Do not change.) NXDD Reserved parameter (Do not change.) 1 Reserved parameter (Do not change.) NXDD Reserved parameter (Do not change.) Pn518*4 (2518h) 4 Motor-Load Position Deviation Overflow Detection Level 1,073,741,824 ence ence unit 1000 Rotary Immediately Setup page 10-8 Pn51E (251Eh) 2 Position Deviation Over- 10 to 100 1% 100 All Immediately Setup Page 8-9 Pn520 (252ch) 4 Position Deviation Over- 1 to 1,073,741,824 ence unit Pn522 (252ch) 4 Positioning Completed 0 to to 1,073,741,824 ence unit Pn522 (252ch) 4 Positioning Completed 0 to to 1,073,741,824 ence unit Page 8-8-8-8-7 All Immediately Setup page 8-8-8-7 All Immediately Setup page 8-8-8-7 All Immediately Setup page 8-8-8-7				А	Enable drive when CN1-7 input signal is OFF (open).							
D Enable drive when CN1-10 input signal is OFF (open). E Enable drive when CN1-11 input signal is OFF (open). F Enable drive when CN1-12 input signal is OFF (open). n.□□X□ Reserved parameter (Do not change.) n.□X□□ Reserved parameter (Do not change.) n.X□□□ Reserved parameter (Do not change.) n.X□□□ Reserved parameter (Do not change.) Pn518*4 (2518h) - Safety Module-Related Parameters All Pn51B (2518h) 4 Motor-Load Position Deviation Overflow Detection Level Unit Pn51E (251Eh) 2 Position Deviation Overflow Gence (unit Pn52) Pn51E (251Eh) 2 Position Deviation Overflow How Warning Level 10 to 100 1% 100 All Immediately Setup Page (2520h) 4 Position Deviation Overflow How Alarm Level 1,073,741,823 1 reference (unit Pn52) Pn522 (2522h) 4 Positioning Completed (1,073,741,824 unit Pn52) Pn522 (2522h) 4 Positioning Completed (1,073,741,824 unit Pn52) Pn522 (2522h) 5 Positioning Completed (1,073,741,824 unit Pn52) Pn522 (2522h) 6 Positioning Completed (1,073,741,824 unit Pn52) Pn522 (2522h) 7 Pn522 (2522h) 8 Positioning Completed (1,073,741,824 unit Pn52) Pn523 (2522h) 8 Positioning Completed (1,073,741,824 unit Pn52) Pn524 (2522h) 8 Positioning Completed (1,073,741,824 unit Pn52) Pn525 (2522h) 8 Positioning Completed (1,073,741,824 unit Pn52) Pn526 (2522h) 8 Positioning Completed (1,073,741,824 unit Pn52) Pn527 (2522h) 8 Positioning Completed (1,073,741,824 unit Pn52) Pn528 (2522h) 8 Pn529 (2522h				В								
E Enable drive when CN1-11 input signal is OFF (open). F Enable drive when CN1-12 input signal is OFF (open). Reserved parameter (Do not change.)				С								
F Enable drive when CN1-12 input signal is OFF (open).												
n.□□X□ Reserved parameter (Do not change.) n.□X□□ Reserved parameter (Do not change.) n.X□□□ Reserved parameter (Do not change.) Pn518*4 (2518h) - Safety Module-Related Parameters All Pn51B (2518h) 4 Motor-Load Position Deviation Overflow Detection Level 1000 Rotary Immediately Setup page 10-8 Pn51E (251Eh) 2 Position Deviation Overflow Warning Level 10 to 100 1% 100 All Immediately Setup Page 8-9 Pn520 (2520h) 4 Position Deviation Overflow Alarm Level 1,073,741,823 1 reference unit 10 to 100 1 reference uni										-		
n.□X□□ Reserved parameter (Do not change.) n.X□□□ Reserved parameter (Do not change.) n.X□□□ Reserved parameter (Do not change.) n.X□□□ Reserved parameter (Do not change.) n.X□□□ Reserved parameter (Do not change.)								1 0	al is OFF (ope	n).		
Pn518*4 (2518h) - Safety Module-Related Parameters - - - - - - - - -					•	`	,					
Pn518*4 (2518h) - Safety Module-Related Parameters All All		n.	. ЦХЦЦ	Reserved	para	imeter (Do not	change.)					
Pn51B (2518h) A Motor-Load Position Deviation Overflow Detection Level Detection Level To to 100 To 1,073,741,824 To 100 Detection Deviation Overflow Detection Level To to 100 To 10		n.	.X000	Reserved	para	ımeter (Do not	change.)					
Pn51B (251Bh)4Motor-Load Position Deviation Overflow Detection Level0 to 		_			ed	-	_	_	All	_	_	_
Pn51E (251Eh) 2 Position Deviation Over-flow Marm Level 10 to 100 1% 100			Motor-Lo	ad Position		0 to			_	Immedi-		nage
Pn520 (2520h) 4 Position Deviation Over-flow Alarm Level 1 to 1,073,741,823	(251Bh)	4	Detection	Level				1000	Rotary	ately	Setup	
Pn520 (2520h) 4 Position Deviation Over- 1 to 1,073,741,823 Pn522 (2522h) 4 Positioning Completed Width 0 to 1,073,741,824 Pn522 (2522h) 4 Positioning Completed Width 0 to 1,073,741,824 Pns24 Pns25 Pn526		2			/er-	10 to 100	1%	100	All		Setup	8-9
(2522h) 4 Positioning Completed 1,073,741,824 ence unit 7 All immediately Setup 6-9		4			/er-		ence	5242880	All		Setup	8-8, page
		4		ng Complete	ed		ence	7	All	ately	'	

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
Pn524 (2524h)	4	Near Signal Width	1 to 1,073,741,824	1 refer- ence unit	1073741824	All	Immedi- ately	Setup	page 6-11
Pn526 (2526h)	4	Position Deviation Over- flow Alarm Level at Servo ON	1 to 1,073,741,823	1 refer- ence unit	5242880	All	Immedi- ately	Setup	page 8-10
Pn528 (2528h)	2	Position Deviation Over- flow Warning Level at Servo ON	10 to 100	1%	100	All	Immedi- ately	Setup	page 8-10
Pn529 (2529h)	2	Speed Limit Level at Servo ON	0 to 10,000	1 min ⁻¹	10000	Rotary	Immedi- ately	Setup	page 8-10
Pn52A (252Ah)	2	Multiplier per Fully- closed Rotation	0 to 100	1%	20	Rotary	Immedi- ately	Tuning	page 10-8
Pn52B (252Bh)	2	Overload Warning Level	1 to 100	1%	20	All	Immedi- ately	Setup	page 5-41
Pn52C (252Ch)	2	Base Current Derating at Motor Overload Detection	10 to 100	1%	100	All	After restart	Setup	page 5-42
	2	Program Jogging- Related Selections	0000h to 0005h	_	0000h	All	Immedi- ately	Setup	page 7-13

	Program	n Jogging Operation Pattern					
	0	(Waiting time in Pn535 \rightarrow Forward by travel distance in Pn531) \times Number of movements in Pn536					
	1	(Waiting time in Pn535 \rightarrow Reverse by travel distance in Pn531) \times Number of movements in Pn536					
	2	(Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536 (Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536					
n.□□□X	3	(Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536 (Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536					
	4	(Waiting time in Pn535 \rightarrow Forward by travel distance in Pn531 \rightarrow Waiting time in Pn535 \rightarrow Reverse by travel distance in Pn531) \times Number of movements in Pn536					
	5	(Waiting time in Pn535 \rightarrow Reverse by travel distance in Pn531 \rightarrow Waiting time in Pn535 \rightarrow Forward by travel distance in Pn531) \times Number of movements in Pn536					
n.□□X□	Reserve	d parameter (Do not change.)					
n.□X□□	Reserve	d parameter (Do not change.)					
n.X□□□	Reserved parameter (Do not change.)						

Pn530 (2530h)

Pn531 (2531h)	4	Program Jogging Travel Distance	1 to 1,073,741,824	1 refer- ence unit	32768	All	Immedi- ately	Setup	page 7-13
Pn533 (2533h)	2	Program Jogging Move- ment Speed	1 to 10,000	Rotary: 1 min ⁻¹ Direct Drive: 0.1 min ⁻¹	500	Rotary	Immedi- ately	Setup	page 7-13
Pn534 (2534h)	2	Program Jogging Acceleration/Deceleration Time	2 to 10,000	1 ms	100	All	Immedi- ately	Setup	page 7-13
Pn535 (2535h)	2	Program Jogging Wait- ing Time	0 to 10,000	1 ms	100	All	Immedi- ately	Setup	page 7-13
Pn536 (2536h)	2	Program Jogging Number of Movements	0 to 1,000	Times	1	All	Immedi- ately	Setup	page 7-13
Pn550 (2550h)	2	Analog Monitor 1 Offset Voltage	-10,000 to 10,000	0.1 V	0	All	Immedi- ately	Setup	page 9-10
·		·	·				Continuo	-l	L

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_	Continued from previous p									
Parameter No.	Size	N	lame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
Pn551 (2551h)	2	Analog Mo Voltage	onitor 2 Offset	-10,000 to 10,000	0.1 V	0	All	Immedi- ately	Setup	page 9-10
Pn552 (2552h)	2	Analog Monification	onitor 1 Mag-	-10,000 to 10,000	× 0.01	100	All	Immedi- ately	Setup	page 9-10
Pn553 (2553h)	2	Analog Monification	onitor 2 Mag-	-10,000 to 10,000	× 0.01	100	All	Immedi- ately	Setup	page 9-10
Pn55A (255Ah)	2	Power Co Monitor U	nsumption nit Time	1 to 1,440	1 min	1	All	Immedi- ately	Setup	_
Pn560 (2560h)	2	Residual \ Detection		1 to 3,000	0.1%	400	All	Immedi- ately	Setup	page 8-55
Pn561 (2561h)	2	Overshoo Level	Detection	0 to 100	1%	100	All	Immedi- ately	Setup	page 8-30, page 8-39
Pn581 (2581h)	2	Zero Spee	ed Level	1 to 10,000	1 mm/s	20	Linear	Immedi- ately	Setup	page 6-7
Pn582 (2582h)	2	Speed Co Detection Width	incidence Signal Output	0 to 100	1 mm/s	10	Linear	Immedi- ately	Setup	page 6-8
Pn583 (2583h)	2	Brake Ref	erence Out- I Level	0 to 10,000	1 mm/s	10	Linear	Immedi- ately	Setup	page 5-33
Pn584 (2584h)	2	Speed Lin Servo ON	nit Level at	0 to 10,000	1 mm/s	10000	Linear	Immedi- ately	Setup	page 8-10
Pn585 (2585h)	2	Program C ment Spe	logging Move- ed	1 to 10,000	1 mm/s	50	Linear	Immedi- ately	Setup	page 7-13
Pn586 (2586h)	2	Motor Rur Ratio	nning Cooling	0 to 100	1%/ Max. speed	0	Linear	Immedi- ately	Setup	_
	2		etection Selection for Linear Encoder	0000h to 0001h	-	0000h	Linear	Immedi- ately	Setup	-
				ction Selection		lute Lineai	r Encoder		Refere	nce
Pn587	r	n.□□□X		not detect pola ect polarity.	arity.				page 5	5-24
(2587h)	r	n.00X0	Reserved par	ameter (Do no	t change.))				
	r	n.□X□□	Reserved par	ameter (Do no	t change.)				
	r	n.X000	Reserved par	ameter (Do no	t change.)				
Pn600 (2600h)	2	Regeneration Capacity*	tive Resistor	Depends on model.*3	10 W	0	All	Immedi- ately	Setup	page 5-57
Pn601 (2601h)	2		Brake Resis- ble Energy tion	0 to 65,535	10 J	0	All	After restart	Setup	*6
Pn603 (2603h)	2	Regenerat	tive Resis-	0 to 65,535	10 mΩ	0	All	Immedi- ately	Setup	page 5-57
Pn604 (2604h)	2	Dynamic E tance	Brake Resis-	0 to 65,535	10 mΩ	0	All	After restart	Setup	*6
		*			*			_ ··		

Classi- Refer-

Continued	from	previous	page.

When

No.	Siz	I N	iame	Range	Unit	Setting	Motors	Enabled	fication	ence
	2	Overheat I Selections		0000h to 0003h	-	0000h	All	After restart	Setup	page 6-56
			Overheat Pro	tection Selecti	ons					
			0 Disa	able overheat p	rotection.					
			1 Use	e overheat prote	ection in th	ne Yaskawa	a Linear Servo	omotor.*7		
Pn61A	r	1.000X		nitor a negative overheat prote		put from a	sensor attac	hed to the m	nachine ar	ıd
(261Ah)				nitor a positive overheat prote		put from a	sensor attach	ned to the m	achine and	t
	r	n.□□X□	Reserved par	rameter (Do no	t change.)				
	r	n.□X□□	Reserved par	rameter (Do no	t change.)				
	r	n.X000	Reserved par	rameter (Do no	t change.)				
		1		1			<u> </u>	<u> </u>	1	
Pn61B		0	۱	0 +- 500	0.04.1/	050	A II	Immedi-	0 -4	page
(261Bh)	2	Overneat	Alarm Level	0 to 500	0.01 V	250	All	ately	Setup	6-57
Pn61C										2000
*8	2	Overheat \	Warning Level	0 to 100	1%	100	All	Immedi- ately	Setup	page 6-57
(261Ch)										<u> </u>
Pn61D *8	2		Alarm Filter	0 to 65,535	1 s	0	All	Immedi-	Setup	page
(261Dh)	_	Time		0 10 00,000	13		All	ately	Jolup	6-57
Pn621 (2621h) to	_	Safety Mo	dule-Related	_	_	_	All	_	_	_

Setting

Default Applicable

ΑII

Setting

*1. Set a percentage of the motor rated torque.

Parameters

Parameter

Pn628 (2628h)*4

- *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 a Safety Module. Refer to the following manual for details.
 - Σ-V-Series/Σ-V-Series for Large-Capacity Models/Σ-7-Series User's Manual Safety Module (Manual No.: SIEP C720829 06)
- *5. With EtherCAT (CoE), this is automatically set when the power supply is turned ON. For setting the electronic gear ratio, use objects 2701h to 2704h. Refer to the following section for details.
 - 14.5 Manufacturer-Specific Objects on page 14-17
- *6. These parameters are for SERVOPACKs that support the dynamic brake hardware option specifications. Refer to the following manual for details.
 - Σ-7-Series AC Servo Drive Σ-7S/Σ-7W SERVOPACK with Dynamic Brake Hardware Option Specifications Product Manual (Manual No.: SIEP S800001 73)
- *7. The SGLFW2 is the only Yaskawa Linear Servomotor that supports this function.
- *8. Enabled only when Pn61A is set to n. \$\square\$000 or n. \$\square\$000.

16.2 Object List

Index	Subin- dex	Name	Data Type	Ac- cess	PDO Map- ping	Saving to EEPROM*1	Default Value	Lower Limit	Upper Limit	Unit	Parame- ter No.*2
1000h	0	Device type	UDINT	RO	No	No	0x00020192	_	-	-	-
1001h	0	Error register	USINT	RO	No	No	-	-	-	-	-
1008h	0	Manufacturer device name	STRING	RO	No	No	_	_	_	_	_
100Ah	0	Manufacturer soft- ware version	STRING	RO	No	No	_	_	_	_	-
	Store par	ameters									
	0	Largest subindex supported	USINT	RO	No	No	4	_	_		-
	1	Save all parameters	UDINT	RW	No	No	0x00000001	0x00000000	0xFFFFFFF	-	PnC00 *3, *4
1010h	2	Save communica- tion parameters	UDINT	RW	No	No	0x00000001	0x00000000	0xFFFFFFF	_	PnC02 *3, *4
	3	Save application parameters	UDINT	RW	No	No	0x00000001	0x00000000	0xFFFFFFF	_	PnC04 *3, *4
	4	Save manufacturer defined parameters	UDINT	RW	No	No	0x00000001	0x00000000	0xFFFFFFF	-	PnC06 *3, *4
	Restore c	lefault parameters	ı						T	T	T.
	0	Largest subindex supported	USINT	RO	No	No	4	-	-	_	-
	1	Restore all default parameters	UDINT	RW	No	No	0x00000001	0x00000000	0xFFFFFFF	_	PnC08 *3, *4
1011h	2	Restore communication default parameters	UDINT	RW	No	No	0x00000001	0x0000000	0xFFFFFFF	_	PnC0A *3, *4
	3	Restore application default parameters	UDINT	RW	No	No	0x00000001	0x00000000	0xFFFFFFF	-	PnC0C *3, *4
	4	Restore manufac- turer defined default parameters	UDINT	RW	No	No	0x00000001	0x00000000	0xFFFFFFF	_	PnC0E *3, *4
	Identity o	bject							1		
	0	Number of entries	USINT	RO	No	No	4	_	-	-	-
1018h	1	Vendor ID	UDINT	RO	No	No	0x539	_	-	-	-
101011	2	Product code	UDINT	RO	No	No	0x02200301*5	_	-	-	_
	3	Revision number	UDINT	RO	No	No	_	_	-	-	-
	4	Serial number	UDINT	RO	No	No	0	_	_	-	_
	Sync erro	r settings	ı							1	1
10E1F	0	Number of entries	USINT	RO	No	No	2	-	-	-	-
10F1h	1	Reserved	UDINT	RO	No	No	0	_	_	-	_
	2	Sync error count limit	UDINT	RW	No	No	9	0	15	-	PnCCC
	1st receiv	re PDO mapping									
	0	Number of objects in this PDO	USINT	RW	No	Yes	8	0	8	-	PnCA0
	1	Mapping entry 1	UDINT	RW	No	Yes	0x60400010	0	0xFFFFFFF	-	PnC20
	2	Mapping entry 2	UDINT	RW	No	Yes	0x607A0020	0	0xFFFFFFF	_	PnC22
1600h	3	Mapping entry 3	UDINT	RW	No	Yes	0x60FF0020	0	0xFFFFFFF	-	PnC24
	4	Mapping entry 4	UDINT	RW	No	Yes	0x60710010	0	0xFFFFFFF	-	PnC26
	5	Mapping entry 5	UDINT	RW	No	Yes	0x60720010	0	0xFFFFFFF	_	PnC28
	6	Mapping entry 6	UDINT	RW	No	Yes	0x60600008	0	0xFFFFFFF	_	PnC2A
	7	Mapping entry 7	UDINT	RW	No	Yes	0x00000008	0	0xFFFFFFF	_	PnC2C
	8	Mapping entry 8	UDINT	RW	No	Yes	0x60B80010	0	0xFFFFFFF	-	PnC2E

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001111111111111111111111111111111111111		p. 0 1. 0 0. 0	1000

Index	Subin- dex	Name	Data Type	Ac- cess	PDO Map- ping	Saving to EEPROM*1	Default Value	Lower Limit	Upper Limit		Parame- ter No.*2
	2nd recei	ve PDO mapping			, ,						
	0	Number of objects in this PDO	USINT	RW	No	Yes	2	0	8	-	PnCA1
	1	Mapping entry 1	UDINT	RW	No	Yes	0x60400010	0	0xFFFFFFF	-	PnC30
	2	Mapping entry 2	UDINT	RW	No	Yes	0x607A0020	0	0xFFFFFFF	_	PnC32
1601h	3	Mapping entry 3	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC34
	4	Mapping entry 4	UDINT	RW	No	Yes	0	0	0xFFFFFFF	_	PnC36
	5	Mapping entry 5	UDINT	RW	No	Yes	0	0	0xFFFFFFF	_	PnC38
	6	Mapping entry 6	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC3A
	7	Mapping entry 7	UDINT	RW	No	Yes	0	0	0xFFFFFFF	_	PnC3C
	8	Mapping entry 8	UDINT	RW	No	Yes	0	0	0xFFFFFFF	_	PnC3E
	3rd receiv	ve PDO mapping									
	0	Number of objects in this PDO	USINT	RW	No	Yes	2	0	8	_	PnCA2
	1	Mapping entry 1	UDINT	RW	No	Yes	0x60400010	0	0xFFFFFFF	-	PnC40
	2	Mapping entry 2	UDINT	RW	No	Yes	0x60FF0020	0	0xFFFFFFF	_	PnC42
1602h	3	Mapping entry 3	UDINT	RW	No	Yes	0	0	0xFFFFFFF	_	PnC44
	4	Mapping entry 4	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC46
	5	Mapping entry 5	UDINT	RW	No	Yes	0	0	0xFFFFFFF	_	PnC48
	6	Mapping entry 6	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC4A
	7	Mapping entry 7	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC4C
	8	Mapping entry 8	UDINT	RW	No	Yes	0	0	0xFFFFFFF	_	PnC4E
	4th receiv	ve PDO mapping									
	0	Number of objects in this PDO	USINT	RW	No	Yes	2	0	8	-	PnCA3
	1	Mapping entry 1	UDINT	RW	No	Yes	0x60400010	0	0xFFFFFFF	_	PnC50
	2	Mapping entry 2	UDINT	RW	No	Yes	0x60710010	0	0xFFFFFFF	-	PnC52
1603h	3	Mapping entry 3	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC54
	4	Mapping entry 4	UDINT	RW	No	Yes	0	0	0xFFFFFFF	_	PnC56
	5	Mapping entry 5	UDINT	RW	No	Yes	0	0	0xFFFFFFF	_	PnC58
	6	Mapping entry 6	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC5A
	7	Mapping entry 7	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC5C
	8	Mapping entry 8	UDINT	RW	No	Yes	0	0	0xFFFFFFF	_	PnC5E
	1st transr	mit PDO mapping						1			
	0	Number of objects in this PDO	USINT	RW	No	Yes	8	0	8	-	PnCA4
	1	Mapping entry 1	UDINT	RW	No	Yes	0x60410010	0	0xFFFFFFF	-	PnC60
	2	Mapping entry 2	UDINT	RW	No	Yes	0x60640020	0	0xFFFFFFF	-	PnC62
1A00h	3	Mapping entry 3	UDINT	RW	No	Yes	0x60770010	0	0xFFFFFFF	-	PnC64
	4	Mapping entry 4	UDINT	RW	No	Yes	0x60F40020	0	0xFFFFFFF	-	PnC66
	5	Mapping entry 5	UDINT	RW	No	Yes	0x60610008	0	0xFFFFFFF	-	PnC68
	6	Mapping entry 6	UDINT	RW	No	Yes	0x00000008	0	0xFFFFFFF	-	PnC6A
	7	Mapping entry 7	UDINT	RW	No	Yes	0x60B90010	0	0xFFFFFFF	-	PnC6C
	8	Mapping entry 8	UDINT	RW	No	Yes	0x60BA0020	0	0xFFFFFFF	_	PnC6E

								Cor	ntinued from	previo	ous page.
Index	Subin- dex	Name	Data Type	Ac- cess	PDO Map- ping	Saving to EEPROM*1	Default Value	Lower Limit	Upper Limit	Unit	Parame- ter No.*2
	2nd trans	mit PDO mapping									
	0	Number of objects in this PDO	USINT	RW	No	Yes	2	0	8	-	PnCA5
	1	Mapping entry 1	UDINT	RW	No	Yes	0x60410010	0	0xFFFFFFF	-	PnC70
	2	Mapping entry 2	UDINT	RW	No	Yes	0x60640020	0	0xFFFFFFF	-	PnC72
1A01h	3	Mapping entry 3	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC74
	4	Mapping entry 4	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC76
	5	Mapping entry 5	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC78
	6	Mapping entry 6	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC7A
	7	Mapping entry 7	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC7C
	8	Mapping entry 8	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC7E
	3rd transi	mit PDO mapping									
	0	Number of objects in this PDO	USINT	RW	No	Yes	2	0	8	_	PnCA6
	1	Mapping entry 1	UDINT	RW	No	Yes	0x60410010	0	0xFFFFFFF	-	PnC80
	2	Mapping entry 2	UDINT	RW	No	Yes	0x60640020	0	0xFFFFFFF	-	PnC82
1A02h	3	Mapping entry 3	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC84
	4	Mapping entry 4	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC86
	5	Mapping entry 5	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC88
	6	Mapping entry 6	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC8A
	7	Mapping entry 7	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC8C
	8	Mapping entry 8	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC8E
	4th transr	mit PDO mapping				1					<u> </u>
	0	Number of objects in this PDO	USINT	RW	No	Yes	3	0	8	-	PnCA7
	1	Mapping entry 1	UDINT	RW	No	Yes	0x60410010	0	0xFFFFFFF	-	PnC90
	2	Mapping entry 2	UDINT	RW	No	Yes	0x60640020	0	0xFFFFFFF	-	PnC92
1A03h	3	Mapping entry 3	UDINT	RW	No	Yes	0x60770010	0	0xFFFFFFF	-	PnC94
	4	Mapping entry 4	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC96
	5	Mapping entry 5	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC98
	6	Mapping entry 6	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC9A
	7	Mapping entry 7	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC9C
	8	Mapping entry 8	UDINT	RW	No	Yes	0	0	0xFFFFFFF	-	PnC9E
	O Sync Mar	Number of used Sync Manager chan- nels	USINT	RO	No	No	4	_	_	_	-
1000	1	Communication type sync manager 0	USINT	RO	No	No	1	_	_	_	PnCB0*4
1C00h	2	Communication type sync manager 1	USINT	RO	No	No	2	-	-	_	PnCB1*4
	3	Communication type sync manager 2	USINT	RO	No	No	3	-	-	_	PnCB2*4
	4	Communication type sync manager 3	USINT	RO	No	No	4	_	_	_	PnCB3*4
1C10h	0	Sync Manager PDO assignment 0	USINT	RO	No	No	0	-	-	_	_
1C11h	0	Sync Manager PDO assignment 1	USINT	RO	No	No	0	-	-	_	-
	Sync Mar	nager PDO assignment	2								
	0	Number of assigned PDOs	USINT	RW	No	Yes	1	0	2	-	PnCB5
1C12h	1	Index of assigned RxPDO 1	UINT	RW	No	Yes	0x1601	0x1600	0x1603	-	PnCB6
	2	Index of assigned RxPDO 2	UINT	RW	No	Yes	0x1600	0x1600	0x1603	-	PnCB7

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Index	Subin- dex	Name	Data Type	Ac- cess	PDO Map- ping	Saving to EEPROM*1	Default Value	Lower Limit	Upper Limit	Unit	Parame- ter No.*2
	Sync Mar	nager PDO assignment	3			1					
	0	Number of assigned PDOs	USINT	RW	No	Yes	1	0	2	-	PnCBB
1C13h	1	Index of assigned TxPDO 1	UINT	RW	No	Yes	0x1A01	0x1A00	0x1A03		PnCBC
	2	Index of assigned TxPDO 2	UINT	RW	No	Yes	0x1A00	0x1A00	0x1A03	_	PnCBD
	Sync Mar	nager 2 (process data o	utput) sy	nchron	ization						
	0	Number of synchro- nization parameters	USINT	RO	No	No	10	_	_		-
	1	Synchronization type	UINT	RO	No	No	-	_	-	-	PnCC0*4
	2	Cycle time	UDINT	RO	No	No	_	-	_	_	PnCC2*4
	3	Shift time	UDINT	RO	No	No	125000	-	-	_	PnCC4*4
	4	Synchronization types supported	UINT	RO	No	No	0x0005	_	_	_	-
1C32h	5	Minimum cycle time	UDINT	RO	No	No	62500	-	-	-	_
	6	Calc and copy time	UDINT	RO	No	No	62500	-	-	-	_
	7	Reserved	UDINT	RO	No	No	0	-	-	-	_
	8	Reserved	UINT	RO	No	No	0	_	-	-	_
	9	Delay time	UDINT	RO	No	No	0	_	_	-	_
	10	Sync0 cycle time	UDINT	RO	No	No	_	_	_	-	PnCC6*4
	11	Reserved	UDINT	RO	No	No	0	-	-	-	-
	12	SM2 event miss count	UDINT	RO	No	No	-	_	-	_	PnCC8*4
	Sync Mar	nager 3 (process data ir	nput) syn	chroniz	zation						
	0	Number of synchro- nization parameters	USINT	RO	No	No	10	_	_	_	-
	1	Synchronization type	UINT	RO	No	No	-	_	-	-	-
	2	Cycle time	UDINT	RO	No	No	_	-	-	-	_
	3	Shift time	UDINT	RW	No	Yes	0	0	Sync0 event cycle - 12,500	-	PnCCA
1C33h	4	Synchronization types supported	UINT	RO	No	No	0x0025	_	-	_	_
	5	Minimum cycle time	UDINT	RO	No	No	62500	-	-	-	_
	6	Calc and copy time	UDINT	RO	No	No	62500	-	-	-	_
	7	Reserved	UDINT	RO	No	No	0	-	-	-	_
	8	Reserved	UINT	RO	No	No	0	_	_	-	_
	9	Delay time	UDINT	RO	No	No	0	-	-	-	_
	10	Sync0 cycle time	UDINT	RO	No	No	-	_	-	-	_
2000h to 26FFh	0	SERVOPACK parameters (Pn000 (2000h) to Pn6FF (26FFh))	_	-	-	-	-	_	-	_	Pn000*4 - Pn6FF*4
2700h	0	User parameter Configuration	UDINT	RW	No	No	0	0	0xFFFFFFF	_	PnB00
	Position (I .	I.	I .	1		1	T	I .	
07041	0	Number of entries	USINT	RO	No	No	2	_	_	_	
2701h	1	Numerator	UDINT	RW	No	Yes	1	1	1073741823	-	PnB02
	2	Denominator	UDINT	RW	No	Yes	1	1	1073741823	_	PnB04
	Velocity u	iser unit	l-	1	li .	1		1	1	1	I.
07001	0	Number of entries	USINT	RO	No	No	2	_	-	-	-
2702h	1	Numerator	UDINT	RW	No	Yes	1	1	1073741823	-	PnB06
	2	Denominator	UDINT	RW	No	Yes	1	1	1073741823	_	PnB08
									1		i

								Cor	tinued from	previo	ous page.
Index	Subin- dex	Name	Data Type	Ac- cess	PDO Map- ping	Saving to EEPROM*1	Default Value	Lower Limit	Upper Limit	Unit	Parame- ter No.*2
	Accelerat	ion user unit									
07001	0	Number of entries	USINT	RO	No	No	2	_	_	_	_
2703h	1	Numerator	UDINT	RW	No	Yes	1	1	1073741823	-	PnB0A
	2	Denominator	UDINT	RW	No	Yes	1	1	1073741823	_	PnB0C
	Torque us	ser unit				'			l	ļ.	
070.45	0	Number of entries	USINT	RO	No	No	2	_	_	_	_
2704h	1	Numerator	UDINT	RW	No	Yes	1	1	1073741823	_	PnB94
	2	Denominator	UDINT	RW	No	Yes	10	1	1073741823	-	PnB96
2705h	0	Encoder Selection	USINT	RW	No	Yes	0x0000	0x0000	0x0001	-	PnB9C
	SERVOPA	ACK adjusting comman	d								
	0	Number of entries	USINT	RO	No	No	3	-	-	-	-
2710h	1	Command	STRING	RW	No	No	0	0	0xFF	_	_
	2	Status	USINT	RO	No	No	_	_	_	_	_
	3	Reply	STRING	RO	No	No	_	-	_	-	_
2720h	0	Safety Module monitor	UDINT	RO	Yes	No	-	-	-	-	-
	Interpolat	ion data configuration f	or 1st pro	ofile							
	0	Number of entries	USINT	RO	No	No	9	-	-	-	-
	1	Maximum buffer size	UDINT	RO	No	No	254	_	_	_	_
	2	Actual buffer size	UDINT	RW	No	No	254	_	_	_	_
	3	Buffer organization	USINT	RW	No	No	0	0	1	-	PnCEC
	4	Buffer position	UINT	RW	Yes	No	1	1	255	_	PnCED
2730h	5	Size of data record	USINT	WO	No	No	1	1	1	_	_
	6	Buffer clear	USINT	WO	No	No	0	0	1	_	_
	7	Position data definition	USINT	RW	Yes	No	1	0	1	_	PnCEE
	8	Position data polarity	USINT	RW	Yes	No	0	0	1	_	PnCEF
	9	Behavior after reaching buffer position	USINT	RW	Yes	No	0	0	1	_	PnCF0
	Interpolat	ion data configuration f	or 2nd pr	ofile							
	0	Number of entries	USINT	RO	No	No	9	-	_	-	_
	1	Maximum buffer size	UDINT	RO	No	No	254	_	_	_	_
	2	Actual buffer size	UDINT	RW	No	No	254	_	_	_	_
	3	Buffer organization	USINT	RW	No	No	0	0	1	_	PnCF1
	4	Buffer position	UINT	RW	Yes	No	1	1	255	_	PnCF2
2731h	5	Size of data record	USINT	WO	No	No	1	1	1	-	_
	6	Buffer clear	USINT	WO	No	No	0	0	1	-	_
	7	Position data definition	USINT	RW	Yes	No	1	0	1	-	PnCF3
	8	Position data polarity	USINT	RW	Yes	No	0	0	1	_	PnCF4
	9	Behavior after reaching buffer position	USINT	RW	Yes	No	0	0	1	-	PnCF5
2732h	0	Interpolation profile select	USINT	RW	Yes	No	0	0	1		PnCF6
	Interpolat	ion data read/write poir	nter posit	ion mo	nitor					•	
	0	Number of entries	UINT	RO	No	No	2	-	_	_	_
2741h	1	Interpolation data read pointer position	UINT	RO	Yes	No	-	1	254	_	PnCF7*4
	2	Interpolation data write pointer position	UINT	RO	Yes	No	-	1	254	_	PnCF8*4
	Interpolat	ion data record for 1st	profile								
27C0h	0	Number of entries	DINT	RO	No	No	254	_	_	_	_
	1 to 254	1st set-point to 254 set-point	DINT	RW	No	No	0	-2147483648	2147483647	_	_

								Cor	ntinued from	previo	ous page.
Index	Subin- dex	Name	Data Type	Ac- cess	PDO Map- ping	Saving to EEPROM*1	Default Value	Lower Limit	Upper Limit	Unit	Parame- ter No.*2
	Interpolat	ion data record for 2nd	profile								
27C1h	0	Number of entries	DINT	RO	No	No	254	-	_	_	_
	1 to 254	1st set-point to 254 set-point	DINT	RW	No	No	0	-2147483648	2147483647	-	_
27E0h	_	Diag.mode	UINT	RW	No	No	0	0	0xFFFF	_	PnCFE
603Fh	0	Error code	UINT	RO	Yes	No	_	_	_	-	PnB10*4
6040h	0	Controlword	UINT	RW	Yes	No	0	0	0xFFFF	-	PnB11
6041h	0	Statusword	UINT	RO	Yes	No	-	-	_	-	PnB12*4
605Ah	0	Quick stop option code	INT	RW	No	Yes	2	0	4	-	PnB13
605Bh	0	Shutdown option code	INT	RW	No	Yes	0	0	1	_	PnB14
605Ch	0	Disable operation option code	INT	RW	No	Yes	1	0	1	-	PnB15
605Dh	0	Halt option code	INT	RW	No	Yes	1	0	4	-	PnB16
605Eh	0	Fault reaction option code	INT	RW	No	Yes	0	0	0	_	PnB17
6060h	0	Modes of operation	SINT	RW	Yes	Yes	0	0	10	-	PnB18
6061h	0	Modes of operation display	SINT	RO	Yes	No	0	-	-	-	PnB19*4
6062h	0	Position demand value	DINT	RO	Yes	No	_	_	_	Pos. unit	PnB20*4
6063h	0	Position actual inter- nal value	DINT	RO	Yes	No	_	_	_	Inc	PnB22*4
6064h	0	Position actual value	DINT	RO	Yes	No	_	_	_	Pos. unit	PnB24*4
6065h	0	Following error window	UDINT	RW	No	Yes	5242880	0	1073741823	Pos. unit	PnB26
6066h	0	Following error time out	UINT	RW	No	Yes	0	0	65535	ms	PnB28
6067h	0	Position window	UDINT	RW	No	Yes	30	0	1073741823	Pos. unit	PnB2A
6068h	0	Position window time	UINT	RW	No	Yes	0	0	65535	ms	PnB2C
606Bh	0	Velocity demand value	DINT	RO	Yes	No	_	_	_	Vel. unit	PnB2E*4
606Ch	0	Velocity actual value	DINT	RO	Yes	No	_	-	-	Vel. unit	PnB30*4
606Dh	0	Velocity window	UINT	RW	No	Yes	20000	0	65535	Vel. unit	PnB32
606Eh	0	Velocity window time	UINT	RW	No	Yes	0	0	65535	ms	PnB34
6071h	0	Target torque	INT	RW	Yes	No	0	-32768	32767	Trq. unit	PnB36
6072h	0	Max torque	UINT	RW	Yes	No	Motor max torque	0	65535	Trq. unit	PnB38
6074h	0	Torque demand value	INT	RO	Yes	No	_	_	_	Trq. unit	PnB3A*4
6076h	0	Motor rated torque	UDINT	RO	No	No	-	-	-	mN m, mN	PnB3C*4
6077h	0	Torque actual value	INT	RO	Yes	No	_	_	_	Trq. unit	PnB3E*4
607Ah	0	Target position	DINT	RW	Yes	No	0	-2147483648	2147483647	Pos. unit	PnB40
607Ch	_	Home offset	DINT	RW	No	Yes	0	-536870912	536870911	Pos. unit	PnB46

Name									Cor	tinued from	previo	ous page.
	Index		Name			Мар-			Lower Limit	Upper Limit	Unit	
		Software	position limit				1					
1	607Dh	0	Number of entries	USINT	RO	No	No	2	-	_		_
		1	Min position limit	DINT	RW	No	Yes	0	-536870912	536870911	unit	PnB48
		2	Max position limit	DINT	RW	No	Yes	0	-536870912	536870911	unit	PnB4A
Color Colo	607Fh	0	Max profile velocity	UDINT	RW	Yes	Yes	2147483647	0	4294967295	unit	PnB4C
Company Comp	6081h	0	Profile velocity	UDINT	RW	Yes	Yes	0	0	4294967295	unit	PnB4E
Color Colo	6083h	0	Profile acceleration	UDINT	RW	Yes	Yes	1000	0	4294967295	unit	PnB50
100	6084h	0		UDINT	RW	Yes	Yes	1000	0	4294967295	unit	PnB52
Company Comp	6085h	0		UDINT	RW	Yes	Yes	1000	-	4294967295		PnB54
Possible Company Com	6086h	0	Motion profile type	INT	RW	Yes	Yes	0	-32768	32767		PnB98*4
Homing speeds	6087h	0	Torque slope	UDINT	RW	Yes	Yes	1000	0	4294967295	unit/	PnB56
Homing speeds	6098h	0	Homing method	SINT	RW	Yes	No	35	0	35		PnB58
1 Speed during search DINT RW Yes Yes 500000 0 4294967295 Vel. PnB5A		Homing s	speeds		1							
For switch		0	Number of entries	USINT	RO	No	No	2	-	-	_	-
Profile jerk	6099h	1	Speed during search for switch	UDINT	RW	Yes	Yes	500000	0	4294967295		PnB5A
Profile jerk		2		UDINT	RW	Yes	Yes	100000	0	4294967295		PnB5C
O Number of entries USINT RO No No 1 - - - - - - -	609Ah	0	Homing acceleration	UDINT	RW	Yes	Yes	1000	0	4294967295		PnB5E
1			I	Т			1			Г	ı	Т
No Velocity offset DINT RW Yes No 0 -2147483648 2147483647 Vel. unit PnB60 Constitution PnB60 Constitution PnB60 PnB60 Constitution PnB60 60A4h											_	
Company Comp		1	Profile jerk1	UDINT	RW	No	Yes	25	0	50		PnB9A*4
Company Comp	60B1h	0	Velocity offset	DINT	RW	Yes	No	0	-2147483648	2147483647	unit	PnB60
Sober O tion String First	60B2h	0		INT	RW	Yes	No	0	-32768	32767		PnB62
60BAh 0 Touch probe pos1 pos value DINT RO Yes No - - - Pos. unit PnB68*4 60BCh 0 Touch probe pos2 pos value DINT RO Yes No - - - Pos. unit PnB64*4 60C0h 0 Interpolation sub mode select INT RW No No 0 -3 0 - PnB92 Interpolation data record 0 Number of entries USINT RO No No 1 - <t< td=""><td></td><td></td><td>tion</td><td></td><td></td><td></td><td></td><td>0</td><td>0</td><td>0xFFFF</td><td>_</td><td></td></t<>			tion					0	0	0xFFFF	_	
Columbia Columbia	60B9h	0		UINT	RO	Yes	No	-	-	_		PnB66*4
District Column	60BAh	0	pos value '	DINT	RO	Yes	No	-	-	_	unit	PnB68*4
Interpolation data record Interpolation data record Interpolation data record Interpolation data record Interpolation data record Interpolation data record Interpolation data record Interpolation data record Interpolation data record Interpolation data record Interpolation time period	60BCh	0	pos value	DINT	RO	Yes	No	_	_	_		PnB6A*4
60C1h 0 Number of entries USINT RO No No 1 -	60C0h		mode select	INT	RW	No	No	0	-3	0	-	PnB92
1			1	HOWE	D0	N.L.	KI.					
Interpolation time period O Number of entries USINT RO No No 2 - - - - -	60C1h		Interpolation data								Pos.	PnB70
O Number of entries USINT RO No No 2 - <td></td> <td>Internalat</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>unit</td> <td></td>		Internalat									unit	
Positive torque limit value				USINT	RO	No	No	2	_	_	_	_
60E0h 0 Positive torque limit value UINT RW Yes Yes 8000 0 65535 Trq. unit PnB80 60E1h 0 Negative torque limit value UINT RW Yes 8000 0 65535 Trq. unit PnB82	60C2h	1			RW	No	No	125	1	250	_	PnB6E
60E1h0Negative torque limit valueUINTRWYesYes8000065535ImitPnB82		2		SINT	RW	No	No	-6	-6	-3	_	PnB6F
value Olivi Rvv Yes Yes 8000 O 65535 unit P1662	60E0h	0		UINT	RW	Yes	Yes	8000	0	65535		PnB80
Continued on payt page	60E1h	0		UINT	RW	Yes	Yes	8000	0			PnB82

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Index	Subin- dex	Name	Data Type	Ac- cess	PDO Map- ping	Saving to EEPROM*1	Default Value	Lower Limit	Upper Limit	Unit	Parame- ter No.*2
	0	Number of entries	USINT	RO	No	No	1	-	_	-	-
60E4h	1	External encoder position	DINT	RO	Yes	Yes	0	_	_	_	_
60F4h	0	Following error actual value	DINT	RO	Yes	No	_	-	_	Pos. unit	PnB84*4
60FCh	O Position demand internal value		DINT	RO	Yes	No	_	-	_	Inc	PnB86*4
60FDh	0	Digital inputs	UDINT	RO	Yes	No	-	-	-	-	PnB88*4
	Digital outputs										
60FEh	0	Number of entries	USINT	RO	No	No	2	-	-	-	_
OUFEII	1	Physical outputs	UDINT	RW	Yes	No	0	0	0xFFFFFFF	-	PnB8A
	2	Bit mask	UDINT	RW	No	Yes	0x000C0000	0	0xFFFFFFF	-	PnB8C
60FFh	0	Target velocity	DINT	RW	Yes	No	0	-2147483648	2147483647	Vel. unit	PnB8E
6502h	0	Supported drive modes	UDINT	RO	No	No	0x03ED	-	-	_	PnB90*4

^{*1.} Write "Save" to object 1010h to save all of the current parameter data to EEPROM.

If the objects are modified by the Digital Operator or SigmaWin+, the data will be directly saved in EEPROM.

^{*2.} The parameter numbers given in the table are the parameter numbers that are used with the Digital Operator and SigmaWin+.

^{*3.} These parameters cannot be written by the Digital Operator.

^{*4.} These parameters are not displayed on the SigmaWin+.

^{*5.} For SGD7S-□□□□E0: 0x02200301.

16.3 SDO Abort Code List

The following table gives the SDO abort codes for SDO communications errors.

Value	Meaning
0x05 03 00 00	Toggle bit did not change.
0x05 04 00 00	SDO protocol timeout
0x05 04 00 01	Client/server command specifier is not valid or is unknown.
0x05 04 00 05	Out of memory
0x06 01 00 00	Unsupported access to an object
0x06 01 00 01	Attempt to read to a write-only object
0x06 01 00 02	Attempt to write to a read-only object
0x06 02 00 00	The object does not exist in the object directory.
0x06 04 00 41	The object cannot be mapped to the PDO.
0x06 04 00 42	The number and length of the objects to be mapped would exceed the PDO length.
0x06 04 00 43	General parameter incompatibility
0x06 04 00 47	General internal incompatibility in the device
0x06 06 00 00	Access failed due to a hardware error.
0x06 07 00 10	Data type does not match: length of service parameter does not match.
0x06 07 00 12	Data type does not match: service parameter too long.
0x06 07 00 13	Data type does not match: service parameter too short.
0x06 09 00 11	Subindex does not exist.
0x06 09 00 30	Value range of parameter was exceeded (only for write access).
0x06 09 00 31	Value of parameter that was written is too high.
0x06 09 00 32	Value of parameter that was written is too low.
0x06 09 00 36	The maximum value is less than the minimum value.
0x08 00 00 00	General error
0x08 00 00 20	Data cannot be transferred or stored to the application.
0x08 00 00 21	Data cannot be transferred or stored to the application because of local control.
0x08 00 00 22	Data cannot be transferred or stored to the application because of the present device state.

16.4 Parameter Recording Table

Use the following table to record the settings of the parameters.

Parameter No.	Default Setting		Name	When Enabled
Pn000 (2000h)	0000h		Basic Function Selections 0	After restart
Pn001 (2001h)	0000h		Application Function Selections 1	After restart
Pn002 (2002h)	0001h		Application Function Selections 2	After restart
Pn006 (2006h)	0002h		Application Function Selections 6	Immediately
Pn007 (2007h)	0000h		Application Function Selections 7	Immediately
Pn008 (2008h)	4000h		Application Function Selections 8	After restart
Pn009 (2009h)	0010h		Application Function Selections 9	After restart
Pn00A (200Ah)	0001h		Application Function Selections A	After restart
Pn00B (200Bh)	0000h		Application Function Selections B	After restart
Pn00C (200Ch)	0000h		Application Function Selections C	After restart
Pn00D (200Dh)	0000h		Application Function Selections D	After restart
Pn00F (200Fh)	0000h		Application Function Selections F	After restart
Pn022 (2022h)	0000h		Application Function Selection 22	After restart
Pn080 (2080h)	0000h		Application Function Selections 80	After restart
Pn081 (2081h)	0000h		Application Function Selections 81	After restart
Pn100 (2100h)	400		Speed Loop Gain	Immediately
Pn101 (2101h)	2000		Speed Loop Integral Time Constant	Immediately
Pn102 (2102h)	400		Position Loop Gain	Immediately
Pn103 (2103h)	100		Moment of Inertia Ratio	Immediately
Pn104 (2104h)	400		Second Speed Loop Gain	Immediately
Pn105 (2105h)	2000		Second Speed Loop Integral Time Constant	Immediately
Pn106 (2106h)	400		Second Position Loop Gain	Immediately
Pn109 (2109h)	0		Feedforward	Immediately
Pn10A (210Ah)	0		Feedforward Filter Time Constant	Immediately
Pn10B (210Bh)	0000h		Gain Application Selections	*

Continued from previous p						
Parameter No.	Default Setting	Name	When Enabled			
Pn10C (210Ch)	200	Mode Switching Level for Torque Reference	Immediately			
Pn10D (210Dh)	0	Mode Switching Level for Speed Reference	Immediately			
Pn10E (210Eh)	0	Mode Switching Level for Acceleration	Immediately			
Pn10F (210Fh)	0	Mode Switching Level for Position Deviation	Immediately			
Pn11F (211Fh)	0	Position Integral Time C stant	on- Immediately			
Pn121 (2121h)	100	Friction Compensation C	Gain Immediately			
Pn122 (2122h)	100	Second Friction Competition Gain	nsa- Immediately			
Pn123 (2123h)	0	Friction Compensation Coefficient	Immediately			
Pn124 (2124h)	0	Friction Compensation F quency Correction	Fre- Immediately			
Pn125 (2125h)	100	Friction Compensation Correction	Gain Immediately			
Pn131 (2131h)	0	Gain Switching Time 1	Immediately			
Pn132 (2132h)	0	Gain Switching Time 2	Immediately			
Pn135 (2135h)	0	Gain Switching Waiting 1	Time Immediately			
Pn136 (2136h)	0	Gain Switching Waiting 2	Time Immediately			
Pn139 (2139h)	0000h	Automatic Gain Switchir Selections 1	Immediately			
Pn13D (213Dh)	2000	Current Gain Level	Immediately			
Pn140 (2140h)	0100h	Model Following Control Related Selections	Immediately			
Pn141 (2141h)	500	Model Following Control	I Gain Immediately			
Pn142 (2142h)	1000	Model Following Control Correction	I Gain Immediately			
Pn143 (2143h)	1000	Model Following Control in the Forward Direction				
Pn144 (2144h)	1000	Model Following Control in the Reverse Direction	I Bias Immediately			
Pn145 (2145h)	500	Vibration Suppression 1 Frequency A	Immediately			
Pn146 (2146h)	700	Vibration Suppression 1 Frequency B	Immediately			
Pn147 (2147h)	1000	Model Following Control Speed Feedforward Cor sation				
Pn148 (2148h)	500	Second Model Following Control Gain	Immediately			
Pn149 (2149h)	1000	Second Model Following Control Correction	Gain Immediately			

Continued from previous					
Parameter No.	Default Setting			Name	When Enabled
Pn14A (214Ah)	800			Vibration Suppression 2 Frequency	Immediately
Pn14B (214Bh)	100			Vibration Suppression 2 Correction	Immediately
Pn14F (214Fh)	0021h			Control-Related Selections	After restart
Pn160 (2160h)	0010h			Anti-Resonance Control- Related Selections	Immediately
Pn161 (2161h)	1000			Anti-Resonance Frequency	Immediately
Pn162 (2162h)	100			Anti-Resonance Gain Correction	Immediately
Pn163 (2163h)	0			Anti-Resonance Damping Gain	Immediately
Pn164 (2164h)	0			Anti-Resonance Filter Time Constant 1 Correction	Immediately
Pn165 (2165h)	0			Anti-Resonance Filter Time Constant 2 Correction	Immediately
Pn166 (2166h)	0			Anti-Resonance Damping Gain 2	Immediately
Pn170 (2170h)	1401h			Tuning-less Function-Related Selections	*
Pn181 (2181h)	0			Mode Switching Level for Speed Reference	Immediately
Pn182 (2182h)	0			Mode Switching Level for Acceleration	Immediately
Pn205 (2205h)	65535			Multiturn Limit	After restart
Pn207 (2207h)	0010h			Position Control Function Selections	After restart
Pn20A (220Ah)	32768			Number of External Scale Pitches	After restart
Pn20E (220Eh)	16			Electronic Gear Ratio (Numerator)	After restart
Pn210 (2210h)	1			Electronic Gear Ratio (Denominator)	After restart
Pn212 (2212h)	2048			Number of Encoder Output Pulses	After restart
Pn22A (222Ah)	0000h			Fully-closed Control Selections	After restart
Pn230 (2230h)	0000h			Position Control Expansion Function Selections	After restart
Pn231 (2231h)	0			Backlash Compensation	Immediately
Pn233 (2233h)	0			Backlash Compensation Time Constant	Immediately
Pn281 (2281h)	20			Encoder Output Resolution	After restart
Pn282 (2282h)	0			Linear Encoder Pitch	After restart
Pn304 (2304h)	500			Jogging Speed	Immediately
Pn305 (2305h)	0			Soft Start Acceleration Time	Immediately

			Continued from p	
Parameter No.	Default Setting		Name	When Enabled
Pn306 (2306h)	0		Soft Start Deceleration Time	Immediately
Pn308 (2308h)	0		Speed Feedback Filter Time Constant	Immediately
Pn30A (230Ah)	0		Deceleration Time for Servo OFF and Forced Stops	Immediately
Pn30C (230Ch)	0		Speed Feedforward Average Movement Time	Immediately
Pn310 (2310h)	0000h		Vibration Detection Selections	Immediately
Pn311 (2311h)	100		Vibration Detection Sensitivity	Immediately
Pn312 (2312h)	50		Vibration Detection Level	Immediately
Pn316 (2316h)	10000		Maximum Motor Speed	After restart
Pn324 (2324h)	300		Moment of Inertia Calculation Starting Level	Immediately
Pn383 (2383h)	50		Jogging Speed	Immediately
Pn384 (2384h)	10		Vibration Detection Level	Immediately
Pn385 (2385h)	50		Maximum Motor Speed	After restart
Pn401 (2401h)	100		First Stage First Torque Reference Filter Time Constant	Immediately
Pn402 (2402h)	800		Forward Torque Limit	Immediately
Pn403 (2403h)	800		Reverse Torque Limit	Immediately
Pn404 (2404h)	100		Forward External Torque Limit	Immediately
Pn405 (2405h)	100		Reverse External Torque Limit	Immediately
Pn406 (2406h)	800		Emergency Stop Torque	Immediately
Pn407 (2407h)	10000		Speed Limit during Torque Control	Immediately
Pn408 (2408h)	0000h		Torque-Related Function Selections	*
Pn409 (2409h)	5000		First Stage Notch Filter Frequency	Immediately
Pn40A (240Ah)	70		First Stage Notch Filter Q Value	Immediately
Pn40B (240Bh)	0		First Stage Notch Filter Depth	Immediately
Pn40C (240Ch)	5000		Second Stage Notch Filter Frequency	Immediately
Pn40D (240Dh)	70		Second Stage Notch Filter Q Value	Immediately
Pn40E (240Eh)	0		Second Stage Notch Filter Depth	Immediately
Pn40F (240Fh)	5000		Second Stage Second Torque Reference Filter Frequency	Immediately
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Parameter No.	Default Setting	Nan	Enabled	ł
Pn410 (2410h)	50	Second Stage S Reference Filter		ely
Pn412 (2412h)	100	First Stage Secon Reference Filter stant		ely
Pn416 (2416h)	0000h	Torque-Related Selections 2	Function Immediate	ely
Pn417 (2417h)	5000	Third Stage Not Frequency	ch Filter Immediate	ely
Pn418 (2418h)	70	Third Stage Not Value	ch Filter Q Immediate	ely
Pn419 (2419h)	0	Third Stage Not Depth	ch Filter Immediate	ely
Pn41A (241Ah)	5000	Fourth Stage No Frequency	otch Filter Immediate	ely
Pn41B (241Bh)	70	Fourth Stage No Value	otch Filter Q Immediate	ely
Pn41C (241Ch)	0	Fourth Stage No Depth	otch Filter Immediate	ely
Pn41D (241Dh)	5000	Fifth Stage Noto Frequency	ch Filter Immediate	ely
Pn41E (241Eh)	70	Fifth Stage Noto Value	ch Filter Q Immediate	ely
Pn41F (241Fh)	0	Fifth Stage Note	ch Filter Depth Immediate	ely
Pn423 (2423h)	0000h	Speed Ripple C Selections	ompensation *	
Pn424 (2424h)	50	Torque Limit at Voltage Drop	Main Circuit Immediate	ely
Pn425 (2425h)	100	Release Time for at Main Circuit \		ely
Pn426 (2426h)	0	Torque Feedford Movement Time		ely
Pn427 (2427h)	0	Speed Ripple C Enable Speed	ompensation Immediate	ely
Pn456 (2456h)	15	Sweep Torque F Amplitude	Reference Immediate	ely
Pn460 (2460h)	0101h	Notch Filter Adji Selections 1	ustment Immediate	ely
Pn475 (2475h)	0000h	Gravity Comper Related Selection		art
Pn476 (2476h)	0	Gravity Comper	nsation Torque Immediate	ely
Pn480 (2480h)	10000	Speed Limit dur Control	ring Force Immediate	ely
Pn481 (2481h)	400	Polarity Detection Loop Gain	on Speed Immediate	ely
Pn482 (2482h)	3000	Polarity Detection Loop Integral Ti		ely
Pn483 (2483h)	30	Forward Force I	_imit Immediate	ely
Pn484 (2484h)	30	Reverse Force L	_imit Immediate	ely

		Continued from p	
Parameter No.	Default Setting	Name	When Enabled
Pn485 (2485h)	20	Polarity Detection Reference Speed	Immediately
Pn486 (2486h)	25	Polarity Detection Reference Acceleration/Deceleration Time	Immediately
Pn487 (2487h)	0	Polarity Detection Constant Speed Time	Immediately
Pn488 (2488h)	100	Polarity Detection Reference Waiting Time	Immediately
Pn48E (248Eh)	10	Polarity Detection Range	Immediately
Pn490 (2490h)	100	Polarity Detection Load Level	Immediately
Pn495 (2495h)	100	Polarity Detection Confirmation Force Reference	Immediately
Pn498 (2498h)	10	Polarity Detection Allowable Error Range	Immediately
Pn49F (249Fh)	0	Speed Ripple Compensation Enable Speed	Immediately
Pn502 (2502h)	20	Rotation Detection Level	Immediately
Pn503 (2503h)	10	Speed Coincidence Detection Signal Output Width	Immediately
Pn506 (2506h)	0	Brake Reference-Servo OFF Delay Time	Immediately
Pn507 (2507h)	100	Brake Reference Output Speed Level	Immediately
Pn508 (2508h)	50	Servo OFF-Brake Command Waiting Time	Immediately
Pn509 (2509h)	20	Momentary Power Interruption Hold Time	Immediately
Pn50A (250Ah)	1881h	Input Signal Selections 1	After restart
Pn50B (250Bh)	8882h	Input Signal Selections 2	After restart
Pn50E (250Eh)	0000h	Output Signal Selections 1	After restart
Pn50F (250Fh)	0100h	Output Signal Selections 2	After restart
Pn510 (2510h)	0000h	Output Signal Selections 3	After restart
Pn511 (2511h)	6543h	Input Signal Selections 5	After restart
Pn512 (2512h)	0000h	Output Signal Inverse Settings	After restart
Pn514 (2514h)	0000h	Output Signal Selections 4	After restart
Pn516 (2516h)	8888h	Input Signal Selections 7	After restart
Pn51B (251Bh)	1000	Motor-Load Position Deviation Overflow Detection Level	Immediately
Pn51E (251Eh)	100	Position Deviation Overflow Warning Level	Immediately

Doronsata	Deferrit	Continued from	previous page.
Parameter No.	Default Setting	Name	When Enabled
Pn520 (2520h)	5242880	Position Deviation Overflow Alarm Level	Immediately
Pn522 (2522h)	7	Positioning Completed Width	Immediately
Pn524 (2524h)	1073741 824	Near Signal Width	Immediately
Pn526 (2526h)	5242880	Position Deviation Overflow Alarm Level at Servo ON	Immediately
Pn528 (2528h)	100	Position Deviation Overflow Warning Level at Servo ON	Immediately
Pn529 (2529h)	10000	Speed Limit Level at Servo ON	Immediately
Pn52A (252Ah)	20	Multiplier per Fully-closed Rotation	Immediately
Pn52B (252Bh)	20	Overload Warning Level	Immediately
Pn52C (252Ch)	100	Base Current Derating at Motor Overload Detection	After restart
Pn530 (2530h)	0000h	Program Jogging-Related Selections	Immediately
Pn531 (2531h)	32768	Program Jogging Travel Distance	Immediately
Pn533 (2533h)	500	Program Jogging Movement Speed	Immediately
Pn534 (2534h)	100	Program Jogging Acceleration/Deceleration Time	Immediately
Pn535 (2535h)	100	Program Jogging Waiting Time	Immediately
Pn536 (2536h)	1	Program Jogging Number of Movements	Immediately
Pn550 (2550h)	0	Analog Monitor 1 Offset Voltage	Immediately
Pn551 (2551h)	0	Analog Monitor 2 Offset Voltage	Immediately
Pn552 (2552h)	100	Analog Monitor 1 Magnification	Immediately
Pn553 (2553h)	100	Analog Monitor 2 Magnification	Immediately
Pn55A (255Ah)	1	Power Consumption Monitor Unit Time	Immediately
Pn560 (2560h)	400	Residual Vibration Detection Width	Immediately
Pn561 (2561h)	100	Overshoot Detection Level	Immediately
Pn581 (2581h)	20	Zero Speed Level	Immediately
Pn582 (2582h)	10	Speed Coincidence Detection Signal Output Width	Immediately
Pn583 (2583h)	10	Brake Reference Output Speed Level	Immediately
Pn584 (2584h)	10000	Speed Limit Level at Servo ON	Immediately
Pn585 (2585h)	50	Program Jogging Movement Speed	Immediately

				Continued from p	nevious page.
Parameter No.	Default Setting			Name	When Enabled
Pn586 (2586h)	0			Motor Running Cooling Ratio	Immediately
Pn587 (2587h)	0000h			Polarity Detection Execution Selection for Absolute Linear Encoder	Immediately
Pn600 (2600h)	0			Regenerative Resistor Capacity	Immediately
Pn601 (2601h)	0			Dynamic Brake Resistor Capacity	After restart
Pn603 (2603h)	0			Regenerative Resistance	Immediately
Pn604 (2604h)	0			Dynamic Brake Resistance	After restart
Pn61A (261Ah)	0000h			Overheat Protection Selections	After restart
Pn61B (261Bh)	250			Overheat Alarm Level	Immediately
Pn61C (261Ch)	100			Overheat Warning Level	Immediately
Pn61D (261Dh)	0			Overheat Alarm Filter Time	Immediately

^{*} The timing for enabling changes to parameter settings depends on the parameter. Refer to the following section for details on the enable timing.

16.1.2 List of Parameters on page 16-3

Appendices

The appendix provides information on interpreting panel displays, and tables of corresponding SERVOPACK and SigmaWin+ function names.

17.1	Interp	reting Panel Displays17-2
	17.1.3 17.1.4	Interpreting Status Displays17-2Alarm and Warning Displays17-2Hard Wire Base Block Active Display17-2Overtravel Display17-2Forced Stop Display17-2
17.2	Correspo	onding SERVOPACK and SigmaWin+ Function Names 17-3
	17.2.1	Corresponding SERVOPACK Utility Function Names
	17.2.2	Corresponding SERVOPACK Monitor Display Function Names

17.1.1 Interpreting Status Displays

17.1 Interpreting 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.

17.1.1 Interpreting Status Displays

The status is displayed as described below.

Display	Meaning
8	/TGON (Rotation Detection) Signal 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	Base Block Display Lit during the base block state (servo OFF). Not lit while the servo is ON.

Display	Meaning
	Reference Input Display Lit while a reference is being input.
	Connected Display Lit while there is a connection.

17.1.2 Alarm and Warning Displays

If there is an alarm or warning, the code will be displayed one character at a time, as shown below.

Example: Alarm A.E60

$$\leftarrow$$
 Status Display \longrightarrow Not lit. \longrightarrow \longleftarrow Not lit. \longrightarrow \longleftarrow Not lit. \longrightarrow \longleftarrow Not lit. \longrightarrow \longleftarrow Not lit. \longrightarrow

17.1.3 Hard Wire Base Block Active Display

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

$$-$$
Status Display \longrightarrow Not lit. \longrightarrow \longrightarrow Not lit. \longrightarrow Not lit. \longrightarrow Not lit. \longrightarrow Not lit. \longrightarrow

17.1.4 Overtravel Display

If overtravel has occurred, the display will change in the following order.

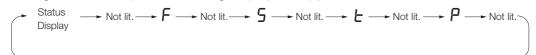
⑤ Forward Overtravel (P-OT)②Status Display → P

9	Reverse Overtravel (N-O1)
	Status Display— T

3 Forward and Reverse Overtravel
Status Display— P — n =

17.1.5 Forced Stop Display

During a forced stop, the following display will appear.



17.2 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+.

17.2.1 Corresponding SERVOPACK Utility Function Names

SigmaWin+			SERVOPACK		
Menu Dialog Box Button	Function Name	Fn No.	Function Name		
	Origin Search	Fn003	Origin Search		
	Absolute Encoder Reset	Fn008	Reset Absolute Encoder		
	Adjust the Apples Maniter Output	Fn00C	Adjust Analog Monitor Output Offset		
	Adjust the Analog Monitor Output	Fn00D	Adjust Analog Monitor Output Gain		
	Adjust the Meter Current Detec	Fn00E	Autotune Motor Current Detection Signal Offset		
	Adjust the Motor Current Detection Signal Offsets	Fn00F	Manually Adjust Motor Current Detection Signal Offset		
Catus	Multiturn Limit Setting	Fn013	Multiturn Limit Setting after Multiturn Limit Disagreement Alarm		
Setup	Reset Option Module Configuration Error	Fn014	Reset Option Module Configuration Error		
	Initialize Vibration Detection Level	Fn01B	Initialize Vibration Detection Level		
	Set Origin	Fn020	Set Absolute Linear Encoder Origin		
	Reset Motor Type Alarm	Fn021	Reset Motor Type Alarm		
	Software Reset	Fn030	Software Reset		
	Polarity Detection	Fn080	Polarity Detection		
	Tuning-less Level Setting	Fn200	Tuning-less Level Setting		
	Easy FFT	Fn206	Easy FFT		
	Initialize	Fn005	Initializing Parameters		
Parameters	Write Prohibition Setting	Fn010	Write Prohibition Setting		
	Setup Wizard	_	-		
	Autotuning without Host Reference	Fn201	Advanced Autotuning without Reference		
	Autotuning with Host Reference	Fn202	Advanced Autotuning with Reference		
Tuning	Custom Tuning	Fn203	One-Parameter Tuning		
	Adjust Anti-resonance Control	Fn204	Adjust Anti-resonance Control		
	Vibration Suppression	Fn205	Vibration Suppression		
	Moment of Inertia Estimation	_	-		
		Fn011	Display Servomotor Model		
		Fn012	Display Software Version		
Monitoring	Product Information	Fn01E	Display SERVOPACK and Servomotor IDs		
		Fn01F	Display Servomotor ID from Feedback Option Module		
Test Opera-	Jog	Fn002	Jog		
tion	Jog Program	Fn004	Jog Program		
Alarms	Alarm Display	Fn000	Display Alarm History		
, liaitio	Λιαττί Βιορίας	Fn006	Clear Alarm History		
Solutions	Mechanical Analysis	_	_		

17.2.2 Corresponding SERVOPACK Monitor Display Function Names

	SigmaWin+	SERVOPACK		
Menu Dialog Box Button	Name [Unit]	Un No.	Name [Unit]	
	Motor Speed [min ⁻¹]	Un000	Motor Speed [min ⁻¹]	
	Speed Reference [min ⁻¹]	Un001	Speed Reference [min ⁻¹]	
	Torque Reference [%]	Un002	Torque Reference [%] (percentage of rated torque)	
	Rotary Servomotors: Rotational Angle 1 [encoder pulses] (number of encoder pulses from origin within one encoder rotation) Linear Servomotors: Electrical Angle 1 [linear encoder pulses] (linear encoder pulses from the polarity origin)	Un003	Rotary Servomotors: Rotational Angle 1 [encoder pulses] (number of encoder pulses from origin within one encoder rotation displayed in decimal) Linear Servomotors: Electrical Angle 1 [linear encoder pulses] (linear encoder pulses from the polarity origin displayed in decimal)	
Motion Monitor	Rotary Servomotors: Rotational Angle 2 [deg] (electrical angle from origin within one encoder rotation) Linear Servomotors: Electrical Angle 2 [deg] (electrical angle from polarity origin)	Un004	Rotary Servomotors: Rotational Angle 2 [deg] (electrical angle from polarity origin) Linear Servomotors: Electrical Angle 2 [deg] (electrical angle from polarity origin)	
	Input Reference Pulse Speed [min ⁻¹]	Un007	Input Reference Pulse Speed [min ⁻¹] (displayed only during position control)	
	Position Deviation [reference units]	Un008	Position Error Amount [reference units] (displayed only during position control)	
	Accumulated Load Ratio [%]	Un009	Accumulated Load Ratio [%] (percentage of rated torque: effective torque in cycles of 10 seconds)	
	Regenerative Load Ratio [%]	Un00A	Regenerative Load Ratio [%] (percentage of processable regenerative power: regenerative power consumption in cycles of 10 seconds)	
	Dynamic Brake Resistor Power Consumption [%]	Un00B	Power Consumed by DB Resistance [%] (percentage of processable power at DB activation: 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]	
			Continued on next page	

		Continued from previous page.			
	SigmaWin+		SERVOPACK		
Menu Dialog Box Button	Name [Unit]	Un No.	Name [Unit]		
	Fully-closed Loop Feedback Pulse Counter [external encoder resolu- tion]	Un00E	Fully-closed Loop Feedback Pulse Counter [external encoder resolution]		
	Upper Limit Setting of Motor Maximum Speed/Upper Limit Setting of Encoder Output Resolution	Un010*1	Upper Limit Setting of Motor Maximum Speed/ Upper Limit Setting of Encoder Output Resolu- 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]		
Motion Monitor	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		
	Position within One Rotation of Absolute Encoder [encoder pulses]	Un041	Position within One Rotation of Absolute Encoder [encoder pulses]		
	Lower Bits of Absolute Encoder Position [encoder pulses]	Un042	Lower Bits of Absolute Encoder Position [encoder pulses]		
	Upper Bits of Absolute Encoder Position [encoder pulses]	Un043	Upper Bits of Absolute Encoder Position [encoder pulses]		
	Polarity Sensor Signal Monitor	Un011	Polarity Sensor Signal Monitor		
Status 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- nal Moni- tor	al Moni- Input Signal Monitor		Input Signal Monitor		
Output Signal Monitor	Output Signal Monitor	Un006	Output Signal Monitor		
	Installation Environment Monitor – SERVOPACK	Un025	SERVOPACK Installation Environment Monitor [%]		
	Installation Environment Monitor – Servomotor*2	Un026*2	Servomotor Installation Environment Monitor [%]		
Service Life Moni-	Service Life Prediction Monitor – 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 Prevention Circuit	Un029	Surge Prevention Circuit Remaining Life Ratio [%]		
	Service Life Prediction Monitor – Dynamic Brake Circuit	Un02A	Dynamic Brake Circuit Remaining Life Ratio [%]		
Product	Motor Population	Un084	Linear Encoder Pitch (Scale pitch = $Un084 \times 10^{Un085}$ [pm])		
Informa- tion	Motor – Resolution	Un085	Linear Encoder Pitch Exponent (Scale pitch = Un084 × 10 ^{Un085} [pm])		
	_	Un020	Rated Motor Speed [min ⁻¹]		
_	_	Un021	Maximum Motor Speed [min ⁻¹]		

17.2.2 Corresponding SERVOPACK Monitor Display Function Names

- *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.1 \(\propersup \), the encoder output resolution (Pn281) that can be set is displayed.

 • If Pn080 = n.1 \(\propersup \) \(\propersup \), 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, SGM7E, SGM7F, and SGMCV

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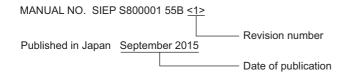
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Revision History

The revision dates and numbers of the revised manuals are given on the bottom of the back cover.



Date of Publication	Rev. No.	Section	Revised Contents
October 2018	<9>	All chapters	Partly revised.
		1.8	Newly added.
		2.1.1	Revision: Built-in Regenerative Resistor Power Loss
		4.4.3, 5.14.1	Addition: Absolute linear encoder from Fagor Automation S. Coop.
		5.1.4, 7.6.3	Revision: Footnote in Origin Search
		14.6	Revision: Description of value 0 of bit 10 for "Bits 10, 12, and 13: Cyclic Synchronous Position, Velocity, or Torque Mode"
		16.2	Addition: Footnote 4
		Back cover	Revision: Address
May 2018	<8>	All chapters	Addition: Information on SERVOPACKs with single-phase, 200 VAC power supply input (SGD7S-120AA0A008)
		Preface, 2.1.1, 7.6.2, 17.2.1	Partly revised.
		4.3.1	Revision: Specifications for L1C and L2C
December 2017	<7>	Preface	Partly revised.
		Preface, 1.5.2, 1.6.1, 5.11.1, 5.14.1	Addition: Information on Rotary Servomotors (SGM7M)
		1.3	Revision: Information on nameplate
		1.6.3	Addition: Information on SGLFW2-90A200A□L, SGLFW2-90A560A, and SGLFW2-1DA560A
		5.10.5	Newly added.
		Chapter 15	Deletion: F50h
		Back cover	Revision: Address
March 2017	<6>	Preface, 15.4	Partly revised.
		4.4.3, 5.14.1	Addition: Information on SQ47 and SQ57 Linear Encoders from Magnescale Co., Ltd.
		5.14.1	Addition: Information on LIC2100-Series and LC415 Linear Encoders from Heidenhain Corporation.
		5.14.1, 5.16.2	Addition: Information on RESOLUTE Linear Encoders from Renishaw PLC.
		5.14.5, 16.2	Addition: 2705h (Encoder Selection)
		16.1.2	Revisions: Reference information
		Back cover	Revision: Address
December 2016	<5>	Preface	Partly revised.
		1.4.2, 4.4.2, 4.4.3, 5.16.1, 5.17, 6.12	Addition: Information on Rotary Servomotors with 24-bit batteryless absolute encoders.
		13.3.1	Addition: Information on SPOSING (S-curve acceleration/deceleration positioning).
		16.2	Addition: 6086h (Motion profile type), 60A4h (Profile jerk)

Date of Publication	Rev. No.	Section	Revised Contents
September 2016	<4>	All chapters	Addition: Information on Direct Drive Servomotors (SGM7E and SGM7F (A, N, and M models))
		2.1.3, 4.2, 4.5	Revision: "Linear Servomotor overheat protection signal input" changed to "overheat protection input."
		3.7	Addition: EMC installations for single-phase 200-VAC and single-phase 100-VAC models.
		4.4.3, 5.14.1, 5.16.2	Addition: Information on Renishaw PLC EVOLUTE linear scales
		6.14, 15.2.1, 15.2.2, 15.3, 16.1.2, 17.2.2	Addition: Information on overheat protection
		8.12.3, 16.1.2	Addition: Information on gravity compensation
April 2016	<3>	All chapters	Addition: Information on SGM7F Direct Drive Servomotors.
			Deletion: Information on SGLC Linear Servomotors
		Preface. 9.1, 9.2	Partly revised.
		2.1.1	Addition: Information on input current from control power supply
		Chapter 16	Deletion: Pn52D
January 2016	<2>	All chapters	Additions: Information on SERVOPACKs with a single-phase, 100-VAC power supply input Revision: Partly revised.
		Preface	Addition: Information on SGMMV Rotary Servomotors Revision: Information on certification for standards
		Chapter 1	Addition: Information on SGMMV Rotary Servomotors
		1.5.2	Addition: Information on Direct Drive Servomotors (SGMCV-16D and -35D).
		4.4.3, 5.14.1, 6.5.1	Addition: Information on SQ10 Linear Encoder from Magnescale Co., Ltd.
		9.5	Addition: Alarm tracing
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Σ -7-Series AC Servo Drive $\Sigma\text{-7S}$ SERVOPACK with EtherCAT (CoE) Communications References Product Manual

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