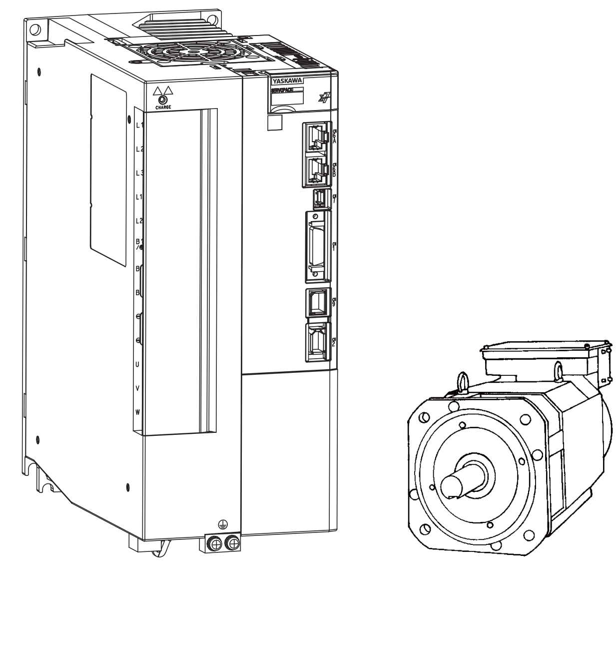
YASKAWA

Σ-7-Series AC Servo Drive

Σ-7S SERVOPACK with FT/EX Specification for Processing Machine, Spindle Motor

Product Manual

Model: SGD7S-□□□A30A124F20



MANUAL NO. SIEP S800001 90L

About this Manual

This manual provides information required to select Σ-7S FT20 SERVOPACKs 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

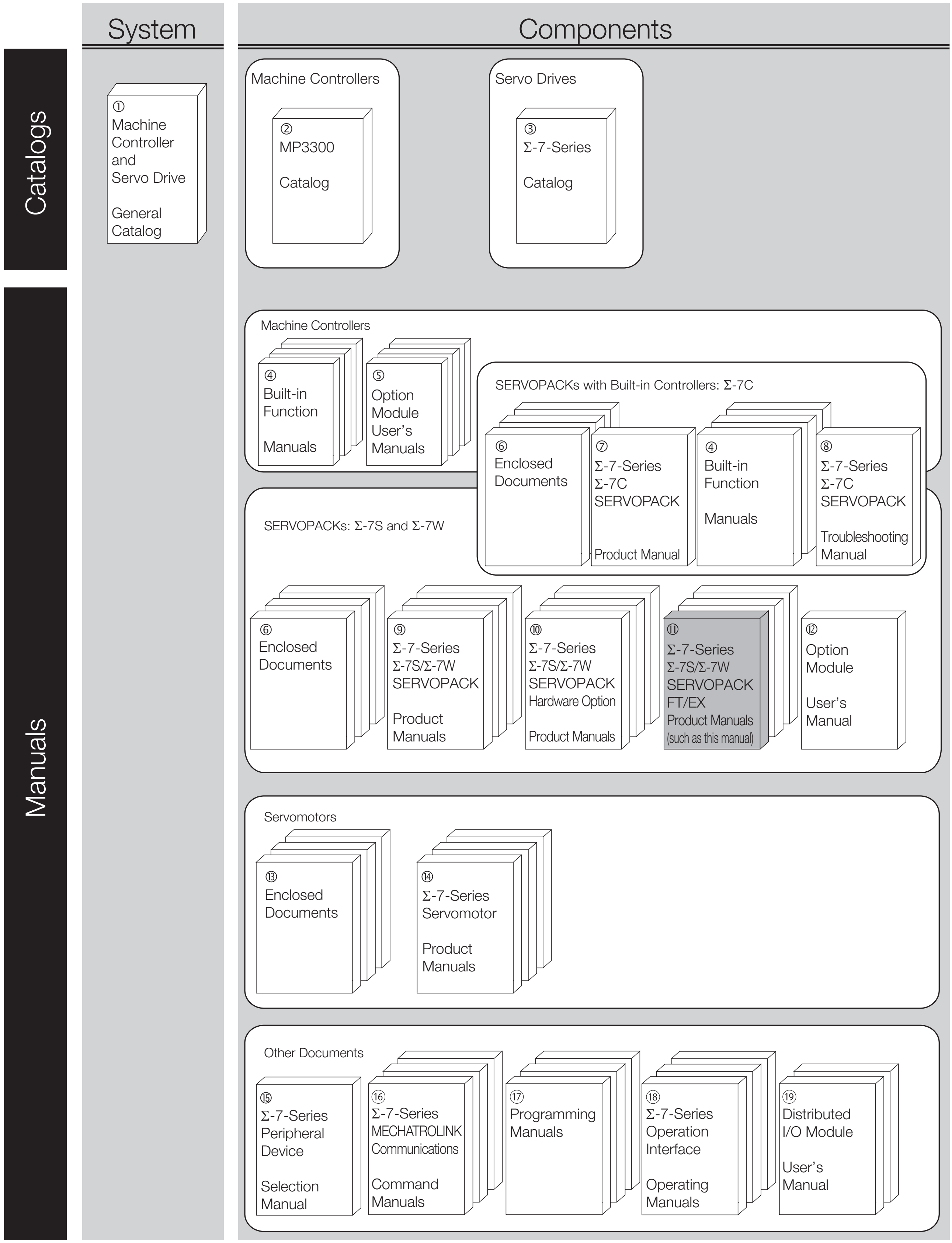
The contents of the chapters of this manual are described in the following table.

Refer to these chapters as required.

Chapter	Chapter Title	Contents
1	Basic Information on SERVOPACKs	Provides information required to select SERVOPACKs, such as SERVOPACK models and combinations with Spindle Motors.
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	Maintenance	Provides information on the meaning of, causes of, and corrections for alarms and warnings.
12	Parameter Lists	Provides information on the parameters.
13	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.



Classification	Document Name	Document No.	Description
① 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.
④ Built-in Function Manuals	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.
	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 SERVOPACKs.
⑤ Option Module User's Manuals	Machine Controller MP2000 Series Communication Module User's Manual	SIEP C880700 04	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 SERVOPACKs.
	Machine Controller MP2000 Series 262IF-01 FL-net Communication Module User's Manual	SIEP C880700 36	
	Machine Controller MP2000 Series 263IF-01 EtherNet/IP Communication Module User's Manual	SIEP C880700 39	
	Machine Controller MP2000 Series I/O Module User's Manual	SIEP C880700 34	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 Analog Input/Analog Output Module AI-01/AO-01 User's Manual	SIEP C880700 26	
	Machine Controller MP2000 Series Counter Module CNTR-01 User's Manual	SIEP C880700 27	

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Classification	Document Name	Document No.	Description
⑥ Enclosed Documents	Σ-7-Series AC Servo Drive Σ-7S, Σ-7W, and Σ-7C SERVOPACK Safety Precautions	TOMP C710828 00	Provides detailed information for the safe usage of Σ-7-Series SERVOPACKs.
	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.
	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 SERVOPACKs; installing, connecting, setting, testing in trial operation, and tuning Servo Drives; writing, monitoring, and maintaining programs; and other information.
⑧ Σ-7-Series Σ-7C SERVOPACK Troubleshooting Manual	Σ-7-Series AC Servo Drive Σ-7C SERVOPACK Troubleshooting Manual	SIEP S800002 07	Provides detailed troubleshooting information for Σ-7-Series Σ-7C SERVOPACKs.

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Classification	Document Name	Document No.	Description
⑨ Σ-7-Series Σ-7S/Σ-7W SERVOPACK Product Manuals	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with MECHATROLINK-4 Communications References Product Manual	SIEP S800002 31	Provide detailed information on selecting Σ-7-Series SERVO-PACKs and information on install-ing, connecting, setting, performing trial operation for, tuning, and mon-itoring the Servo Drives.
	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	
	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-7W SERVOPACK with MECHATROLINK-III Communications References Product Manual	SIEP S800001 29	
⑩ Σ-7-Series Σ-7S/Σ-7W SERVOPACK with Hardware Option Specifications Product Manuals	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 Hardware Options for Σ-7-Series SERVOPACKs.
	Σ-7-Series AC Servo Drive Σ-7W/Σ-7C SERVOPACK with Hardware Option Specifica- tions HWBB Function Product Manual	SIEP S800001 72	

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Classification	Document Name	Document No.	Description
⑪ Σ-7-Series Σ-7S/Σ-7W SERVOPACK FT/EX Product Manuals	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Indexing 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 Tracking Application Product Manual	SIEP S800001 89	
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Processing Machine, Spindle Motor Product Manual	This manual (SIEP S800001 90)	
	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	
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Transfer and Alignment Application Product Manual	SIEP S800001 95	
	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	

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Classification	Document Name	Document No.	Description
⑫ 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 details information required for the design and maintenance of a Safety Module.
⑬ Enclosed Documents	AC Servo Drive Rotary Servomotor Safety Precautions	TOBP C230260 00	Provides detailed information for the safe usage of Rotary Servomotors and Direct Drive Servomotors.
	AC Servomotor Linear Σ Series Safety Precautions	TOBP C230800 00	Provides detailed information for the safe usage of Linear Servomotors.
⑭ Σ-7-Series Servomotor Product Manuals	Σ-7-Series AC Servo Drive Rotary Servomotor Product Manual	SIEP S800001 36	Provide detailed information on selecting, installing, and connecting the Σ-7-Series Servomotors.
	Σ-7-Series AC Servo Drive Linear Servomotor Product Manual	SIEP S800001 37	
	Σ-7-Series AC Servo Drive Direct Drive Servomotor Product Manual	SIEP S800001 38	
⑮ Σ-7-Series Peripheral Device Selection Manual	Σ-7-Series AC Servo Drive Peripheral Device Selection Manual	SIEP S800001 32	Describes the peripheral devices for a Σ-7-Series Servo System.
⑯ Σ-7-Series MECHATROLINK Communications Command Manuals	Σ-7-Series AC Servo Drive MECHATROLINK-II Communications Command Manual	SIEP S800001 30	Provides detailed information on the MECHATROLINK-II communications commands that are used for a Σ-7-Series Servo System.
	Σ-7-Series AC Servo Drive MECHATROLINK-III Communications Standard Servo Profile Command Manual	SIEP S800001 31	Provides detailed information on the MECHATROLINK-III communications standard servo profile commands that are used for a Σ-7-Series Servo System.
	Σ-7-Series AC Servo Drive MECHATROLINK-4 Communications Standard Servo Profile Command Manual	SIEP S800002 32	Provides detailed information on the MECHATROLINK-4 communications standard servo profile commands that are used for a Σ-7-Series Servo System.
⑰ Programming Manuals	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.
	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 Σ-7-Series Operation Interface Operating Manuals	System Integrated Engineering Tool MPE720 Version 7 USER'S MANUAL	SIEP C880761 03	Describes in detail how to operate MPE720 version 7.
	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.

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Classification	Document Name	Document No.	Description
⑲ Distributed I/O Module User's Manuals	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.
	MECHATROLINK-4 Compatible I/O Module User's Manual	SIEP C880782 01	Describes the functions, specifications, operating methods, and MECHATROLINK-4 communications for the Remote I/O Modules for MP3000-Series Machine Controllers.

Using This Manual

◆ Technical Terms Used in This Manual

The following terms are used in this manual.

Term	Meaning
Spindle Motor	A Σ-7-Series UAKAJ Motor.
SERVOPACK	A Σ-7-Series Σ-7S Servo Amplifier with MECHATROLINK-III Communications References.
Servo Drive	The combination of a Spindle Motor and SERVOPACK.
Servo System	A servo control system that includes the combination of a Servo Drive with a host controller and peripheral devices.
servo ON	Supplying power to the motor.
servo OFF	Not supplying power to the motor.
base block (BB)	Shutting OFF the power supply to the motor by shutting OFF the base current to the power transistor in the SERVOPACK.
servo lock	A state in which the motor is stopped and is in a position loop with a position reference of 0.
main circuit cable	One of the cables that connect to the main circuit terminals, including the Main Circuit Power Supply Cable, Control Power Supply Cable, and Spindle Motor main circuit cable.
SigmaWin+	The Engineering Tool for setting up and tuning Servo Drives or a computer in which the Engineering Tool is installed.

◆ 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

$\overline{BK}$ 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

The control methods for which the parameters apply are given.
Speed : Speed control Position : Position control Torque : Torque control

Pn100	Speed Loop Gain			Speed Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1 Hz	400	Immediately	Tuning

Parameter number

This is the setting range for the parameter.

This is the minimum unit (setting increment) that you can set for the parameter.

This is the parameter setting before shipment.

This is when any change made to the parameter will become effective.

This is the parameter classification.

- Parameters for Selecting Functions

Parameter		Meaning	When Enabled	Classification
Pn002	n.□0□□ (default setting)	Use the encoder according to encoder specifications.	After restart	Setup
	n.□1□□	Use the encoder as an incremental encoder.		
	n.□2□□	Use the encoder as a single-turn absolute encoder.		

Parameter number

The notation "n.□□□□" indicates a parameter for selecting functions.
Each □ indicates the setting for one digit.
The notation shown here means that the third digit from the right is set to 2.

This column explains the selections for the function.

Notation Example

n.0 0 0 0

Notation Examples for Pn002

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

◆ Engineering Tools Used in This Manual

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

◆ Trademarks

- QR code is a trademark of Denso Wave Inc.
- MECHATROLINK is a trademark of the MECHATROLINK Members Association.
- 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.

Important

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

Term

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.

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

⚠ 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.

⚠ WARNING

- 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 Spindle Motor to ground poles according to local electrical codes (100 Ω or less for a SERVOPACK with a 100-VAC or 200-VAC power supply, 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, Spindle Motors, and other components can be very hot while power is ON or soon after the power is turned OFF. Implement safety measures, such as installing covers, so that hands and parts such as cables do not come into contact with hot components.
  There is a risk of burn injury.
- For a 24-VDC power supply, use a power supply device with double insulation or reinforced insulation.
  There is a risk of electric shock.
- Do not damage, pull on, apply excessive force to, place heavy objects on, or pinch cables.
  There is a risk of failure, damage, or electric shock.
- The person who designs the system that uses the hard wire base block safety function must have a complete knowledge of the related safety standards and a complete understanding of the instructions in this document.
  There is a risk of injury, product damage, or machine damage.
- Do not use the product in an environment that is subject to water, corrosive gases, or flammable gases, or near flammable materials.
  There is a risk of electric shock or fire.

NOTICE

- Do not attempt to use a SERVOPACK or Spindle Motor 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 SERVOPACK and Spindle Motor in one of the specified combinations.
- Do not touch a SERVOPACK or Spindle Motor with wet hands.
  There is a risk of product failure.

■ Storage Precautions

⚠ 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

⚠ 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 Spindle Motor to move the machine.
  There is a risk of damage or injury.
- When you handle a SERVOPACK or Spindle Motor, be careful of sharp parts, such as the corners.
  There is a risk of injury.
- Do not place an excessive load on the product during transportation. (Follow all instructions on the packages.)
  There is a risk of injury or damage.

NOTICE

- Do not hold onto the front cover or connectors when you move a SERVOPACK.
  There is a risk of the SERVOPACK falling.
- A SERVOPACK or Spindle Motor 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 Spindle Motor.
  If you use a tool to overtighten the eyebolts, the tapped holes may be damaged.

■ Installation Precautions

⚠ CAUTION

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

NOTICE

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

  If you store or install the product in any of the above locations, the product may fail or be damaged.
- **Use the product in an environment that is appropriate for the product specifications.**
  If you use the product in an environment that exceeds product specifications, the product may fail or be damaged.
- **A SERVOPACK or Spindle Motor 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 Spindle Motor with a Cooling Fan and do not cover the outlet from the Spindle Motor'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.
- **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.

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

■ Operation Precautions

⚠ WARNING

- Before starting operation with a machine connected, change the settings of the switches and parameters to match the machine.
  Unexpected machine operation, failure, or personal injury may occur if operation is started before appropriate settings are made.
- Do not radically change the settings of the parameters.
  There is a risk of unstable operation, machine damage, or injury.
- Install limit switches or stoppers at the ends of the moving parts of the machine to prevent unexpected accidents.
  There is a risk of machine damage or injury.
- For trial operation, securely mount the Spindle Motor 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.
- 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 Spindle Motor 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 Spindle Motor to drive a vertical load, set the Spindle Motor to enter a zero-clamped state after the Spindle Motor stops. Also, install safety devices (such as an external brake or counterweight) to prevent the moving parts of the machine from falling.

NOTICE

- When you adjust the gain during system commissioning, use a measuring instrument to monitor the torque waveform and speed waveform and confirm that there is no vibration.
  If a high gain causes vibration, the Spindle Motor 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.

⚠ WARNING

- 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 motor 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.
- 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, always ensure that safety can be maintained by installing an external brake structure.

■ Disposal Precautions

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

■ General Precautions

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

Warranty

◆ Details of Warranty

■ Warranty Period

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

■ Warranty Scope

Yaskawa shall replace or repair a defective product free of charge if a defect attributable to Yaskawa occurs during the above warranty period.
This warranty does not cover defects caused by the delivered product reaching the end of its service life and replacement of parts that require replacement or that have a limited service life.

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

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

◆ Limitations of Liability

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

◆ Suitability for Use

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

◆ Specifications Change

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

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

Certification marks for the standards for which the product has been certified by certification bodies are shown on nameplate. Products that do not have the marks are not certified for the standards.

Refer to the Servomotor manual for compliant standards of Servomotors.

◆ North American Safety Standards (UL)

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

◆ EU Directives

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

* The SGD7S-□□□A30A124F20 are not certified.

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

◆ UK Conformity Assessed (UKCA)

UK
CA

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

* The SGD7S-☐☐☐A30A124F20 are not certified.

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

◆ Safety Standards

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

Note: The SGD7S-☐☐☐A30A124F20 are not certified.

■ Safety Parameters

Item	Standards	Performance Level	
Safety Integrity Level	EN 61508	SIL3	
	EN IEC 62061	maximum SIL 3	
Mission Time	EN 61508	10 years	20 years
Probability of Dangerous Failure per Hour	EN 61508 EN IEC 62061	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	EN 60204-1	Stop category 0	
Safety Function	EN 61800-5-2	STO	
Hardware Fault Tolerance	EN 61508	HFT = 1	
Subsystem	EN 61508	B	

Contents

4 Wiring and Connecting SERVOPACKs

5 Basic Functions That Require Setting before Operation

8 Tuning

9 Monitoring

10 Fully-Closed Loop Control

Basic Information on SERVOPACKs

1

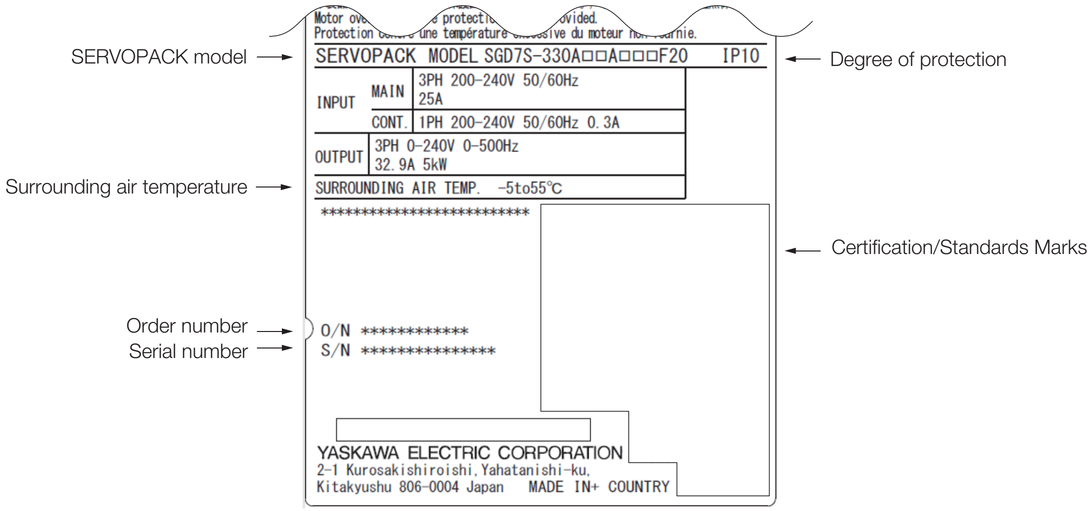
This chapter provides information required to select SERVOPACKs, such as SERVOPACK models and combinations with Spindle Motors.

1.1 Σ-7-Series FT20 SERVOPACKs

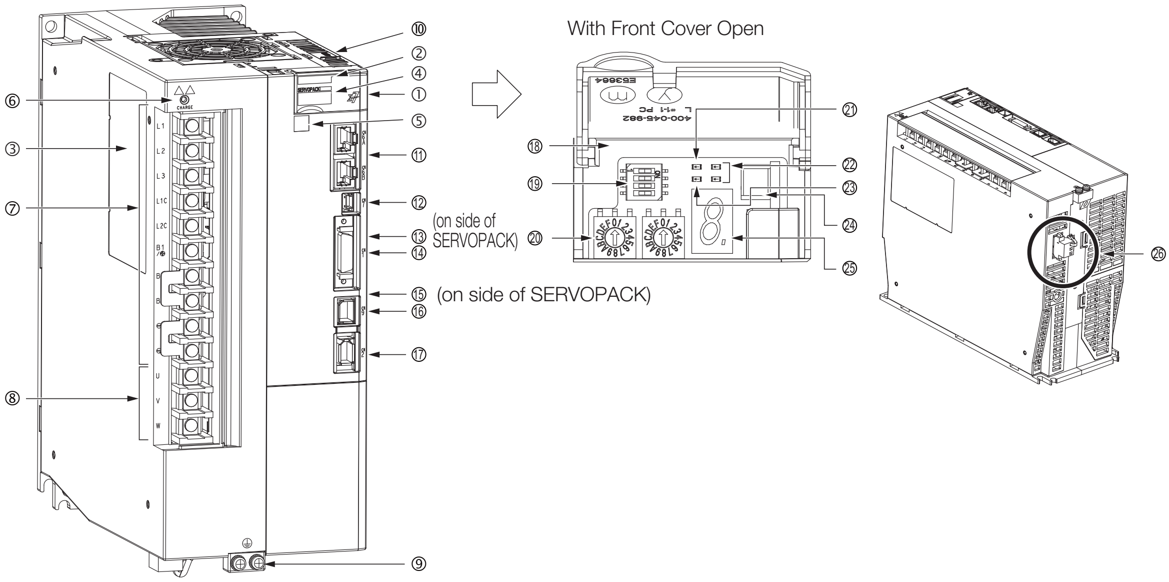
The Σ-7-Series FT20 SERVOPACKs have been specialized to control Spindle Motors. They are mainly used to control Spindle Motors for processing machines.

1.2 Interpreting the Nameplate

The following basic information is provided on the nameplate.



1.3 Part Names



No.	Name	Description	Reference
①	Front Cover	–	–
②	Input Voltage	–	–
③	Nameplate	Indicates the SERVOPACK model and ratings.	page 1-3
④	Model	The model of the SERVOPACK.	page 1-6
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 4-10
⑧	Spindle Motor Terminals (U, V, and W)	The connection terminals for the Spindle Motor main circuit cable (power line).	page 4-16
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 4-26
⑪	Serial Communications Connector (CN3)	Connects to the Digital Operator (a peripheral device) or a computer (RS-422).	page 4-27
⑫	Computer Connector (CN7)	A USB connector to connect a computer.	page 4-27
⑬	Safety Option Module Connector	A Safety Option Module is not supported.	–
⑭	I/O Signal Connector (CN1)	Connects to sequence I/O signals.	page 4-21
⑮	Feedback Option Module Connector	Connects to a Feedback Option Module.	–
⑯	Pulse Encoder Connector (CN9)	Pulse encoder connector (CN9) that connects to a pulse encoder.	–
⑰	Encoder Connector (CN2)	This is the connector for the encoder mounted on the Spindle Motor.	page 4-16
⑱	Serial Number	–	–
⑲	DIP Switch (S3)	Used to set MECHATROLINK-III communications.	page 5-16
⑳	Rotary Switches (S1 and S2)	Used to set the MECHATROLINK station address.	
㉑	PWR	Lights when the control power is being supplied.	–
㉒	L1, L2	Lights during MECHATROLINK communications.	–

Continued on next page.

Continued from previous page.

No.	Name	Description	Reference
㉓	CN	Lights when the SERVOPACK normally receives a CONNECT command.	–
㉔	Analog Monitor Connector (CN5)	You can use a special cable (peripheral device) to monitor the motor speed, torque reference, or other values.	page 4-28
㉕	Panel Display	Displays the servo status with a seven-segment display.	page 13-2
㉖	–	Do not use these terminals. Do not disconnect the terminals.	–

1.4 Model Designations

SGD7S - 330 A 30 A 124 F20

Σ-7-Series Σ-7S SERVOPACKs	1st+2nd+3rd digits	4th digit	5th+6th digits	7th digit	8th+9th+10th digits	11th+12th+13th digits

1st+2nd+3rd digits Maximum Applicable Motor Capacity

Voltage	Code	Specification
Three-Phase, 200 VAC	330	5.0 kW (continuous rating)
	780	15 kW (continuous rating)

4th digit Voltage

Code	Specification
A	200 VAC

5th+6th digits Interface

Code	Specification
30	MECHATROLINK-III communications reference (RJ-45 Connector)

7th digit Design Revision Order

A

B

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

Code	Specification	Applicable Models
124	Varnished, external dynamic brake resistor, pulse encoder support, and no safety functions	All models
324		

11th+12th+13th digits FT/EX Specification

Code	Specification
F20	Spindle Motor control applications for processing machines

1.5 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
Motor Direction Setting	page 5-17
Overtravel and Related Settings	page 5-18
Motor Stopping Methods for Servo OFF and Alarms	page 5-22
Setting the Regenerative Resistor Capacity	page 5-28
Operation for Momentary Power Interruptions	page 6-13
SEMI F47 Function	page 6-14
Setting the Motor Maximum Speed	page 6-16
Software Limits and Settings	page 6-19
Adjusting the Motor Current Detection Signal Offset	page 6-27
Forcing the Motor to Stop	page 6-31
Fully-Closed Loop Control	page 10-1
External Latches	–

- Functions Related to the Host Controller

Function	Reference
Electronic Gear Settings	page 5-26
I/O Signal Allocations	page 6-3
ALM (Servo Alarm) Signal	page 6-6
/WARN (Warning) Signal	page 6-6
/TGON (Rotation Detection) Signal	page 6-6
/S-RDY (Servo Ready) Signal	page 6-7
/V-CMP (Speed Coincidence Detection) Signal	page 6-8
/COIN (Positioning Completion) Signal	page 6-9
/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 6-20
Initializing the Vibration Detection Level	page 6-24
Resetting Alarms	page 11-32
Setting the Position Deviation Overflow Alarm Level	page 8-6

- Functions to Achieve Optimum Motions

Function	Reference
Automatic Adjustment without a Host Reference	–
Automatic Adjustment with a Host Reference	–
Custom Tuning	page 8-33
Anti-Resonance Control Adjustment	page 8-42
Backlash Compensation	page 8-48
Compatible Adjustment Functions	page 8-62

- Functions for Trial Operation during Setup

Function	Reference
Software Reset	page 6-21
Trial Operation of Spindle Motor without a Load	page 7-5
Program Jogging	page 7-12
Origin Search	page 7-16
Monitoring Machine Operation Status and Signal Waveforms	page 9-9

- Functions for Inspection and Maintenance

Function	Reference
Write Prohibition Setting for Parameters	page 5-11
Initializing Parameter Settings	page 5-14
Monitoring Product Information	page 9-2
Monitoring Product Life	page 9-17
Displaying the Alarm History	page 11-33

The following table lists the functional differences from a Σ-7S SERVOPACK with MECHATROLINK-III Communications References (model: SGD7S-□□□A20A).

<table>
<tr><th colspan="2">Unsupported Functions</th></tr>
<tr><td rowspan="13">Functions Related to the Machine</td><td>Power Supply Type Settings for the Main Circuit and Control Circuit</td></tr>
<tr><td>Automatic Detection of Connected Motor</td></tr>
<tr><td>Linear Encoder Pitch</td></tr>
<tr><td>Writing Linear Motor Parameters</td></tr>
<tr><td>Selecting the Phase Sequence for a Linear Motor</td></tr>
<tr><td>Polarity Sensor Setting</td></tr>
<tr><td>Polarity Detection</td></tr>
<tr><td>Holding Brake</td></tr>
<tr><td>Resetting the Absolute Encoder</td></tr>
<tr><td>Setting the Origin of the Absolute Encoder</td></tr>
<tr><td>Speed Ripple Compensation</td></tr>
<tr><td>Current Control Mode Selection</td></tr>
<tr><td>Speed Detection Method Selection</td></tr>
<tr><td>Functions Related to the Host Controller</td><td>Replacing the Battery</td></tr>
<tr><td rowspan="6">Functions to Achieve Optimum Motions</td><td>Tuning-less Function</td></tr>
<tr><td>Vibration Suppression</td></tr>
<tr><td>Friction Compensation</td></tr>
<tr><td>Model Following Control</td></tr>
<tr><td>Mechanical Analysis</td></tr>
<tr><td>Easy FFT</td></tr>
<tr><td>Functions for Trial Operation during Setup</td><td>Test without a Motor</td></tr>
<tr><td>Functions for Inspection and Maintenance</td><td>Automatic Detection of Connected Motor</td></tr>
</table>

Selecting a SERVOPACK

2

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

2.1 Ratings and Specifications

This section gives the ratings and specifications of SERVOPACKs.

2.1.1 Ratings

Three-Phase, 200 VAC

Model SGD7S-			330A	780A
Maximum Applicable Motor Capacity [kW] (Continuous Rating)			5.0	15
Continuous Output Current [Arms]			32.9	78.0
Instantaneous Maximum Output Current [Arms]			84	170
Main Circuit	Power Supply		200 VAC to 240 VAC, 50 Hz/60 Hz	
	Permitted Voltage Fluctuation		-15% to +10%	
	Input Current [Arms][*1]		25	73
Control	Power Supply		200 VAC to 240 VAC, 50 Hz/60 Hz	
	Permitted Voltage Fluctuation		-15% to +10%	
	Input Current [Arms][*1]		0.3	0.4
Power Supply Capacity [kVA][*1]			7.5	29.6
Power Loss[*1]	Main Circuit Power Loss [W]		226.6	501.4
	Control Circuit Power Loss [W]		19	28
	Built-in Regenerative Resistor Power Loss [W]		36	–
	External Regenerative Resistor Power Loss [W]		–	350[*2]
	Total Power Loss [W]		281.6	529.4
Regenerative Resistor	Built-In Regenerative Resistor	Resistance [Ω]	8	–
		Capacity [W]	180	–
External Regenerative Resistor	Resistance [Ω]		–	3.13[*2]
	Capacity [W]		–	1760[*2]
	Minimum Allowable External Resistance [Ω]		8	2.9
Overvoltage Category			III	

*1. This is the net value at the rated load.
*2. This value is for the optional JUSP-RA05-E Regenerative Resistor Unit.

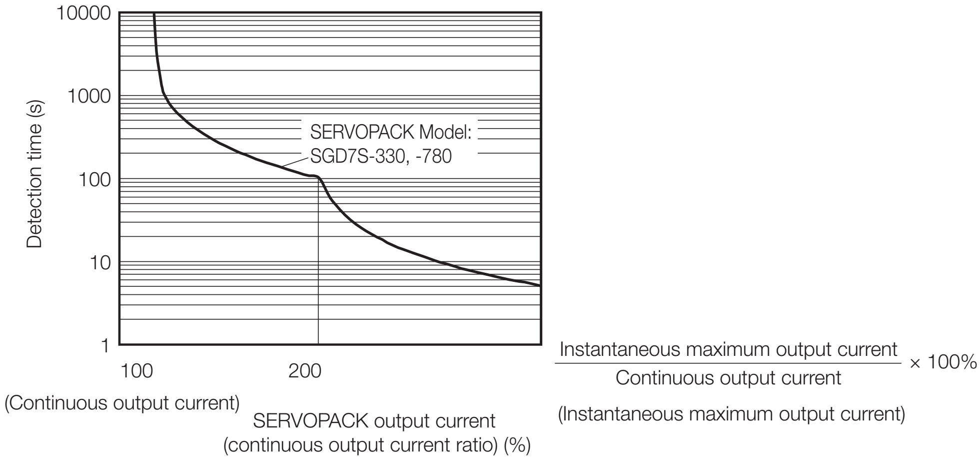
2.1.2 SERVOPACK Overload Protection Characteristics

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 Spindle Motor that has the lower overload protection characteristics.

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



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 Spindle Motor, maintain the effective torque within the continuous duty zone of the torque-motor speed characteristic of the Spindle Motor.

Selecting a SERVOPACK

2

2.1.3 Specifications

Item		Specification
Drive Method		IGBT-based PWM control, sine wave current drive
Feedback		Serial encoder: 18-bit (incremental encoder)
		Pulse encoder: 1,024 pulses
Environ-mental Conditions	Surrounding Air Temperature[*1]	-5°C to 55°C (With derating, usage is possible between 55°C and 60°C.) Refer to the following manual for derating specifications. Σ-7-Series Σ-7S SERVOPACK with MECHATROLINK-III Communications References Product Manual (SIEP S800001 28)
	Storage Temperature	-20°C to 85°C
	Surrounding Air Humidity	95% relative humidity max. (with no freezing or condensation)
	Storage Humidity	95% relative humidity max. (with no freezing or condensation)
	Vibration Resistance	4.9 m/s^2
	Shock Resistance	19.6 m/s^2
	Degree of Protection	IP10
	Pollution Degree	2 • 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 max.
	Others	Do not use the SERVOPACK in the following locations: Locations subject to static electricity, noise, strong electromagnetic/magnetic fields, or radioactivity
Compliant Standards		Refer to the following section for details. *Compliance with UL Standards, EU Directives, UK Regulations, and Other Safety Standards* on page xxv
Mounting		Base-mounted
Perfor-mance	Speed Control Range	1:5000 (At the rated torque, the lower limit of the speed control range must not cause the motor to stop.)
	Coefficient of Speed Fluctuation[*2]	±0.01% of rated speed max. (for a load fluctuation of 0% to 100%)
		0% of rated speed max. (for a load fluctuation of ±10%)
		±0.1% of rated speed max. (for a temperature fluctuation of 25°C ±25°C)
	Torque Control Precision (Repeatability)	±1%
	Soft Start Time Setting	0 s to 10 s (Can be set separately for acceleration and deceleration.)

Continued on next page.

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Item			Specification
I/O Signals	Encoder Divided Pulse Output		Phase A, phase B, phase C: Line-driver output Number of divided output pulses: Any setting is allowed. However, if you use a pulse encoder for semi-closed loop control, the pulse signal from the pulse encoder is output as it is.
	Sequence Input Signals	Input Signals That Can Be Allocated	Allowable voltage range: 24 VDC ±20% Number of input points: 7 (Input method: Sink inputs or source inputs)
			Input Signals • /DEC (Origin Return Deceleration Switch) signal • /EXT1 to /EXT3 (External Latch Input 1 to 3) signals • P-OT (Forward Drive Prohibit) and N-OT (Reverse Drive Prohibit) signals A signal can be allocated and the positive and negative logic can be changed.
	Sequence Output 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
		Output Signals That Can Be Allocated	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 • /BK (Brake) signal • /WARN (Warning) signal • /NEAR (Near) signal A signal can be allocated and the positive and negative logic can be changed.
Communications	RS-422A Communications (CN502)	Interfaces	Digital Operator (JUSP-OP05A-1-E) A JUSP-JC001 Communications Unit is required to connect to a Digital Operator.
		1:N Communications	Up to N = 15 stations possible for RS-422A port
		Axis Address Setting	Set with parameters.
	USB Communications (CN7)	Interface	Personal computer (with SigmaWin+)
		Communications Standard	Conforms to USB2.0 standard (12 Mbps).
Displays/Indicators			CHARGE, PWR, CN, L1, and L2 indicators, and one-digit seven-segment display
MECHATROLINK-III Communications	Communications Protocol		MECHATROLINK-III
	Station Address Settings		03 to EF hex (maximum number of slaves: 62) The rotary switches (S1 and S2) are used to set the station address.
	Baud Rate		100 Mbps
	Transmission Cycle		125 μs, 250 μs, 500 μs, 750 μs, 1.0 ms to 4.0 ms (multiples of 0.5 ms)
	Number of Transmission Bytes		32 or 48 bytes/station A DIP switch (S3) is used to select the number of transmission bytes.

Continued on next page.

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Item		Specification
Reference Method	Performance	Position, speed, or torque control with MECHATROLINK-III communications
	Reference Input	MECHATROLINK-III commands (sequence, motion, data setting, data access, monitoring, adjustment, etc.)
	Profile	MECHATROLINK-III standard servo profile
MECHATROLINK-III Communications Setting Switches		Rotary switch (S1 and S2) positions: 16
		Number of DIP switch (S3) pins: 4
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)
Regenerative Processing		Built-in (An external resistor must be connected to the SGD7S-470A to -780A.)
Overtravel (OT) Prevention		Stopping with deceleration to a stop or coasting to a stop for the P-OT (Forward Drive Prohibit) or N-OT (Reverse Drive Prohibit) signal
Protective Functions		Overcurrent, overvoltage, low voltage, overload, regeneration error, etc.
Utility Functions		Gain adjustment, alarm history, jogging, origin search, etc.
Applicable Option Modules		Fully-closed Module

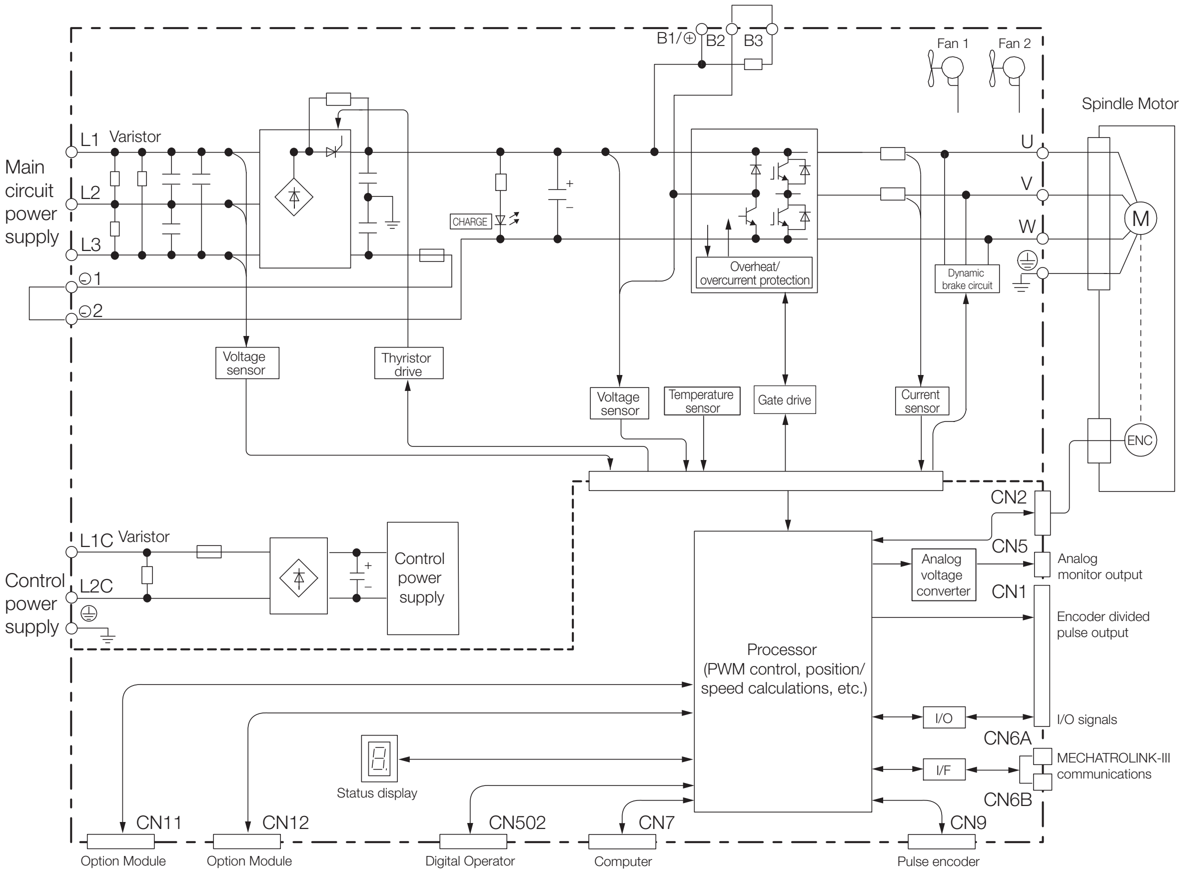
*1. If you combine a Σ-7-Series SERVOPACK with a Σ-V-Series Option Module, the following Σ-V-Series SERVOPACKs specifications must be used: a surrounding air temperature of 0°C to 55°C and an altitude of 1,000 m max. Also, the applicable surrounding range cannot be increased by derating.

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

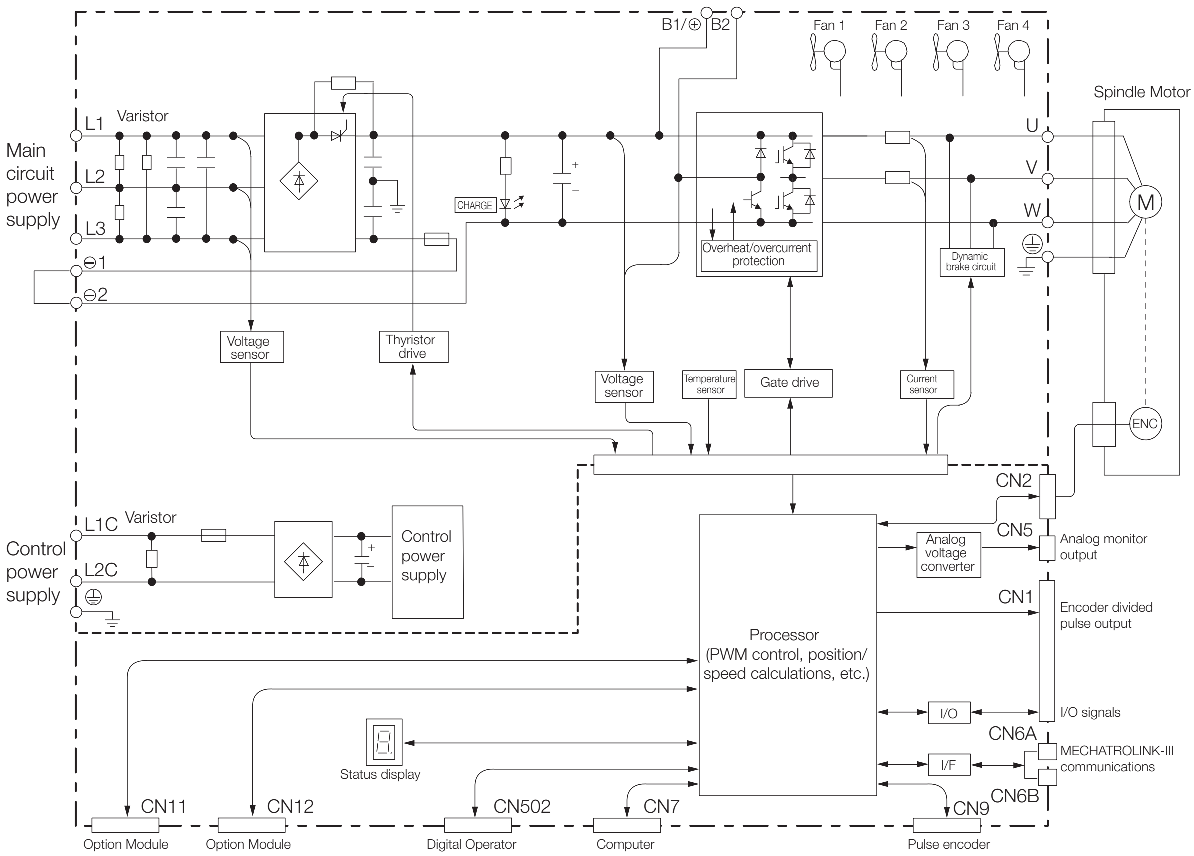
$$\text{Coefficient of speed fluctuation} = \frac{\text{No-load motor speed - Total-load motor speed}}{\text{Rated motor speed}} \times 100\%$$

2.2 Block Diagrams

2.2.1 SGD7S-330A



2.2.2 SGD7S-780A

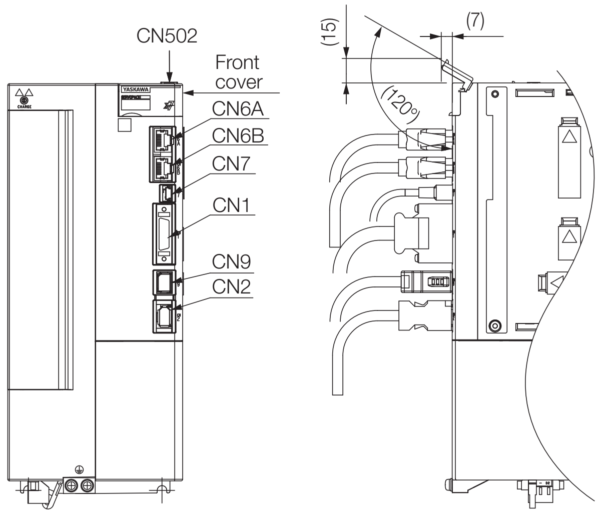


2.3 External Dimensions

2.3.1 Front Cover Dimensions and Connector Specifications

The front cover dimensions and panel connector section depend on the model. Refer to the following figures and tables.

Front Cover Dimensions



Connector Specifications

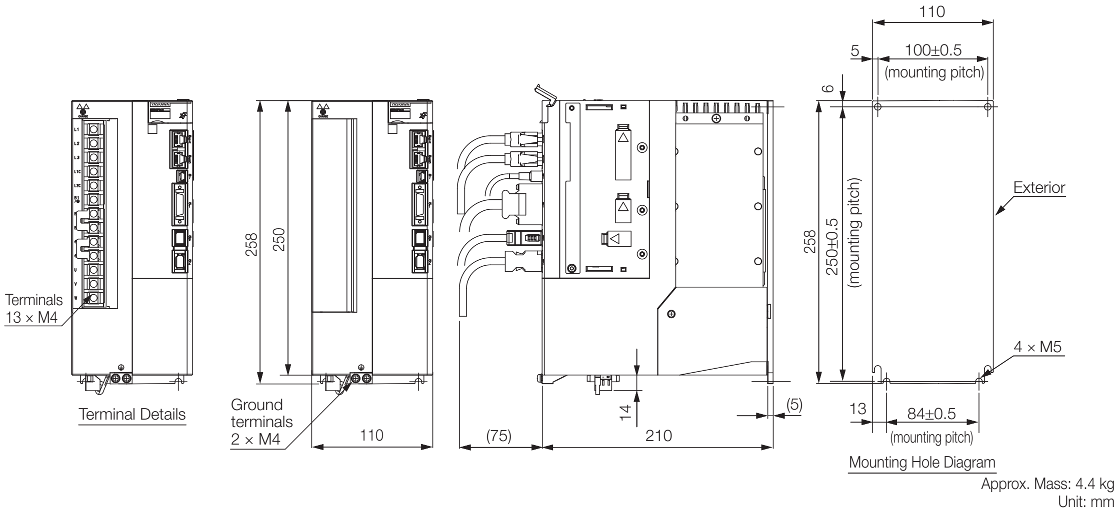
Connector No.	Model	Number of Pins	Manufacturer
CN1	10226-59A3MB	26	3M Japan Limited
CN2	3E106-0220KV	6	3M Japan Limited
CN502	S8B-ZR-SM4A-TF (LF)(SN)	8	J.S.T. Mfg. Co., Ltd.
CN6A, CN6B	1-1734579-4	8	Tyco Electronics Japan G.K.
CN7	2172034-1	5	Tyco Electronics Japan G.K.
CN9	MUF-RS10SK-GKX-TB (LF)	10	J.S.T. Mfg. Co., Ltd.

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

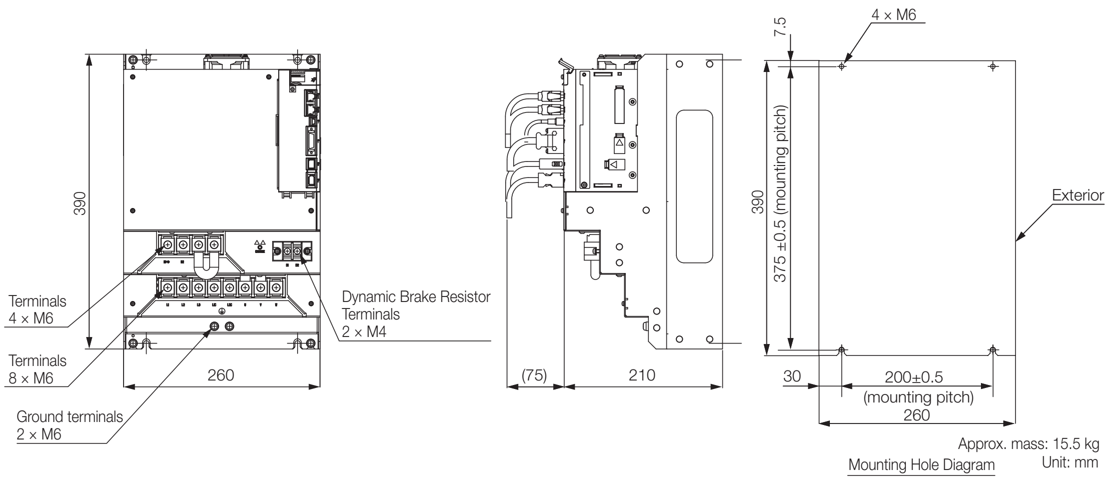
2.3.2 SERVOPACK External Dimensions

Base-mounted SERVOPACKs

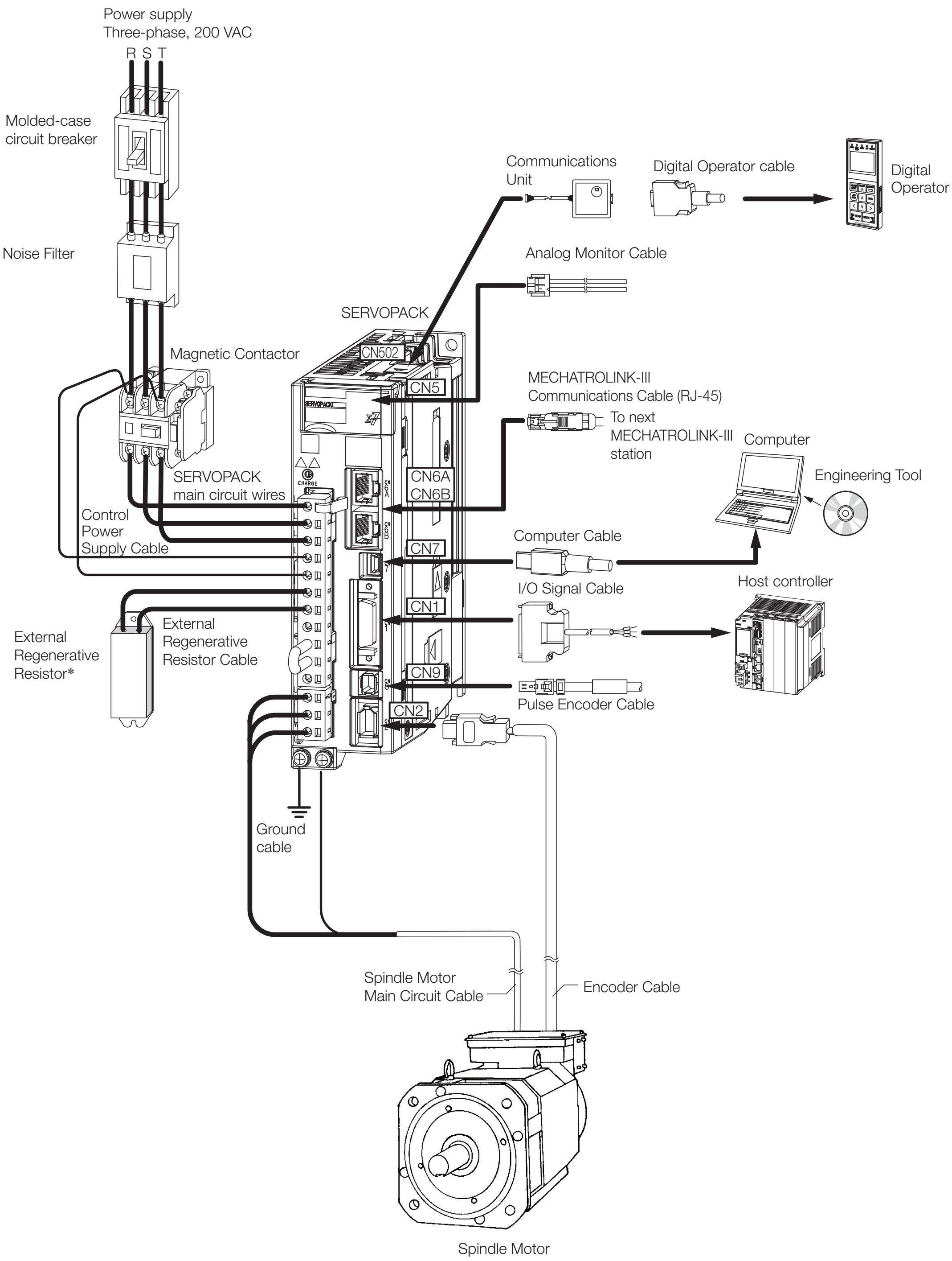
• Three-phase, 200 VAC: SGD7S-330A



• Three-phase, 200 VAC: SGD7S-780A



2.4 Examples of Standard Connections between SERVOPACKs and Peripheral Devices



* 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

Refer to the following section for the ambient installation conditions.

☞ *2.1.3 Specifications* on page 2-4

■ 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.

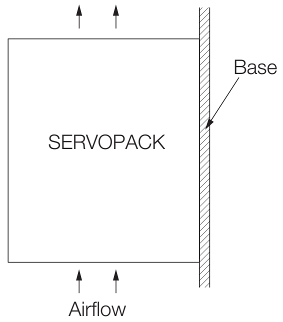
3.2 Mounting Types and Orientation

Base-mounted SERVOPACKs are available. 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.)

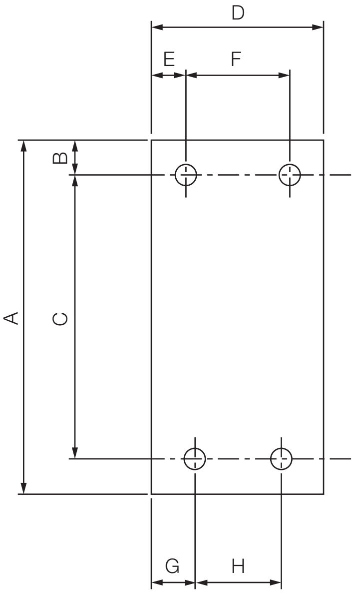
- Base-mounted SERVOPACK



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 SERVOPACK.



◆ Σ-7-series Mounting Hole Dimensions

SERVOPACK Model		Dimensions (mm)								Screw Size	Number of Screws
		A	B	C	D	E	F	G	H		
SGD7S	-330A	258	6	250±0.5	110	5	100±0.5	13	84±0.5	M5	4
	-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

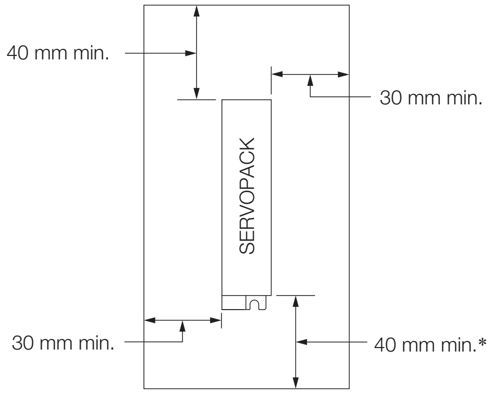
If you are replacing a Σ-V-Series SERVOPACK with a Σ-7-Series SERVOPACK, you can also use the mounting holes that were used for the Σ-V-Series SERVOPACK. Refer to the following table.

SERVOPACK Model		Dimensions (mm)								Screw Size	Number of Screws
		A	B	C	D	E	F	G	H		
SGD7S	-330A	250	6	238.5±0.5	110	5	100±0.5	5	100±0.5	M5	4
	-780A	A mounting compatibility attachment is required. The attachment is not provided by Yaskawa. Contact your Yaskawa representative for details.									

3.4 Mounting Interval

3.4.1 Installing One SERVOPACK in a Control Panel

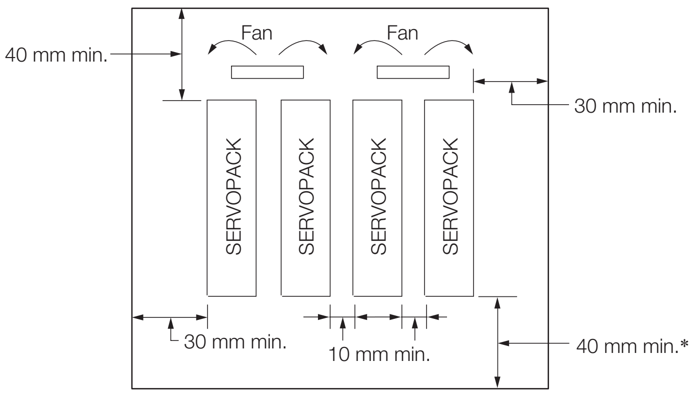
Provide the following spaces around the SERVOPACK.



* 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

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



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

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

SERVOPACK Model	Space on Right Side	Cooling Fan Installation Conditions
		10 mm above SERVOPACK's Top Surface
SGD7S-330A or -780A	10 mm min.	Air speed: 0.5 m/s min.

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

SERVOPACK Installation

3

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.

Important

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 EMC Installation Conditions

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

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

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

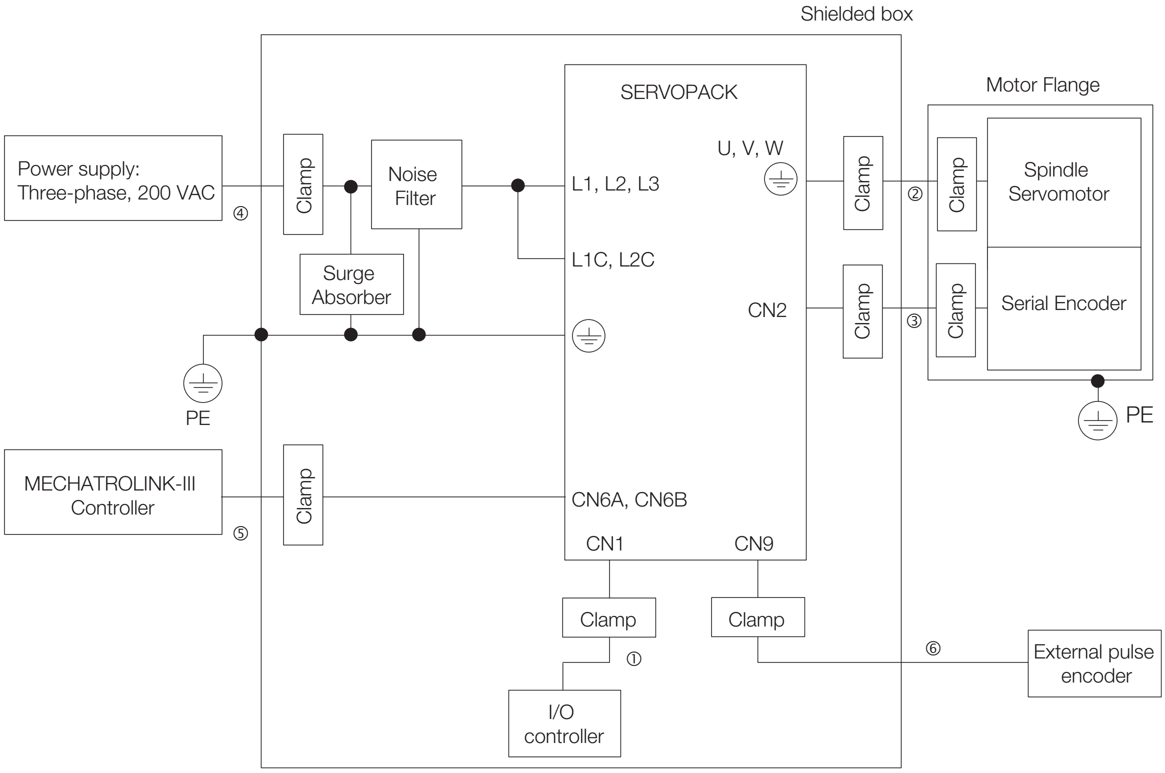
⚠ WARNING

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

⚠ CAUTION

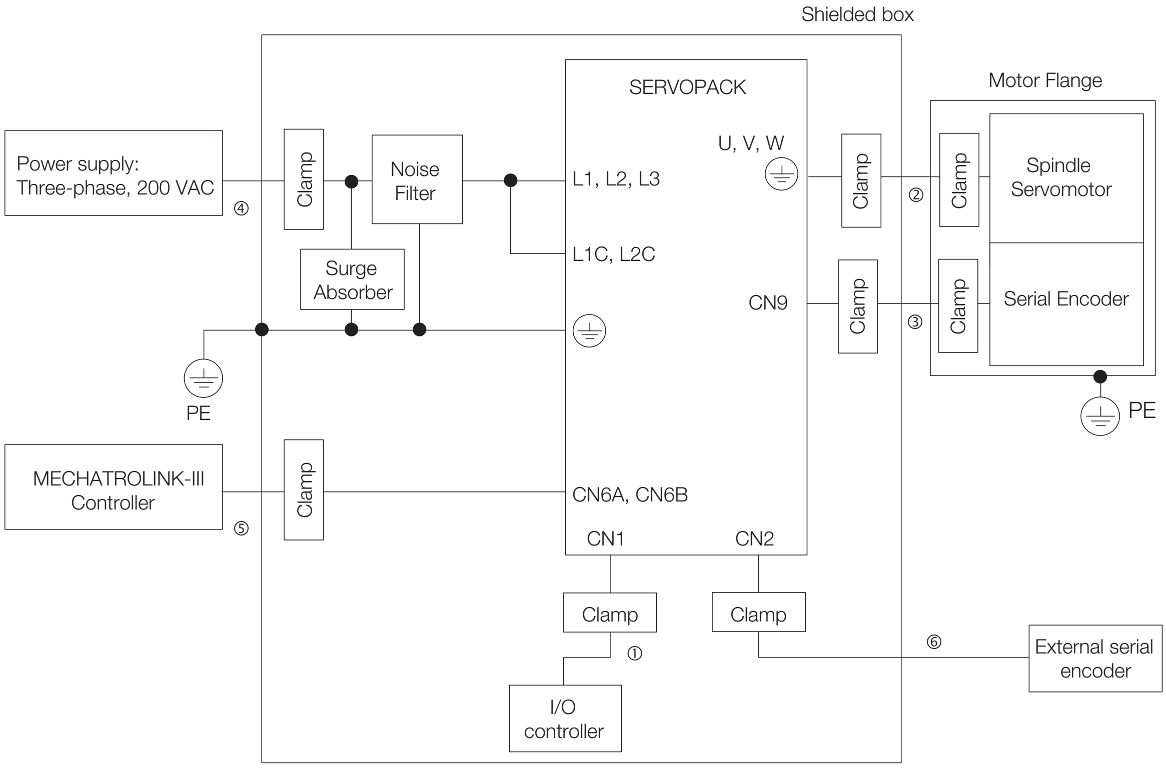
- This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

- Three-phase 200 VAC When the Motor Encoder Is a Serial Encoder



Symbol	Cable Name	Specification
①	I/O Signal Cable	Shielded cable
②	Motor Main Circuit Cable	Shielded cable
③	Serial Encoder Cable	Shielded cable
④	Main Circuit Power Cable	Shielded cable
⑤	MECHATROLINK-III Communications Cable	Shielded cable
⑥	Pulse Encoder Cable	Shielded cable

• Three-phase 200 VAC When the Motor Encoder Is a Pulse Encoder



Symbol	Cable Name	Specification
①	I/O Signal Cable	Shielded cable
②	Motor Main Circuit Cable	Shielded cable
③	Pulse Encoder Cable	Shielded cable
④	Main Circuit Power Cable	Shielded cable
⑤	MECHATROLINK-III Communications Cable	Shielded cable
⑥	Serial Encoder Cable	Shielded cable

Wiring and Connecting SERVOPACKs

4

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

4.1 Wiring and Connecting SERVOPACKs

4.1.1 General Precautions

DANGER

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

WARNING

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

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 Spindle Motor Main Circuit Cables or Encoder 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 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.

Important

- 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 for information on the specified cables.
  Σ-7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)
- The signal cable conductors are as thin as 0.2 mm^2 or 0.3 mm^2. Do not subject them to excessive bending stress or tension.

4.1.2 Countermeasures against Noise

Important

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.

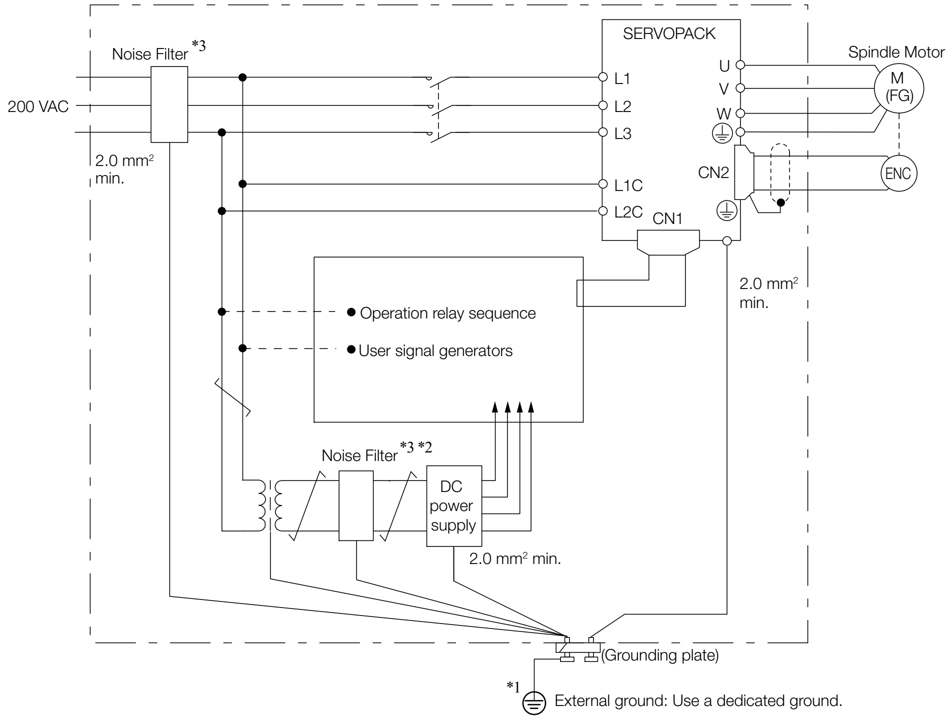
The SERVOPACK uses microprocessors. Therefore, it may be affected by switching noise from peripheral devices.

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 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 4-6
- Implement suitable grounding measures. Refer to the following section for information on grounding measures.
  ☞ *4.1.3 Grounding* on page 4-8

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 mm^2 (preferably, flat braided copper wire).

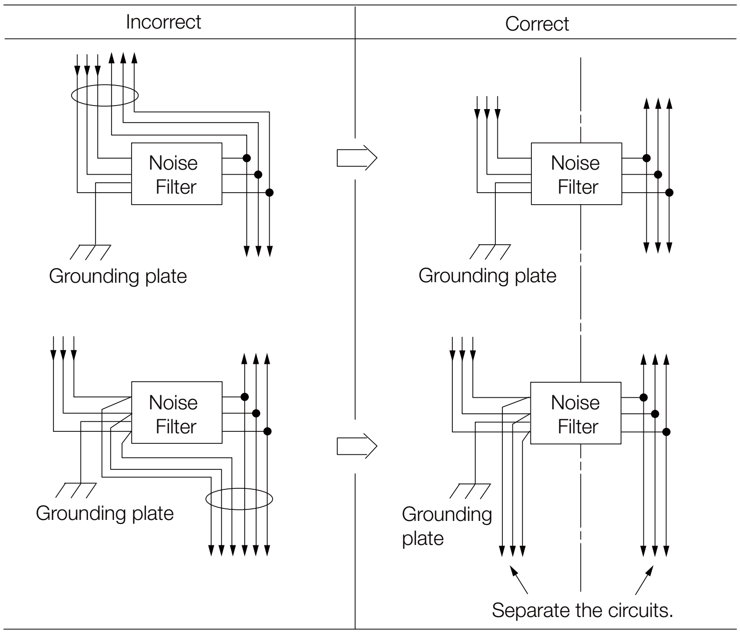
*2. Whenever possible, use twisted-pair wires to wire all connections marked with .

*3. Refer to the following section for precautions when using Noise Filters.
☞ *Noise Filter Wiring and Connection Precautions* on page 4-7

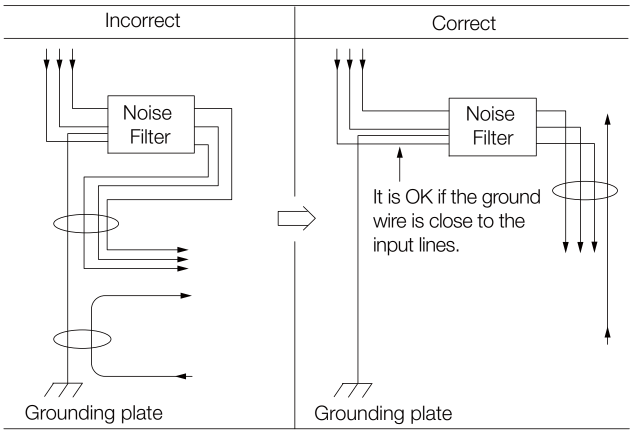
Noise Filter Wiring and Connection Precautions

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

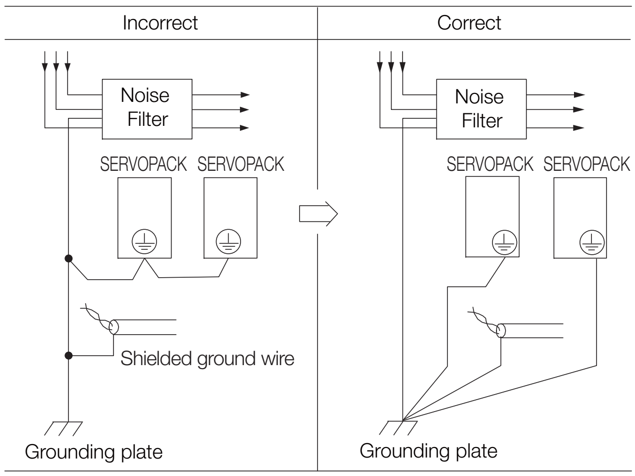
- Separate input lines from output lines. Do not place input lines and output lines in the same duct or bundle them together.



- 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.



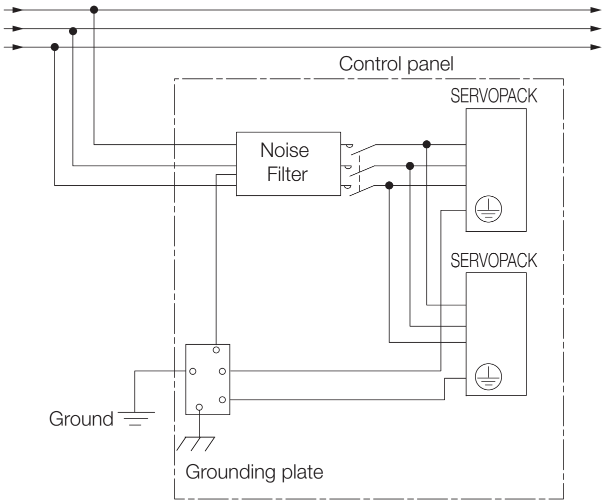
- Connect the Noise Filter ground wire directly to the grounding plate. Do not connect the Noise Filter ground wire to other ground wires.



Wiring and Connecting SERVOPACKs

4

- 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 Spindle Motor directly if the Spindle Motor is insulated from the machine.

Motor Frame Ground or Motor Ground

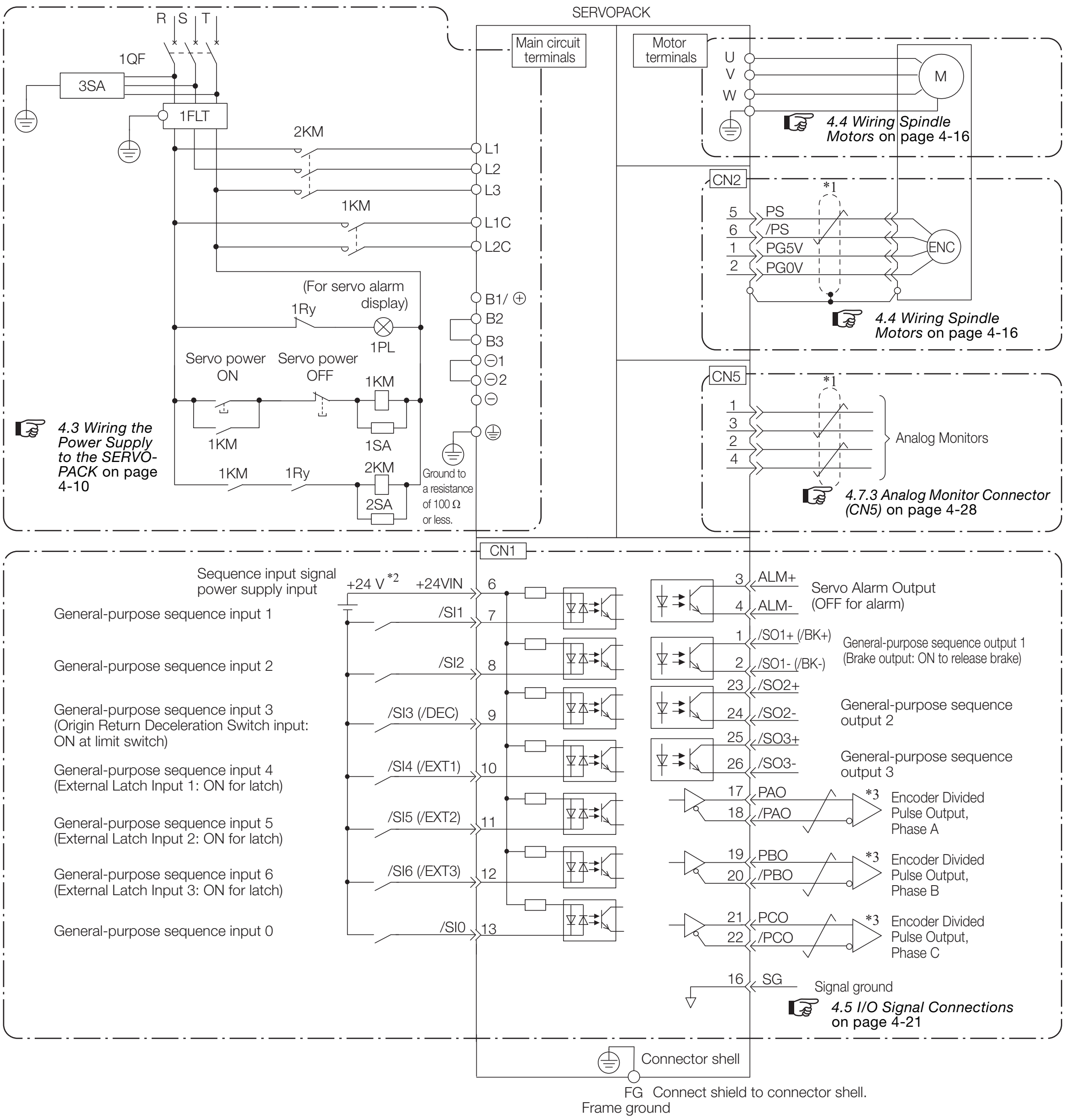
If you ground the Spindle Motor through the machine, a current resulting from switching noise can flow from the main circuit of the SERVOPACK through the stray capacitance of the Spindle Motor. To prevent this, always connect the motor frame terminal (FG) or ground terminal (FG) of the Spindle Motor to the ground terminal (⏚) on the SERVOPACK. Also be sure to ground the ground terminal ⏚.

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 Spindle Motor 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.

*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 /DEC, P-OT, N-OT, /EXT1, /EXT2, and /EXT3 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 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.

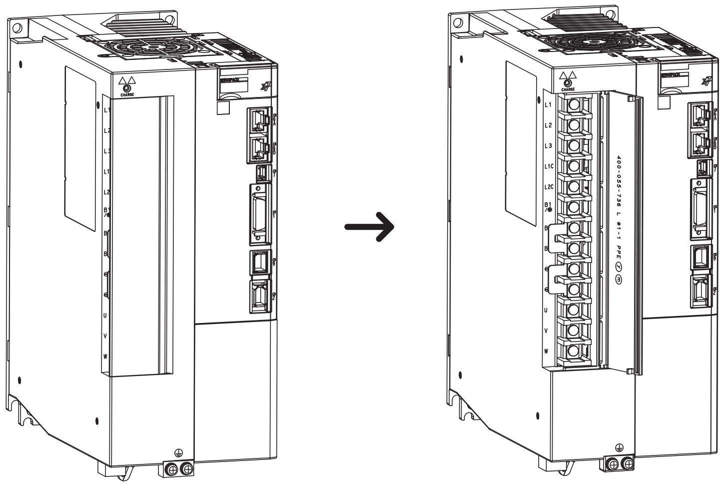
⚠ CAUTION

- 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.

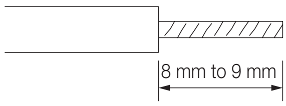
Terminal Symbols	Terminal Name	Specifications and Reference
L1, L2, L3	Main circuit power supply input terminals for AC power supply input	Three-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz
L1C, L2C	Control power supply terminals	Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz
B1/⊕, B2, B3	Regenerative Resistor terminals	*4.3.5 Wiring Regenerative Resistors* on page 4-14 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.
⊖1, ⊖2	DC Reactor terminals for power supply harmonic suppression	*4.3.6 Wiring DC Reactors* on page 4-15 These terminals are used to connect a DC Reactor for power supply harmonic suppression.
⊖	–	None. (Do not connect anything to this terminal.)

4.3.2 Wiring Procedure for Main Circuit Terminals

1. Open the terminal cover on the SERVOPACK.



2. Remove the sheath from the wire to connect.



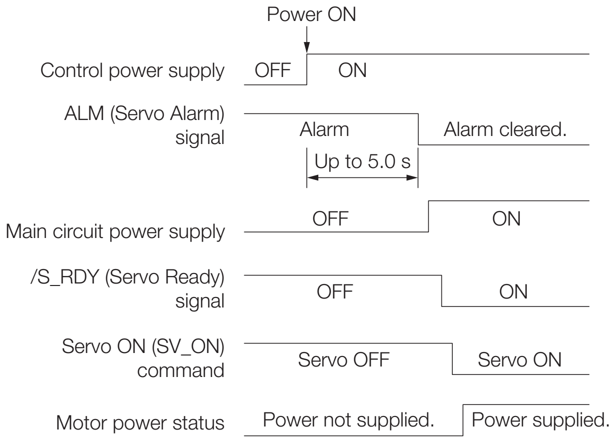
3. Use a Phillips screwdriver to attach the conductors to the main circuit terminals with the terminal screws.

4. Close the terminal cover on the SERVOPACK.

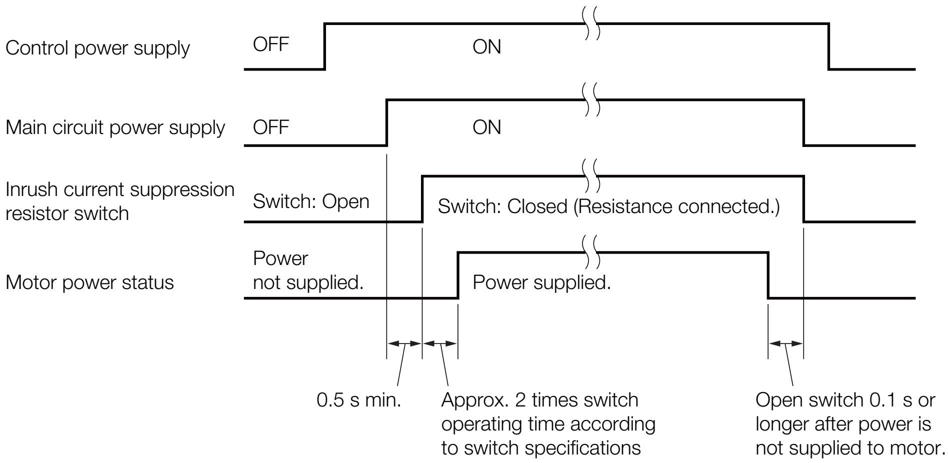
4.3.3 Power ON Sequence

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).



- If you use a DC power supply input, use the power ON sequence shown below.



- 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 100 ms after the power supply is turned OFF before you turn it ON again.

Important

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

Wiring and Connecting SERVOPACKs

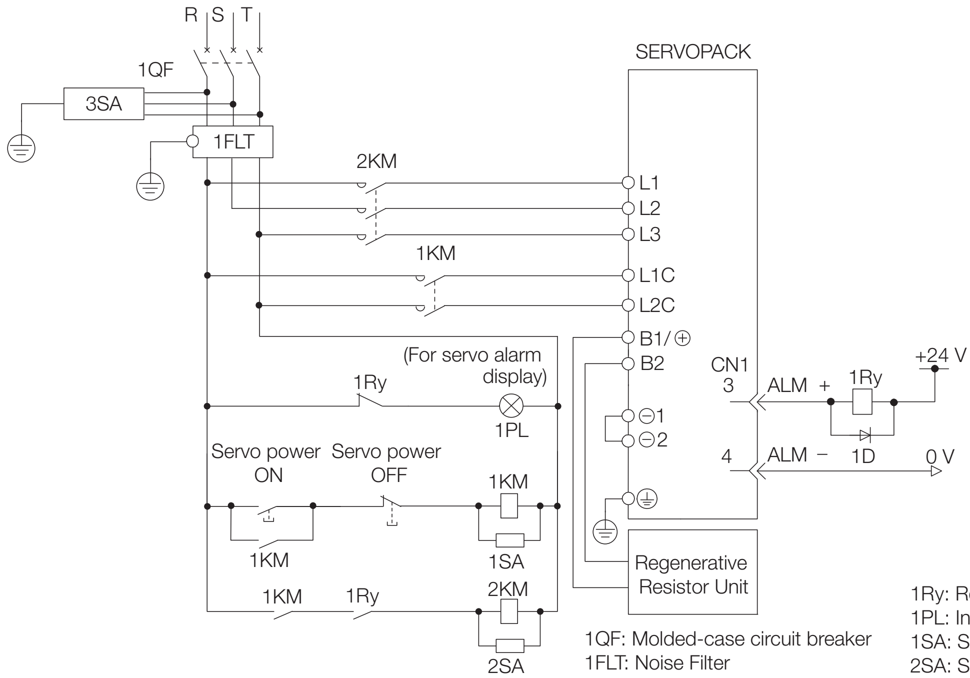
4

⚠ WARNING

- 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



1QF: Molded-case circuit breaker
1FLT: Noise Filter
1KM: Magnetic Contactor (for control power supply)
2KM: Magnetic Contactor (for main circuit power supply)

1Ry: Relay
1PL: Indicator lamp
1SA: Surge Absorber
2SA: Surge Absorber
3SA: Surge Absorber
1D: Flywheel diode

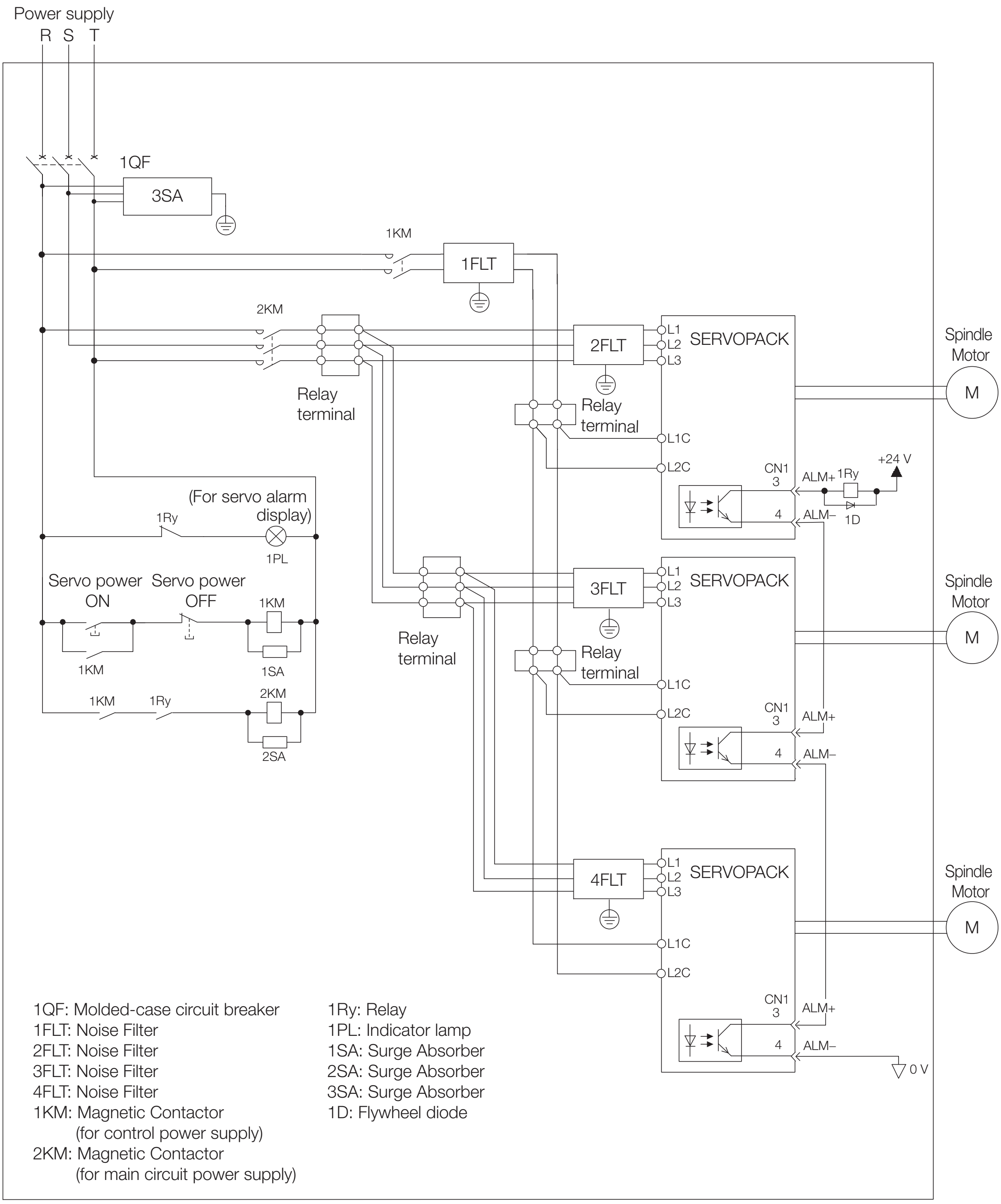
Using More Than One SERVOPACK

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 Spindle Motors when there is an alarm for any one SERVOPACK.

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



To comply with UL/cUL standards, you must install a branch circuit protective device at the power supply input section to each SERVOPACK. Refer to the following manual for details.

Σ-7-Series Σ-7S/Σ-7W/Σ-7C SERVOPACK Safety Precautions (Manual No.: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 External Regenerative Resistors.

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

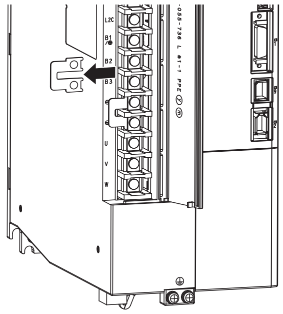
WARNING

- 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.

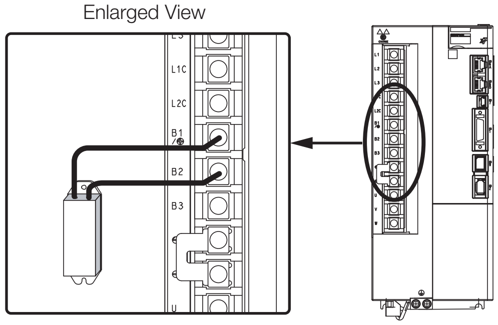
Connecting Regenerative Resistors

◆ SERVOPACK Model SGD7S-330A

1. Remove the lead from between the B2 and B3 terminals on the SERVOPACK.



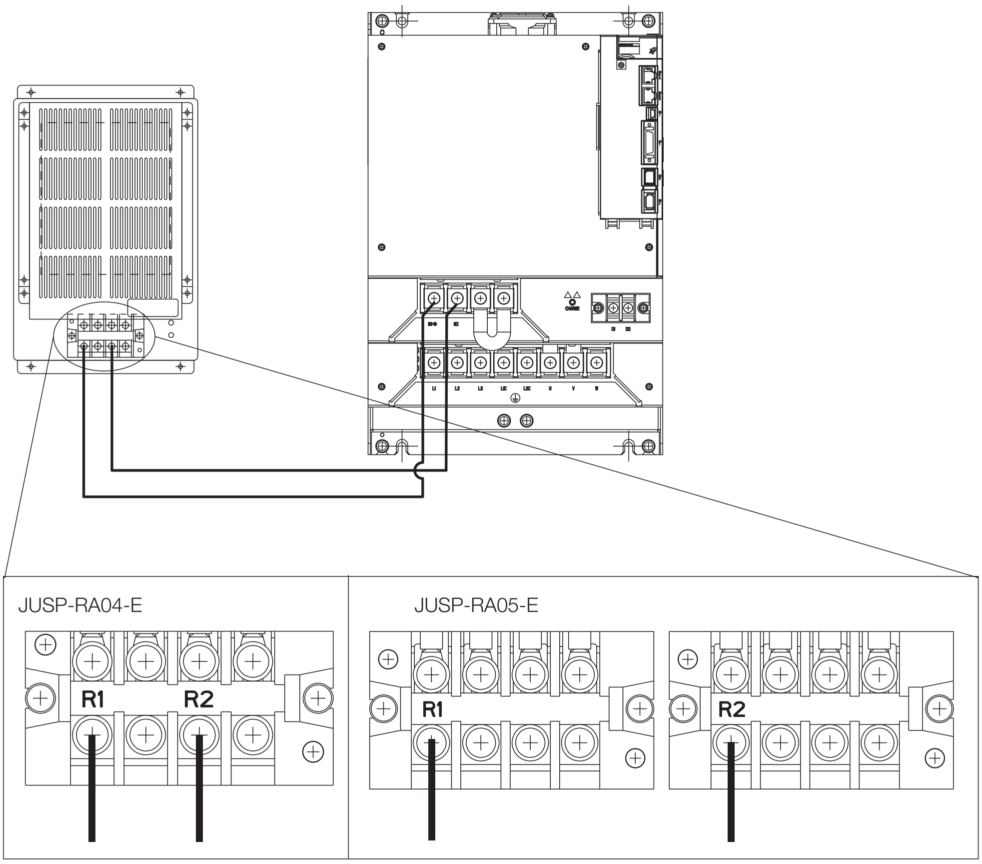
2. Connect the External Regenerative Resistor between the B1/⊕ and B2 terminals.



3. Set Pn600 (Regenerative Resistor Capacity) and Pn603 (Regenerative Resistance).
   Refer to the following section for details on the settings.
   5.9 Setting the Regenerative Resistor Capacity on page 5-28

◆ SERVOPACK Model SGD7S-780A

1. Connect the R1 and R2 terminals on the Regenerative Resistor Unit to the B1/⊕ and B2 terminals on the SERVOPACK.



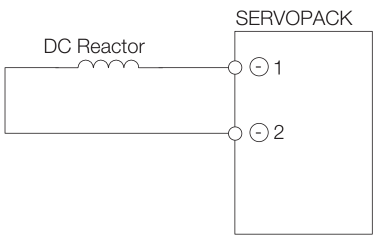
2. Set Pn600 (Regenerative Resistor Capacity) and Pn603 (Regenerative Resistance) as required.
   - When using the Yaskawa-recommended Regenerative Resistor Unit, use the default settings for Pn600 and Pn603.
   - If you use any other external regenerative resistor, set Pn600 and Pn603 according to the specifications of the regenerative resistor.

   Refer to the following section for details on the settings.

   ☞ *5.9 Setting the Regenerative Resistor Capacity* on page 5-28

4.3.6 Wiring DC Reactors

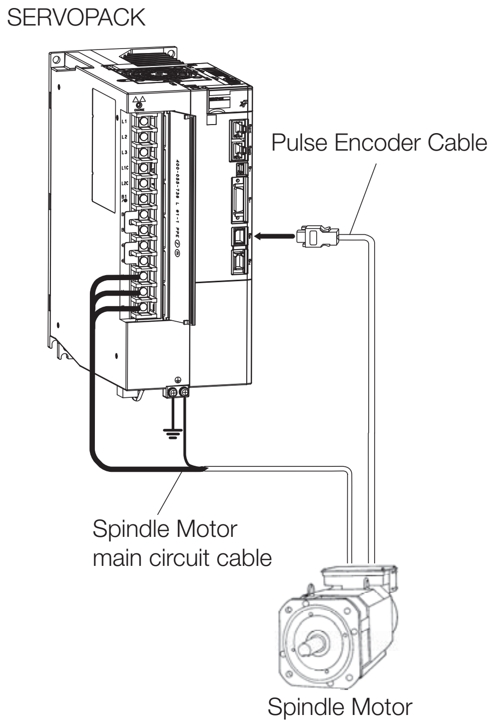
You can connect a DC Reactor to the SERVOPACK when power supply harmonic suppression is required. Connection terminals ⊖1 and ⊖2 for a DC Reactor are connected when the SERVOPACK is shipped. Remove the lead wire and connect a DC Reactor as shown in the following diagram.



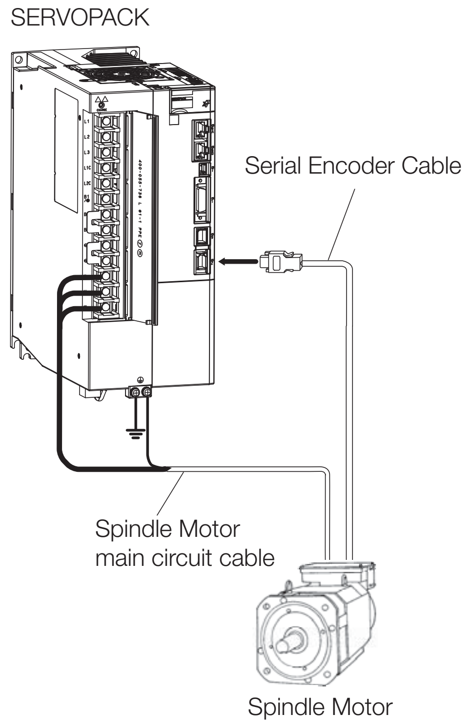
4.4 Wiring Spindle Motors

4.4.1 Cables

Wiring Example for Using a Pulse Encoder



Wiring Example for Using a Serial Encoder



Main Circuit Cable

The Spindle Motor main circuit cable is not provided by Yaskawa.

Note: A connector is not used to connect the Spindle Motor main circuit cable. Terminal screws are used for all models. Refer to the following sections for details.

☞ *4.3.2 Wiring Procedure for Main Circuit Terminals* on page 4-10

Select the materials based on the following specifications.

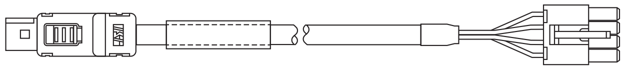
◆ Cable

We recommend 600-V heat-resistant polyvinyl cable. The wire size depends on the motor and SERVOPACK that are used.

◆ Wiring

SERVOPACK (SGD7S-330A) Terminal Name		Motor Terminal Name
U	—	U
V	—	V
W	—	W
⏚	—	⏚

Pulse Encoder Cables

Name	Length	Order Number	Appearance
Pulse Encoder Cables for Spindle Motors	3 m	JZSP-CJP00-03-E	
	5 m	JZSP-CJP00-05-E	
	10 m	JZSP-CJP00-10-E	
	15 m	JZSP-CJP00-15-E	
	20 m	JZSP-CJP00-20-E	

If you make your own pulse encoder cable, select the materials based on the following specifications.

◆ SERVOPACK Connector Specifications

Name	Model	Manufacturer
Connector Plug	MUF-PK10K-X	J.S.T. Mfg. Co., Ltd.
Contacts	MUF-RS10DS-GKXR	

Note: This connector is compatible with the following connector: 10120-6000LE (from 3M Japan Ltd.).

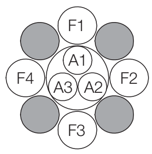
◆ Spindle Motor Connector Specifications

The connector for the Spindle Motor is provided in the motor terminal box.

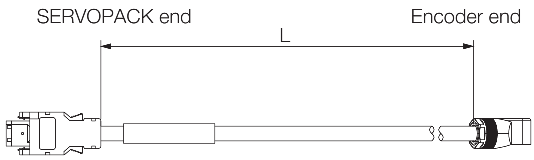
Name		Model	Manufacturer
Connector		ELP-12V	J.S.T. Mfg. Co., Ltd.
Contacts	Pins other than No. 10	LLF-01T-P1.3E*	
	No. 10 pin	LLF-41T-P1.3E*	

* A Crimping Tool (model: YC-202) is required. Consult with the connector manufacturer for information on the Crimping Tool.

◆ Cable

Item	Standard Type
Order Number	B9400064-1-E (3 m)
	B9400064-2-E (5 m)
	B9400064-3-E (10 m)
	B9400064-4-E (15 m)
	B9400064-5-E (20 m)
Specifications	Composite KQVV-SW AWG22 × 3C AWG26 × 4P
Finished Diameter	7.5 mm
Internal Structure and Lead Colors	 A1: Red A2: Black A3: Yellow-green F1: Blue-Light blue twisted pair F2: Yellow-Light yellow twisted pair F3: Green-Light green twisted pair F4: Orange-Light orange twisted pair
Standard Lengths Prepared by Yaskawa	3 m, 5 m, 10 m, 15 m, and 20 m

Serial Encoder Cables

Name	Length	Order Number	Appearance
Serial Encoder Cables for Spindle Motors	3 m	JZSP-C7PI0E-03-E	
	5 m	JZSP-C7PI0E-05-E	
	10 m	JZSP-C7PI0E-10-E	
	15 m	JZSP-C7PI0E-15-E	
	20 m	JZSP-C7PI0E-20-E	

If you make your own serial encoder cable, select the materials based on the following specifications.

◆ SERVOPACK Connector Specifications

Name	Model	Manufacturer
Connector	36210-0100PL	3M Japan Ltd.
Shell	36310-3200-008	

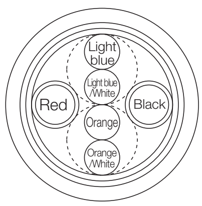
◆ Spindle Motor Connectors

The connector for the Spindle Motor is provided in the motor terminal box.

Name	Model	Manufacturer
Connector	JEC-9P	J.S.T. Mfg. Co., Ltd.
Contacts	J-SP1140*	

* A Crimping Tool (model: YRS-440) and Extraction Tool (model: DEJ-0.3) are required. Consult with the connector manufacturer for information on the Crimping Tool and Extraction Tool.

◆ Cable Specifications

Item	Standard Type
Order Number*	JZSP-CMP09-□□-E
Cable Length	20 m max.
Specifications	UL 20276 (rated temperature: 80°C) AWG22 × 2C + AWG24 × 2P AWG22 (0.33 mm^2) Outer diameter of insulating sheath: 1.15 mm AWG24 (0.20 mm^2) Outer diameter of insulating sheath: 1.09 mm
Finished Diameter	6.5 mm
Internal Structure and Lead Colors	
Standard Lengths Prepared by Yaskawa	3 m, 5 m, 10 m, 15 m, and 20 m

* The boxes (□□) in the order number indicate the cable length.
Example: JZSP-CMP09-03-E (3 m)

Encoder Wiring

◆ Pulse Encoder (SERVOPACK Connector: CN9)

■ Connections

Pin	Signal	I/O	Meaning
1	PG5V	–	Encoder power supply +5 V
2	PG0V	–	Encoder power supply 0 V
3	PA	I	Encoder's phase A signal input
4	/PA	I	
5	PB	I	Encoder's phase B signal input
6	/PB	I	
7	PC	I	Encoder's phase C signal input
8	/PC	I	
9	THM1+	I	Motor winding temperature detection
10	THM1-	I	

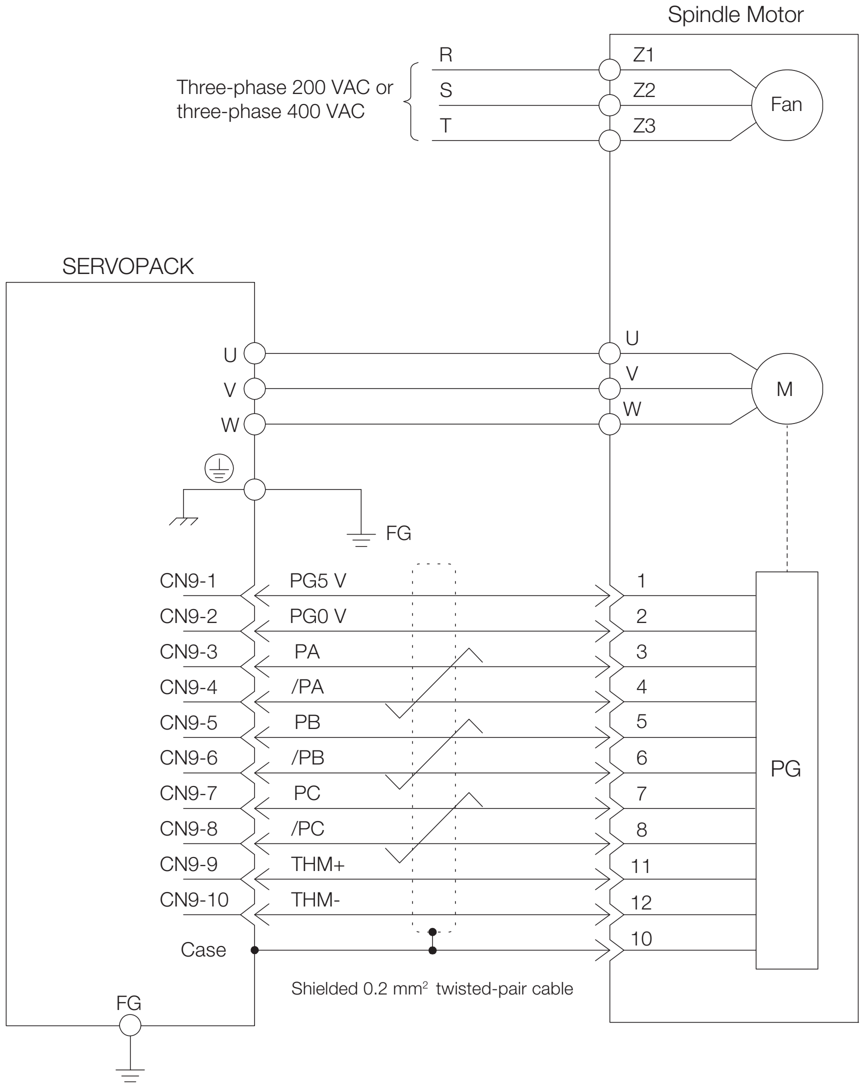


Figure 4.1 Spindle Motor Pulse Encoder Connection Diagram

◆ Serial Encoder (SERVOPACK Connector: CN2)

■ Connections

Pin	Signal	I/O	Meaning	Pin	Signal	I/O	Meaning
1	PG5V	O	Encoder power supply +5 V	2	PG0V	–	0 V
3	PGBAT+	O	Battery for encoder (+)	4	PGBAT-	O	Battery for encoder (-)
5	PS	I/O	Encoder serial signal (+)	6	/PS	I/O	Encoder serial signal (-)
7*	(NC)	–	–	8*	(NC)	–	–
9*	(NC)	–	–	10*	(NC)	–	–

* Do not use “(NC)” signals.

SERVOPACK End (CN2)		Motor End	
Pin	Signal	Pin	Signal
6	/PS	6	/PS
5	PS	2	PS
4	PGBAT-	–	(NC)
3	PGBAT+	–	(NC)
2	PG0V	5	PG0V
1	PG5V	1	PG5V
Shell	FG	Shell	FG

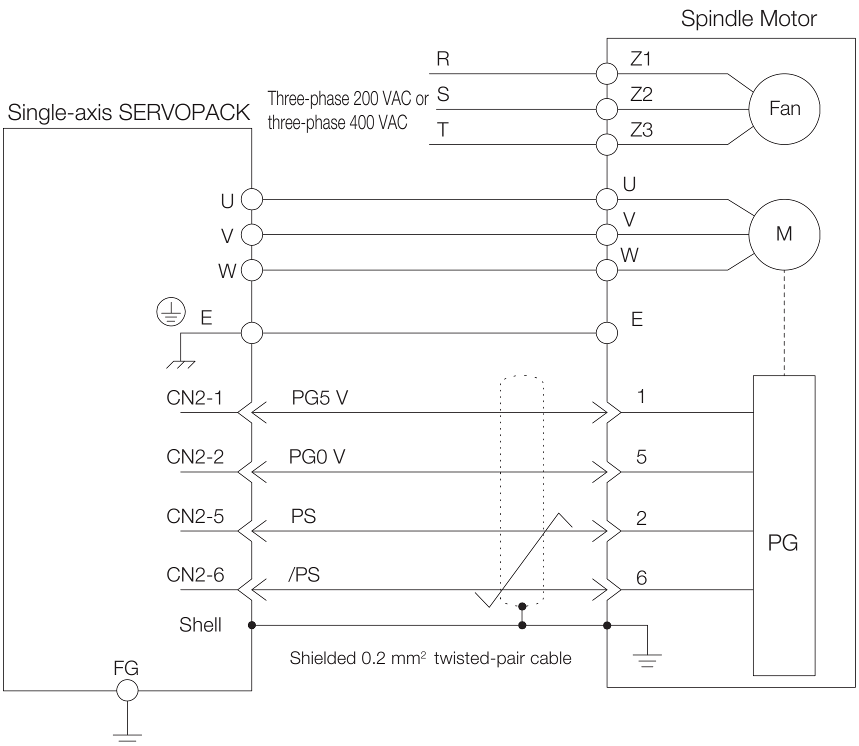


Figure 4.2 Spindle Motor Serial Encoder Connection Diagram

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*	7	General-purpose Sequence Input 1	You can allocate the input signal to use with a parameter. (Used for general-purpose inputs. You can monitor this signal with SVCMD_IO field of MECHATROLINK.)	–
/SI2*	8	General-purpose Sequence Input 2		
/SI3* (/DEC)	9	General-purpose Sequence Input 3 (Origin Return Deceleration Switch Input)	You can allocate the input signal to use with a parameter. (Connects the deceleration limit switch for origin return.)	–
/SI4* (/EXT1)	10	General-purpose Sequence Input 4 (External Latch Input 1)	You can allocate the input signals to use with parameters. (Connect the external signals that latch the current feedback pulse counter.)	–
/SI5* (/EXT2)	11	General-purpose Sequence Input 5 (External Latch Input 2)		
/SI6* (/EXT3)	12	General-purpose Sequence Input 6 (External Latch Input 3)		
/SI0*	13	General-purpose Sequence Input 0	You can allocate the input signal to use with a parameter. (Used for general-purpose input. You can monitor this signal with SVCMD_IO field of MECHATROLINK.)	–
+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.	–

* You can change the allocations. Refer to the following section for details.
☞ *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.

Output Signals

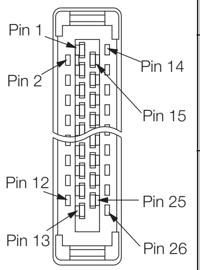
Signal	Pin No.	Name	Function	Reference
ALM+	3	Servo Alarm Output	Turns OFF (opens) when an error is detected.	page 6-6
ALM-	4			
/SO1+* (/BK+)	1	General-purpose Sequence Output 1	You can allocate the output signal to use with a parameter. (Controls the brake. The brake is released when the signal turns ON (closes).)	–
/SO1-* (/BK-)	2			
/SO2+*	23	General-purpose Sequence Output 2	Used for general-purpose outputs. Set the parameters to allocate functions.	–
/SO2-*	24			
/SO3+*	25	General-purpose Sequence Output 3		
/SO3-*	26			
PAO	17	Encoder Divided Pulse Output, Phase A	Output the encoder divided pulse output signals with a 90° phase differential.	–
/PAO	18			
PBO	19	Encoder Divided Pulse Output, Phase B		
/PBO	20			
PCO	21	Encoder Divided Pulse Output, Phase C	Output the encoder origin signal.	
/PCO	22			
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.

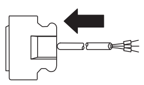
☞ *6.1.2 Output Signal Allocations* on page 6-4

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.



The above view is from the direction of the following arrow without the connector shell attached.



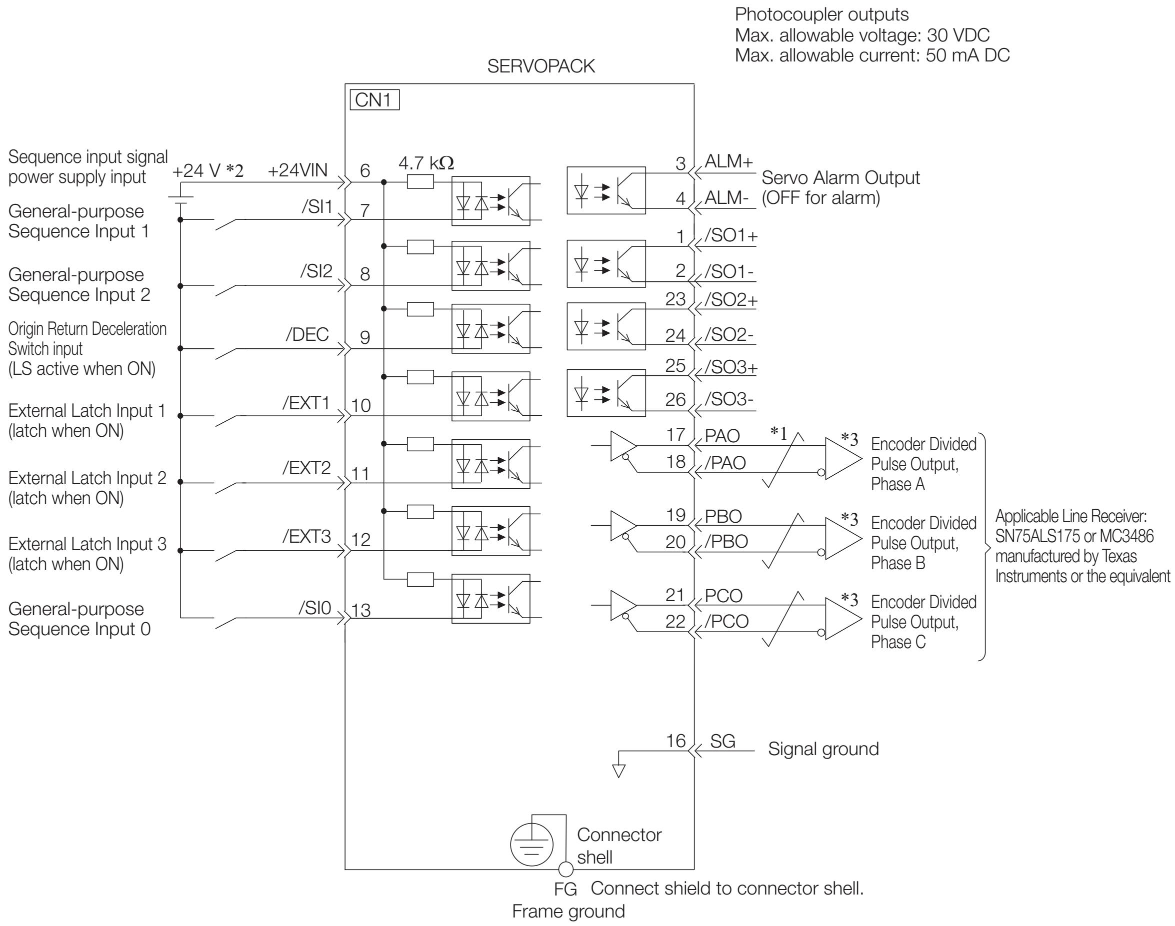
2	/SO1- (/BK-)	General-purpose Sequence Output 1
4	ALM-	Servo Alarm Output
6	+24VIN	Sequence Input Signal Power Supply Input
8	/SI2	General-purpose Sequence Input 2
10	/SI4 (/EXT1)	General-purpose Sequence Input 4
12	/SI6 (/EXT3)	General-purpose Sequence Input 6

1	/SO1+ (/BK+)	General-purpose Sequence Output 1
3	ALM+	Servo Alarm Output
5	–	(NC)
7	/SI1	General-purpose Sequence Input 1
9	/SI3 (/DEC)	General-purpose Sequence Input 3
11	/SI5 (/EXT2)	General-purpose Sequence Input 5
13	/SI0	General-purpose Sequence Input 0

15	–	(NC)
17	PAO	Encoder Divided Pulse Output, Phase A
19	PBO	Encoder Divided Pulse Output, Phase B
21	PCO	Encoder Divided Pulse Output, Phase C
23	/SO2+	General-purpose Sequence Output 2
25	/SO3+	General-purpose Sequence Output 3

14	–	(NC)
16	SG	Signal Ground
18	/PAO	Encoder Divided Pulse Output, Phase A
20	/PBO	Encoder Divided Pulse Output, Phase B
22	/PCO	Encoder Divided Pulse Output, Phase C
24	/SO2-	General-purpose Sequence Output 2
26	/SO3-	General-purpose Sequence Output 3

4.5.3 I/O Signal Wiring Examples



*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: You can use parameters to change the functions allocated to the /DEC, P-OT, N-OT, /EXT1, /EXT2, and /EXT3 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

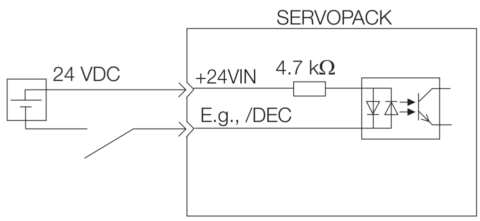
4.5.4 I/O Circuits

Sequence Input Circuits

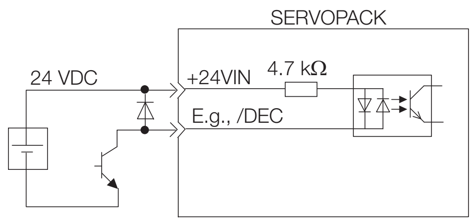
◆ Photocoupler Input Circuits

This section describes CN1 connector terminals 6 to 13.

Examples for Relay Circuits



Examples for Open-Collector Circuits

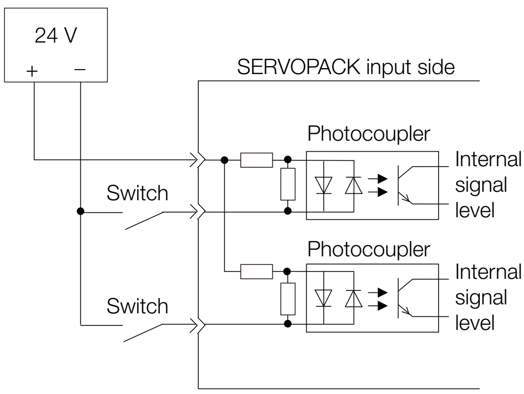


Note: The 24-VDC external power supply capacity must be 50 mA minimum.

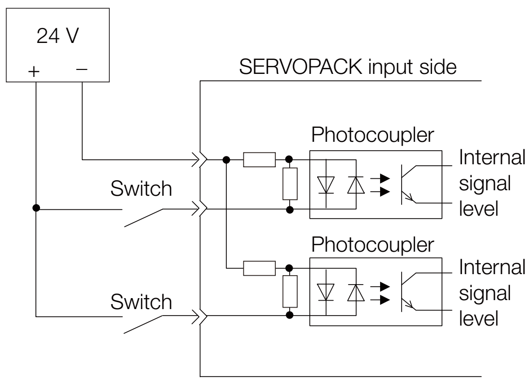
The SERVOPACK input circuits use bidirectional photocouplers. Select either a sink circuit or source circuit according to the specifications required by the machine.

Note: The connection examples in *4.5.3 I/O Signal Wiring Examples* on page 4-23 are for sink circuit connections.

Sink Circuits



Source Circuits



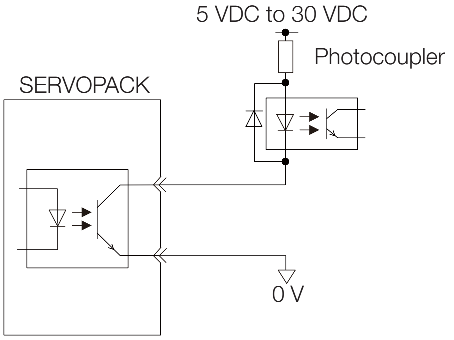
Sink Circuits: Input Signal Polarity		Source Circuits: Input Signal Polarity	
Photocoupler	Internal Signal Level	Photocoupler	Internal Signal Level
ON	Low level	ON	Low level
OFF	High level	OFF	High level

Sequence Output Circuits

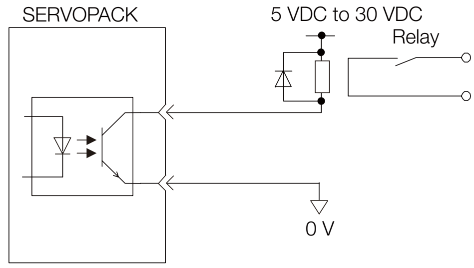
◆ Photocoupler Output Circuits

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 photocoupler, relay, or line-receiver circuit.

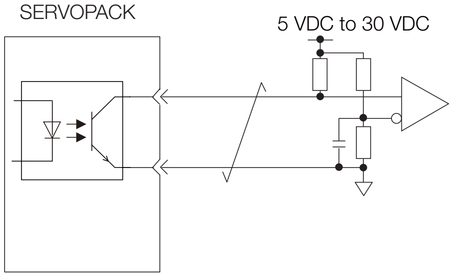
Example for Photocoupler Circuit



Example for Relay Circuit



Example for Line Receiver Circuit



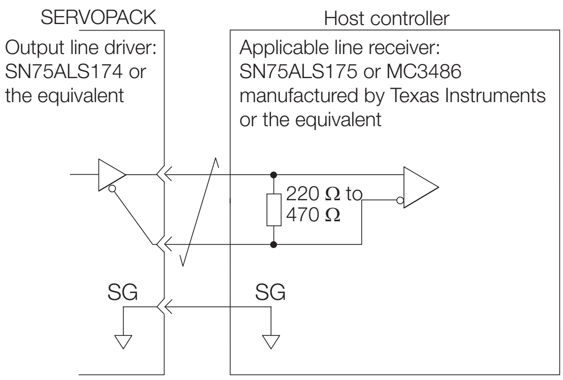
Note: The maximum allowable voltage and current range for photocoupler output circuits are as follows:
- Maximum allowable voltage: 30 VDC
- Current range: 5 mA to 50 mA DC

◆ 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).

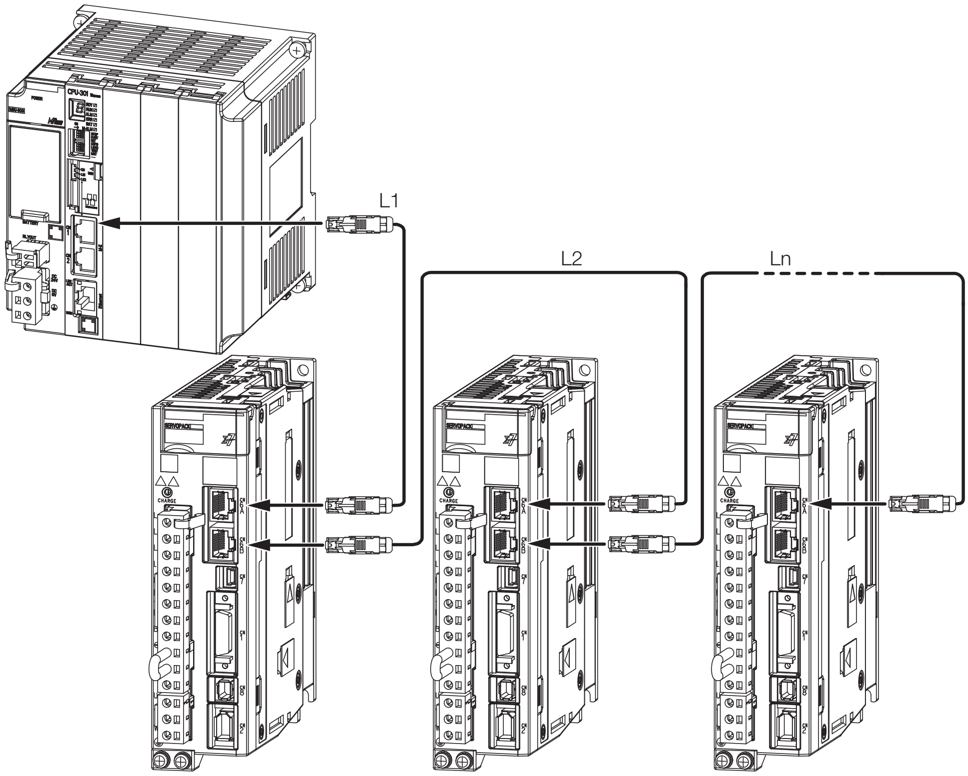
The serial data from the encoder is converted to two-phase (phases A and B) pulses. The resulting output signals (PAO, /PAO and PBO, /PBO), encoder phase C output signals (PCO and /PCO), and the absolute encoder position output signals (PSO and /PSO) are output with line-driver output circuits. Connect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

Example for Line-Receiver Circuit



4.6 Connecting MECHATROLINK Communications Cables

Connect the MECHATROLINK-III 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.

Use the cables specified in the selection table for the MECHATROLINK-III Communications Cables (RJ-45). The maximum cable lengths are as follows:

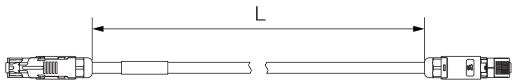
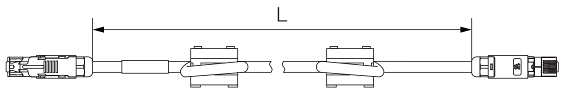
- Cables with Connectors on Both Ends without Ferrite Cores: 30 m
- Cables with Connectors on Both Ends with Ferrite Cores: 50 m

Selection Table

Type	Length (L)	Order Number*
Cables with Connectors on Both Ends without Ferrite Cores	0.2 m, 0.5 m, 1 m, 2 m, 3 m, 4 m, 5 m, 10 m, 20 m, and 30 m	JZSP-CM3RR00-□□-E (□□: 00P2/00P5/01/02/03/04/05/10/20/30)
Cables with Connectors on Both Ends with Ferrite Cores	10 m, 20 m, 30 m, and 50 m	JZSP-CM3RR01-□□-E (□□: 10/20/30/50)

* Replace the boxes (□□) in the order number with the code for the cable length.

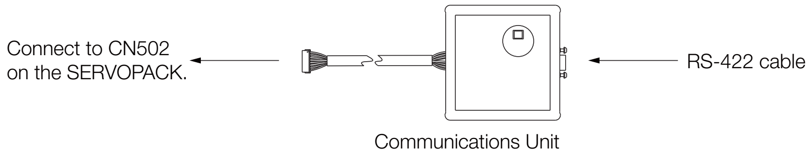
External Dimensions

Cables without Ferrite Cores	Cables with Ferrite Cores
	

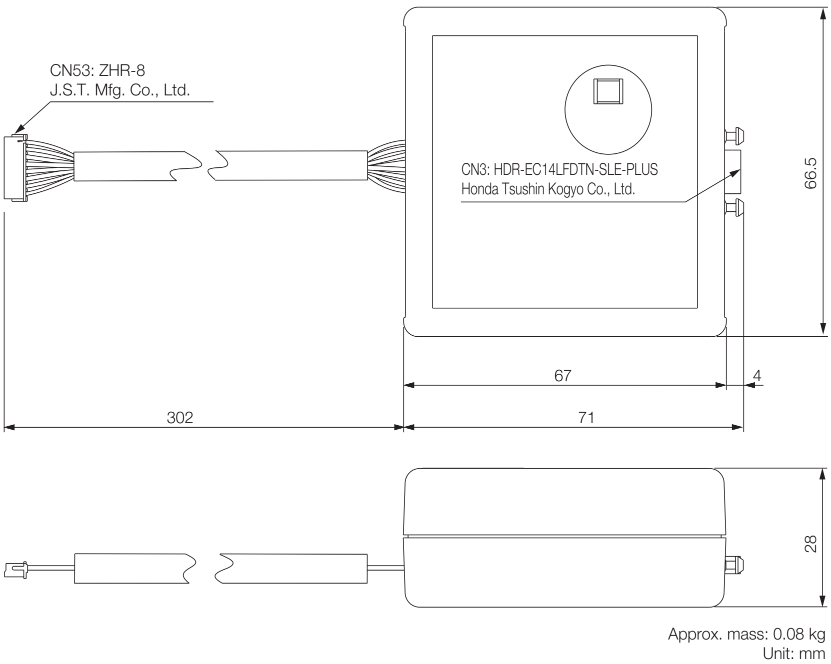
4.7 Connecting the Other Connectors

4.7.1 Serial Communications Connector (CN502)

To use an RS-422 cable to connect a Digital Operator, connect it to CN502 on the SERVOPACK. A JUSP-JC001-1 Communications Unit is required to make the connection.



Communications Unit

Item	Description
Inquiries	Your Yaskawa representative
Order Number	JUSP-JC001-1
External Dimensions	

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

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

4.7.2 Computer Connector (CN7)

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

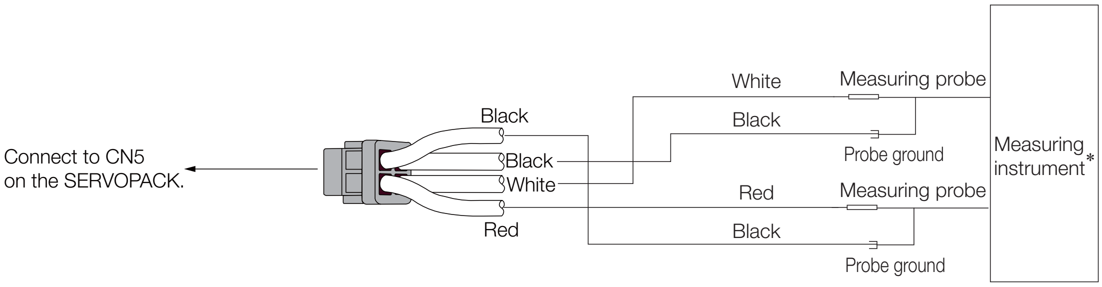
Refer to the following manual for the operating procedures for the SigmaWin+.

AC Servo Drives Engineering Tool SigmaWin+ Online Manual Σ-7 Component (Manual No.: SIEP S800001 48)

4.7.3 Analog Monitor Connector (CN5)

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

• Wiring Example



* The measuring instrument is not provided by Yaskawa.

Refer to the following section for information on the monitoring methods for an analog monitor.

☞ *9.3 Monitoring Machine Operation Status and Signal Waveforms* on page 9-9

Basic Functions That Require Setting before Operation

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

5.1 Spindle Motor Parameter Settings

The motor parameters of the Spindle Motor must be written to the SERVOPACK.
Yaskawa provides the motor parameters in an electronic file.
You can use either of the following two ways to write the motor parameters to the SERVOPACK.

- Use the SigmaWin+ Engineering Tool to write the motor parameters to the SERVOPACK.
- Write the motor parameters to the SERVOPACK from the host controller.

5.1.1 Setting Spindle Motor Parameters

⚠ WARNING

- **Check the Spindle Motor information before writing the motor parameters.**
  If you do not write the correct motor parameters, the motor may run out of control or burning may occur, possibly resulting in injury, equipment damage, or fire.

If a Spindle Motor is used, use the following procedure to set the parameters with the SigmaWin+.

Important

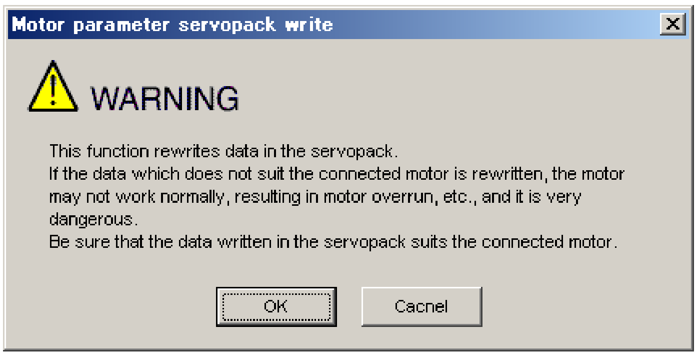
Make the correct settings for the items described in this section.
An incorrect setting may prevent the Spindle Motor from operating or result in incorrect operation.

Spindle Motor Parameter Settings

Use the following procedure to write the motor parameters of the Spindle Motor to the SERVOPACK.

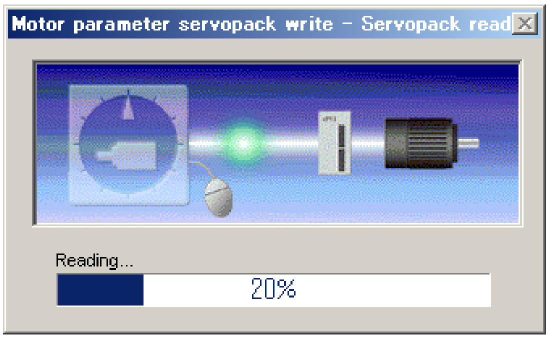
1. Obtain the motor parameter file. Ask your Yaskawa representative how to obtain the motor parameter file.

2. Select ***Others*** - ***Motor Parameter SERVOPACK Write*** from the menu bar of the Main Window of the SigmaWin+. A warning message appears, reminding you of the possible danger.

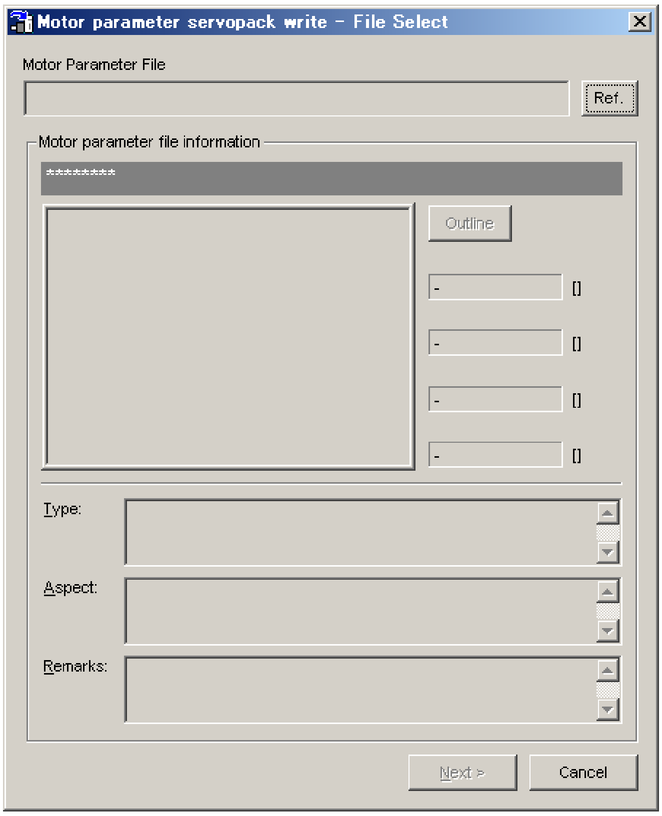


Click the **Cancel** Button to return to the Main Window without writing the motor parameters to the SERVOPACK. You will return to the main window.

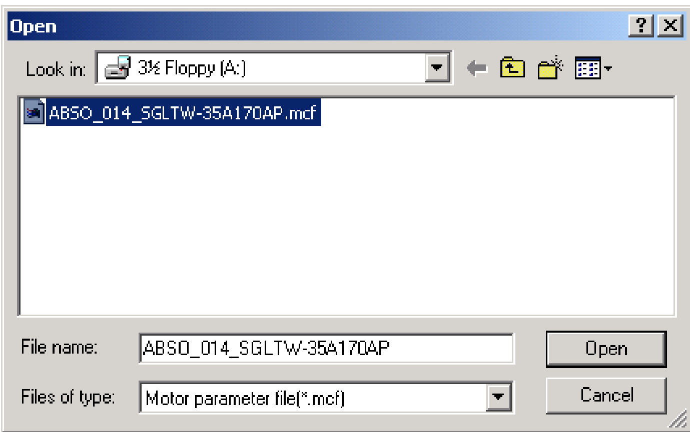
3. Click the **OK** Button. The SERVOPACK will start reading the motor parameters and the following dialog box will be displayed.



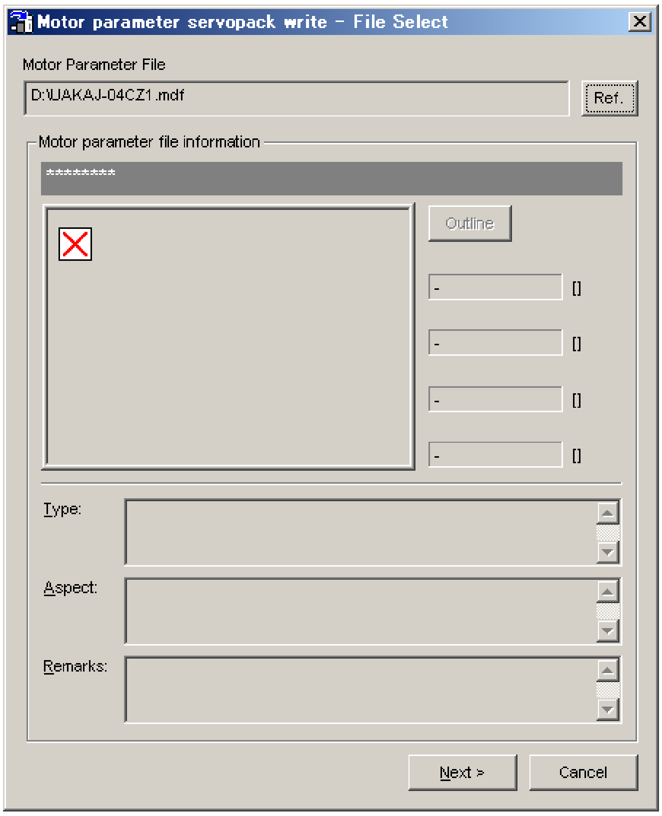
If the motor parameters were read successfully, the following dialog box will be displayed.



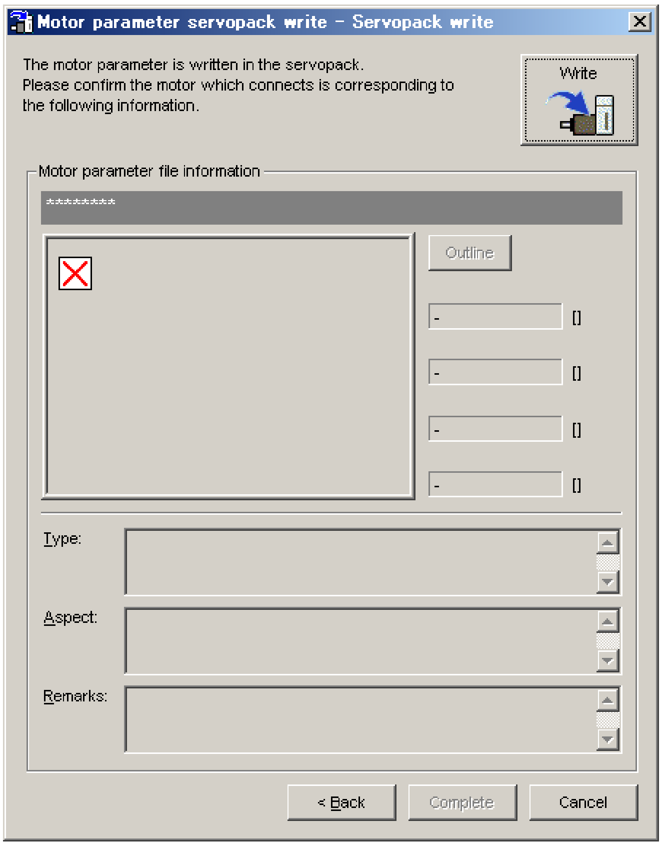
4. Click the **Ref.** Button. The following dialog box will be displayed.



5. Select the motor parameter file that you received from Yaskawa and click the **Open** Button. Nothing is displayed in the Motor Parameter SERVOPACK Write - File Select Dialog Box.



6. Click the **Next** Button. The following dialog box will be displayed.



Click the **Cancel** Button to return to the Main Window without writing the motor parameters to the SERVOPACK. You will return to the main window.
Click the **Back** Button to return to the Motor Parameter SERVOPACK Write - File Select Dialog Box.

Basic Functions That Require Setting before Operation

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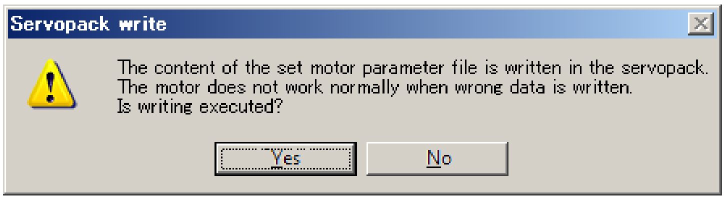
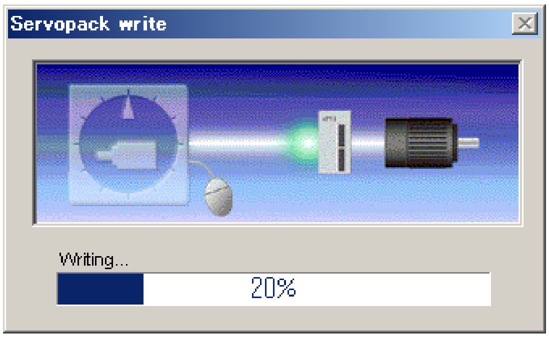
7. Click the **Write** Button. The following dialog box will be displayed.

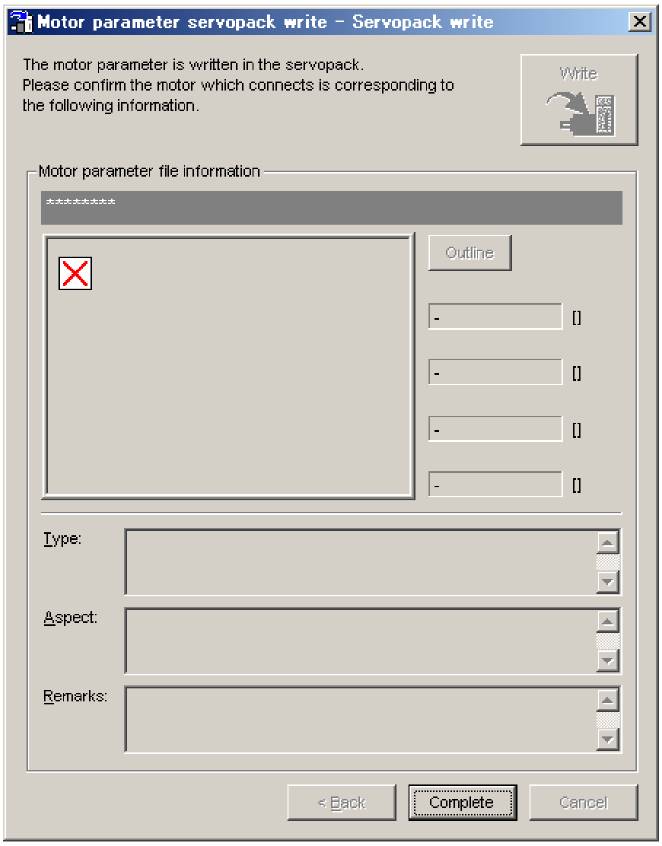


Click the **No** Button to cancel writing the motor parameters to the SERVOPACK.

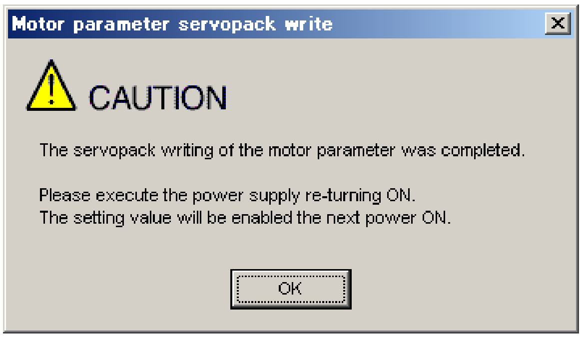
8. Click the **Yes** Button. Writing the motor parameters to the SERVOPACK will be started and the following dialog box will be displayed.



The following dialog box will return when the motor parameters have been written to the SERVO-PACK.



9. Click the **Complete** Button. The following dialog box will be displayed.



10. Click the **OK** Button and turn the power supply OFF and ON again.

5.2 Manipulating Parameters (Pn□□□)

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

5.2.1 Parameter Classification

There are the following two types of SERVOPACK parameters.

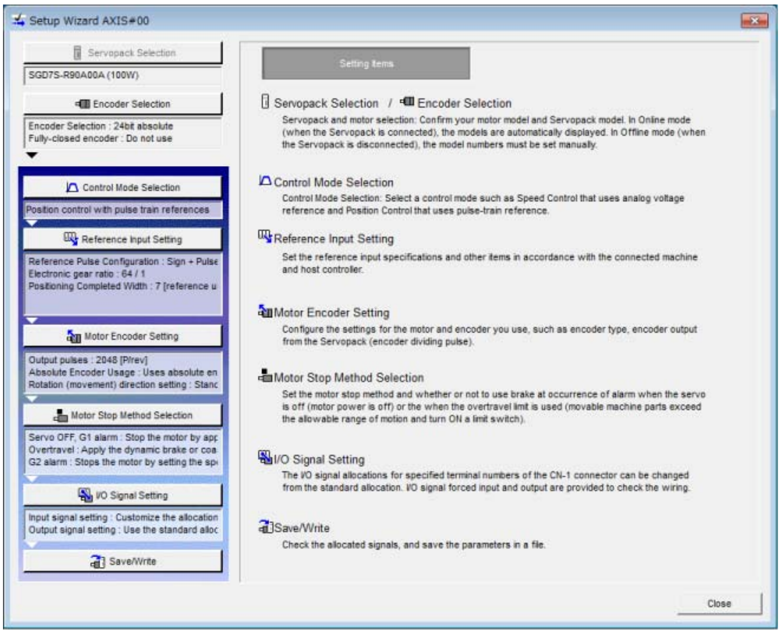
Classification	Meaning
Setup Parameters	Parameters for the basic settings that are required for operation.
Tuning Parameters	Parameters that are used to adjust servo performance.

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.



Tuning Parameters

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

☞ *8.10 Manual Tuning* on page 8-54

5.2.2 Notation for Parameters

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

- Parameters for Numeric Settings

The control methods for which the parameters apply are given.
Speed : Speed control Position : Position control Torque : Torque control

Pn100	Speed Loop Gain				Speed Position
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1 Hz	400	Immediately	Tuning

Parameter number

This is the setting range for the parameter.

This is the minimum unit (setting increment) that you can set for the parameter.

This is the parameter setting before shipment.

This is when any change made to the parameter will become effective.

This is the parameter classification.

- Parameters for Selecting Functions

Parameter		Meaning	When Enabled	Classification
Pn002	n.□0□□ (default setting)	Use the encoder according to encoder specifications.	After restart	Setup
	n.□1□□	Use the encoder as an incremental encoder.		
	n.□2□□	Use the encoder as a single-turn absolute encoder.		

Parameter number

The notation "n.□□□□" indicates a parameter for selecting functions.
Each □ indicates the setting for one digit.
The notation shown here means that the third digit from the right is set to 2.

This column explains the selections for the function.

5.2.3 Parameter Setting Methods

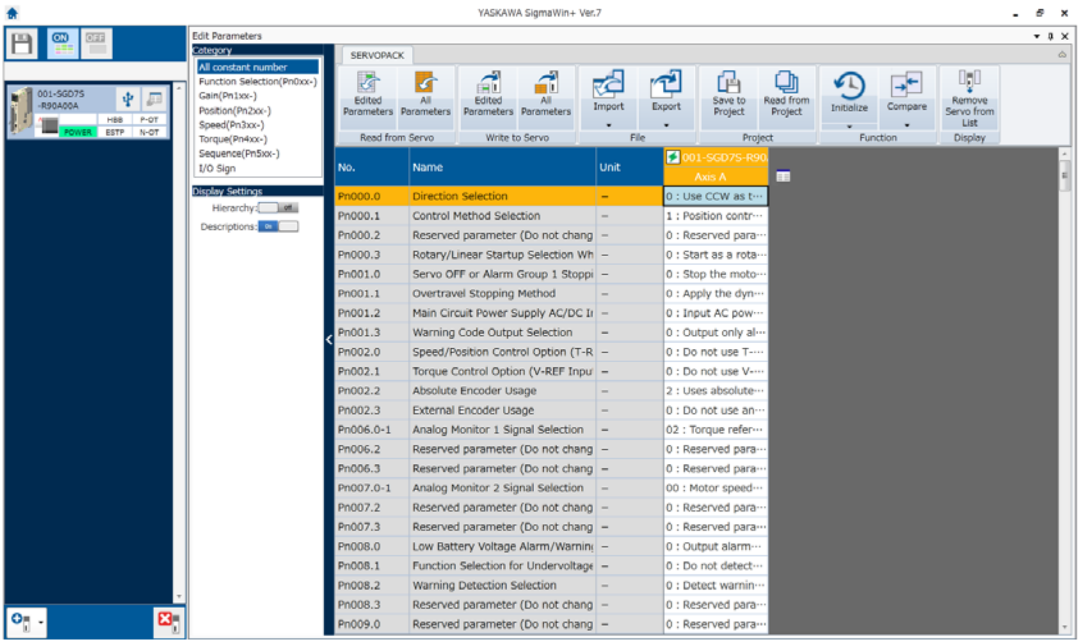
You can use the SigmaWin+ or a Digital Operator to set parameters.
A sample operating procedure is given below.

Setting Parameters with the SigmaWin+

1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.

2. Select **Edit Parameters** in the Menu Dialog Box.
   The Parameter Editing Dialog Box will be displayed.

3. Click the cell of the parameter to edit.
   If the parameter to edit is not displayed in the Parameter Editing Dialog Box, click the ▲ or ▼ Button to display the parameter to edit.

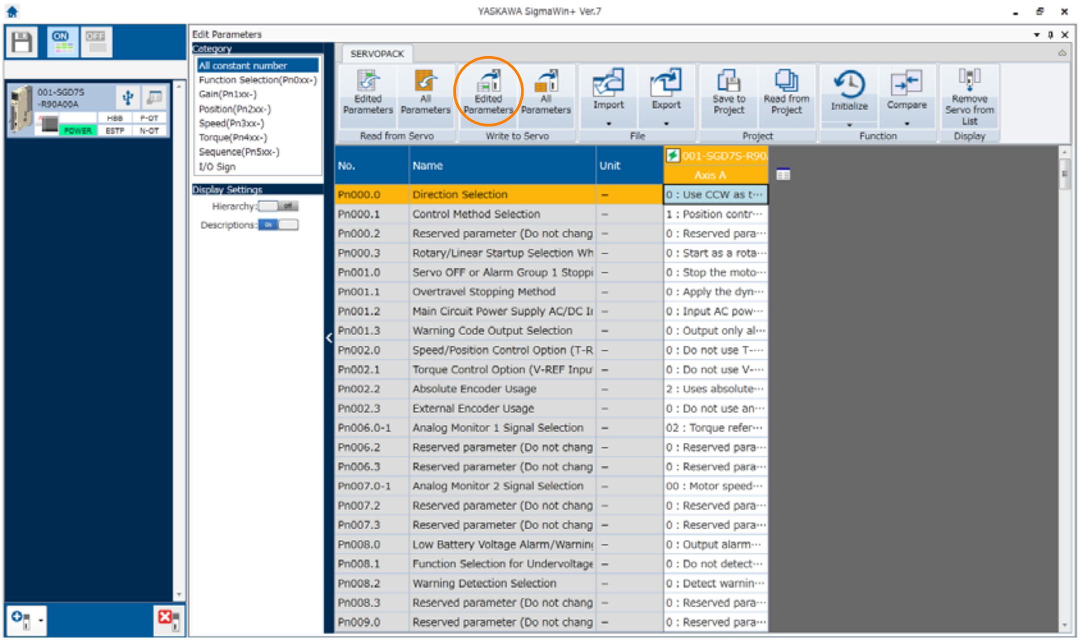


4. Change the setting of the parameter.

   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.

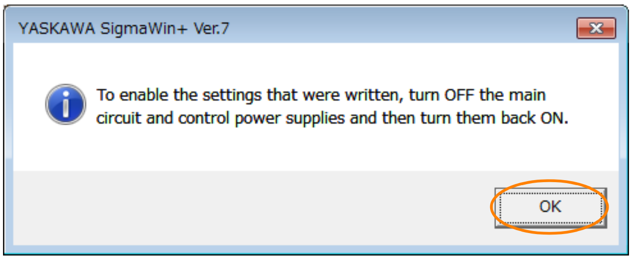
5. Press the **Enter** Key.
   The background of the edited parameter cell will change to green.

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 Parameters with a Digital Operator

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

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

5.2.4 Write Prohibition Setting for Parameters

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

Preparations

No preparations are required.

Applicable Tools

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

Tool	Fn No./Function Name	Reference
Digital Operator	Fn010	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Others - Write Prohibited Setting***	*Operating Procedure* on page 5-12

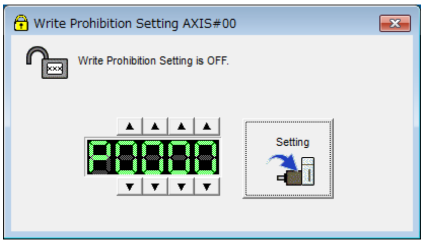
Operating Procedure

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

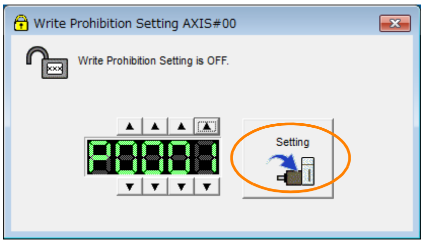
1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.

2. Select **Write Prohibition Setting** in the Menu Dialog Box.
   The Write Prohibition Setting Dialog Box will be displayed.

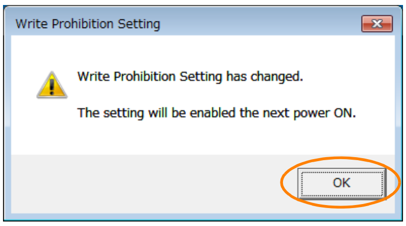
3. Press the ▼ or ▲ for the rightmost digit and set one of the following.
   0000: Writing is permitted (default setting).
   0001: Writing is prohibited.



4. Click the **Setting** Button.



5. Click the **OK** Button.
   The setting will be written to the SERVOPACK.



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

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

Restrictions

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

SigmaWin+		Digital Operator		When Writing Is Prohibited	Reference
Button in Menu Dialog Box	SigmaWin+ Function Name	Fn No.	Utility Function Name		
Basic Functions	Initialize*	Fn005	Initializing Parameters	Cannot be executed.	page 5-14
	Software Reset	Fn030	Software Reset	Can be executed.	page 6-21
	Product Information	Fn011	Display Servomotor Model	Can be executed.	page 9-2
		Fn012	Display Software Version	Can be executed.	
		Fn01E	Display SERVOPACK and Servomotor IDs	Can be executed.	
		Fn01F	Display Servomotor ID from Feedback Option Module	Can be executed.	
Encoder Setting	Search Origin	Fn003	Origin Search	Cannot be executed.	page 7-16
Trouble-shooting	Display Alarm	Fn000	Display Alarm History	Can be executed.	page 11-33
		Fn006	Clear Alarm History	Cannot be executed.	page 11-34
		Fn014	Reset Option Module Configuration Error	Cannot be executed.	page 11-35
Operation	Jog	Fn002	Jog	Cannot be executed.	page 7-5
	Program JOG Operation	Fn004	Jog Program	Cannot be executed.	page 7-12
Tuning	Tuning - Autotuning without Host Reference	Fn201	Advanced Autotuning without Reference	Cannot be executed.	–
	Tuning - Autotuning with Host Reference	Fn202	Advanced Autotuning with Reference	Cannot be executed.	–
	Tuning - Custom Tuning	Fn203	One-Parameter Tuning	Cannot be executed.	page 8-33
	Tuning - Custom Tuning - Adjust Anti-resonance Control	Fn204	Adjust Anti-resonance Control	Cannot be executed.	page 8-42
	Tuning - Custom Tuning - Vibration Suppression	Fn205	Vibration Suppression	Cannot be executed.	–
Others	Adjust the Analog Monitor Output	Fn00C	Adjust Analog Monitor Output Offset	Cannot be executed.	page 9-12
		Fn00D	Adjust Analog Monitor Output Gain	Cannot be executed.	
	Adjust the Motor Current Detection Offsets	Fn00E	Autotune Motor Current Detection Signal Offset	Cannot be executed.	page 6-27
		Fn00F	Manually Adjust Motor Current Detection Signal Offset	Cannot be executed.	
	Initialize Vibration Detection Level	Fn01B	Initialize Vibration Detection Level	Cannot be executed.	page 6-24

* An **Initialize** Button will be displayed in the Parameter Editing Dialog Box.

5.2.5 Initializing Parameter Settings

You can return the 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.

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

Preparations

Always check the following before you initialize the parameter settings.

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

Applicable Tools

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

Tool	Fn No./Function Name	Reference
Digital Operator	Fn005	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Basic Functions - Edit Parameters***	*Operating Procedure* on page 5-14

Operating Procedure

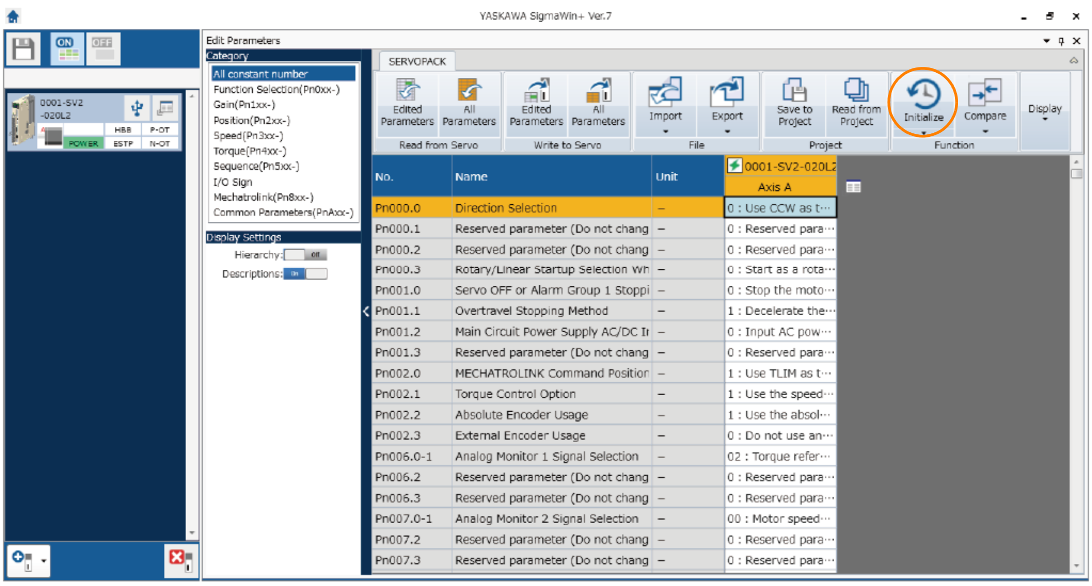
Use the following procedure to initialize the parameter settings.

1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.

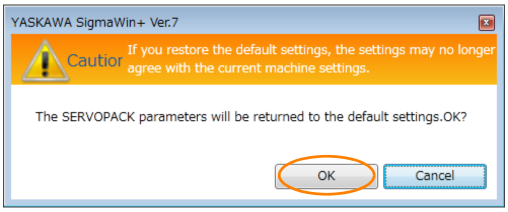
2. Select **Edit Parameters** in the Menu Dialog Box.
   The Parameter Editing Dialog Box will be displayed.

3. Select any parameter of the axis to initialize.

4. Click the **Initialize** Button in the **Function** Group.

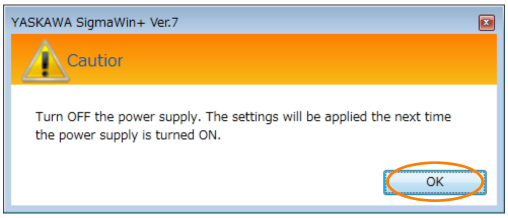


5. Click the **OK** Button.



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

6. Click the **OK** Button.

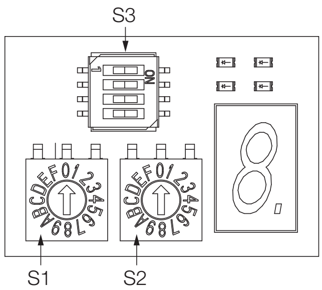


7. Turn the power supply to the SERVOPACK OFF and ON again after the parameter settings have been initialized.

This concludes the procedure to initialize the parameter settings.

5.3 MECHATROLINK-III Communications Settings

The settings for MECHATROLINK-III communications are made with the DIP switch (S3).
The station address is set using the rotary switches (S1 and S2).



5.3.1 Communications Settings

Use the DIP switch (S3) to make the communications settings.

Pin No.	Function	Setting			Default Setting
		1	2	Description	
1, 2	Sets the number of transmission bytes.	OFF	OFF	Reserved. (Do not change.)	1: OFF 2: ON
		ON	OFF	32 bytes	
		OFF	ON	48 bytes	
		ON	ON	Reserved. (Do not change.)	
3	Reserved. (Do not change.)				OFF
4	Reserved. (Do not change.)				OFF

Important

- If you will use the MECHATROLINK-III standard servo profile, set the number of transmission bytes to either 32 or 48.
- To enable the new setting, turn the power supply to the SERVOPACK OFF and ON again after you change the communications switches (S1, S2, and S3).

5.3.2 Setting the Station Address

Use the rotary switches (S1 and S2) to set the station address.

Station Address	S1	S2
00 to 02 hex: Disabled (Do not set.)	0	0 to 2
03 hex (default setting)	0	3
04 hex	0	4
⋮	⋮	⋮
EF hex	E	F
F0 to FF hex: Disabled (Do not set.)	F	0 to F

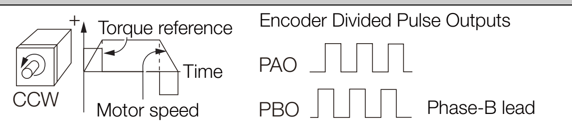
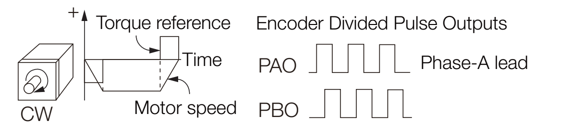
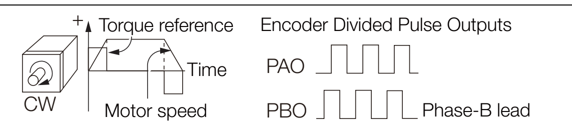
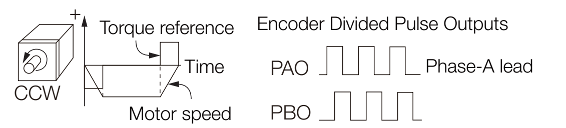
5.4 Motor Direction Setting

You can reverse the direction of Spindle Motor rotation by changing the setting of Pn000 = n.□□□X (Rotation Direction Selection) without changing the polarity of the speed or position reference. This causes the rotation direction of the motor 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

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

Parameter		Forward/Reverse Reference	Motor Direction and Encoder Divided Pulse Outputs	Applicable Overtravel Signal (OT)
Pn000	n.□□□0 Use CCW as the forward direction. (default setting)	Forward reference		P-OT (Forward Drive Prohibit) signal
		Reverse reference		N-OT (Reverse Drive Prohibit) signal
	n.□□□1 Use CW as the forward direction. (Reverse Rotation Mode)	Forward reference		P-OT (Forward Drive Prohibit) signal
		Reverse reference		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.

Basic Functions That Require Setting before Operation

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5.5 Overtravel and Related Settings

The overtravel function is disabled by default because it is generally not required for spindle axis applications. Allocate signals if you need to use the overtravel function.

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.
- A base block state is entered after stopping for overtravel. This may cause the Spindle Motor to be pushed back by an external force on the load shaft. To prevent the Spindle Motor from being pushed back, set Pn001 to n.□□1□ to place the Spindle Motor in a zero-clamped state when it stops.

5.5.1 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	CN1-7	ON	Forward drive is enabled (actual operation).
			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 motor in the opposite direction during overtravel by inputting a reference.

5.5.2 Setting to Enable/Disable Overtravel

You can use Pn50A = n.X□□□ (P-OT (Forward Drive Prohibit) Signal Allocation) and Pn50B = n.□□□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□□□	The forward overtravel function is enabled and the P-OT (Forward Drive Prohibit) signal is input from CN1-7.	After restart	Setup
	n.8□□□ (default setting)	The reverse overtravel function is disabled. Forward drive is always enabled.		
Pn50B	n.□□□2	The reverse overtravel function is enabled and the N-OT (Reverse Drive Prohibit) signal is input from CN1-8.		
	n.□□□8 (default setting)	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

5.5.3 Motor Stopping Method for Overtravel

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

Parameter		Motor Stopping Method*	Status after Stopping	When Enabled	Classification
Pn001	n.□□00 (default setting)	Coasting	Coasting	After restart	Setup
	n.□□01				
	n.□□02				
	n.□□1□	Deceleration according to setting of Pn406	Zero clamp		
	n.□□2□		Coasting		
	n.□□3□	Deceleration according to setting of Pn30A	Zero clamp		
	n.□□4□		Coasting		

* You cannot decelerate a motor to a stop during torque control. For torque control, the Spindle Motor will 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 Spindle Motor will enter a coasting state.

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

☞ *5.6.1 Stopping Method for Servo OFF* on page 5-22

Stopping the Spindle Motor by Setting Emergency Stop Torque

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

If Pn001 = n.□□X□ is set to 1 or 2, the Spindle Motor 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 Spindle Motor at the maximum torque. However, the maximum emergency stop torque that you can actually use is the maximum torque of the Spindle Motor.

Pn406	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.

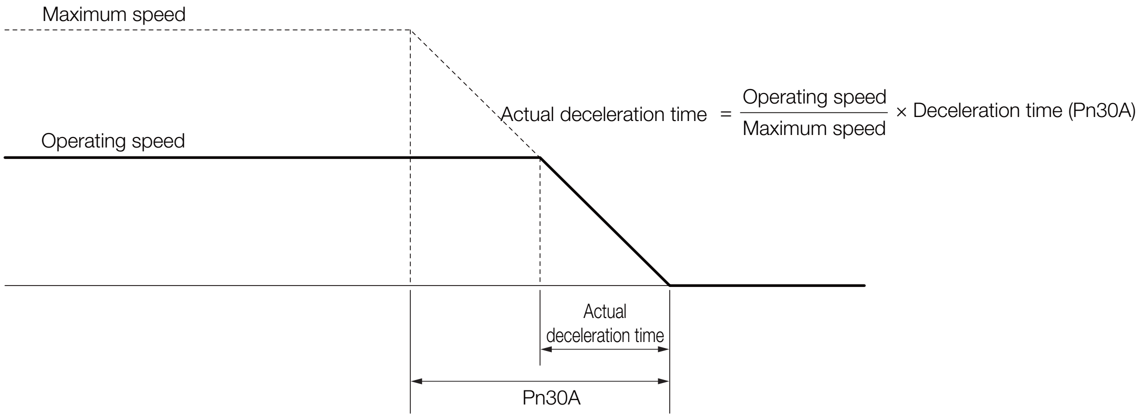
Stopping the Spindle Motor by Setting the Deceleration Time

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

Pn30A	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 motor will be stopped with a zero speed.

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



5.5.4 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.

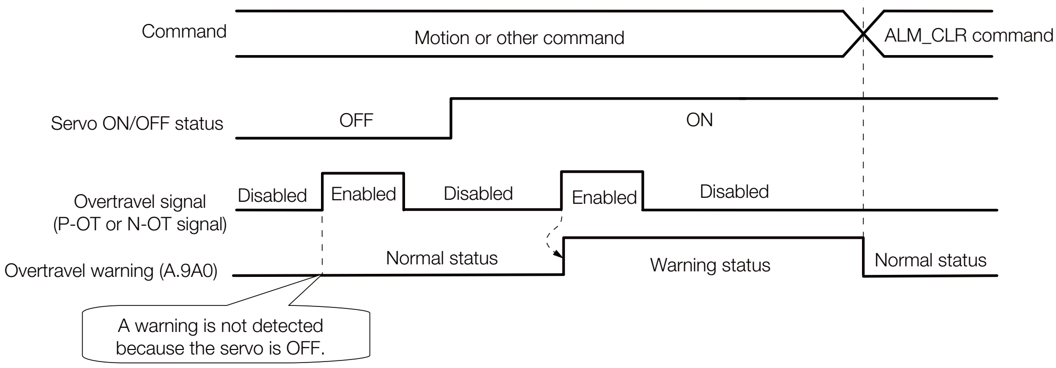
Important

1. The occurrence of an A.9A0 warning will not stop the motor or have any affect 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 Spindle Motor 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	n.0□□□ (default setting)	Do not detect overtravel warnings.	After restart	Setup
	n.1□□□	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.
2. 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.
3. A warning can be detected in either the forward or reverse direction if there is no reference.
4. 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 ALM_CLR (Clear Alarms and Warnings) 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.

5.6 Motor Stopping Methods for Servo OFF and Alarms

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

There are the following three stopping methods.

Motor Stopping Method	Meaning
Coasting to a Stop	The motor stops naturally due to friction during operation.
Zero Clamping	The speed reference is set to 0 to stop the Spindle Motor quickly.
Decelerating to a Stop	Emergency stop torque is used to decelerate the motor to a stop.

There are the following two conditions after stopping.

Status after Stopping	Meaning
Coasting	The SERVOPACK does not control the Spindle Motor. (The machine will move in response to a force from the load.)
Zero Clamping	A position loop is created and the motor remains stopped at a position reference of 0. (The current stop position is held.)

5.6.1 Stopping Method for Servo OFF

Do not change the motor stopping method when the servo turns OFF from coasting to a stop (Pn001 = n.□□□2).

<table>
<tr><th colspan="2">Parameter</th><th>Spindle Motor Stopping Method</th><th>Status after Stopping</th><th>When Enabled</th><th>Classifi-cation</th></tr>
<tr><td rowspan="3">Pn001</td><td>n.□□□0</td><td colspan="2" rowspan="2">Reserved settings (Do not use.)</td><td rowspan="3">After restart</td><td rowspan="3">Setup</td></tr>
<tr><td>n.□□□1</td></tr>
<tr><td>n.□□□2
(default setting)</td><td>Coasting</td><td>Coasting</td></tr>
</table>

5.6.2 Motor 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.

☞ *11.2.1 List of Alarms* on page 11-3

Motor Stopping Method for Group 1 Alarms

When a group 1 alarm occurs, the Spindle Motor will stop according to the setting of Pn001 = n.□□□X. The default setting is for coasting to a stop.

Refer to the following section for details.

☞ *5.6.1 Stopping Method for Servo OFF* on page 5-22

Motor Stopping Method for Group 2 Alarms

When a group 2 alarm occurs, the Spindle Motor 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.□□1□ (Apply the dynamic brake or coast the motor to a stop), you can use the same stopping method as group 1. If you are coordinating a number of Spindle Motors, 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.

<table>
<tr><th colspan="3">Parameter</th><th rowspan="2">Spindle Motor Stopping Method</th><th rowspan="2">Status after Stopping</th><th rowspan="2">When Enabled</th><th rowspan="2">Classification</th></tr>
<tr><th>Pn00B</th><th>Pn00A</th><th>Pn001</th></tr>
<tr><td>n.□□0□
(default setting)</td><td>–</td><td rowspan="7">n.□□□2
(default setting)</td><td>Zero-speed stopping</td><td rowspan="7">Coasting</td><td rowspan="7">After restart</td><td rowspan="7">Setup</td></tr>
<tr><td>n.□□1□</td><td>–</td><td>Coasting</td></tr>
<tr><td rowspan="5">n.□□2□</td><td>n.□□□0
(default setting)</td><td>Coasting</td></tr>
<tr><td>n.□□□1</td><td rowspan="2">Motor is decelerated using the torque set in Pn406 as the maximum torque.</td></tr>
<tr><td>n.□□□2</td></tr>
<tr><td>n.□□□3</td><td rowspan="2">Motor is decelerated according to setting of Pn30A.</td></tr>
<tr><td>n.□□□4</td></tr>
</table>

Note: 1. The setting of Pn00A is ignored if Pn001 is set to n.□□0□ or n.□□1□.
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 Spindle Motor by Setting Emergency Stop Torque* on page 5-19
4. Refer to the following section for details on Pn30A (Deceleration Time for Servo OFF and Forced Stops).
☞ *Stopping the Spindle Motor by Setting the Deceleration Time* on page 5-19

5.7 Motor Overload Detection Level

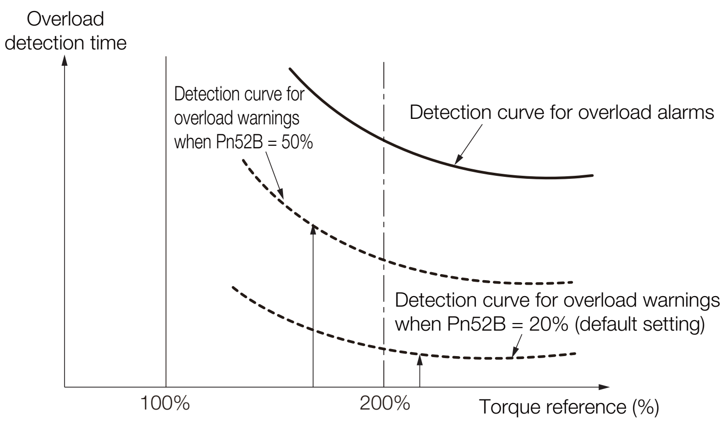
The motor overload detection level is the threshold used to detect overload alarms and overload warnings when the Spindle Motor is subjected to a continuous load that exceeds the Spindle Motor ratings.

It is designed to prevent Spindle Motor 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).

5.7.1 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.



Pn52B	Overload Warning Level		Speed Position Torque		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 100	1%	20	Immediately	Setup

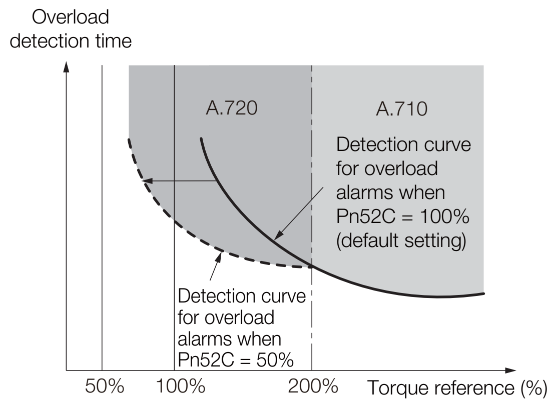
5.7.2 Detection Timing for Overload Alarms (A.720)

If Spindle Motor 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).

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

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



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

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

5.8 Electronic Gear Settings

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

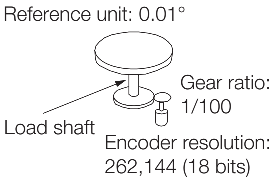
The electronic gear is used to convert the travel distances that are specified in reference units to pulses, which are required for actual movements.

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

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

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

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



When the Electronic Gear Is Not Used

To move a workpiece 10°:
1. Calculate the number of revolutions.
   The workpiece rotates 3.60° per motor rotation.
   To move 10°: 10/3.60 rotations
2. Calculate the required number of reference pulses.
   One revolution is 262,144 pulses, therefore
   10/3.60 × 262,144 = 728,177.77 pulses.
3. Input 728,178 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 10° when one reference unit is set to 0.01°, the travel distance is 0.01° per pulse.
To move the workpiece 10°,
10 ÷ 0.01 × 100 = 100,000 pulses, so 100,000 pulses would be input.

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

5.8.1 Electronic Gear Ratio Settings

Set the electronic gear ratio using Pn20E and Pn210.

> **Important**
> Set the electronic gear ratio within the following range.
> 0.001 ≤ Electronic gear ratio (B/A) ≤ 64,000
> If the electronic gear ratio is outside of this range, an A.040 alarm (Parameter Setting Error) will occur.

Pn20E	Electronic Gear Ratio (Numerator)			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,824	1	2	After restart	Setup
Pn210	Electronic Gear Ratio (Denominator)			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,824	1	1	After restart	Setup

Calculating the Settings for the Electronic Gear Ratio

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

$$\text{Electronic gear ratio } \frac{B}{A} = \frac{\text{Pn20E}}{\text{Pn210}} = \frac{\text{Encoder resolution}}{\text{Travel distance per load shaft revolution (reference units)}} \times \frac{m}{n}$$

5.9 Setting the Regenerative Resistor Capacity

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

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

⚠ WARNING

- **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.

Pn600	Regenerative Resistor Capacity				Speed / Position / Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to SERVOPACK's maximum applicable motor capacity	10 W	0	Immediately	Setup
Pn603	Regenerative Resistance				Speed / Position / Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	10 mΩ	0	Immediately	Setup

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

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

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

Note: 1. An A.320 alarm will be displayed if the setting is not suitable.
2. The default setting of 0 specifies that the SERVOPACK's built-in regenerative resistor or Yaskawa's Regenerative Resistor Unit is being used.

Important

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

6

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

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

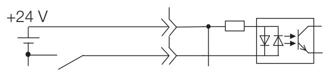
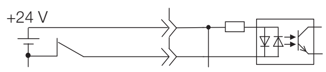
> **Important**
> If you allocate two or more signals to the same input circuit, a logical OR of the inputs will be used and all of the allocated signals will operate accordingly. This may result in unexpected operation.

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 = n.X□□□
N-OT	Reverse Drive Prohibit	Pn50B = n.□□□X
/DEC	Origin Return Deceleration Switch Input	Pn511 = n.□□□X
/EXT1	External Latch Input 1	Pn511 = n.□□X□
/EXT2	External Latch Input 2	Pn511 = n.□X□□
/EXT3	External Latch Input 3	Pn511 = n.X□□□
FSTP	Forced Stop Input	Pn516 = 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.

<table>
<tr><th>Parameter Setting</th><th>Pin No.</th><th>Description</th></tr>
<tr><td>0</td><td>13</td><td rowspan="7">A reverse signal (a signal with “/” before the signal abbreviation, such as the /P-CL signal) is active when the contacts are ON (closed).
A signal that does not have “/” before the signal abbreviation (such as the P-OT signal) is active when the contacts are OFF (open).</td></tr>
<tr><td>1</td><td>7</td></tr>
<tr><td>2</td><td>8</td></tr>
<tr><td>3</td><td>9</td></tr>
<tr><td>4</td><td>10</td></tr>
<tr><td>5</td><td>11</td></tr>
<tr><td>6</td><td>12</td></tr>
<tr><td>7</td><td>–</td><td>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.</td></tr>
<tr><td>8</td><td>–</td><td>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.</td></tr>
<tr><td>9</td><td>13</td><td rowspan="7">A reverse signal (a signal with “/” before the signal abbreviation, such as the /P-CL signal) is active when the contacts are OFF (open).
A signal that does not have “/” before the signal abbreviation (such as the P-OT signal) is active when the contacts are ON (closed).</td></tr>
<tr><td>A</td><td>7</td></tr>
<tr><td>B</td><td>8</td></tr>
<tr><td>C</td><td>9</td></tr>
<tr><td>D</td><td>10</td></tr>
<tr><td>E</td><td>11</td></tr>
<tr><td>F</td><td>12</td></tr>
</table>

Note: 1. You cannot allocate the /EXT1 to /EXT3 (External Latch Inputs 1 to 3) signals to pins 10 to 12 on the I/O signal connector (CN1).
2. Refer to the following section for details on input signal parameter settings.
☞ *12.1.2 List of Servo Parameters* on page 12-3

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□□1   Pn511 = n.□□□3   Before change

↓   ↓

Pn50A = n.3□□1   Pn511 = n.□□□1   After change

Refer to the following section for the parameter setting procedure.
☞ *5.2.3 Parameter Setting Methods* on page 5-10

Confirming the Allocation Status of Input Signals

You can confirm the allocation status of input signals with the I/O Signal Allocations Window of the SigmaWin+. Refer to the following section for details.
☞ *9.2.3 I/O Signals Status 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.

Important

- 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.
- If you reverse the polarity of the /BK (Brake) signal, i.e., change it to positive logic, 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.

The following table shows the relationship between the parameters and the output signals that can be allocated to the pins on the I/O signal connector (CN1).

Output Signals	Output Signal Name	Parameter
/COIN	Positioning Completion	Pn50E = n.□□□X
/V-CMP	Speed Coincidence Detection	Pn50E = n.□□X□
/TGON	Rotation Detection	Pn50E = n.□X□□
/S-RDY	Servo Ready	Pn50E = n.X□□□
/CLT	Torque Limit Detection	Pn50F = n.□□□X
/VLT	Speed Limit Detection	Pn50F = n.□□X□
/BK	Brake	Pn50F = n.□X□□
/WARN	Warning	Pn50F = n.X□□□
/NEAR	Near	Pn510 = n.□□□X
/PM	Preventative Maintenance	Pn514 = n.□X□□

◆ Relationship between Parameter Settings and Allocated Pin Numbers

The following table shows the relationship between the output signal parameter settings and the pin numbers on the I/O signal connector (CN1).

Parameter Setting	Pin No.	Description
0	–	Disable (signal output is not used)
1	1 or 2	Output the allocated signal from the CN1-1 or CN1-2 output terminal.
2	23 or 24	Output the allocated signal from the CN1-23 or CN1-24 output terminal.
3	25 or 26	Output the allocated signal from the CN1-25 or CN1-26 output terminal.
4 to 6	–	Reserved setting (Do not use.)

◆ Output Signal Polarity Switching

The polarity of the output signal is switched using Pn512.

Parameter			Pin No.	Description
Parameter No.		Setting Value		
Pn512	n.□□□X	0	1 or 2	The signal is not inverted.
		1		The signal is inverted.
	n.□□X□	0	23 or 24	The signal is not inverted.
		1		The signal is inverted.
	n.□X□□	0	25 or 26	The signal is not inverted.
		1		The signal is inverted.

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□□3 Before change

↓

Pn50E = n.3□□0 After change

Refer to the following section for the parameter setting procedure.

☞ *5.2.3 Parameter Setting Methods* on page 5-10

Confirming the Allocation Status of Output Signals

You can confirm the allocation status of output signals with the I/O Signal Allocations Window of the SigmaWin+. Refer to the following section for details.

☞ *9.2.3 I/O Signals Status Monitor* on page 9-5

6.1.3 ALM (Servo Alarm) Signal

This signal is output when the SERVOPACK detects an error.

Important

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
			OFF (open)	SERVOPACK alarm

Alarm Reset Methods

Refer to the following section for information on the alarm reset methods.

11.2.3 Resetting Alarms on page 11-32

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	Must be allocated.	ON (closed)	Warning
			OFF (open)	Normal status

Note: You must allocate the /WARN signal to use it. Use Pn50F = n.X□□□ (/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 Spindle Motor is operating.

This signal is output when the Spindle Motor is operating at the setting of the following parameters or faster.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	/TGON	Must be allocated.	ON (closed)	The Spindle Motor is operating at the setting of the following parameters or faster.
			OFF (open)	The Spindle Motor is operating slower than the setting of the following parameters.

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

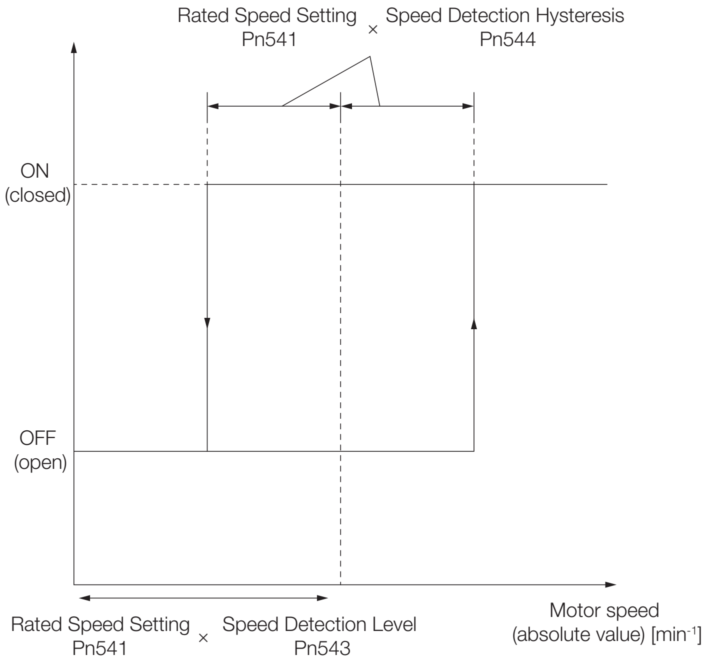
6.1.2 Output Signal Allocations on page 6-4

Setting the Rotation Detection Level

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

Pn541*1	Rated Speed Setting			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	100 to 65,535	min^{-1}	65,535	After restart	Setup
Pn543	Speed Detection Level			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0.00 to 100.00	0.01%*2	10.00	Immediately	Setup
Pn544	Speed Detection Hysteresis			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0.00 to 100.00	0.01%*2	1.00	Immediately	Setup

*1. If you set a value that exceeds the maximum speed of the Spindle Motor, the actual speed will be limited to the maximum speed of the Spindle Motor.
*2. Set a percentage of the value of Pn541 (Rated Speed Setting).



6.1.6 /S-RDY (Servo Ready) Signal

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

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

- Main circuit power supply is ON.
- There is no hard wire base block state.
- There are no alarms.
- There is no forced stop state (FSTP).

* Do not include this condition if the SV_ON (Servo ON) command is input for the first time after the control power supply was turned ON. In that case, when the first SV_ON command is input, polarity detection is started immediately and the /S-RDY signal turns ON at the completion of polarity detection.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	/S-RDY	Must be allocated.	ON (closed)	Ready to receive the SV_ON (Servo ON) command.
			OFF (open)	Not ready to receive the SV_ON (Servo ON) command.

Note: You must allocate the /S-RDY signal to use it. Use Pn50E = n.X□□□ (/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

6.1.7 /V-CMP (Speed Coincidence Detection) Signal

The /V-CMP (Speed Coincidence Output) signal is output when the Spindle Motor 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

Set the speed detection width for the /V-CMP signal in Pn503 and Pn542.

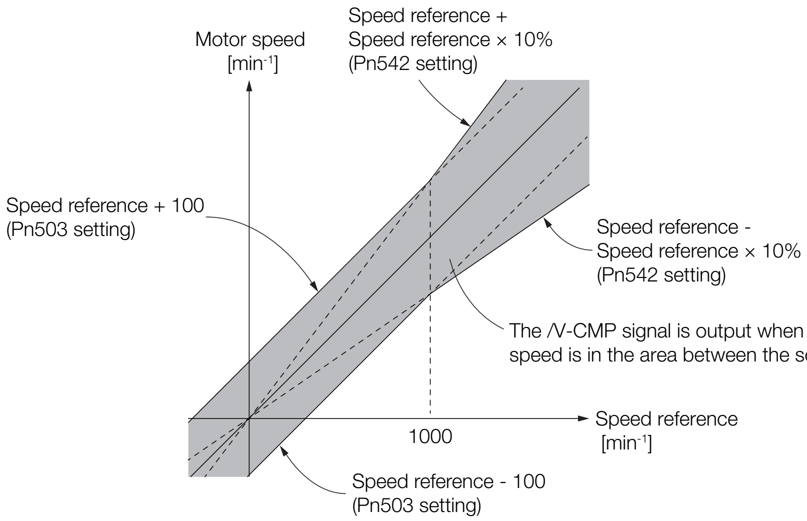
Pn503	Speed Coincidence Signal Detection Width			Speed	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	1 min^{-1}	10	Immediately	Setup
Pn542	Speed Coincidence Detection Width			Speed	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 50	1%*	15	Immediately	Setup

* Set a percentage of the speed reference.

The signal is output when the difference between the reference speed and motor speed is equal or less than the setting of the Speed Coincidence Detection Width.

The setting of Speed Coincidence Detection Width is the greater of the setting of Pn503 (Speed Coincidence Signal Detection Width) or the speed reference [min^{-1}] × Pn542 (Speed Coincidence Detection Width).

Example If Pn503 is set to 100, Pn542 is set to 10, and the speed reference is 2,000 min^{-1}, the /V-CMP signal would be output when the motor speed is between 1,800 and 2,200 min^{-1}.
If Pn503 is set to 100, Pn542 is set to 10, and the speed reference is 300 min^{-1}, the /V-CMP signal would be output when the motor speed is between 200 and 400 min^{-1}.



6.1.8 /COIN (Positioning Completion) Signal

The /COIN (Positioning Completion) signal indicates that Spindle Motor 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 Spindle Motor (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.□□□X (/COIN (Positioning Completion Output) Signal Allocation) to allocate the signal to connector pins. Refer to the following section for details on allocations.

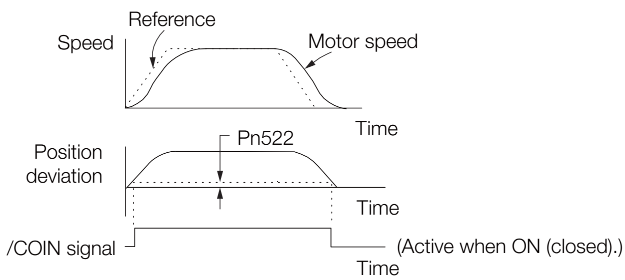
☞ *6.1.2 Output Signal Allocations* on page 6-4

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).

Pn522	Positioning Completed Width			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	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.

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□□□ (/COIN (Positioning Completion Output) Signal Output Timing) to change output timing for the /COIN signal.

Parameter		Description	When Enabled	Classification
Pn207	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).	After restart	Setup
	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.		
	n. 2□□□	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.

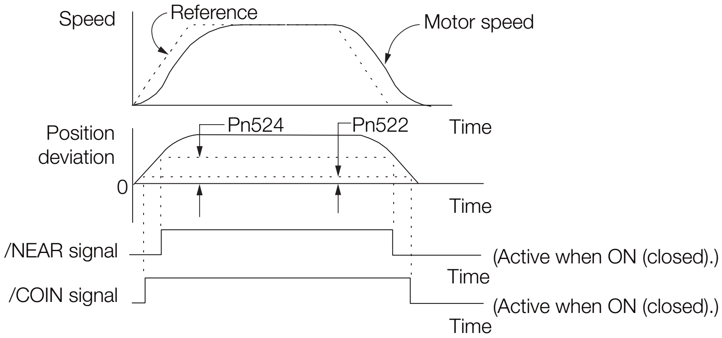
Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	/NEAR	Must be allocated.	ON (closed)	The motor has reached a point near to positioning completion.
			OFF (open)	The motor has not reached a point near to positioning completion.

Note: You must allocate the /NEAR signal to use it. Use Pn510 = n.□□□X (/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).

Pn524	Near Signal Width			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,824	1 reference unit	1,073,741,824	Immediately	Setup



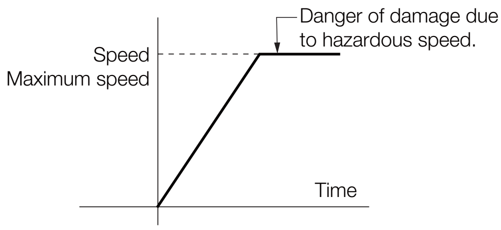
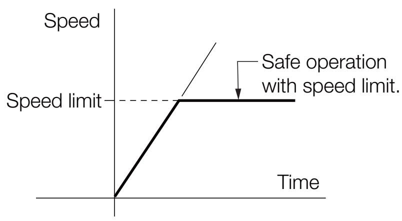
Note: Normally, set Pn524 to a value that is larger than the setting of Pn522 (Positioning Completed Width).

6.1.10 Speed Limit during Torque Control

You can limit the speed of the Spindle Motor to protect the machine.

When you use a Spindle Motor for torque control, the Spindle Motor 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 motor may increase greatly. If that may occur, use this function to limit the speed.

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

With No Speed Limit	With a Speed Limit
	

/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 motor speed is being limited.
			OFF (open)	The motor speed is not being limited.

Note: You must allocate the /VLT signal to use it. Use Pn50F = n.□□X□ (/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

Selecting the Speed Limit

The smaller of the external speed limit and internal speed limit will be used.

Parameter		Meaning	When Enabled	Classification
Pn002	n.□□0□	Reserved settings (Do not use.)	After restart	Setup
	n.□□1□ (default setting)	Use the speed limit from the VLIM (Limit Speed for Torque Control) command as the speed limit. (Use external speed limiting.)		

◆ Internal Speed Limiting

Set the speed limit for the motor in Pn407 (Speed Limit during Torque Control).

Also set Pn408 = n.□□X□ (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 as the speed limit.	After restart	Setup
	n.□□1□	Use the smaller of the overspeed alarm detection speed and the setting of Pn407 as the speed limit.		

Pn407	Speed Limit during Torque Control				Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 min^{-1}	10,000	Immediately	Setup

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

◆ External Speed Limiting

The motor speed will be limited by VLIM (Limit Speed for Torque Control). Refer to the following manual for details.

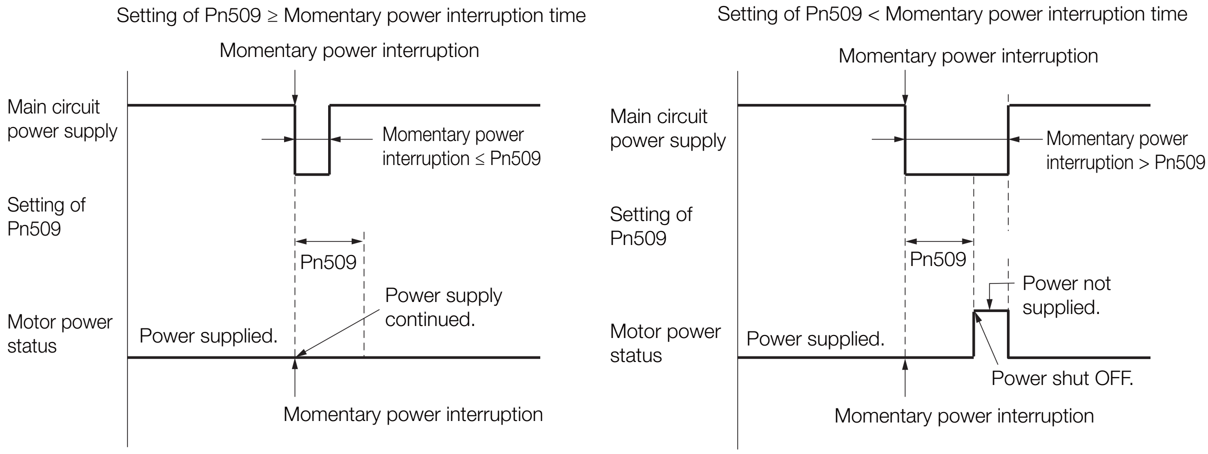
Σ-7-Series MECHATROLINK-III Communications Standard Servo Profile Command Manual (Manual No.: SIEP S800001 31)

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).

Pn509	Momentary Power Interruption Hold Time			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	20 to 50,000	1 ms	20	Immediately	Setup

If the momentary power interruption time is equal to or less than the setting of Pn509, power supply to the motor will be continued. If it is longer than the setting, power supply to the motor will be stopped. Power will be supplied to the motor again when the main circuit power supply recovers.



Information

1. If the momentary power interruption time exceeds the setting of Pn509, the /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.

Important

The holding time of the main circuit power supply depends on the output from the SERVOPACK. If the load on the Spindle Motor 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 motor to continue operating without stopping for an alarm or without recovery work even if the power supply voltage drops.

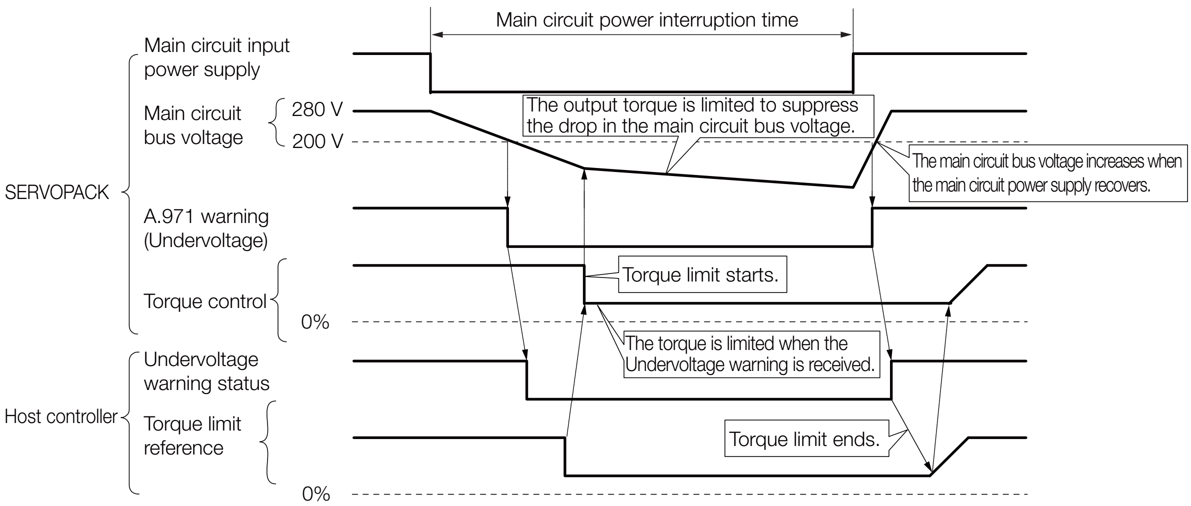
Execution Sequence

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

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

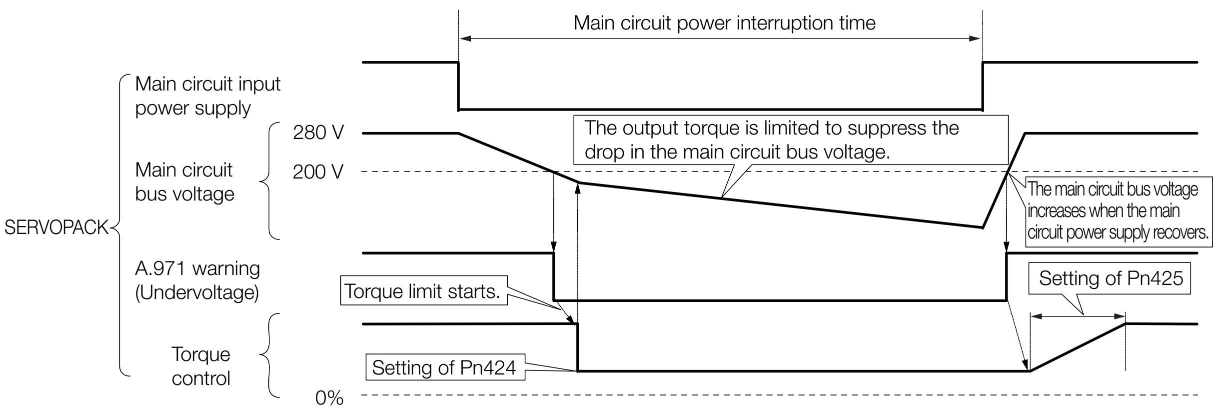
The host controller limits the torque in response to an A.971 warning (Undervoltage).

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.



Setting for A.971 Warnings (Undervoltage)

You can set whether or not to detect A.971 warnings (Undervoltage).

Parameter		Meaning	When Enabled	Classification
Pn008	n.□□0□ (default setting)	Do not detect undervoltage.	After restart	Setup
	n.□□1□	Detect undervoltage warning and limit torque at host controller.		
	n.□□2□	Detect undervoltage warning and limit torque with Pn424 and Pn425 (i.e., only in SERVOPACK).		

◆ Related Parameters

The following parameters are related to the SEMI F47 function.

Pn424	Torque Limit at Main Circuit Voltage Drop			Speed Position	Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	1%*	50	Immediately	Setup
Pn425	Release Time for Torque Limit at Main Circuit Voltage Drop			Speed Position	Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,000	1 ms	100	Immediately	Setup
Pn509	Momentary Power Interruption Hold Time			Speed Position	Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	20 to 50,000	1 ms	20	Immediately	Setup

* Set a percentage of the motor rated torque.

Note: If you will use the SEMI F47 function, set the time to 1,000 ms.

Important

- 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 SV_OFF (Servo OFF) command.

6.4 Setting the Motor Maximum Speed

You can set the maximum speed of the Spindle Motor with the following parameter.

Pn541	Rated Speed Setting			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	100 to 65,535	1 min^{-1}	65,535	After restart	Setup

You can achieve the following by lowering the maximum speed of the Spindle Motor.
- If the motor speed exceeds the setting, an A.510 alarm (Overspeed) will occur.

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

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.

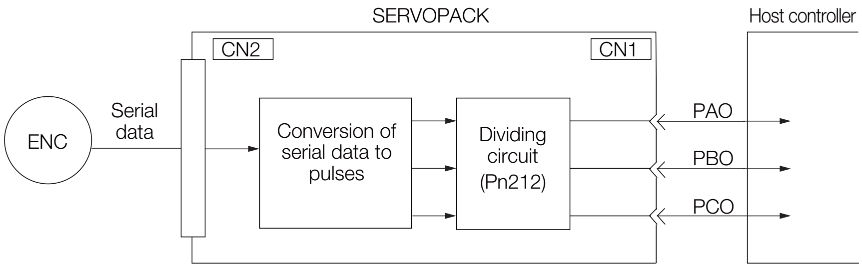
If semi-closed loop control is used with a pulse encoder, the output does not depend on the setting of the Number of Encoder Output Pulses (Pn212), and the pulse signal from the encoder is output as it is.

If a serial encoder is used, the pulse signal set for the Number of Encoder Output Pulses (Pn212) is output.

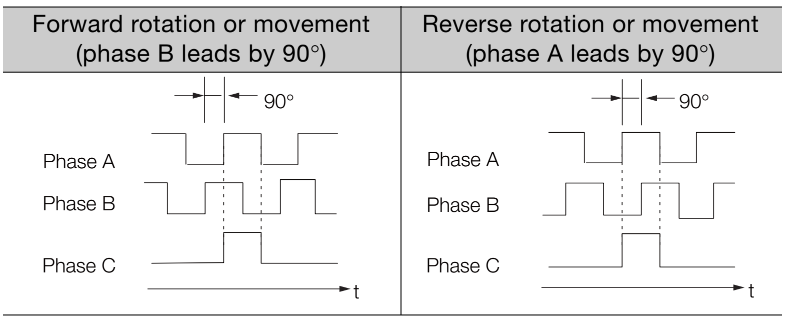
The following table describes the signals and output phase forms.

6.5.1 Encoder Divided Pulse Output Signals

Type	Signal	Connector Pin No.	Name	Remarks
Output	PAO	CN1-17	Encoder Divided Pulse Output, Phase A	These encoder divided pulse output pins output the number of pulses per motor resolution that is set in Pn212 (Number of Encoder Output Pulses/Number of External Pulse Encoder Output Pulses). The phase difference between phase A and phase B is an electric angle of 90°.
	/PAO	CN1-18		
	PBO	CN1-19	Encoder Divided Pulse Output, Phase B	
	/PBO	CN1-20		
	PCO	CN1-21	Encoder Divided Pulse Output, Phase C	These pins output one pulse every motor rotation.
	/PCO	CN1-22		



Output Phase Forms



Note: The pulse width of encoder phase C depends on the setting of Pn212 (Number of Encoder Output Pulses) or Pn281 (Encoder Output Resolution). It is the same as the width of phase A.
Even for Pn000 = n.□□□1 (reverse operation), the output phase form is the same as shown above.

> **Important**
> If you use the SERVOPACK's phase-C pulse output for an origin return, rotate the Spindle Motor two or more rotations before you start an origin return. If the Spindle Motor 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.

6.5.2 Setting for the Encoder Divided Pulse Output

Pn212	Number of Encoder Output Pulses			Speed Position	Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	16 to 1,073,741,824	1 P/Rev	512	After restart	Setup

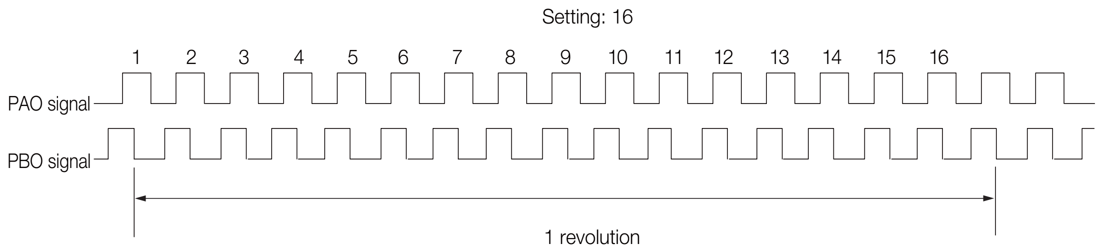
The number of pulses from the encoder per rotation are processed inside the SERVOPACK, divided by the setting of Pn212, and then output.

Set the number of encoder divided output pulses according to the system specifications of the machine or host controller.

Setting Range of the Number of External Encoder Output Pulses [P/Rev]	Setting Increment	Encoder Resolution 18 bits (262,144 pulses)	Upper Limit of Motor Speed for Set Number of Encoder Output Pulses [min^{-1}]
16 to 6,144	1	○	16,000
6,145 to 8,192	1	○	12,000
8,193 to 16,384	1	○	6,000
16,836 to 32,768	2	○	3,000
32,772 to 65,536	4	○	1,500

Note: 1. The setting range of the Number of Encoder Output Pulses (Pn212) depends on the resolution of the Spindle Motor 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 Spindle Motor 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).



6.6 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.
You must make the following settings to use the software limits.

- You must enable the software limit function.
- You must set the software limits.

6.6.1 Setting to Enable/Disable Software Limits

You can use Pn801= n.□□□X (Software Limit Selection) to enable and disable the software limit function. One of following commands must be executed to define the origin of the machine coordinate system before the software limits will operate. Otherwise, the software limit function will not operate even if a software limit is exceeded.

- The ZRET command has been executed.
- The POS_SET command has been executed with REFE set to 1.

Parameter		Meaning	When Enabled	Classification
Pn801	n.□□□0	Enable both forward and reverse software limits.	Immediately	Setup
	n.□□□1	Disable forward software limit.		
	n.□□□2	Disable reverse software limit.		
	n.□□□3 (default setting)	Disable both forward and reverse software limits.		

6.6.2 Setting the Software Limits

Software limits are set in both the forward and reverse directions.

The reverse software limit must be less than the forward software limit to set a limit in each direction.

Pn804	Forward Software Limit			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-1,073,741,823 to 1,073,741,823	1 reference unit	1,073,741,823	Immediately	Setup

Pn806	Reverse Software Limit			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-1,073,741,823 to 1,073,741,823	1 reference unit	-1,073,741,823	Immediately	Setup

6.6.3 Software Limit Check for References

You can enable or disable software limit checks for commands that have target position references, such as POSING or INTERPOLATE. If the target position exceeds a software limit, a deceleration stop will be performed from the position set as the software limit.

Parameter		Meaning	When Enabled	Classification
Pn801	n.□0□□ (default setting)	Do not perform software limit checks for references.	Immediately	Setup
	n.□1□□	Perform software limit checks for references.		

6.7 Selecting Torque Limits

You can limit the torque that is output by the Spindle Motor.

There are two 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.	Speed control, position control, or torque control	6.7.1
Limiting Torque with TLIM Data in Commands*	The TLIM data in a command is used to set the required torque limits.	Speed control or position control	–

* Refer to the following manual for details.
Σ-7-Series MECHATROLINK-III Communications Standard Servo Profile Command Manual (Manual No.: SIEP S800001 31)

Note: If you set a value that exceeds the maximum torque of the Spindle Motor, the torque will be limited to the maximum torque of the Spindle Motor.

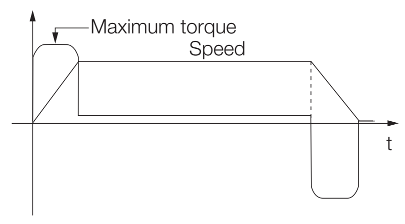
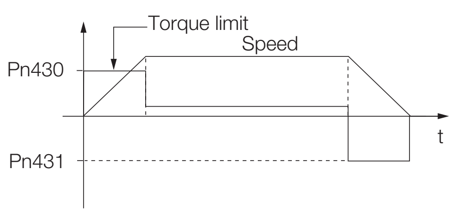
6.7.1 Internal Torque Limits

Set the internal torque limit during motor acceleration in Pn430 (Powering Torque Limit). Set the internal torque limit during motor deceleration in Pn431 (Regeneration Torque Limit). The internal torque limits do not affect the direction of motor rotation.

	Powering Torque Limit			Speed Position Torque	
Pn430	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	150	Immediately	Setup
	Regeneration Torque Limit			Speed Position Torque	
Pn431	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	150	Immediately	Setup

* Set a percentage of the rated motor torque.

Note: If the setting of Pn430 or Pn431 is too low, the torque may be insufficient for acceleration or deceleration of the Spindle Motor.

Without Internal Torque Limits (Output to the maximum torque is possible.)	With Internal Torque Limits
	

6.7.2 /CLT (Torque Limit Detection) Signal

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

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

Note: You must allocate the /CLT signal to use it. Use Pn50F = n.□□□X (/CLT (Torque Limit 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

6.8 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 motor is stopped before you start a software reset.
2. This function resets the SERVOPACK independently of the host controller. The SERVOPACK 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 motor and make sure that no problems will occur.

6.8.1 Preparations

Always check the following before you perform a software reset.
- The servo must be OFF.
- The motor must be stopped.

6.8.2 Applicable Tools

The following table lists the tools that you can use to perform a software reset.

Tool	Fn No./Function Name	Operating Procedure Reference
Digital Operator	Fn030	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Basic Functions - Software Reset***	*6.8.3 Operating Procedure* on page 6-21

6.8.3 Operating Procedure

There are the following two methods that you can use to perform a software reset.
- Direct connection to the SERVOPACK
- Resetting only MECHATROLINK communications

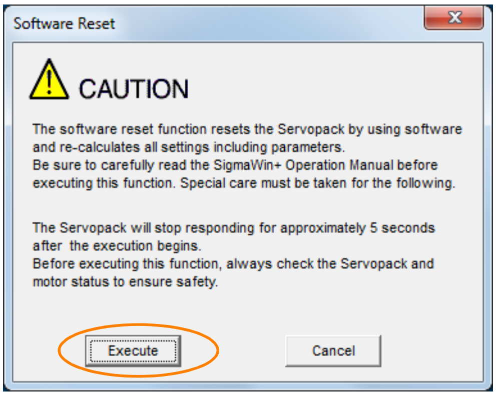
The procedure for each method is given below.

Direct Connection to the SERVOPACK

1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.

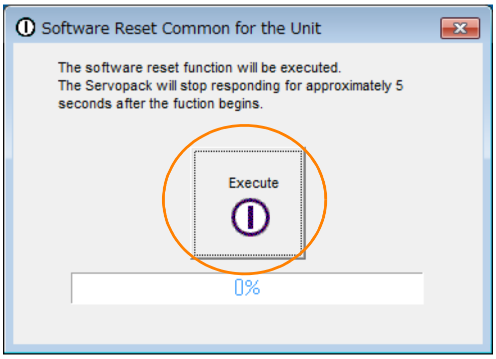
2. Select **Software Reset** in the Menu Dialog Box.
   The Software Reset Dialog Box will be displayed.

3. Click the **Execute** Button.

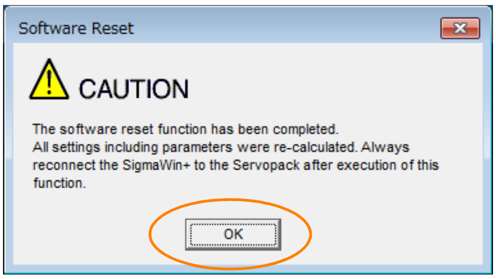


   Click the **Cancel** Button to cancel the software reset. The Main Window will return.

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.

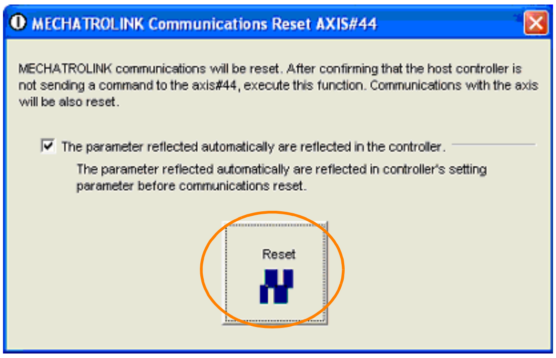
Resetting Only MECHATROLINK Communications

You can also reset only MECHATROLINK communications.

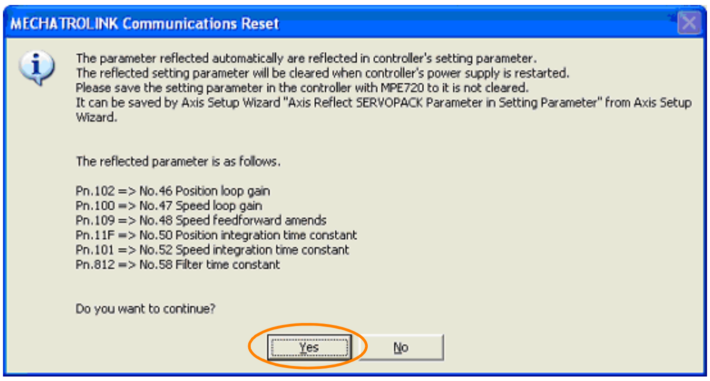
This will clear communications errors between the controller and SERVOPACK so that communications between the controller and SERVOPACK are enabled again.

1. Select ***Setup - MECHATROLINK Communication Reset*** from the menu bar of the Main Window of the SigmaWin+.

2. Click the **Reset** Button.



3. Click the **Yes** Button.
   The parameters that are automatically updated will be updated in controller's setting parameters (registers: OW□□□□).
   At the same time, MECHATROLINK communications will be reset and the MECHATROLINK Communications Reset Dialog Box will be closed.



6.9 Initializing the Vibration Detection Level

You can detect machine vibration during operation to automatically adjust the settings of Pn312 (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 Spindle Motor speed.

Parameter		Meaning	When Enabled	Classification
Pn310	n.□□□0 (default setting)	Do not detect vibration.	Immediately	Setup
	n.□□□1	Output a warning (A.911) if vibration is detected.		
	n.□□□2	Output an alarm (A.520) if vibration is detected.		

If the vibration exceeds the detection level calculated with the following formula, an alarm or warning occurs according to Pn310 (Vibration Detection Selection).

$$\text{Detection level} = \frac{\text{Vibration detection level (Pn312 [min-1])} \times \text{Vibration detection sensitivity (Pn311 [\%])}}{100}$$

Use this function only if A.520 or A.911 alarms are not output at the correct times when vibration is detected with the default vibration detection level (Pn312).

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).

Pn311	Vibration Detection Sensitivity		Speed	Position	Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 500	1%	100	Immediately	Tuning

Information
1. Vibration may not be detected because of unsuitable servo gains. Also, not all kinds of vibrations can be detected.
2. Set a suitable moment of inertia ratio (Pn103). An unsuitable setting may result in falsely detecting or not detecting vibration alarms or vibration warnings.
3. To use this function, you must input the actual references that will be used to operate your system.
4. Execute this function under the operating conditions for which you want to set the vibration detection level.
5. Execute this function while the motor is operating at 10% of its maximum speed or faster.

6.9.1 Preparations

Always check the following before you initialize the vibration detection level.
- The parameters must not be write prohibited.

6.9.2 Applicable Tools

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

Tool	Fn No./Function Name	Operating Procedure Reference
Digital Operator	Fn01B	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Others - Initialize Vibration Detection Level***	*6.9.3 Operating Procedure* on page 6-25

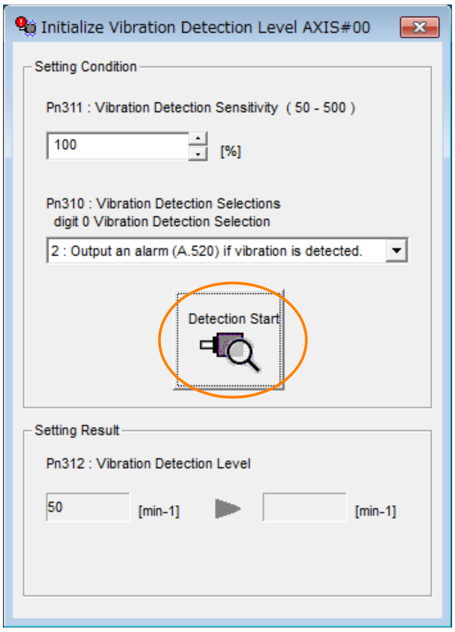
6.9.3 Operating Procedure

Use the following procedure to initialize the vibration detection level.

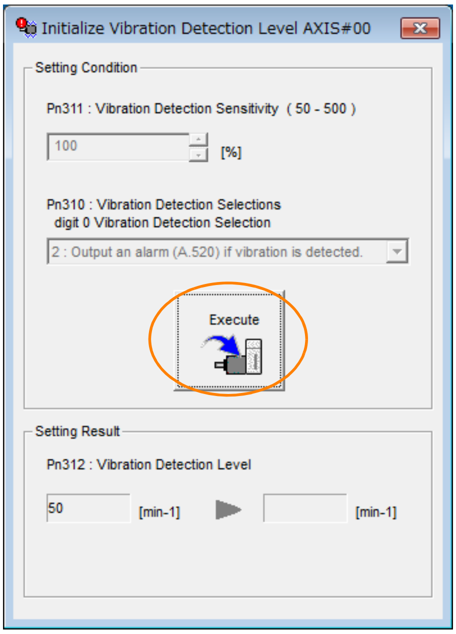
1. Click the  Servo Drive Button in the workspace of the Main Window of the SigmaWin+.

2. Select **Initialize Vibration Detection Level** in the Menu Dialog Box.
   The Initialize Vibration Detection Level Dialog Box will be displayed.

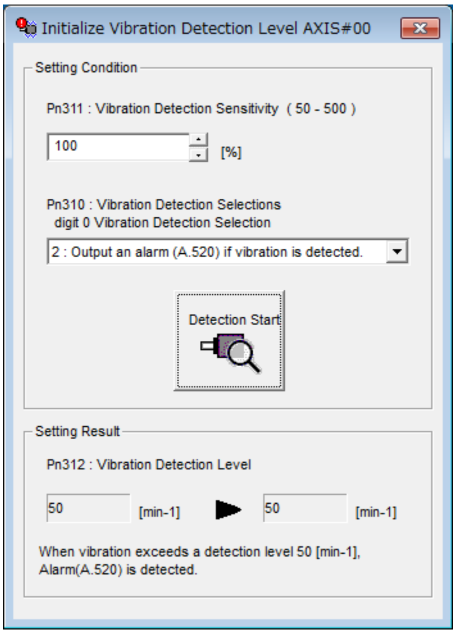
3. Select **Pn311: Vibration Detection Sensitivity** and **Pn310: Vibration Detection Selections** and then click the **Detection Start** Button.
   A setting execution standby mode will be entered.



4. Click the **Execute** Button.



The newly set vibration detection level will be displayed and the value will be saved in the SERVOPACK.



This concludes the procedure to initialize the vibration detection level.

6.9.4 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	Vibration Detection Sensitivity	Allowed	No
Pn312	Vibration Detection Level	Not allowed	Yes

6.10 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.

6.10.1 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.

Important

Execute the automatic offset adjustment if the torque ripple is too large when compared with other SERVOPACKs.

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

Preparations

Always check the following before you automatically adjust the motor current detection signal offset.

- The parameters must not be write prohibited.
- The servo must be in ready status.
- The servo must be OFF.

Applicable Tools

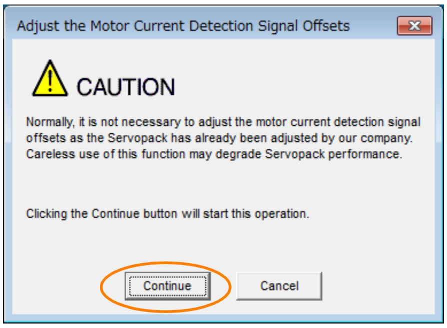
The following table lists the tools that you can use to automatically adjust the offset.

Tool	Fn No./Function Name	Operating Procedure Reference
Digital Operator	Fn00E	Σ-7-Series Digital Operator Operating Manual (Manual No. SIEP S800001 33)
SigmaWin+	***Others - Adjust the Motor Current Detection Offset***	*Operating Procedure* on page 6-28

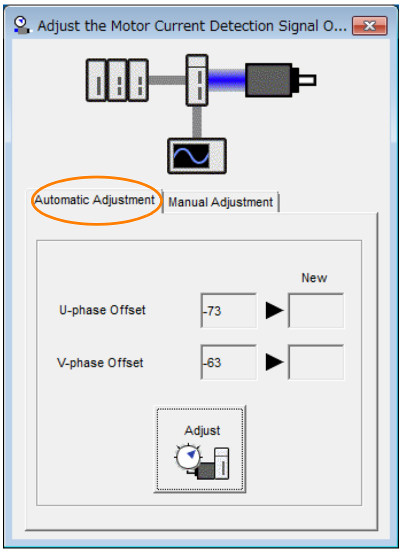
Operating Procedure

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

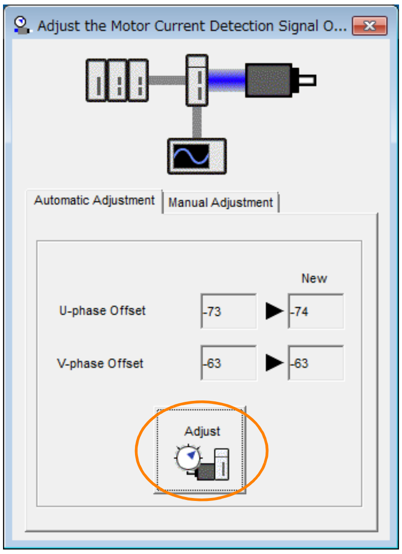
1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
2. Select **Adjust the Motor Current Detection Offset** in the Menu Dialog Box.
   The Adjust the Motor Current Detection Signal Offsets Dialog Box will be displayed.
3. Click the **Continue** Button.



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.

6.10.2 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.

Important

If the offset is incorrectly adjusted with this function, the motor characteristics may be adversely affected.
Observe the following precautions when you manually adjust the offset.
- Operate the Spindle Motor 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 Spindle Motor so that they are balanced. Alternately adjust both offsets several times.

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

Preparations

Always check the following before you manually adjust the motor current detection signal offset.
- The parameters must not be write prohibited.

Applicable Tools

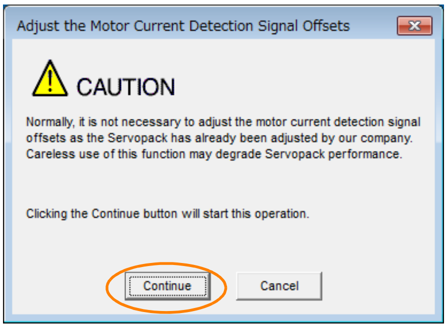
The following table lists the tools that you can use to manually adjust the offset.

Tool	Fn No./Function Name	Operating Procedure Reference
Digital Operator	Fn00F	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Others - Adjust the Motor Current Detection Offset***	*Operating Procedure* on page 6-30

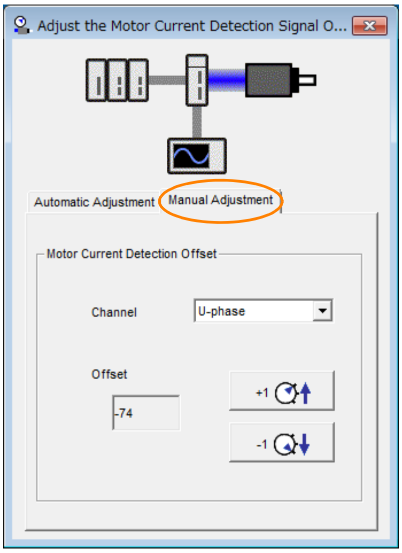
Operating Procedure

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 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
3. Select **Adjust the Motor Current Detection Offset** in the Menu Dialog Box.
   The Adjust the Motor Current Detection Signal Offsets Dialog Box will be displayed.
4. Click the **Continue** Button.



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.

6.11 Forcing the Motor to Stop

You can force the Spindle Motor 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.□□□X. You can set the motor stopping method to either 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 Operator and Digital Operator Displays**
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.

6.11.1 FSTP (Forced Stop Input) Signal

Classification	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

6.11.2 Stopping Method Selection for Forced Stops

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

Parameter		Description	When Enabled	Classification
Pn00A	n.□□0□	Apply the dynamic brake or coast the motor to a stop (use the stopping method set in Pn001 = n.□□□X).	After restart	Setup
	n.□□1□ (default setting)	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque. Use the setting of Pn001 = n.□□□X for the status after stopping.		
	n.□□2□	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then let the motor coast.		
	n.□□3□	Decelerate the motor to a stop using the deceleration time set in Pn30A. Use the setting of Pn001 = n.□□□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 motor to a stop during torque control. For torque control, the motor will coast to a stop according to the setting of Pn001 = n.□□□X (Motor Stopping Method for Servo OFF and Group 1 Alarms, Overtravel Stopping Method).

Stopping the Spindle Motor by Setting Emergency Stop Torque (Pn406)

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

If Pn00A = n.□□X□ is set to 1 or 2, the Spindle Motor 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 Spindle Motor at the maximum torque. However, the maximum emergency stop torque that you can actually use is the maximum torque of the Spindle Motor.

Pn406	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.

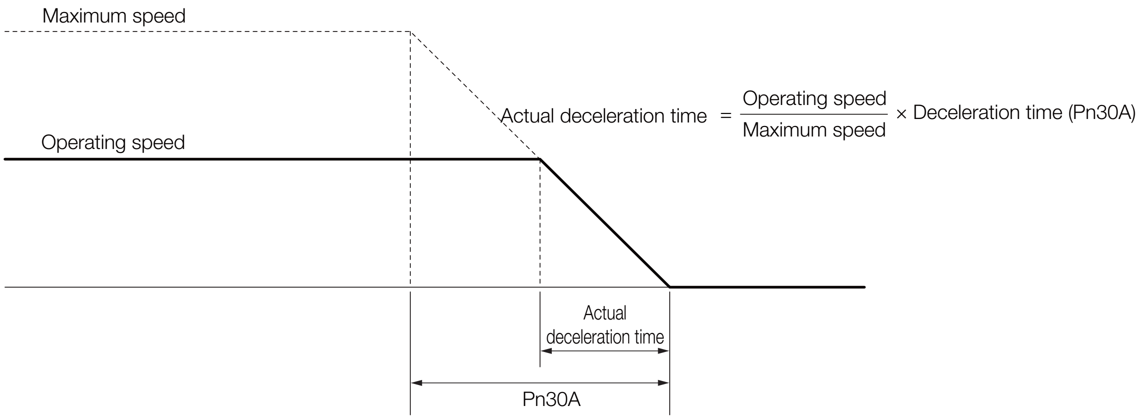
Stopping the Spindle Motor by Setting the Deceleration Time for Servo OFF and Forced Stops (Pn30A)

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

Pn30A	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 Spindle Motor will be stopped with a zero speed.

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

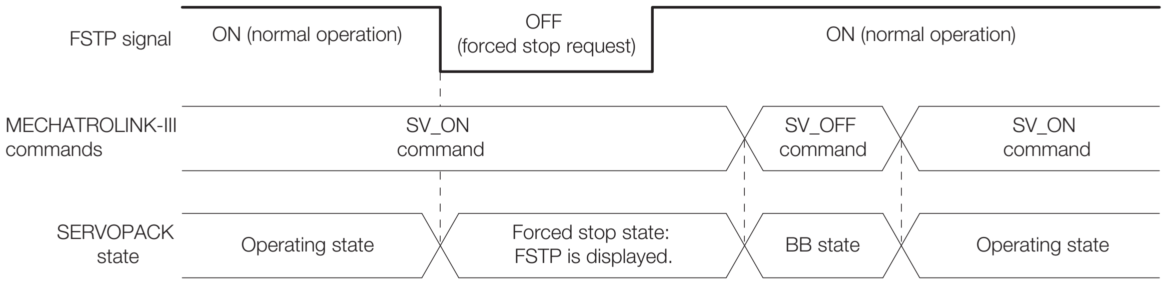


6.11.3 Resetting Method for Forced Stops

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 SV_ON (Servo ON) command is sent, the forced stop state will be maintained even after the FSTP signal is turned ON.

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



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 Operation

7.1.1 Flow of Trial Operation for Spindle Motor

The procedure for trial operation is given below.

• Preparations for Trial Operation

Step	Meaning	Reference
1	Installation Install the Spindle Motor and SERVOPACK according to the installation conditions. First, operation is checked with no load. Do not connect the Spindle Motor to the machine.	☞ *Chapter 3 SERVOPACK Installation*
2	Wiring and Connections Wire and connect the SERVOPACK. First, Spindle Motor 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 7-4
4	Power ON	–

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 Spindle Motor 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 Spindle Motor mounting.
- If you are performing trial operation on a Spindle Motor that has been stored for a long period of time, make sure that all Spindle Motor inspection and maintenance procedures have been completed. Refer to the manual for your Spindle Motor for Spindle Motor maintenance and inspection information.
- Make sure that the motor parameters of the Spindle Motor to use are set in the SERVOPACK.
- Make sure that a suitable regenerative resistance is set.
- Set Pn01F = n.□□□X (Encoder Type Selection) according to the Spindle Motor's encoder specifications.

7.3 Trial Operation for the Spindle Motor without a Load

You use jogging for trial operation of the Spindle Motor without a load.

Jogging is used to check the operation of the Spindle Motor without connecting the SERVOPACK to the host controller. The Spindle Motor 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 motor.

7.3.1 Preparations

Always check the following before you execute jogging.

- The parameters must not be write prohibited.
- The main circuit power supply must be ON.
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- The servo must be OFF.
- The jogging speed must be set considering the operating range of the machine. The jogging speed is set with the following parameters.

Pn304	Jogging Speed				Speed Position Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 min^{-1}	500	Immediately	Setup
Pn305	Soft Start Acceleration Time				Speed
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup
Pn306	Soft Start Deceleration Time				Speed
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup

7.3.2 Applicable Tools

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

Tool	Fn No./Function Name	Operating Procedure Reference
Digital Operator	Fn002	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Operation - Jog***	*7.3.3 Operating Procedure* on page 7-6

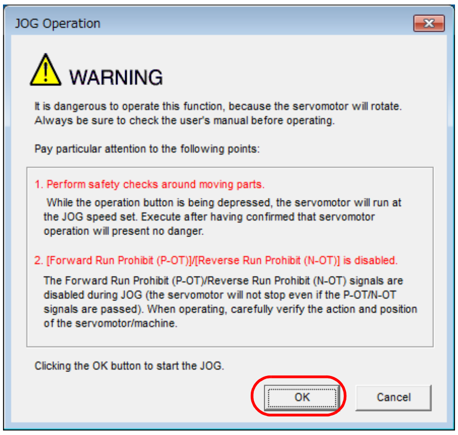
7.3.3 Operating Procedure

Use the following procedure to jog the motor.

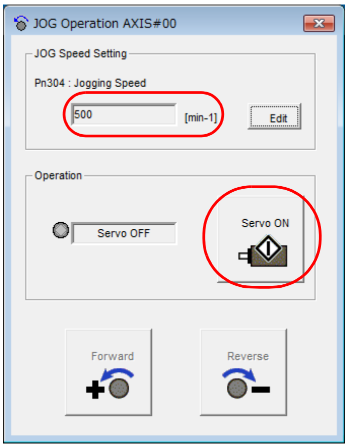
1. Click the  Servo Drive Button in the workspace of the Main Window of the SigmaWin+.

2. Select **JOG Operation** in the Menu Dialog Box.
The Jog Operation Dialog Box will be displayed.

3. Read the warnings and then click the **OK** Button.



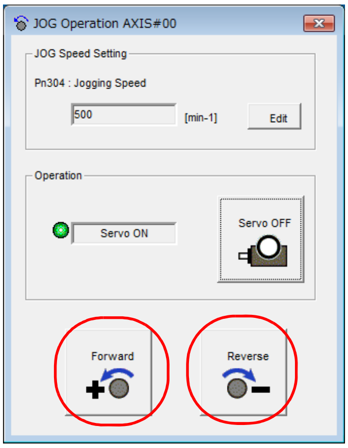
4. Check the jogging speed and then click the **Servo ON** Button.



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 MECHATROLINK-III Communications

A trial operation example for MECHATROLINK-III communications is given below.

Refer to the following manual for command details.

Σ-7-Series MECHATROLINK-III Communications Standard Servo Profile Command Manual (Manual No.: SIEP S800001 31)

1. **Confirm that the wiring is correct, and then connect the I/O signal connector (CN1 connector).**
   Refer to the following chapter for details on wiring.
   Chapter 4 Wiring and Connecting SERVOPACKs

2. **Turn ON the power supplies to the SERVOPACK and host controller.**
   If control power is being supplied correctly, the PWR indicator on the SERVOPACK will light.
   If main circuit power is being supplied correctly, the CHARGE indicator on the SERVOPACK will light.
   If communications are established, the L1 or L2 indicators, whichever one corresponds to the CN6A or CN6B connector where the MECHATROLINK-III cable is connected, will light. If the L1 or L2 indicator does not light, recheck the settings of MECHATROLINK-III setting switches (S1, S2, and S3) and then turn the power supply OFF and ON again.

3. **Send the CONNECT command from the host controller.**
   If the SERVOPACK correctly receives the CONNECT command, the CN indicator will light.
   If the CN indicator does not light, the settings of the CONNECT command are not correct. Correct the settings of the CONNECT command, and then send it from the host controller again.

4. **Confirm the product model with the ID_RD command.**
   The SERVOPACK will return the product model (example: SGD7S-R90A20A).

5. **Set the following items, which are necessary for trial operation.**

Setting	Reference
Electronic Gear	*5.8 Electronic Gear Settings* on page 5-26
Motor Direction	*5.4 Motor Direction Setting* on page 5-17
Overtravel	*5.5 Overtravel and Related Settings* on page 5-18

6. **Save the settings that you made in step 5.**
   If the settings are saved in the host controller, use the SVPRM_WR command with the mode set to RAM to save them.
   If the settings are saved in the SERVOPACK, use the SVPRM_WR command with the mode set to non-volatile memory to save them.

7. **Send the CONFIG command to enable the settings.**

8. **Send the SENS_ON command to obtain the position information (encoder ready).**

9. **Send the SV_ON command.**
   Spindle Motor operation will be enabled and the SERVOPACK will return 1 for SVON (power supplied to motor) in the status.

10. **Operate the Spindle Motor at low speed.**
    Operating Example for a Positioning Command
    Command: POSING
    Command settings: Positioning position = 10,000, Rapid traverse speed = 400

11. While operation is in progress for step 10, confirm the following items.

Confirmation Item	Reference
Confirm that the rotational direction of the Spindle Motor agrees with the forward or reverse reference. If they do not agree, correct the rotation direction of the Spindle Motor.	☞ *5.4 Motor Direction Setting* on page 5-17
Confirm that no abnormal vibration, noise, or temperature rise occurs. If any abnormalities are found, implement corrections.	☞ *11.5 Troubleshooting Based on the Operation and Conditions of the Spindle Motor* on page 11-46

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

7.5 Trial Operation with the Spindle Motor Connected to the Machine

This section provides the procedure for trial operation with both the machine and Spindle Motor.

7.5.1 Precautions

⚠ WARNING

- Operating mistakes that occur after the Spindle Motor is connected to the machine may not only damage the machine, but they may also cause accidents resulting in personal injury.

7.5.2 Preparations

Always confirm the following before you perform the trial operation procedure for both the machine and Spindle Motor.

- Make sure that the procedure described in *7.4 Trial Operation with MECHATROLINK-III Communications* on page 7-8 has been completed.
- Make sure that the SERVOPACK is connected correctly to both the host controller and the peripheral devices.
  - 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. Make the settings for the protective functions, such as overtravel.
   ☞ *5.5 Overtravel and Related Settings* on page 5-18
2. Turn OFF the power supplies to the SERVOPACK.
   The control power supply and main circuit power supply will turn OFF.
3. Couple the Spindle Motor to the machine.
4. 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.
5. Confirm that the protective functions operate correctly.
   Note: Enable activating an emergency stop so that the motor can be stopped safely in case an error occurs during the remainder of the procedure.
6. Perform trial operation according to *7.4 Trial Operation with MECHATROLINK-III Communications* on page 7-8 and confirm that the same results are obtained as when trial operation was performed on the Spindle Motor without a load.
7. If necessary, adjust the servo gain to improve the Spindle Motor response characteristics.
   The motor 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.

8. 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 Spindle Motor.

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 Spindle Motor without connecting it to the host controller in order to check Spindle Motor operation and execute simple positioning operations.

Preparations

Always check the following before you execute program jogging.

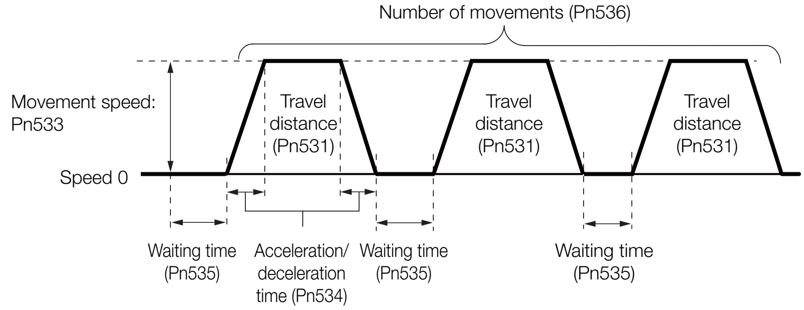
- The parameters must not be write prohibited.
- The main circuit power supply must be ON.
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- The servo must be OFF.
- The range of machine motion and the safe movement speed of your machine must be considered when you set the travel distance and movement speed.
- There must be no overtravel.

Additional Information

- You can use the functions that are applicable to position control. However, parameters related to motion control through MECHATROLINK communications (i.e., Pn800 and higher) are disabled.
- The overtravel function is enabled.

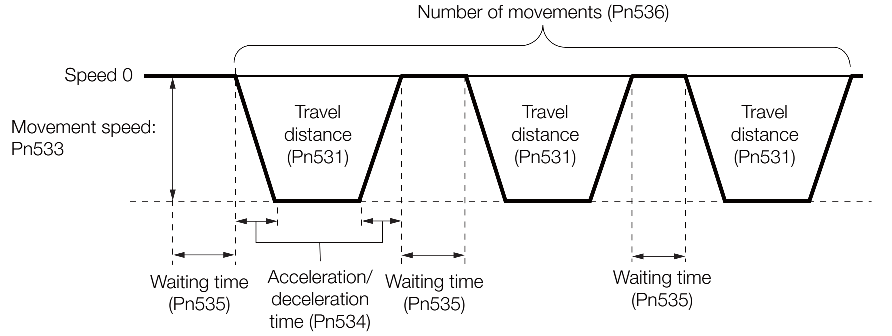
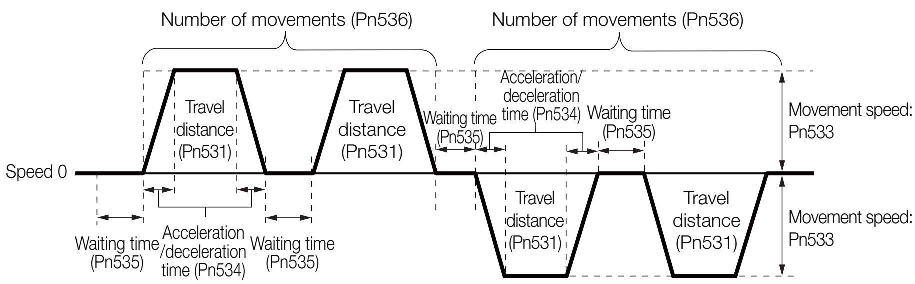
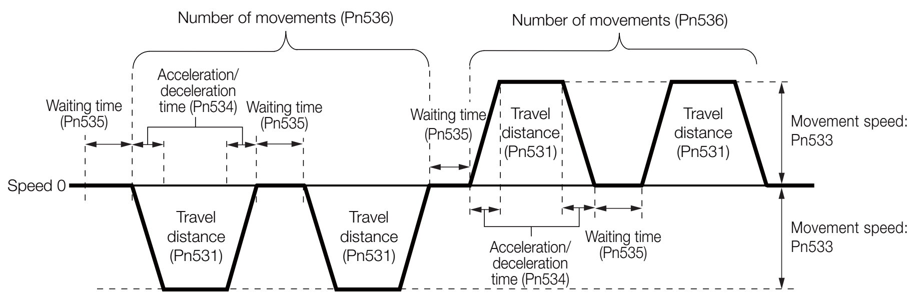
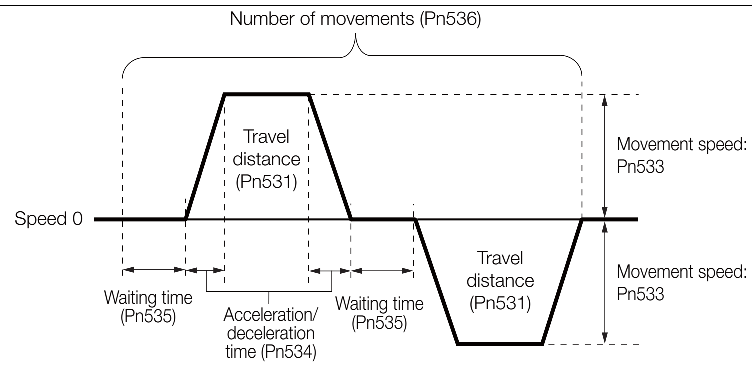
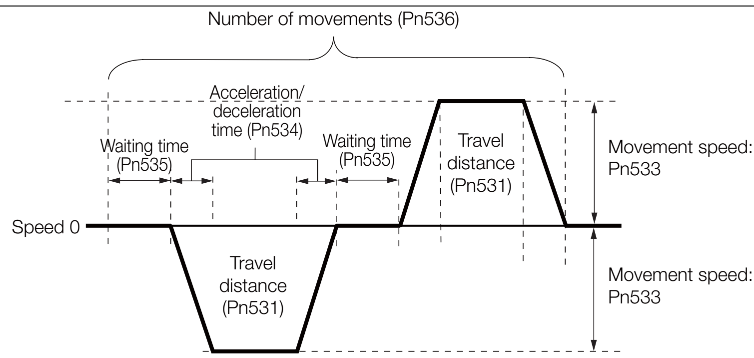
Program Jogging Operation Pattern

An example of a program jogging operation pattern is given below. In this example, the motor direction is set to Pn000 = n.□□□0 (Use CCW as the forward direction).

Setting of Pn530	Setting	Operation Pattern
n.□□□0	(Waiting time → Forward travel distance) × Number of movements	

Continued on next page.

Continued from previous page.

Setting of Pn530	Setting	Operation Pattern
n.□□□1	(Waiting time → Reverse by travel distance) × Number of movements	
n.□□□2	(Waiting time → Forward by travel distance) × Number of movements → (Waiting time → Reverse by travel distance) × Number of movements	
n.□□□3	(Waiting time → Reverse by travel distance) × Number of movements → (Waiting time → Forward by travel distance) × Number of movements	
n.□□□4	(Waiting time → Forward by travel distance → Waiting time → Reverse by travel distance) × Number of movements	
n.□□□5	(Waiting time → Reverse by travel distance → Waiting time → Forward by travel distance) × Number of movements	

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.

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.

Pn530	Program Jogging-Related Selections			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0000 to 0005	–	0000	Immediately	Setup
Pn531	Program Jogging Travel Distance			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,824	1 reference unit	32,768	Immediately	Setup
Pn533	Program Jogging Movement Speed			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 10,000	1 min^{-1}	500	Immediately	Setup
Pn534	Program Jogging Acceleration/Deceleration Time			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	2 to 10,000	1 ms	100	Immediately	Setup
Pn535	Program Jogging Waiting Time			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	100	Immediately	Setup
Pn536	Program Jogging Number of Movements			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,000	1	1	Immediately	Setup

Applicable Tools

The following table lists the tools that you can use to perform program jogging.

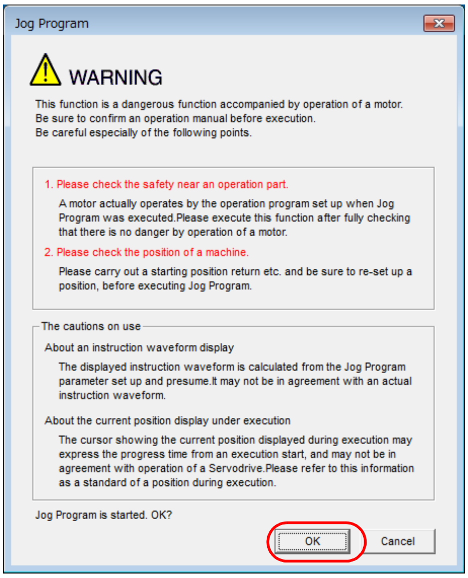
Tool	Fn No./Function Name	Reference
Digital Operator	Fn004	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Operation - Program JOG Operation***	*Operating Procedure* on page 7-14

Operating Procedure

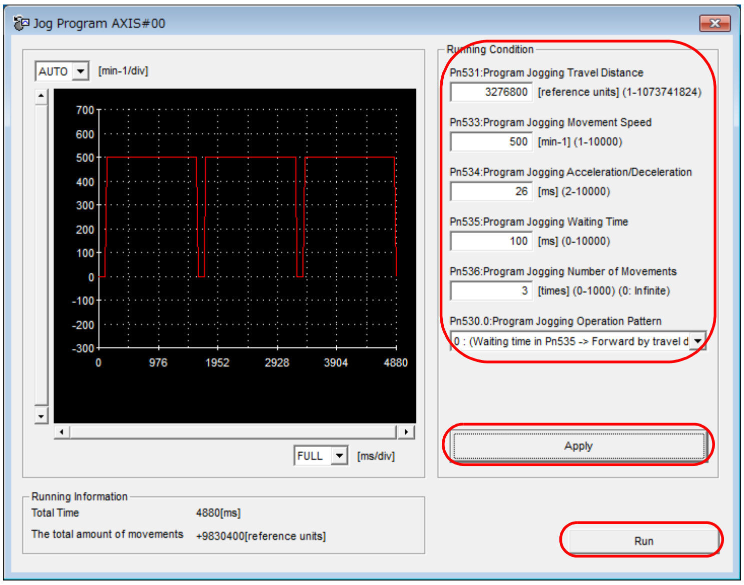
Use the following procedure for a program jog operation.

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.

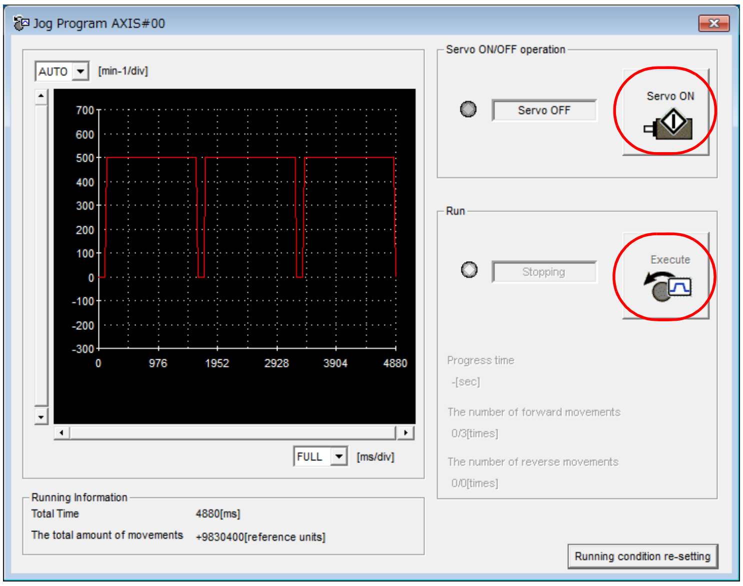
3. Read the warnings and then click the **OK** Button.



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.



⚠ CAUTION

- **Be aware of the following points if you cancel the program jogging operation while the motor is operating.**
  - If you cancel operation with the **Servo OFF** Button, the motor will stop according to setting of the Servo OFF stopping method (Pn001 = n.□□□X).
  - If you cancel operation with the **Cancel** Button, the motor 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 phase C of the encoder and then clamps it there.

Even when using fully-closed loop control the motor is positioned to phase C of the encoder, and not to the external encoder origin.

The overtravel function is disabled during an origin search.

⚠ CAUTION

- **Make sure that the load is not coupled when you execute an origin search.**
  Since the P-OT (Forward Drive Prohibit Input) signal and N-OT (Reverse Drive Prohibit Input) signal are disabled during an origin search, the machine may be damaged by exceeding its movement limits.

Use an origin search when it is necessary to align encoder phase C of the servomotor with the machine origin. The following speeds are used for origin searches.

Preparations

Always check the following before you execute an origin search.
- The parameters must not be write prohibited.
- The main circuit power supply must be ON.
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- The servo must be OFF.

Applicable Tools

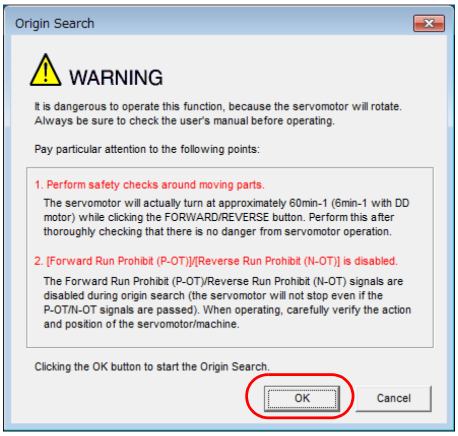
The following table lists the tools that you can use to perform an origin search.

Tool	Fn No./Function Name	Reference
Digital Operator	Fn003	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Encoder Setting - Search Origin***	*Operating Procedure* on page 7-17

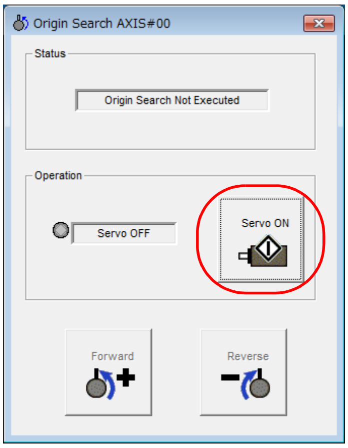
Operating Procedure

Use the following procedure to perform an origin search.

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

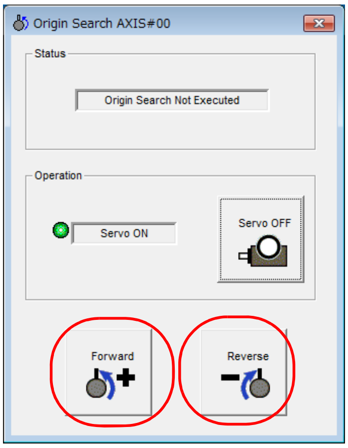


4. Click the **Servo ON** Button.



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.

7.7 Operation Using MECHATROLINK-III Commands

The following sections list the MECHATROLINK commands added from the Σ-7-Series Σ-7S SERVOPACKs with MECHATROLINK-III Communications References (models: SGD7S-□□□A20A).

Refer to the following manual for information on other MECHATROLINK-III commands.

Σ-7-Series MECHATROLINK-III Communications Standard Servo Profile Command Manual (Manual No.: SIEP S800001 31)

7.7.1 Changes from Σ-7-Series Σ-7S SERVOPACKs with MECHATROLINK-III Communications References (Models: SGD7S-□□□A20A)

The following changes have been made in comparison with Σ-7-Series Σ-7S SERVOPACKs with MECHATROLINK-III Communications References.

- The zero speed (ZSPD) judgment status for bit 19 of the servo command input signal bits has been changed.
  With the SERVOPACKs described in this manual, zero speed is detected when the speed goes below Pn541 (Rated Speed Setting) × Pn543 (Speed Detection Level (0.01%)) ± Pn544 (Speed Detection Hysteresis (0.01%)).

7.7.2 Newly Added MECHATROLINK-III Commands

Orientation functions have been added to the SERVOPACKs described in this manual. There are two types of orientation: QUICK orientation and SPINDEX orientation. These commands can be used as detailed below. The features are as follows:

Method	Operation Summary	Features
QUICK_ORT*	Positioning is performed at the maximum possible deceleration rate after reaching the target speed.	• Positioning time is shorter than SPINDEX. • Optimal positioning can be performed because the maximum deceleration rate is calculated according to the change in the load moment of inertia.
SPINDEX	Positioning is performed at the set deceleration rate after reaching the target speed.	• Positioning time is longer than QUICK_ORT. • The deceleration rate can be set for the machine.

* Use SPINDEX if shocks occur with QUICK_ORT.

QUICK Orientation Command (QUICK_ORT: CA Hex)

Phases in Which the Command Can Be Executed	2, 3	Command Classification	Vendor-specific command	Asynchronous command
Processing Time	Within communications cycle	Subcommand	Can be used	

<table>
<tr><th rowspan="2">Byte</th><th colspan="2">QUICK_ORT</th><th rowspan="2">Description</th></tr>
<tr><th>Command</th><th>Response</th></tr>
<tr><td>0</td><td>CA hex</td><td>CA hex</td><td rowspan="32">• The QUICK_ORT command performs positioning by accelerating or decelerating to the referenced target speed (TSPD) towards the referenced target position (TPOS) and then decelerating to a stop at the target position.
• Confirm the completion of command execution by checking that RCMD = QUICK_ORT (= CA hex) and that CMD_STAT.CMDRDY = 1.
• Confirm motion reference output completion by checking that SVCMD_IO.DEN = 1, and the completion of positioning by checking that SVCMD_IO.PSET = 1.
However, if latching is not completed for some reason, the SERVOPACK will detect an error and the motor will stop at a position that is not the target position. If that occurs, the following conditions will exist: SVCMD_IO.DEN = 1, SVCMD_IO.PSET = 1, and SVCMD_IO.L_CMP= 0. When checking completion of positioning, also check the latch completion signal.
• CPRM_SEL_MON1 and CPRM_SEL_MON2 in the response are set to the monitor data set in common parameters 87 and 88.
• Confirm the completion of latching by the latch signal by checking that SVCMD_STAT.L_CMP1 = 1.

Notes on Using the Command
• When you execute this command, you must select a latch signal in LT_SEL1 of SVCMD_CTRL and set LT_REQ1 to 1 to request a latch. (Latch Signal 2 cannot be used.)
• TPOS (target position): Set the target position from the latch position. This value is unsigned 4-byte data. The position reference range is as follows:
0 ≤ TPOS < Pn830 (Number of Reference Units per Machine Revolution) [reference units]
Check the setting of Pn830.
• TSPD (target speed): Set the target speed. This value is unsigned 4-byte data. The value will be corrected internally based on the rotation direction. This affects latch requests and control mode switching. Also, the upper limit to TSPD must be smaller than or equal to the base speed.
• POS_TREF (positioning torque reference): Used to generate the acceleration/deceleration rates and for torque feedforward during positioning.
• You can change the QUICK_ORT positioning operation with the setting of MODE.
When MODE = 0, feedforward is used.
When MODE = 1, feedforward is not used.
• Do not execute the POS_SET command during execution of this command.
• When you use this command, set SVCMD_IO.SV-MOD (bit 30) to 1.
• Once a QUICK_ORT command has been issued, the latch operation and positioning will be performed again whenever TPOS (Target Position), TSPD (Target Speed), POS_TREF (Positioning Torque Reference), MODE, or TLIM (Torque Limit) is changed. If TPOS, TSPD, POS_TREF, MODE, and TLIM are the same when the QUICK_ORT command is issued again, the command will be ignored.
• Set TLIM so that it is larger than POS_TREF. Torque saturation may occur due to torque limiting.</td></tr>
<tr><td>1</td><td>WDT</td><td>RWDT</td></tr>
<tr><td>2</td><td rowspan="2">CMD_CTRL</td><td rowspan="2">CMD_STAT</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td rowspan="4">SVCMD_CTRL</td><td rowspan="4">SVCMD_STAT</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td><td rowspan="4">SVCMD_IO</td><td rowspan="4">SVCMD_IO</td></tr>
<tr><td>9</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td><td rowspan="4">TPOS</td><td rowspan="4">CPRM_SEL_MON1</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td></tr>
<tr><td>16</td><td rowspan="4">TSPD</td><td rowspan="4">CPRM_SEL_MON2</td></tr>
<tr><td>17</td></tr>
<tr><td>18</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td><td rowspan="4">POS_TREF</td><td rowspan="4">MONITOR1</td></tr>
<tr><td>21</td></tr>
<tr><td>22</td></tr>
<tr><td>23</td></tr>
<tr><td>24</td><td>MODE</td><td rowspan="4">MONITOR2</td></tr>
<tr><td>25</td><td rowspan="3">–</td></tr>
<tr><td>26</td></tr>
<tr><td>27</td></tr>
<tr><td>28</td><td rowspan="4">TLIM</td><td rowspan="4">MONITOR3</td></tr>
<tr><td>29</td></tr>
<tr><td>30</td></tr>
<tr><td>31</td></tr>
</table>

Note: When using QUICK orientation, make sure that Pn830 (Number of Reference Units per Machine Revolution) is set correctly.

SPINDEX Orientation Command (SPINDEX: EF Hex)

<table>
<tr><td colspan="2">Phases in Which the Command Can Be Executed</td><td>2, 3</td><td>Command Classification</td><td>Vendor-specific command</td><td>Asynchronous command</td></tr>
<tr><td colspan="2">Processing Time</td><td>Within communications cycle</td><td>Subcommand</td><td colspan="2">Can be used</td></tr>
<tr><td rowspan="2">Byte</td><td colspan="2">SPINDEX</td><td colspan="3" rowspan="2">Description</td></tr>
<tr><td>Command</td><td>Response</td></tr>
<tr><td>0</td><td>EF hex</td><td>EF hex</td><td colspan="3" rowspan="32">• The SPINDEX command performs positioning by accelerating or decelerating to the referenced target speed (TSPD) towards the referenced target position (TPOS) and then decelerating to a stop at the target position.
• Set SVCMD_CTRL.CMD_CANCEL to 1 to cancel the SPINDEX command.
• Set SVCMD_CTRL.CMD_PAUSE to 1 to pause the SPINDEX command.
• Confirm the completion of command execution by checking that RCMD = SPINDEX (= EF hex) and that CMD_STAT.CMDRDY = 1.
• Confirm motion reference output completion by checking that SVCMD_IO.DEN = 1, and the completion of positioning by checking that SVCMD_IO.PSET = 1. However, if latching is not completed for some reason, the SERVOPACK will detect an error and the motor will stop at a position that is not the target position. If that occurs, the following conditions will exist: SVCMD_IO.DEN = 1, SVCMD_IO.PSET = 1, and SVCMD_IO.L_CMP= 0. When checking completion of positioning, also check the latch completion signal.
• Confirm the completion of canceling SPINDEX command execution by checking that RCMD = SPINDEX (= EF hex), CMD_STAT.CMDRDY = 1, and SVCMD_STAT.CMD_CANCEL_CMP = 1.
• Confirm the completion of pausing SPINDEX command execution by checking that RCMD = SPINDEX (= EF hex), CMD_STAT.CMDRDY = 1, and SVCMD_STAT.CMD_PAUSE_CMP = 1.
• CPRM_SEL_MON1 and CPRM_SEL_MON2 in the response are set to the monitor data set in common parameters 87 and 88.
• Confirm the completion of latching by the latch signal by checking that SVCMD_STAT.L_CMP1 = 1.
Notes on Using the Command
• When you execute this command, you must select a latch signal in LT_SEL1 of SVCMD_CTRL and set LT_REQ1 to 1 to request a latch. (Latch Signal 2 cannot be used.)
• TPOS (target position): Set the target position from the latch position. This value is unsigned 4-byte data. The position reference range is as follows:
0 ≤ TPOS < Pn830 (Number of Reference Units per Machine Revolution) [reference units]
Check the setting of Pn830.
• TSPD (target speed): Set the target speed. This value is unsigned 4-byte data.
• ACCR (acceleration rate): Set the acceleration rate. This value is unsigned 4-byte data.
• DECR (deceleration rate): Set the deceleration rate. This value is unsigned 4-byte data.
• Do not execute the POS_SET command during execution of this command.
• When positioning control is performed, SVCMD_IO.SVMOD (bit 30) must be set to 1.
• Once a SPINDEX command has been issued, the latch operation and positioning will be performed again whenever TPOS (Target Position), TSPD (Target Speed), ACCR/DECR (Acceleration/Deceleration Rate), or TLIM (Torque Limit) is changed. If TPOS, TSPD, ACCR/DECR, and TLIM are the same when the SPINDEX command is issued again, the command will be ignored.</td></tr>
<tr><td>1</td><td>WDT</td><td>RWDT</td></tr>
<tr><td>2</td><td rowspan="2">CMD_CTRL</td><td rowspan="2">CMD_STAT</td></tr>
<tr><td>3</td></tr>
<tr><td>4</td><td rowspan="4">SVCMD_CTRL</td><td rowspan="4">SVCMD_STAT</td></tr>
<tr><td>5</td></tr>
<tr><td>6</td></tr>
<tr><td>7</td></tr>
<tr><td>8</td><td rowspan="4">SVCMD_IO</td><td rowspan="4">SVCMD_IO</td></tr>
<tr><td>9</td></tr>
<tr><td>10</td></tr>
<tr><td>11</td></tr>
<tr><td>12</td><td rowspan="4">TPOS</td><td rowspan="4">CPRM_SEL_MON1</td></tr>
<tr><td>13</td></tr>
<tr><td>14</td></tr>
<tr><td>15</td></tr>
<tr><td>16</td><td rowspan="4">TSPD</td><td rowspan="4">CPRM_SEL_MON2</td></tr>
<tr><td>17</td></tr>
<tr><td>18</td></tr>
<tr><td>19</td></tr>
<tr><td>20</td><td rowspan="4">ACCR</td><td rowspan="4">MONITOR1</td></tr>
<tr><td>21</td></tr>
<tr><td>22</td></tr>
<tr><td>23</td></tr>
<tr><td>24</td><td rowspan="4">DECR</td><td rowspan="4">MONITOR2</td></tr>
<tr><td>25</td></tr>
<tr><td>26</td></tr>
<tr><td>27</td></tr>
<tr><td>28</td><td rowspan="4">TLIM</td><td rowspan="4">MONITOR3</td></tr>
<tr><td>29</td></tr>
<tr><td>30</td></tr>
<tr><td>31</td></tr>
</table>

Note: When using SPINDEX orientation, make sure that Pn830 (Number of Reference Units per Machine Revolution) is set correctly.

◆ Orientation Command Near Course Positioning

This function can be used with the QUICK_ORT and SPINDEX commands.

Positioning will be performed with the nearer course if Pn878 is set to n.□□1□ and the following conditions are met.

Positioning will be performed with the normal operation if even one of the conditions is not met.

Parameter		Meaning	When Enabled	Classification
Pn878	n.□□0□ (default setting)	Disable near course positioning during orientation.	After restart	Setup
	n.□□1□	Enable near course positioning during orientation.		

■ Conditions for Near Course Positioning

- The position of the motor is within Pn830 ± 0.5 rotations of the previous orientation target position.
- The orientation command was already executed at least once.
- None of the following commands were executed before the orientation command.
  - DISCONNECT (Release Connection) command
  - SYNC_SET (Start Synchronous Communications) command
  - CONFIG (Enable Parameters) command
  - POS_SET (Set Coordinate System) command

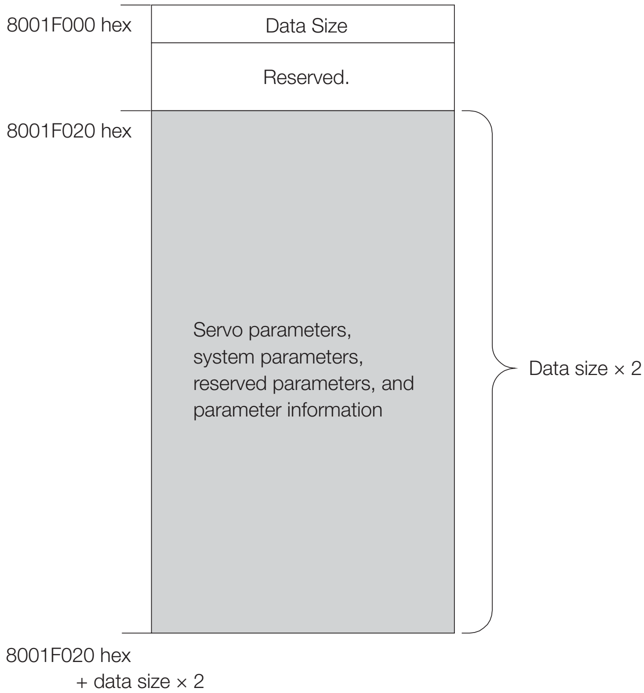
■ Target Position

The target position for positioning with the nearer course is the previous orientation target position. The setting of TPOS is disabled.

7.7.3 Uploading and Downloading Parameters

The Spindle Motor parameters contain parameters that correspond to each model, so the correct parameters must be saved to the SERVOPACK.

You can use the MEM_RD and MEM_WR commands to upload and download parameters to do so.



When you need to write parameters to more than one machine, you can use the SigmaWin+ to write the parameters to the first SERVOPACK and let the CNC Unit upload/download the parameters for the remaining SERVOPACKs. If you do, unused parameters and additional parameters are also uploaded or downloaded.

The procedure is given below.

1. **When adjusting the first machine, use SigmaWin+ to write the correct parameters to the SERVOPACK.**

2. **Then, after you have adjusted the servo parameter settings and gains, upload the servo parameters and motor parameters in the SERVOPACK to the CNC Unit.**
Refer to the following section for details on uploading parameters.
☞ *Uploading* on page 7-24

3. **Copy the parameters that are stored in the CNC Unit for the first SERVOPACK to the CNC Units for the other SERVOPACKs**

4. **Download the parameters that are copied to the CNC Units to the SERVOPACKs.**
Refer to the following section for details on downloading parameters.
☞ *Downloading* on page 7-25

Uploading

The MEM_RD command must be issued to upload parameters. Details on the MEM_RD command and the upload sequence are given below.

0	MEM_RD (1D hex)	MEM_RD (1D hex)
1	WDT	RWDT
2	CMD_CTRL	CMD_STAT
3		
4	Reserved.	Reserved.
5	MODE/DATA TYPE	MODE/DATA TYPE
6	SIZE	SIZE
7		
8	ADDRESS	ADDRESS
9		
10		
11		
12	Reserved.	DATA
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

Mode/Data Type = 13 hex
Size = 1
Address = DataSize: 8001F000 hex
Area: 8001F020 hex to 8001F020 hex + DataSize × 2 – 4

■ Upload Sequence

1. Specify the following command parameters for the Read Memory command (MEM_RD: 1D hex) to read the data size from address 8001F000 hex.

Command = MEM_RD (= 1D hex)
MODE/DATA_TYPE = 13 hex (RAM area, Long size: 4 bytes)
SIZE = 0001 hex
ADDRESS = 8001F000 hex
Confirm completion by confirming that RCMD = MEM_WR (= 1E hex) and CMD_STAT.CMDRDY = 1.
If an error occurs, perform error processing and execute the command again.
If an error still occurs, end the parameter upload operation.

2. **Use the Read Memory command (MEM_RD: 1D hex) to read data 4 bytes at a time from addresses 8001F020 hex to 8001F020 hex + DATASIZE × 2 – 4.**
Command = MEM_RD (= 1D hex)
MODE/DATA_TYPE = 13 hex (RAM area, Long size: 4 bytes)
SIZE = 0001 hex
ADDRESS = 8001F020 hex to 8001F020 hex + DATASIZE × 2 – 4 (Increment the addresses 4 at a time.)
Confirm completion of the read operation by confirming that RCMD = MEM_WR (= 1E hex) and CMD_STAT.CMDRDY = 1. If an error occurs, perform error processing and execute the command again.
If an error still occurs, end the parameter upload operation.

3. **Store the read data in the Controller’s memory area.**

Downloading

The MEM_WR command must be issued to download parameters. Details on the MEM_WR command and the download sequence are given below.

0	MEM_WR (1E hex)	MEM_WR (1E hex)
1	WDT	RWDT
2	CMD_CTRL	CMD_STAT
3		
4	Reserved.	Reserved.
5	MODE/DATA TYPE	MODE/DATA TYPE
6	SIZE	SIZE
7		
8	ADDRESS	ADDRESS
9		
10		
11		
12	DATA	DATA
13		
14		
15		
16	Reserved.	Reserved.
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		

Mode/Data Type = 13 hex
Size = 1
Address = DataSize: 8001F000 hex
Area: 8001F020 hex to 8001F020 hex + DataSize × 2 – 4

■ Download Sequence

1. **Specify the following command parameters for the Read Memory command (MEM_RD: 1D hex) to read the data size from address 8001F000 hex.**
Command = MEM_RD (= 1D hex)
MODE/DATA_TYPE = 13 hex (RAM area, Long size: 4 bytes)
SIZE = 0001 hex
ADDRESS = 8001F000 hex
Confirm completion by confirming that RCMD = MEM_WR (= 1E hex) and CMD_STAT.CMDRDY = 1.
If an error occurs, perform error processing and execute the command again. If an error still occurs, end the parameter download operation.

2. **Use the Write Memory command (MEM_WR: 1E hex) to write data 4 bytes at a time to addresses 8001F020 hex to 8001F020 hex + DATASIZE × 2 – 4.**
Command = MEM_WR (= 1E hex)
MODE/DATA_TYPE = 13 hex (RAM area, Long size: 4 bytes)
SIZE = 0001 hex
ADDRESS = 8001F020 hex to 8001F020 hex + DATASIZE × 2 – 4 (Increment the addresses 4 at a time.)
DATA = XXXX
Data is written 4 bytes at a time. Confirm write operation completion by confirming that RCMD = MEM_WR (= 1E hex) and CMD_STAT.CMDRDY = 1.
If an error occurs, perform error processing and execute the command again. If an error still occurs, end the parameter download operation.

After the last data is written, it will take a few seconds to write the data to the SERVOPACK's internal non-volatile memory (EEPROM).

Be sure to move to the next process only after confirming that the write operation has been completed (CMD_STAT.CMDRDY = 1).

Do not turn OFF the power supply while parameters are being downloaded. If the power supply is turned OFF, the servo parameters may not be assigned their correct values.

To enable the downloaded data (parameters), turn the power supply OFF and ON again.

7.7.4 Gain Selection

The gains are selected with G-SEL (4 bits) in the MECHATROLINK-III servo command I/O signals (SVCMD_IO). When the motor is stopped, input the G-SEL signal and wait 2 ms or more to input a command (e.g., positioning). G-SEL allocation is as shown in the following table.

Operating Mode	SVCMD_IO (Output)	
	G-SEL	
	Bit 9	Bit 8
	Gain Selection	
Spindle operation	Select gain bank 0 to 3.	

The following table lists the parameters used for gain banks 0 to 3.

Parameter Name	Gain Bank			
	0	1	2	3
Speed Loop Gain	Pn100	Pn104	Pn12B	Pn12E
Speed Loop Integral Time Constant	Pn101	Pn105	Pn12C	Pn12F
Position Loop Gain	Pn102	Pn106	Pn12D	Pn130
Torque Reference Filter	Pn401	Pn412	Pn413	Pn414

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
N_CL	P_CL	Reserved (0).	V_PPI	Reserved (0).			

Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8
Reserved (0).				G-SEL			

Bit 23	Bit 22	Bit 21	Bit 20	Bit 19	Bit 18	Bit 17	Bit 16
Reserved (0).							

Bit 31	Bit 30	Bit 29	Bit 28	Bit 27	Bit 26	Bit 25	Bit 24
Reserved (0).	SV-MOD	Reserved (0).					

7.7.5 Servo Mode

Enable servo mode when you operate a motor with position control.

There are the following two ways to enable it.
- Enabling servo mode with SV-MOD (bit 30) in SVCM_IO
- Use servo mode automatic switching.

Enabling Servo Mode with SV-MOD

Switch servo mode using SV-MOD in SVCMD_IO in MECHATROLINK-III. SV-MOD is bit 30 of SVCMD_IO.

The SV-MOD settings are given below.

Name	Description	Value	Setting
SV-MOD (bit 30)	Servo mode	0	Disable servo mode.
		1	Enable servo mode.

Using Servo Mode Automatic Switching

You can enable and disable servo mode automatic switching with Pn878 = n.□□□X.

Parameter		Meaning	When Enabled	Classification
Pn878	n.□□□0 (default setting)	Disable servo mode automatic switching (enable manual switching).	After restart	Setup
	n.□□□1	Enable servo mode automatic switching (disable manual switching).		

After you enable servo mode automatic switching, servo mode will be enabled when you execute any of the following commands regardless of the setting of SV-MOD in SVCMD_IO.

Applicable commands: INTERPOLATE (Interpolation Feeding) command, SPINDEX (SPINDEX Orientation) command, and QUICK_ORT (Quick Orientation) command.

Note: If servo mode automatic switching is enabled, you cannot disable servo mode with SV-MOD when you execute any of the above commands. If you attempt to disable servo mode with SV-MOD, an A.94C warning will occur.

Tuning

8

This chapter provides information on the flow of tuning, details on tuning functions, and related operating procedures.

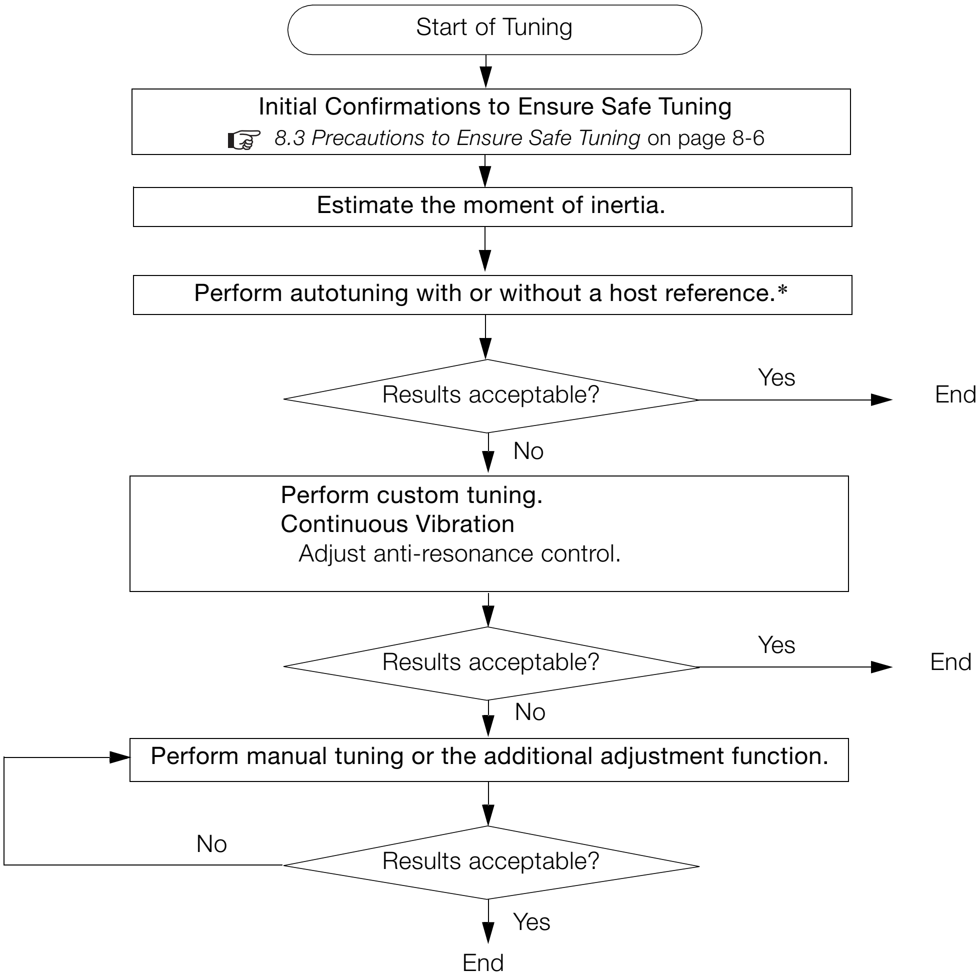
8.1 Overview and Flow of Tuning

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 Control Methods	Reference
Autotuning without Host Reference	The following parameters are automatically adjusted in the internal references in the SERVOPACK during automatic operation. • Gains (e.g., position loop gain and speed loop gain) • Filters (torque reference filter and notch filters) • Anti-resonance control	Speed control or position control	page 8-33
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) • Anti-resonance control	Position Control	page 8-42
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) • Anti-resonance control	Speed control or position control	page 8-47
Anti-resonance Control Adjustment	This function effectively suppresses continuous vibration.	Speed control or position control	page 8-54
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 8-47
Manual Tuning	You can manually adjust the servo gains to adjust the response.	Speed control, position control, or torque control	page 8-54

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

Item	Unit
Torque reference	%
Feedback speed	min^{-1}
Position reference speed	min^{-1}
Position deviation	Reference units

- Speed Control

Item	Unit
Torque reference	%
Feedback speed	min^{-1}
Reference speed	min^{-1}

- Torque Control

Item	Unit
Torque reference	%
Feedback speed	min^{-1}

8.3 Precautions to Ensure Safe Tuning

⚠ 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 Spindle Motor, 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 Spindle Motor 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.

☞ *5.5 Overtravel and Related Settings* on page 5-18

8.3.2 Torque Limit Settings

You can limit the torque that is output by the motor 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 6-20

8.3.3 Setting the Position Deviation Overflow Alarm Level

The position deviation overflow alarm is a protective function that is enabled when the SERVOPACK 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 motor if the motor 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.

$$\text{Position deviation [reference units]} = \frac{\text{Motor speed [min}^{-1}]}{60} \times \frac{\text{Encoder resolution}^{*1}}{\text{Pn102 [0.1/s]}/10^{*2}} \times \frac{\text{Pn210}}{\text{Pn20E}}$$

Position Deviation Overflow Alarm Level (Pn520) [setting unit: reference units]

$$\text{Pn520} > \frac{\text{Maximum motor speed [min}^{-1}]}{60} \times \frac{\text{Encoder resolution}^{*1}}{\text{Pn102 [0.1/s]}/10^{*2}} \times \frac{\text{Pn210}}{\text{Pn20E}} \times \underline{\underline{(1.2 \text{ to } 2)^{*3}}}$$

*1. Refer to the following section for details.
☞ *5.8 Electronic Gear Settings* on page 5-26

*2. To check the setting of Pn102 on the Digital Operator, change the parameter display setting to display all parameters (Pn00B = n.□□□1).

*3. 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 motor operation does not agree with the reference, position deviation will occur, an error will be detected, and the motor will stop.

If the acceleration/deceleration rate required for the position reference exceeds the tracking capacity of the motor, 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 motor can follow the position reference or increase the position deviation overflow alarm level.

Related Parameters

Pn520	Position Deviation Overflow Alarm Level			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,823	1 reference unit	5,242,880	Immediately	Setup
Pn51E	Position Deviation Overflow Warning Level			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 100	1%	100	Immediately	Setup

Related Alarms

Alarm Number	Alarm Name	Alarm Meaning
A.d00	Position Deviation Overflow Alarm	This alarm is displayed when the position deviation exceeds the setting of Pn520 (Position Deviation Overflow Alarm Level).

Related Warnings

Warning Number	Warning Name	Meaning
A.900	Position Deviation Overflow Warning	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.

☞ *6.9 Initializing the Vibration Detection Level* on page 6-24

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 motor 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

Pn526	Position Deviation Overflow Alarm Level at Servo ON			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,823	1 reference unit	5,242,880	Immediately	Setup

Pn528	Position Deviation Overflow Warning Level at Servo ON			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 100	1%	100	Immediately	Setup

Pn529	Speed Limit Level at Servo ON			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 min^{-1}	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 the servo is turned ON 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.
☞ *11.2.3 Resetting Alarms* on page 11-32

Related Warnings

Warning Number	Warning Name	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 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.

☞ *8.8.4 Operating Procedure* on page 8-43

8.4.1 Outline

The moment of inertia during operation is automatically calculated by the SERVOPACK for round-trip (forward and reverse) operation. A reference from the host controller is not used.

The moment of inertia ratio (i.e., the ratio of the load moment of inertia to the motor moment of inertia) is a basic parameter for adjusting gains. It must be set as accurately as possible.

Although the load moment of inertia can be calculated from the weight and structure of the mechanisms, doing so is very troublesome and calculating it accurately can be very difficult with the complex mechanical structures that are used these days. With an estimate of the moment of inertia, you can obtain an accurate load moment of inertia simply by running the Servomotor in the actual system in a forward and reverse direction a few times.

8.4.2 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

  Note: If you specify calculating the moment of inertia, an error will occur if V_PPI in the servo command output signals (SVCMD_IO) changes to specify the proportional action during moment of inertia estimation.
- 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

Preparations

Always check the following before you execute moment of inertia estimation.

- The main circuit power supply must be ON.
- There must be no overtravel.
- The servo must be OFF.
- The control method must not be set to torque control.
- There must be no alarms or warnings.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.

8.4.3 Applicable Tools

The following table lists the tools that you can use to estimate the moment of inertia.

Tool	Fn No./Function Name	Operating Procedure Reference
SigmaWin+	***Tuning - Tuning***	☞ *8.4.4 Operating Procedure* on page 8-10

8.4.4 Operating Procedure

Use the following procedure to set the moment of inertia ratio.

⚠ WARNING

- **Estimating the moment of inertia requires operating the motor 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.

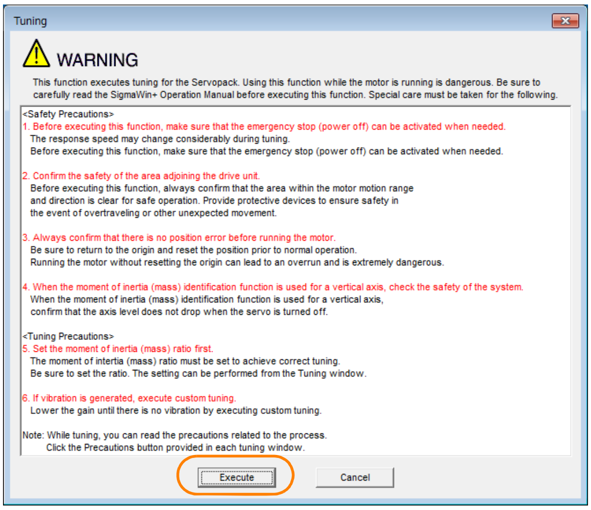
⚠ CAUTION

- **Be aware of the following points if you cancel the moment of inertia estimation while the motor is operating.**
  - If you cancel operation with the **Servo OFF** Button, the motor will stop according to setting of the Servo OFF stopping method (Pn001 = n.□□□X).
  - If you cancel operation with the **Cancel** Button, the motor will decelerate to a stop and then enter a zero-clamped state.

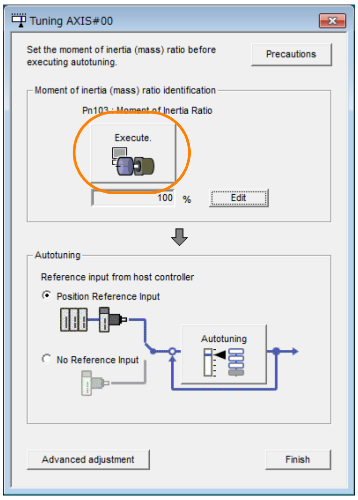
1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.

2. Select **Tuning** in the Menu Dialog Box.
   The Tuning Dialog Box will be displayed.
   Click the **Cancel** Button to cancel tuning.

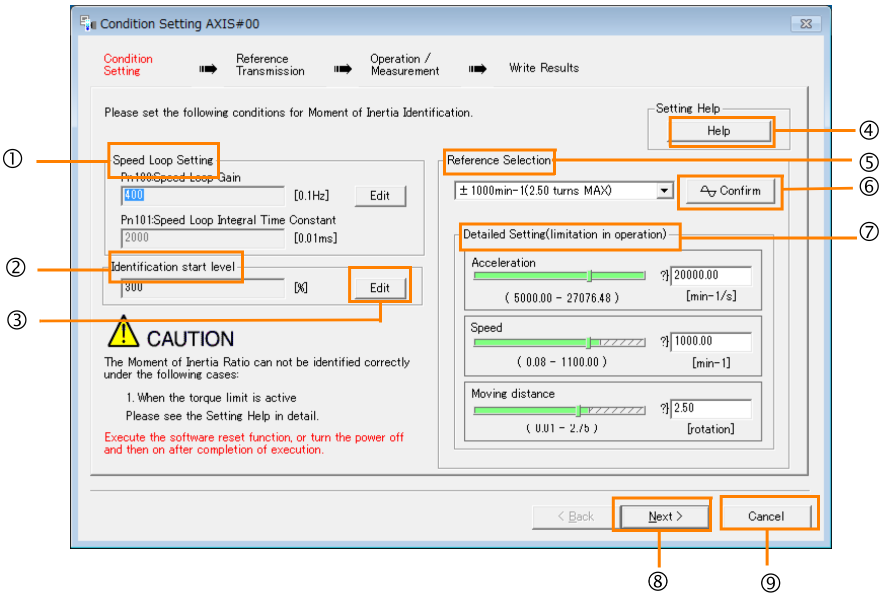
3. Click the **Execute** Button.



4. Click the **Execute** Button.



5. Set the conditions as required.



Tuning

8

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.

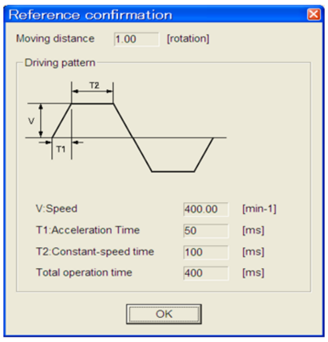
③ **Edit** Buttons
Click the button to display a dialog box to change the settings related to the speed loop or estimation start level.

④ **Help** Button
Click this button to display guidelines for setting the reference conditions. Make the following settings as required.

- Operate the motor 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.

⑤ **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 allowable acceleration rate.

⑥ **Confirm** Button
Click this button to display the Reference Confirmation Dialog Box.



⑦ **Detailed Setting** Area
You can change the settings by moving the bars or directly inputting the settings to create the required reference pattern.

⑧ **Next** Button
Click this button to display the Reference Transmission Dialog Box.

⑨ **Cancel** Button
Click this button to return to the Tuning Dialog Box.

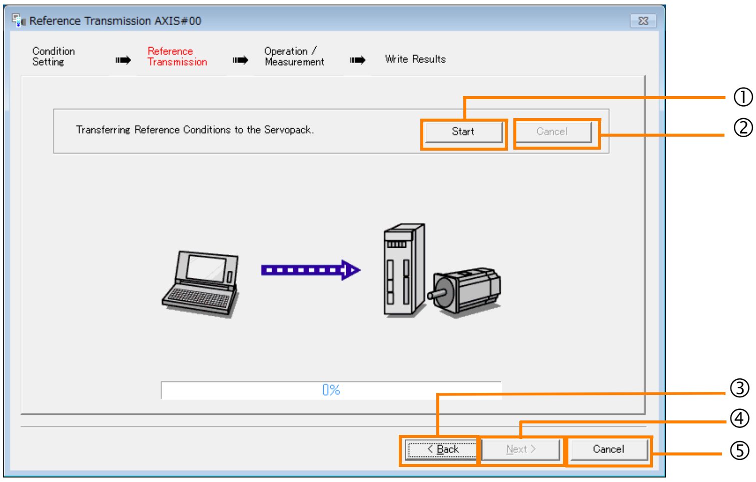
⚠ CAUTION

- 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 may occur and may cause the maximum speed setting to be exceeded temporarily. Allow sufficient leeway in the settings.

Information **When Measurement Is Not Correct**
Estimating the moment of inertia ratio cannot be performed correctly if the torque limit is activated. Adjust the limits or reduce the acceleration rate in the reference selection so that the torque limit is not activated.

6. Click the **Next** Button.
The Reference Transmission Dialog Box will be displayed.

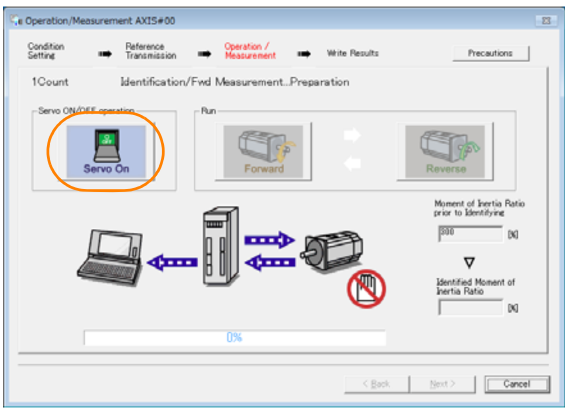
7. Click the **Start** Button.



① **Start** Button
The reference conditions will be transferred to the SERVOPACK. A progress bar will show the progress of the transfer.
② **Cancel** Button
The **Cancel** Button is enabled only while data is being transferred to the SERVOPACK. You cannot use it after the transfer has been completed.
③ **Back** Button
This button returns you to the Condition Setting Dialog Box. It is disabled while data is being transferred.
④ **Next** Button
This button is enabled only when the data has been transferred correctly. You cannot use it if an error occurs or if you cancel the transfer before it is completed.
Click the **Next** Button to display the Operation/Measurement Dialog Box.
⑤ **Cancel** Button
This button cancels processing and returns you to the Tuning Dialog Box.

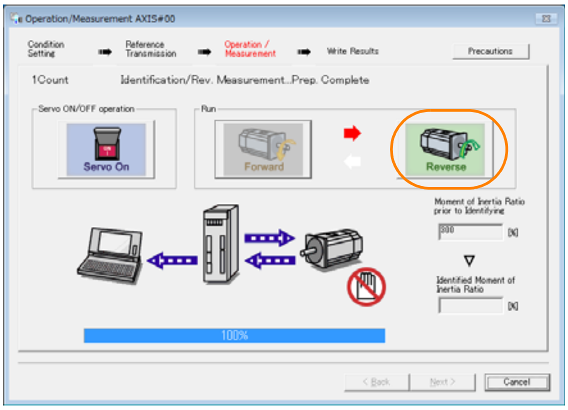
8. Click the **Next** Button.
The Operation/Measurement Dialog Box will be displayed.

9. Click the **Servo On** Button.

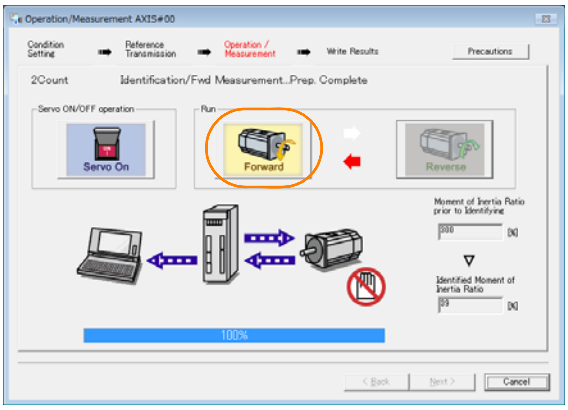


10. Click the **Forward** Button.
The Servomotor shaft will rotate in the forward direction and the measurement will start. After the measurement and data transfer have been completed, the **Reverse** Button will be displayed in color.

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.

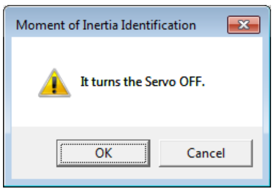


12. Repeat steps 9 to 11 until the **Next** Button is enabled.
Measurements are performed from 2 to 7 times and then verified. The number of measurements is displayed in upper left corner of the dialog box. A progress bar at the bottom of the dialog box will show the progress of the transfer each time.

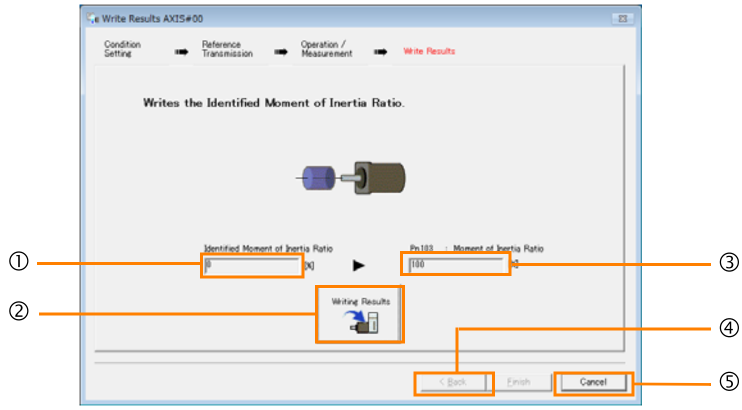
13. When the measurements have been completed, click the **Servo On** Button to turn OFF the servo.

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.



15. Click the **Writing Results** Button.



① **Identified Moment of Inertia Ratio** Box
The moment of inertia ratio that was found with operation and measurements is displayed here.

② **Writing Results** Button
If you click this button, Pn103 (Moment of Inertia Ratio) in the SERVOPACK is set to the value that is displayed for the identified moment of inertia ratio.

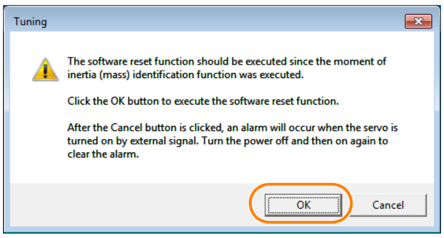
③ **Pn103: Moment of Inertia Ratio** Box
The value that is set for the parameter is displayed here.
After you click the **Writing Results** Button, the value that was found with operation and measurements will be displayed as the new setting.

④ **Back** Button
This button is disabled.

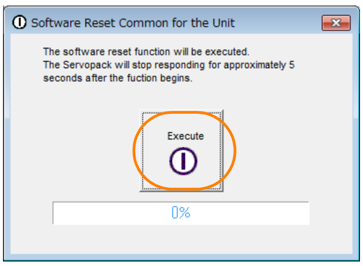
⑤ **Cancel** Button
This button will return you to the Tuning Dialog Box.

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.

8.5 Autotuning without Host Reference

This section describes autotuning without a host reference.

Important

- 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.
- 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.
  Pn160 = n.□□□0 (Do not use anti-resonance control.)
  Pn408 = n.00□0 (Do not use a first or 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.□□□1) and then turn the power supply OFF and ON again.

8.5.1 Outline

For autotuning without a host reference, operation is automatically performed by the SERVOPACK 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.

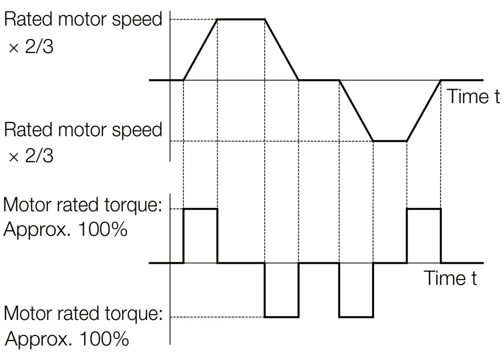
- Moment of inertia ratio
- Gains (e.g., speed loop gain and position loop gain)
- Filters (torque reference filter and notch filters)
- Anti-resonance control
- Vibration suppression (only for mode 2 or 3)

Refer to the following section for details on the parameters that are adjusted.

8.5.7 Related Parameters on page 8-25

The motor is operated with the following specifications.

Maximum speed	Rated motor speed × $\frac{2}{3}$	
Acceleration Torque	Rated motor torque: Approx. 100% Note: The acceleration torque depends on the setting of the influence of the moment of inertia ratio (Pn103), machine friction, and external disturbance.	
Travel Distance	Spindle Motor	You can set the desired travel distance. The default setting is for a value equivalent to 3 motor shaft rotations.



Example of Automatic Operation Pattern

⚠ WARNING

- **Autotuning without a host reference requires operating the motor 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.

8.5.2 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.

☞ *8.6 Autotuning with a Host Reference* on page 8-26
☞ *8.7 Custom Tuning* on page 8-33

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

  Note: If you specify calculating the moment of inertia, an error will occur if V_PPI in the servo command output signals (SVCMD_IO) changes to specify the proportional action during moment of inertia estimation.
- 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

Always check the following before you execute autotuning without a host reference.

- The main circuit power supply must be ON.
- There must be no overtravel.
- The servo must be OFF.
- The control method must not be set to torque control.
- The first gains must be selected.
- There must be no alarms or warnings.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.
- 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.

8.5.3 Applicable Tools

The following table lists the tools that you can use to perform autotuning without a host reference.

Tool	Fn No./Function Name	Operating Procedure Reference
Digital Operator	Fn201	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	*Tuning - Tuning*	*8.5.4 Operating Procedure* on page 8-18

8.5.4 Operating Procedure

Use the following procedure to perform autotuning without a host reference.

CAUTION

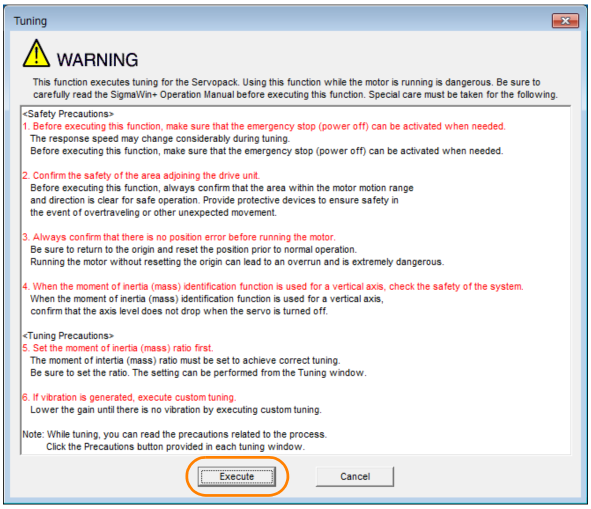
- If you specify not estimating the moment of inertia, set the moment of inertia ratio (Pn103) correctly. If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.

1. Confirm that the moment of inertia ratio (Pn103) is set correctly.

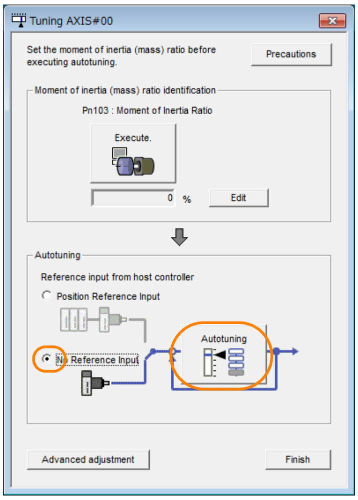
2. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.

3. Select **Tuning** in the Menu Dialog Box.
   The Tuning Dialog Box will be displayed.
   Click the **Cancel** Button to cancel tuning.

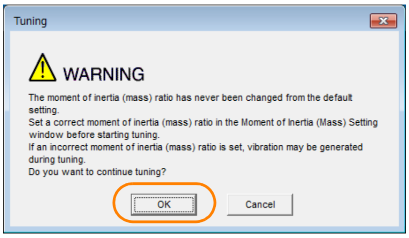
4. Click the **Execute** Button.



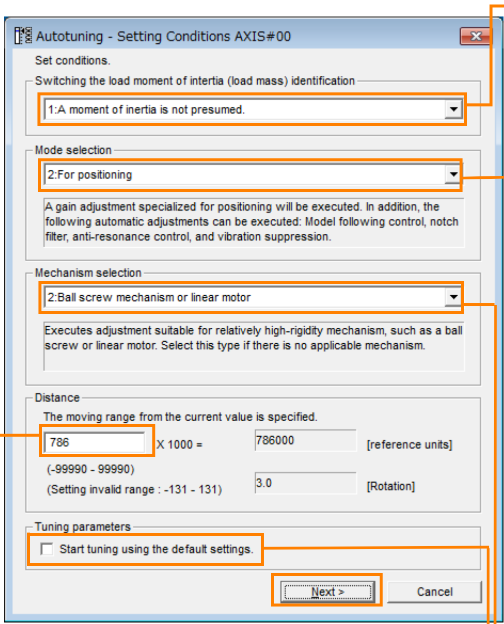
5. Select the **No Reference Input** Option in the **Autotuning** Area and then click the **Autotuning** Button.



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.



- **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 not presumed.

- **Mode selection** Box
  Set the mode.

Mode Selection	Description
1: Standard	Standard gain adjustment is performed. In addition to gain adjustment, 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, anti-resonance control, and vibration suppression are automatically adjusted.

- **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
  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

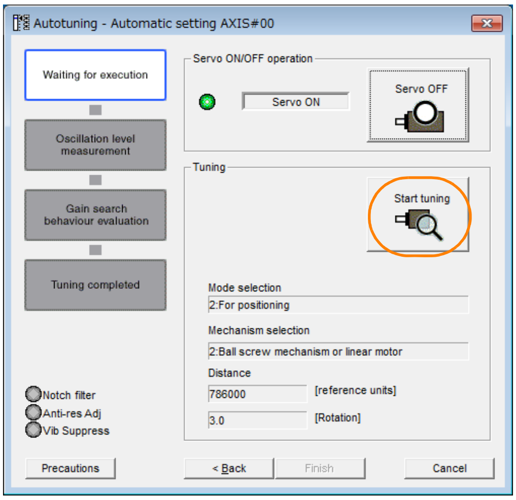
- **Mechanism selection** Box
  Select the type according to the machine element to drive.
  If there is noise or if the gain does not increase, better results may be obtained by changing the rigidity type. Select the type according to the following guidelines.

Mechanism Selection	Description
1: Belt mechanism	Tuning is performed for a mechanism with relatively low rigidity, e.g., a belt.
2: Ball screw mechanism	Tuning is performed for a mechanism with relatively high rigidity, e.g., a ball screw. 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.

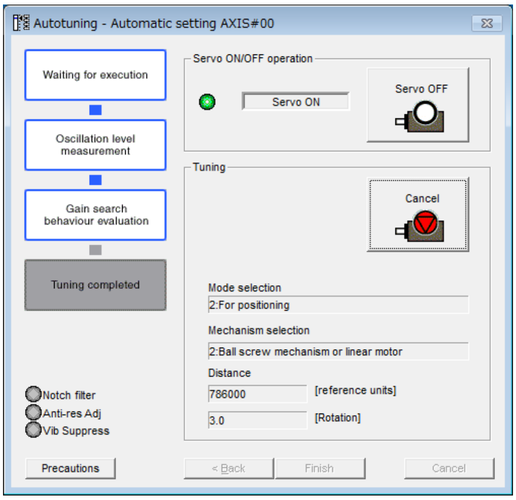
7. Click the **Servo ON** Button.

8. Click the **Start tuning** Button.



9. Confirm safety around moving parts and click the **Yes** Button.

The motor 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.

8.5.5 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, third, and fourth gains were selected with the gain selection.	Select the first gains.
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.

◆ 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 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 8-23	
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). • Set V_PPI to 0 in the servo command output signals (SVCMD_IO).

◆ 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).
The speed control section changed to proportional control during calculation of the moment of inertia, e.g., V_PPI in the servo command output signals (SVCMD_IO) was set to 1.	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 the electronic gear (Pn20E/Pn210).

If satisfactory results are still not possible, adjust the overshoot detection level (Pn561). That may improve the adjustment results.

- Pn561 = 100% (default setting)
  This will allow tuning with overshooting that is equivalent to the positioning completed width.
- Pn561 = 0%
  This will allow tuning to be performed without overshooting within the positioning completed width, but the positioning completed width may be extended.

Pn561	Overshoot Detection Level		Speed	Position	Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	1%	100	Immediately	Setup

8.5.6 Automatically Adjusted Function Settings

You can specify whether to automatically adjust the following functions during autotuning.

◆ Automatic Notch Filters

Normally, set Pn460 to n.□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.□0□□ (Do not adjust automatically) only if you do not change the setting of the notch filter before you execute this function.

Parameter		Function	When Enabled	Classification
Pn460	n.□□□0	Do not adjust the first stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately	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.		
	n.□0□□	Do not adjust the second 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 second stage notch filter automatically 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.

Parameter		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
	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.		

8.5.7 Related Parameters

The following parameters are automatically adjusted or used as reference when you execute autotuning without a host reference.

Do not change the settings while autotuning without a host reference is being executed.

Parameter	Name	Automatic Changes
Pn100	Speed Loop Gain	Yes
Pn101	Speed Loop Integral Time Constant	Yes
Pn102	Position Loop Gain	Yes
Pn103	Moment of Inertia Ratio	Yes
Pn401	First Stage First Torque Reference Filter Time Constant	Yes
Pn408	Torque-Related Function Selections	Yes
Pn409	First Stage Notch Filter Frequency	Yes
Pn40A	First Stage Notch Filter Q Value	Yes
Pn40C	Second Stage Notch Filter Frequency	Yes
Pn40D	Second Stage Notch Filter Q Value	Yes
Pn145	Vibration Suppression 1 Frequency A	Yes
Pn146	Vibration Suppression 1 Frequency B	Yes
Pn160	Anti-Resonance Control-Related Selections	Yes
Pn161	Anti-Resonance Frequency	Yes
Pn163	Anti-Resonance Damping Gain	Yes
Pn531	Program Jogging Travel Distance	No
Pn533	Program Jogging Movement Speed for Rotary Servomotor	No
Pn534	Program Jogging Acceleration/Deceleration Time	No
Pn535	Program Jogging Waiting Time	No
Pn536	Program Jogging Number of Movements	No

Yes: The parameter is automatically set.

No: The parameter is not automatically set, but the setting is read during execution.

8.6 Autotuning with a Host Reference

This section describes autotuning with a host reference.

Important

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.

8.6.1 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)
- Anti-resonance control
- Vibration suppression

Refer to the following section for details on the parameters that are adjusted.

☞ *8.6.7 Related Parameters* on page 8-32

⚠ 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.

8.6.2 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)
- 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.

☞ *8.7 Custom Tuning* on page 8-33

Preparations

Always check the following before you execute autotuning with a host reference.

- The servo must be in ready status.
- There must be no overtravel.
- The servo must be OFF.
- Position control must be selected if power is supplied to the motor (i.e., when the servo is ON).
- The first gains must be selected.
- There must be no warnings.
- The parameters must not be write prohibited.

8.6.3 Applicable Tools

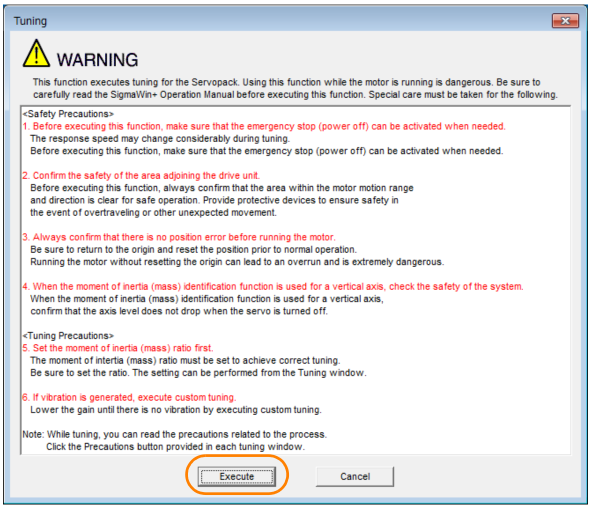
The following table lists the tools that you can use to perform autotuning with a host reference.

Tool	Fn No./Function Name	Operating Procedure Reference
Digital Operator	Fn202	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Tuning - Tuning***	*8.6.4 Operating Procedure* on page 8-27

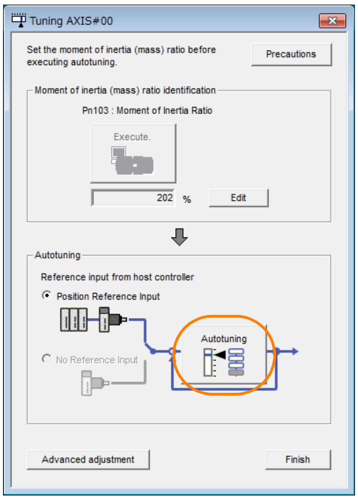
8.6.4 Operating Procedure

Use the following procedure to perform autotuning with a host reference.

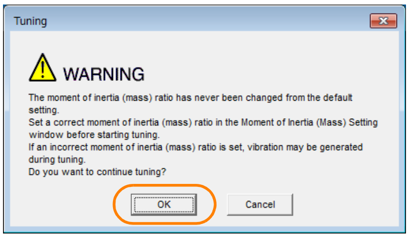
1. Confirm that the moment of inertia ratio (Pn103) is set correctly.
2. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
3. Select **Tuning** in the Menu Dialog Box.
   The Tuning Dialog Box will be displayed.
   Click the **Cancel** Button to cancel tuning.
4. Click the **Execute** Button.



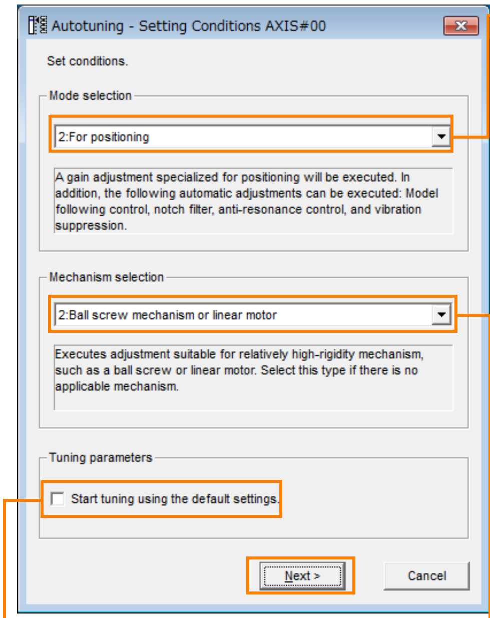
5. Select the **Position reference input** Option in the **Autotuning** Area and then click the **Autotuning** Button.



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.



- **Mode selection** Box
  Set the mode.

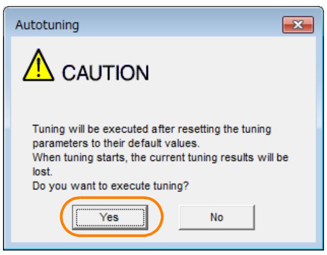
Mode Selection	Description
1: Standard	Standard gain adjustment is performed. In addition to gain adjustment, notch filters and anti-resonance control are automatically adjusted.
2: For positioning	Tuning is performed for positioning applications. In addition to gain adjustment, notch filters, anti-resonance 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, anti-resonance control, and vibration suppression are automatically adjusted.

- **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.

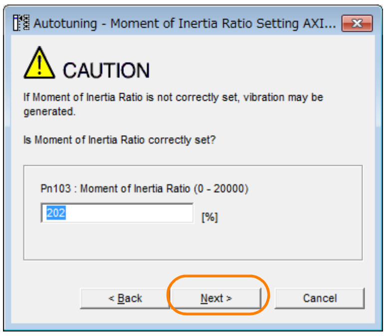
- **Mechanism selection** Box
  Select the type according to the machine element to drive.
  If there is noise or if the gain does not increase, better results may be obtained by changing the rigidity type.
  Select the type according to the following guidelines.

Mechanism Selection	Description
1: Belt mechanism	Tuning is performed for a mechanism with relatively low rigidity, e.g., a belt.
2: Ball screw mechanism	Tuning is performed for a mechanism with relatively high rigidity, e.g., a ball screw. 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.

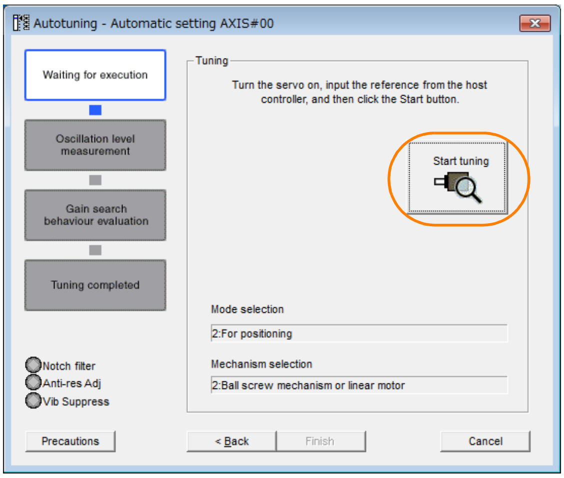
7. Click the **Yes** Button.



8. Input the correct moment of inertia ratio and click the **Next** Button.

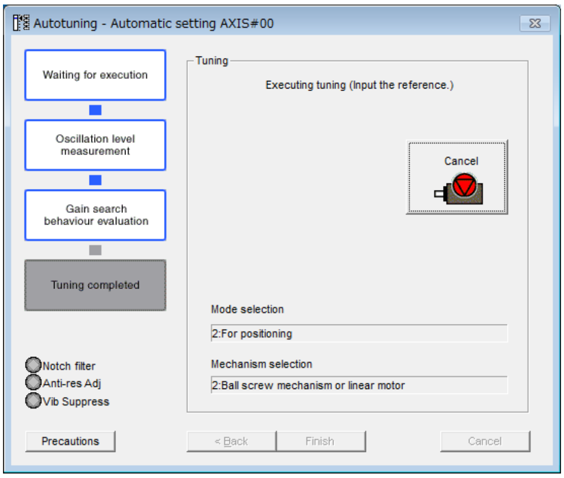


9. First confirm safety around moving parts. Then turn ON the servo, enter a reference from the host controller, and click the **Start tuning** Button.



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.



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.

8.6.5 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, third, and fourth gains were selected with the gain selection.	Select the first gains.
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 the positioning completed width (Pn522). • Change the mode from 2 to 3. • If machine vibration occurs, suppress the vibration with the anti-resonance control 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 the positioning completed width (Pn522). • Set V_PPI to 0 in the servo command output signals (SVCMD_IO).

◆ Adjustment Results Are Not Satisfactory for Position Control

You may be able to improve the adjustment results by changing the settings of the positioning completed width (Pn522) and the electronic gear (Pn20E/Pn210).

If satisfactory results are still not possible, adjust the overshoot detection level (Pn561). That may improve the adjustment results.

- Pn561 = 100% (default setting)
  This will allow tuning with overshooting that is equivalent to the positioning completed width.
- Pn561 = 0%
  This will allow tuning to be performed without overshooting within the positioning completed width, but the positioning completed width may be extended.

Pn561	Overshoot Detection Level		Speed Position Torque		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	1%	100	Immediately	Setup

8.6.6 Automatically Adjusted Function Settings

These function settings are the same as for autotuning without a host reference. Refer to the following section.

☞ *8.5.6 Automatically Adjusted Function Settings* on page 8-24

8.6.7 Related Parameters

The following parameters are automatically adjusted or used as reference when you execute autotuning with a host reference.

Do not change the settings while autotuning with a host reference is being executed.

Parameter	Name	Automatic Changes
Pn100	Speed Loop Gain	Yes
Pn101	Speed Loop Integral Time Constant	Yes
Pn102	Position Loop Gain	Yes
Pn103	Moment of Inertia Ratio	No
Pn401	First Stage First Torque Reference Filter Time Constant	Yes
Pn408	Torque-Related Function Selections	Yes
Pn409	First Stage Notch Filter Frequency	Yes
Pn40A	First Stage Notch Filter Q Value	Yes
Pn40C	Second Stage Notch Filter Frequency	Yes
Pn40D	Second Stage Notch Filter Q Value	Yes
Pn145	Vibration Suppression 1 Frequency A	Yes
Pn146	Vibration Suppression 1 Frequency B	Yes
Pn160	Anti-Resonance Control-Related Selections	Yes
Pn161	Anti-Resonance Frequency	Yes
Pn163	Anti-Resonance Damping Gain	Yes

Yes: The parameter is automatically set.

No: The parameter is not automatically set, but the setting is read during execution.

8.7 Custom Tuning

This section describes custom tuning.

8.7.1 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)
- Anti-resonance control

Refer to the following section for details on the parameters that are adjusted.

☞ *8.7.7 Related Parameters* on page 8-41

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. Manual anti-resonance control adjustment is 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.

8.7.2 Preparations

Always check the following before you execute custom tuning.

- If speed control is used, tuning mode 0 or 1 must be set.
- The parameters must not be write prohibited.

8.7.3 Applicable Tools

The following table lists the tools that you can use to perform custom tuning.

Tool	Fn No./Function Name	Operating Procedure Reference
Digital Operator	Fn203	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Tuning* – *Tuning***	*8.7.4 Operating Procedure* on page 8-34

8.7.4 Operating Procedure

Use the following procedure to perform custom tuning.

WARNING

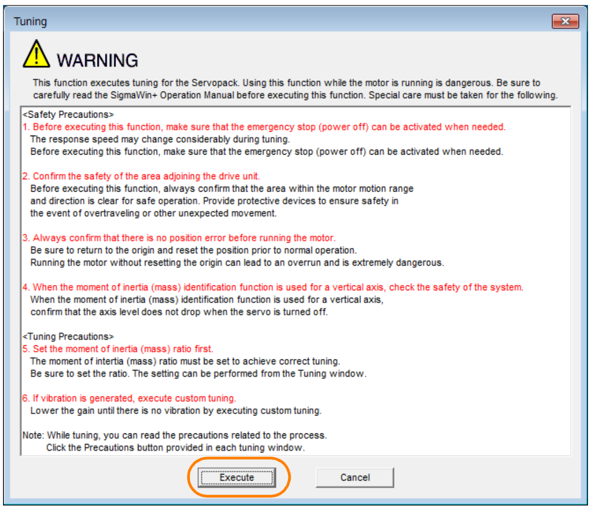
- Before you execute custom tuning, check the information provided in the SigmaWin+ operation manual.
  Observe the following precautions.
  - Make sure that you can perform an emergency stop at any time.
    When custom tuning is started, several parameters will be overwritten with the recommended settings, 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.

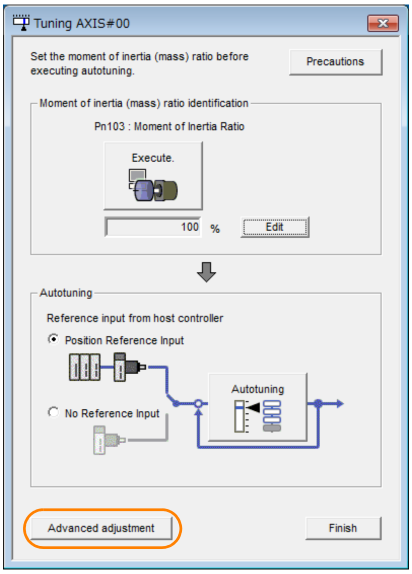
2. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.

3. Select **Tuning** in the Menu Dialog Box.
   The Tuning Dialog Box will be displayed.
   Click the **Cancel** Button to cancel tuning.

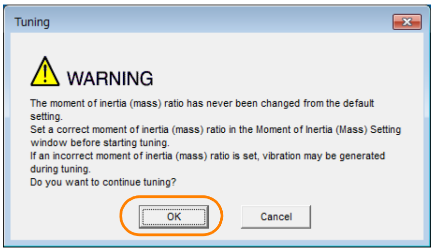
4. Click the **Execute** Button.



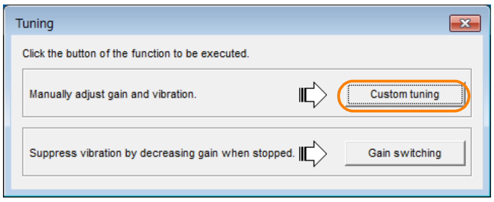
5. Click the **Advanced adjustment** Button.



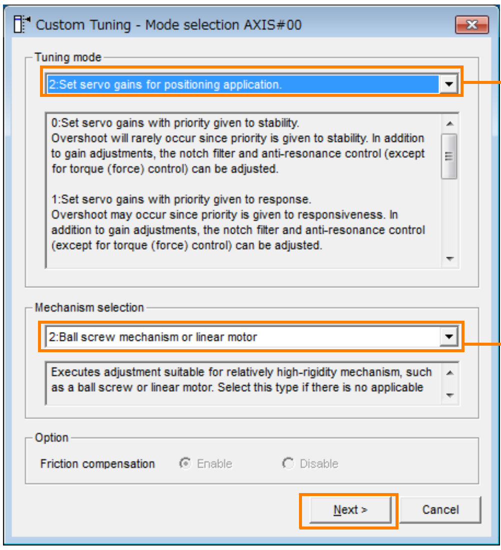
Information When the following dialog box is displayed, click the **OK** Button and then confirm that the correct moment of inertia ratio is set in Pn103 (Moment of Inertia Ratio).



6. Click the **Custom tuning** Button.



7. Set the **Tuning mode** Box and **Mechanism selection** Box, and then click the **Next** Button.



Tuning mode Box

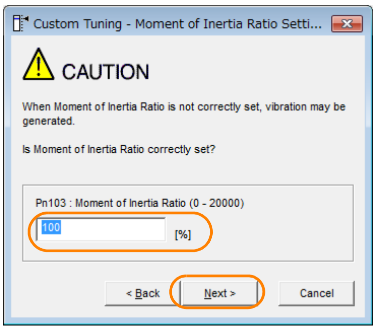
Mode Selection	Description
0: Set servo gains with priority given to stability.	This setting gives priority to stability and preventing overshooting. In addition to gain adjustment, notch filters and anti-resonance control (except during torque control) are automatically adjusted.
1: Set servo gains with priority given to response.	Overshooting may occur because priority is given to response. In addition to gain adjustment, notch filters and anti-resonance control (except during torque control) are automatically adjusted.
2: Set servo gains for positioning application.	Tuning is performed for positioning applications. In addition to gain adjustment, notch filters, anti-resonance control, and vibration suppression are adjusted.
3: Set servo gains especially to prevent overshooting during positioning application.	Tuning is performed for positioning applications with emphasis on eliminating overshooting. In addition to gain adjustment, notch filters, anti-resonance control, and vibration suppression are adjusted.

- **Mechanism Selection** Box
  Select the type according to the machine element to drive.
  If there is noise or if the gain does not increase, better results may be obtained by changing the rigidity type. Select the type according to the following guidelines.

Mechanism Selection	Description
1: Belt mechanism	Tuning is performed for a mechanism with relatively low rigidity, e.g., a belt.
2: Ball screw mechanism	Tuning is performed for a mechanism with relatively high rigidity, e.g., a ball screw. 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.

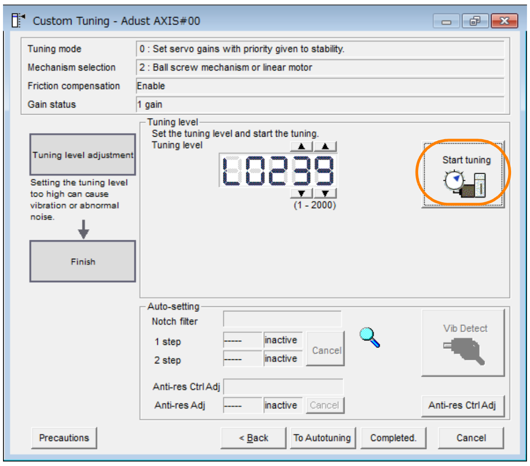
Information The tuning modes that you can select depend on the SERVOPACK setting.

8. If the moment of inertia ratio is not set correctly, correct the setting and then click the **Next** Button.

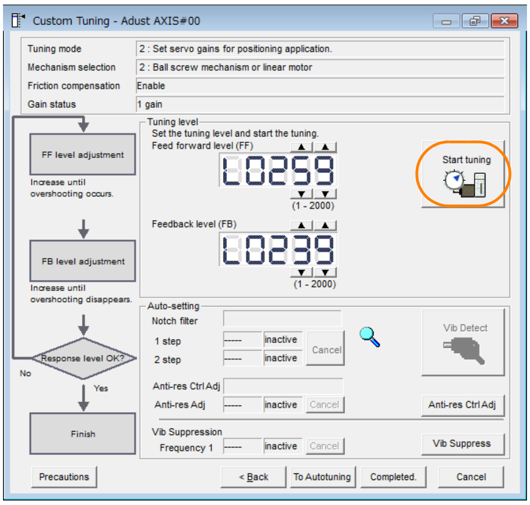


9. Turn ON the servo, enter a reference from the host controller, and then click the **Start tuning** Button.

Tuning Mode 0 or 1



Tuning Mode 2 or 3

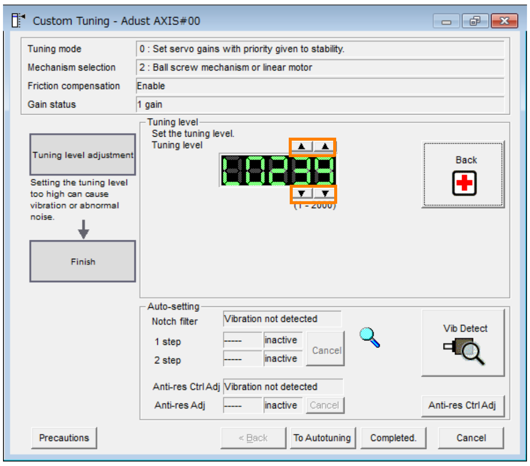


10. Use the ▲ and ▼ Buttons to change the tuning level.

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.

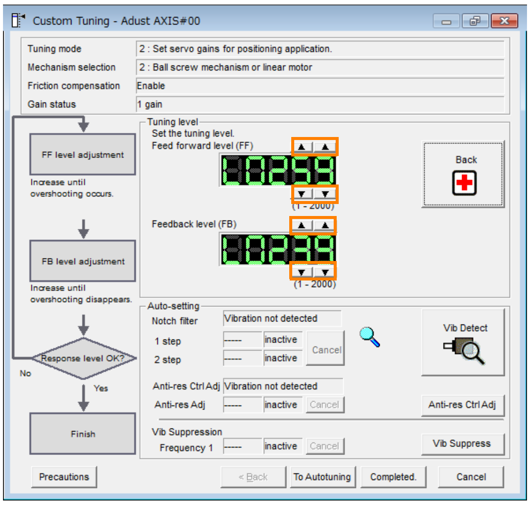
Tuning Mode 0 or 1

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.



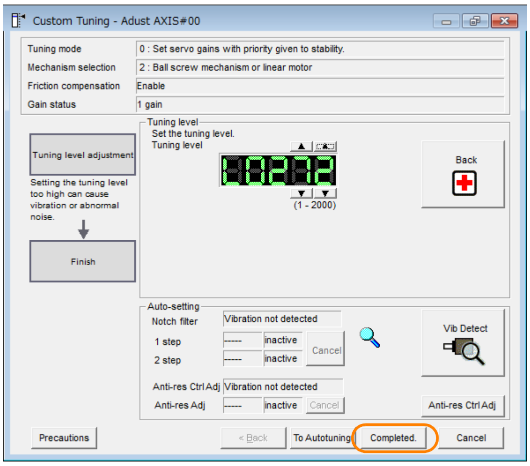
Information The new feedforward level will not be used until the positioning completed signal is output.

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 8-38

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.

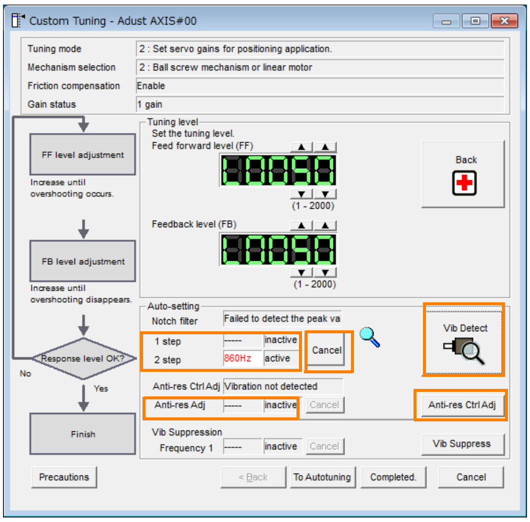
Vibration Suppression Functions

◆ Notch Filters and Automatic Anti-resonance 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.



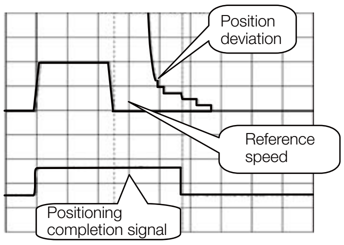
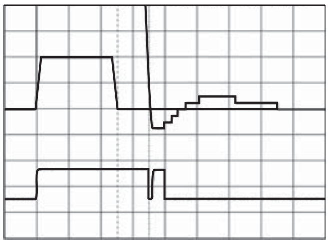
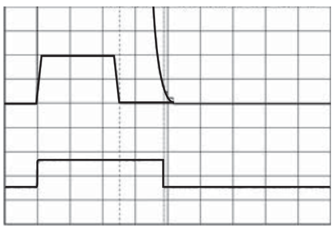
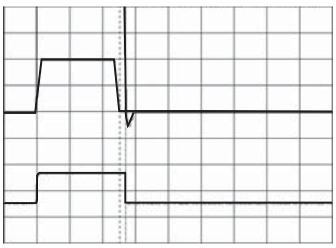
- **Auto-setting Cancel** Buttons
  The automatically set notch filter frequencies or the anti-resonance control frequencies may not always suppress vibration. Click the **Cancel** Button to reset the notch filter frequencies or the anti-resonance control frequencies to the values from just before these frequencies were set automatically.
  When they are reset, vibration detection will start again.
- **Vib Detect** Button
  While the notch filter or anti-resonance control adjustment automatic 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 function if fine-tuning is required. Refer to the following section.
  ☞ *8.8 Anti-Resonance Control Adjustment* on page 8-42
- **Vib Suppress** Button
  You cannot use this button.

8.7.5 Automatically Adjusted Function Settings

These function settings are the same as for autotuning without a host reference. Refer to the following section.

☞ *8.5.6 Automatically Adjusted Function Settings* on page 8-24

8.7.6 Tuning Example for Tuning Mode 2 or 3

Step	Measurement Display Examples	Operation
1		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 feedforward 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.

8.7.7 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	Speed Loop Gain	Yes
Pn101	Speed Loop Integral Time Constant	Yes
Pn102	Position Loop Gain	Yes
Pn103	Moment of Inertia Ratio	No
Pn408	Torque-Related Function Selections	Yes
Pn409	First Stage Notch Filter Frequency	Yes
Pn40A	First Stage Notch Filter Q Value	Yes
Pn40C	Second Stage Notch Filter Frequency	Yes
Pn40D	Second Stage Notch Filter Q Value	Yes
Pn160	Anti-Resonance Control-Related Selections	Yes
Pn161	Anti-Resonance Frequency	Yes
Pn163	Anti-Resonance Damping Gain	Yes

Yes: The parameter is automatically set.

No: The parameter is not automatically set, but the setting is read during execution.

8.8 Anti-Resonance Control Adjustment

This section describes anti-resonance control.

8.8.1 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.

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.

⚠ 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.**

Important

- 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.
- 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.

8.8.2 Preparations

Always check the following before you execute anti-resonance control adjustment.

- The control method must not be set to torque control.
- The parameters must not be write prohibited.

8.8.3 Applicable Tools

The following table lists the tools that you can use to perform anti-resonance control adjustment.

Tool	Fn No./Function Name	Operating Procedure Reference
Digital Operator	Fn204	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Tuning - Tuning***	*8.8.4 Operating Procedure* on page 8-43

8.8.4 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.

⚠ CAUTION

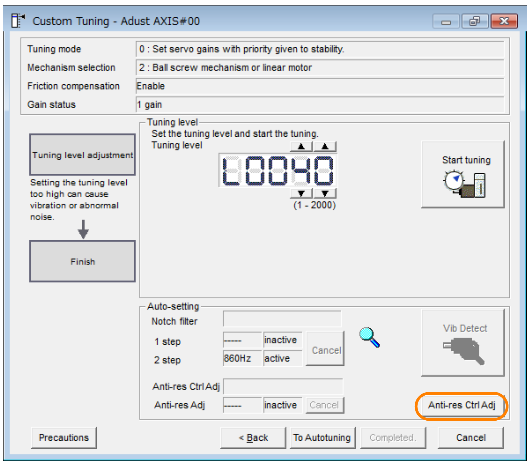
- Before you execute anti-resonance control adjustment, check the information provided in the SigmaWin+ operating manual.
  Observe the following precautions.
  - Make sure that you can perform an emergency stop at any time.
    Parameters will be set automatically when anti-resonance control adjustment 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.

1. Perform steps 1 to 8 of the procedure for custom tuning. Refer to the following section for details.

☞ *8.7.4 Operating Procedure* on page 8-34

2. Click the **Anti-res Ctrl Adj** Button.

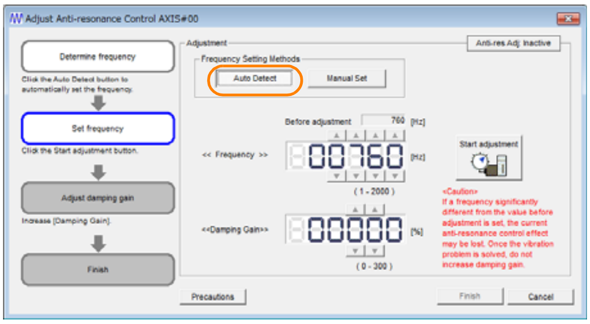
The rest of the procedure depends on whether you know the vibration frequency.



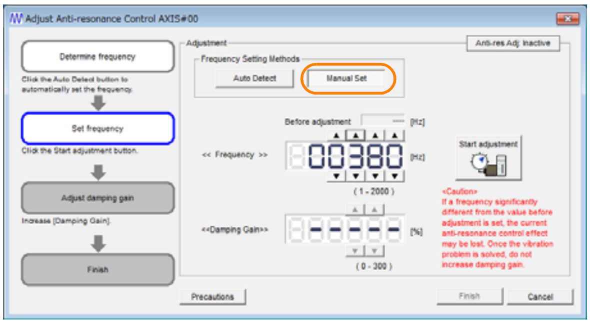
3. If you do not know the vibration frequency, click the **Auto Detect** Button. If you know the vibration frequency, click the **Manual Set** Button.

To Automatically Detect the Vibration Frequency

The frequency will be set.



To Manually Set the Vibration Frequency

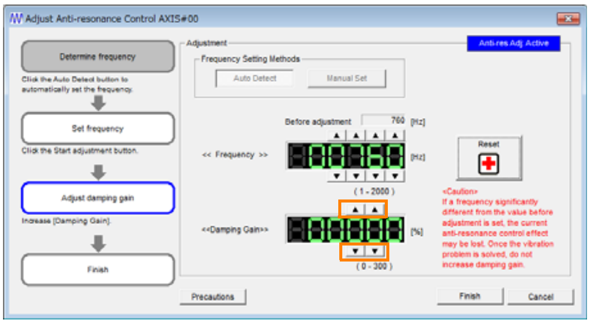


4. Click the **Start adjustment** Button.

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.

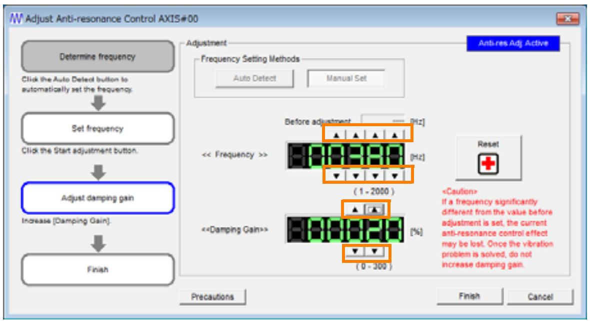
To Automatically Detect the Vibration Frequency

Change the setting of the damping gain.

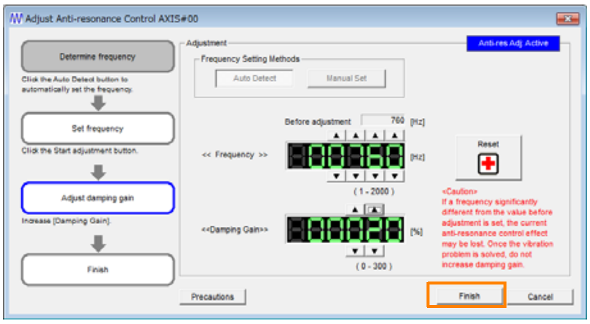


To Manually Set the Vibration Frequency

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.

8.8.5 Related Parameters

The following parameters are automatically adjusted or used as reference when you execute anti-resonance control adjustment.

Do not change the settings while anti-resonance control adjustment is being executed.

Parameter	Name	Automatic Changes
Pn160	Anti-Resonance Control-Related Selections	Yes
Pn161	Anti-Resonance Frequency	Yes
Pn162	Anti-Resonance Gain Correction	No
Pn163	Anti-Resonance Damping Gain	Yes
Pn164	Anti-Resonance Filter Time Constant 1 Correction	No
Pn165	Anti-Resonance Filter Time Constant 2 Correction	No

Yes: The parameter is automatically set.

No: The parameter is not automatically set, but the setting is read during execution.

8.8.6 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: $1 < (fb/fa) \leq 3$ 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	Classification
Pn160	n.□□□0 (default setting)	Do not use anti-resonance control.	After restart	Setup
	n.□□□1	Use anti-resonance control.		

Pn161	Anti-Resonance Frequency		Speed Position Torque		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1 Hz	1000	Immediately	Tuning
Pn162	Anti-Resonance Gain Correction		Speed Position Torque		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,000	1%	100	Immediately	Tuning
Pn163	Anti-Resonance Damping Gain		Speed Position Torque		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 300	1%	0	Immediately	Tuning
Pn164	Anti-Resonance Filter Time Constant 1 Correction		Speed Position Torque		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-1,000 to 1,000	0.01 ms	0	Immediately	Tuning
Pn165	Anti-Resonance Filter Time Constant 2 Correction		Speed Position Torque		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-1,000 to 1,000	0.01 ms	0	Immediately	Tuning
Pn166	Anti-Resonance Damping Gain 2		Speed Position Torque		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,000	1%	0	Immediately	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. ☞ *8.8.4 Operating Procedure* on page 8-43
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.

8.9 Adjustments for High-speed Control

You can perform additional adjustments based on the machine operation after performing custom tuning to enable high-speed, high-precision machine operation.

Use the following procedure.

1. Set the control function that matches the machine operation.
Select the control function to use based on the following table.

Operating Mode	Required Operation	Control Function to Use
Spindle operation	Gain switching	Gain switching

2. Set the SVCMD_IO* command and related parameters.
Refer to the following table and set the SVCMD_IO command and the required parameters.

Operating Mode	SVCMD_IO (Output)		Remarks
	G-SEL		
	Bit9	Bit8	
	Gain Switching		
Spindle operation	Select gain bank 0 to 3.		Internal speed feedforward is disabled.

- Parameters for Gain Banks 0 to 3

Parameter Name	Gain Bank			
	0	1	2	3
Speed Loop Gain	Pn100	Pn104	Pn12B	Pn12E
Speed Loop Integral Time Constant	Pn101	Pn105	Pn12C	Pn12F
Position Loop Gain	Pn102	Pn106	Pn12D	Pn130
Torque Reference Filter	Pn401	Pn412	Pn413	Pn414

Related Parameters

Pn100	Speed Loop Gain			Speed Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1 Hz	400	Immediately	Tuning
Pn101	Speed Loop Integral Time Constant			Speed Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	15 to 51,200	0.01 ms	2,000	Immediately	Tuning
Pn102	Position Loop Gain			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1/s	400	Immediately	Tuning
Pn401	First Stage First Torque Reference Filter Time Constant			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	100	Immediately	Tuning
Pn104	Second Speed Loop Gain			Speed Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1 Hz	400	Immediately	Tuning
Pn105	Second Speed Loop Integral Time Constant			Speed Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	15 to 51,200	0.01 ms	2,000	Immediately	Tuning
Pn106	Second Position Loop Gain			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1/s	400	Immediately	Tuning

Continued on next page.

Continued from previous page.

Pn412	First Stage Second Torque Reference Filter Time Constant			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	100	Immediately	Tuning

Related Monitoring

- SigmaWin+
  You can monitor gain switching with the status monitor or with tracing.
- Analog Monitors

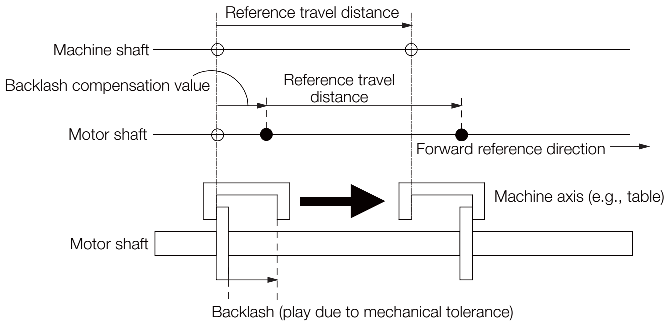
Parameter	Analog Monitor	Monitor Name	Output Value	Description
Pn006 Pn007	n.□□0B	Active Gain Monitor	1 V	Gain settings 1 are enabled.
			2 V	Gain settings 2 are enabled.
			3 V	Gain settings 3 are enabled.
			4 V	Gain settings 4 are enabled.

8.9.1 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 motor. This will ensure that the travel distance of the actual machine will be the same as the travel distance in the host controller.

Note: Backlash compensation can be used only 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.

Parameter		Meaning	When Enabled	Classification
Pn230	n. □□□0 (default setting)	Compensate forward references.	After restart	Setup
	n. □□□1	Compensate reverse references.		

◆ Backlash Compensation Value

Set the amount of backlash compensation to add to the position reference.
The amount is set in increments of 0.1 reference unit. However, when the amount is converted to encoder pulses, it is rounded off at the decimal point.

Example When Pn231 = 6,553.6 [reference units] and electronic gear ratio (Pn20E/Pn210) = 4/1:
6,553.6 × 4 = 26,214.4 [pulses]
⇒ The backlash compensation will be 26,214 encoder pulses.

Pn231	Backlash Compensation				Position
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-500,000 to 500,000	0.1 reference units	0	Immediately	Setup

Important

- The backlash compensation value is restricted by the following formula. Backlash compensation is not performed if this condition is not met.

$$\text{Pn231} \leq \frac{\text{Pn210}}{\text{Pn20E}} \times \frac{\text{Maximum motor speed [min}^{-1}]}{60} \times \text{Encoder resolution* } \times 0.00025$$

*Refer to the following section for the encoder resolution.
5.8 Electronic Gear Settings on page 5-26
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:
Pn20E = 4, Pn210 = 1, Maximum motor speed = 6,000 [min^{-1}], and Encoder resolution = 16,777,216 (24 bits)
1/4 × 6,000/60 × 16,777,216 × 0.00025 = 104,857.6 [reference units]
⇒ The backlash compensation will be limited to 104,857.6 reference units.

Example 2:
Pn20E = 4, Pn210 = 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 × 6,000/60 × (500 × 256) × 0.00025 = 800.0 [reference units]
⇒ 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+.

◆ 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.

Pn233	Backlash Compensation Time Constant				Position
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	0	Immediately	Setup

Note: Changes to the settings are applied when there is no reference pulse input and the motor is stopped. The current operation is not affected if the setting is changed during motor 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: TPOS (target position in the reference coordinate system), POS (reference position in the reference coordinate system), and APOS (feedback position in the machine coordinate system). The monitor information includes the feedback position in machine coordinate system (APOS) and other feedback information.
The backlash compensation value is subtracted from the feedback positions in the monitor information, so it is not necessary for the host controller to consider the backlash compensation value.

⚠ 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.

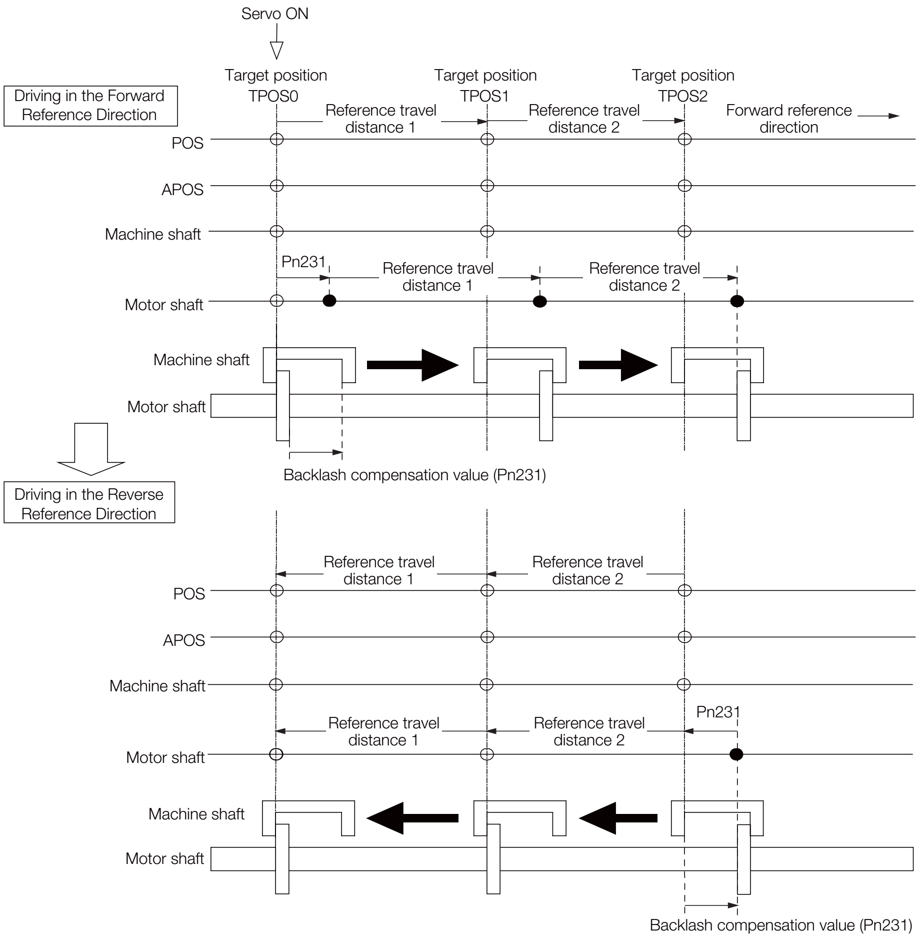
◆ Operation When the Servo Is ON

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.□□□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 APOS and the motor shaft position is as follows:

- If a reference is input in the compensation direction: APOS = Motor shaft position – Pn231
- If a reference is input in the direction opposite to the compensation direction: APOS = Motor shaft position

The following figure shows driving the motor in the forward direction from target position TPOS0 to TPOS1 and then to TPOS2, and then returning from TPOS2 to TPOS1 and then to TPOS0.
Backlash compensation is applied when moving from TPOS0 to TPOS1, but not when moving from TPOS2 to TPOS1.

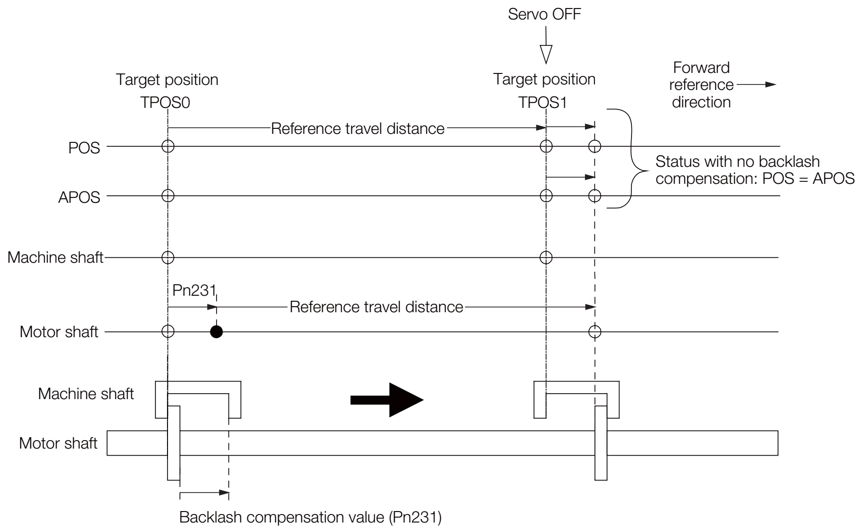


◆ Operation When the Servo Is OFF

Backlash compensation is not applied when the servo is OFF (i.e., when power is not supplied to motor). Therefore, the reference position POS is moved by only the backlash compensation value.
The relationship between APOS and the motor shaft position is as follows:

- When servo is OFF: APOS = Motor shaft position

The following figure shows what happens when the servo is turned OFF after driving the motor in the forward direction from target position TPOS0 to TPOS1. Backlash compensation is not applied when the servo is OFF. (The SERVOPACK manages the position data so that APOS and POS are the same.)



◆ Operation When There Is Overtravel

When there is overtravel (i.e., when driving is prohibited due to an overtravel signal or software limit), the operation is the same as for when the servo is OFF (*◆ Operation When the Servo Is OFF* on page 8-51), 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 8-50) 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.

Tuning
8

MECHATROLINK Monitor Information

This section describes the information that is set for the MECHATROLINK monitor information (monitor 1, monitor 2, monitor 3, and monitor 4) and the backlash compensation operation.

Monitor Code	Abbreviation	Description	Unit	Remarks
0	POS	Reference position in the reference coordinate system (after the position reference filter)	Reference units	–
1	MPOS	Reference position	Reference units	–
2	PERR	Position deviation	Reference units	–
3	APOS	Feedback position in machine coordinate system	Reference units	Feedback position with the backlash compensation subtracted
4	LPOS	Feedback latch position in the machine coordinate system	Reference units	Feedback position with the backlash compensation subtracted
5	IPOS	Reference position in the reference coordinate system (before the position reference filter)	Reference units	–
6	TPOS	Target position in the reference coordinate system	Reference units	–
E	OMN1	Option monitor 1 (selected with Pn824)	–	–
F	OMN2	Option monitor 2 (selected with Pn825)	–	–

Parameter		Monitor Information	Output Unit	Remarks
Pn824 Pn825	0003 hex	Position deviation (lower 32 bits)	Reference units	–
	0004 hex	Position deviation (upper 32 bits)	Reference units	–
	000A hex	PG count (lower 32 bits)	Reference units	Count value of the actually driven motor encoder
	000B hex	PG count (upper 32 bits)	Reference units	
	000C hex	FPG count (lower 32 bits)	Reference units	Count value of the actually driven external encoder
	000D hex	FPG count (upper 32 bits)	Reference units	
	0017 hex	Input reference pulse speed	min^{-1}	–
	0018 hex	Position deviation	Reference units	–
	001C hex	Input reference pulse counter	Reference units	–
	001D hex	Feedback pulse counter	Encoder pulses	–
	001E hex	Fully-closed feedback pulse counter	External encoder resolution	–
	0080 hex	Previous value of latched feedback position (LPOS)	Reference units	Feedback position with the backlash compensation subtracted

◆ Related Monitoring Diagrams

The following symbols are used in the related monitoring diagrams.

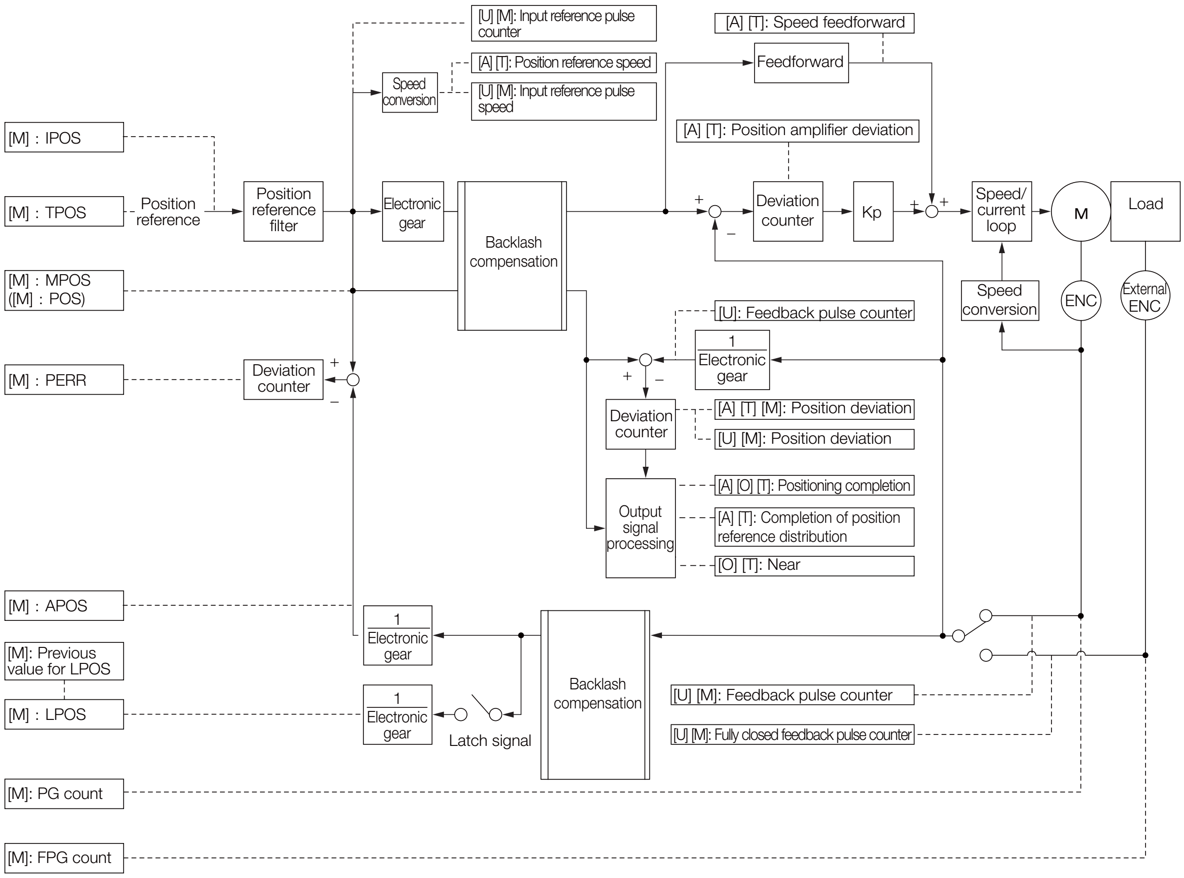
[A]: Analog monitor

[U]: Monitor mode (Un monitor)

[O]: Output signal

[T]: Trace data

[M]: MECHATROLINK monitor information



8.10 Manual Tuning

This section describes manual tuning.

8.10.1 Tuning the Servo Gains

Servo Gains

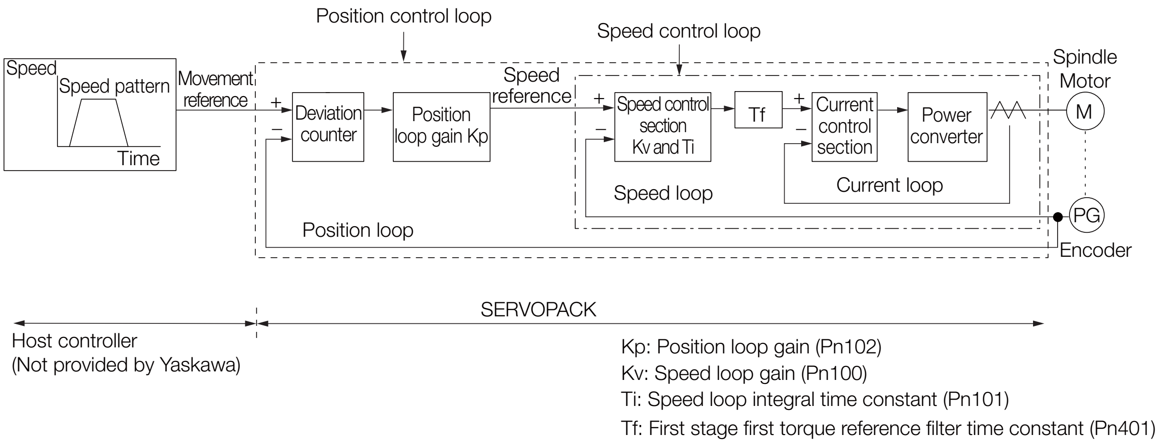


Figure 8.1 Simplified Block Diagram for Position Control

In order to manually tune the servo gains, you must understand the configuration and characteristic of the SERVOPACK and adjust the servo gains individually. In most cases, if you greatly change any one parameter, you must adjust the other parameters again. To check the response characteristic, you must prepare a measuring instrument to monitor the output waveforms from the analog monitor.

The SERVOPACK has three feedback systems (the position loop, speed loop, and current loop), and the response characteristic must be increased more with the inner loops. If this relationship is not maintained, the response characteristic will suffer and vibration will occur more easily.

A sufficient response characteristic is ensured for the current loop. There is never a need for it to be adjusted by the user.

Outline

You can use manual tuning to set the servo gains in the SERVOPACK to increase the response characteristic of the SERVOPACK. 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.□□□2) to detect vibration. Refer to the following section for information on vibration detection.

☞ *6.9 Initializing the Vibration Detection Level* on page 6-24

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 SERVOPACK. 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.

Pn102	Position Loop Gain			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	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.

$$\text{Pn520} \geq \frac{\text{Maximum feed speed [reference units/s]}}{\text{Pn102} \div 10\ (1/\text{s})} \times 2.0$$

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.

Pn520	Position Deviation Overflow Alarm Level			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	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.

Pn100	Speed Loop Gain			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1 Hz	400	Immediately	Tuning

$$\text{Setting of Pn103} = \frac{\text{Load moment of inertia at motor shaft } (J_L)}{\text{Spindle Motor moment of inertia } (J_M)} \times 100(\%)$$

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.

Pn103	Moment of Inertia Ratio			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 20,000	1%	100	Immediately	Tuning

◆ Speed Loop Integral Time Constant

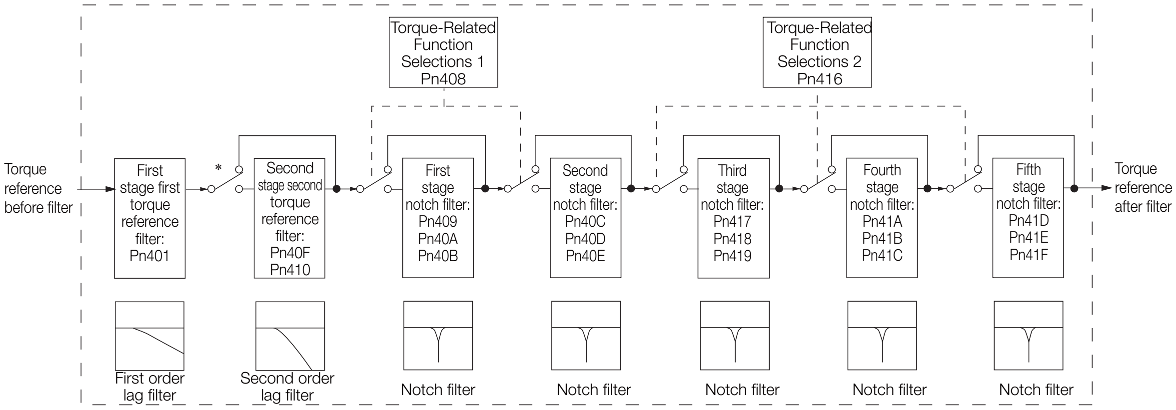
To enable response to even small inputs, the speed loop has an integral element. The integral element becomes a delay factor in the servo system. If the time constant is set too high, overshooting will occur, positioning settling time will increase, and the response characteristic will suffer.

Pn101	Speed Loop Integral Time Constant			Speed Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	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.□X□X and Pn416 = n.□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	First Stage First Torque Reference Filter Time Constant			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	100	Immediately	Tuning
Pn40F	Second Stage Second Torque Reference Filter Frequency			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	100 to 5,000	1 Hz	5000*	Immediately	Tuning
Pn410	Second Stage Second Torque Reference Filter Q Value			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 100	0.01	50	Immediately	Tuning

* The filter is disabled if you set the parameter to 5,000.

■ Notch Filters

The notch filter can eliminate specific frequency elements generated by the vibration of sources such as resonance of the shaft of a ball screw.

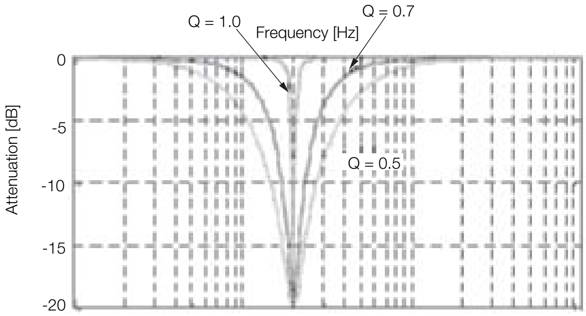
The notch filter puts a notch in the gain curve at the specific vibration frequency (called the notch frequency). The frequency components near the notch frequency can be reduced or removed with a notch filter.

Notch filters are set with three parameters for the notch filter frequency, notch filter Q value, and notch filter depth. This section describes the notch filter Q value and notch filter depth.

- Notch filter Q Value

The setting of the notch filter Q value determines the width of the frequencies that are filtered for the notch filter frequency. The width of the notch changes with the notch filter Q value. The larger the notch filter Q value is, the steeper the notch is and the narrower the width of frequencies that are filtered is.

The notch filter frequency characteristics for different notch filter Q values are shown below.



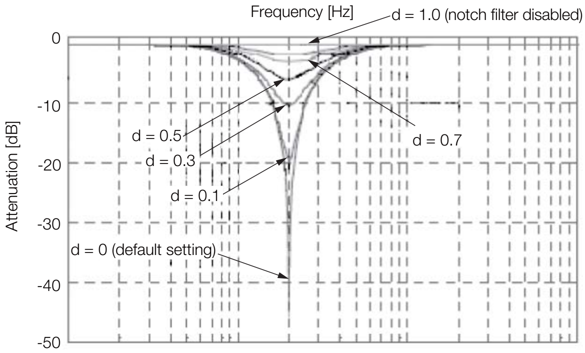
Note: The above notch filter frequency characteristics are based on calculated values and may be different from actual characteristics.

• Notch Filter Depth

The setting of the notch filter depth determines the depth of the frequencies that are filtered for the notch filter frequency. The depth of the notch changes with the notch filter depth. The smaller the notch filter depth is, the deeper the notch is, increasing the effect of vibration suppression. However, if the value is too small, vibration can actually increase.

The notch filter is disabled if the notch filter depth, d, is set to 1.0 (i.e., if Pn419 is set to 1,000).

The notch filter frequency characteristics for different notch filter depths are shown below.



Note: The above notch filter frequency characteristics are based on calculated values and may be different from actual characteristics.

You can enable or disable the notch filter with Pn408.

Parameter		Meaning	When Enabled	Classification
Pn408	n.□□□0 (default setting)	Disable first stage notch filter.	Immediately	Setup
	n.□□□1	Enable first stage notch filter.		
	n.□0□□ (default setting)	Disable second stage notch filter.		
	n.□1□□	Enable second stage notch filter.		
Pn416	n.□□□0 (default setting)	Disable third stage notch filter.		
	n.□□□1	Enable third stage notch filter.		
	n.□□0□ (default setting)	Disable fourth stage notch filter.		
	n.□□1□	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.

Pn409 — First Stage Notch Filter Frequency (Speed, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
50 to 5,000	1 Hz	5,000	Immediately	Tuning

Pn40A — First Stage Notch Filter Q Value (Speed, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
50 to 1,000	0.01	70	Immediately	Tuning

Pn40B — First Stage Notch Filter Depth (Speed, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
0 to 1,000	0.001	0	Immediately	Tuning

Pn40C — Second Stage Notch Filter Frequency (Speed, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
50 to 5,000	1 Hz	5,000	Immediately	Tuning

Pn40D — Second Stage Notch Filter Q Value (Speed, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
50 to 1,000	0.01	70	Immediately	Tuning

Pn40E — Second Stage Notch Filter Depth (Speed, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
0 to 1,000	0.001	0	Immediately	Tuning

Pn417 — Third Stage Notch Filter Frequency (Speed, Position, Torque)

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)

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, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
0 to 1,000	0.001	0	Immediately	Tuning

Pn41A — Fourth Stage Notch Filter Frequency (Speed, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
50 to 5,000	1 Hz	5,000	Immediately	Tuning

Pn41B — Fourth Stage Notch Filter Q Value (Speed, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
50 to 1,000	0.01	70	Immediately	Tuning

Pn41C — Fourth Stage Notch Filter Depth (Speed, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
0 to 1,000	0.001	0	Immediately	Tuning

Pn41D — Fifth Stage Notch Filter Frequency (Speed, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
50 to 5,000	1 Hz	5,000	Immediately	Tuning

Pn41E — Fifth Stage Notch Filter Q Value (Speed, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
50 to 1,000	0.01	70	Immediately	Tuning

Pn41F — Fifth Stage Notch Filter Depth (Speed, Position, Torque)

Setting Range	Setting Unit	Default Setting	When Enabled	Classification
0 to 1,000	0.001	0	Immediately	Tuning

Important

- Do not set notch filter frequencies (Pn409, Pn40C, Pn417, Pn41A, and Pn41D) that are close to the speed loop's response frequency. Set a frequency that is at least four times the speed loop gain (Pn100). (However, Pn103 (Moment of Inertia Ratio) must be set correctly. If the setting is not correct, vibration may occur and the machine may be damaged.
- Change the notch filter frequencies (Pn409, Pn40C, Pn417, Pn41A, and Pn41D) only while the motor 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 motor 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 motor.

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.

> Important
> 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), gain settings 3, and gain settings 4.

- Speed Loop Gain (Pn100 [Hz]) and Position Loop Gain (Pn102 [/s])
  Stable gain: Pn102 [/s] $\leq 2\pi \times$ Pn100/4 [Hz]
  Critical gain: Pn102 [/s] $< 2\pi \times$ Pn100 [Hz]

- Speed Loop Gain (Pn100 [Hz]) and Speed Loop Integral Time Constant (Pn101 [ms])
  Stable gain: Pn101 [ms] $\geq$ 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/($2\pi \times$ Pn100 [Hz] $\times$ 4)
  Critical gain: Pn401 [ms] $<$ 1,000/($2\pi \times$ Pn100 [Hz] $\times$ 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 notch 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] ≤ 1,000/(2π × Pn100 [Hz] × 4)
  Critical gain: Pn308 [ms] < 1,000/(2π × Pn100 [Hz] × 1)

◆ When Pn10B = n.□□1□ (I-P Control)

Guidelines are given below for gain settings 1.

The same guidelines apply to gain settings 2 (Pn104, Pn105, Pn106, and Pn412), gain settings 3, and gain settings 4.

For I-P control, the relationships between the speed loop integral time constant, speed loop gain, and position loop gain are different from the relationships for PI control. The relationship between other servo gains is the same as for PI control.

- Speed Loop Gain (Pn100 [Hz]) and Speed Loop Integral Time Constant (Pn101 [ms])
  Stable gain: Pn100 [Hz] ≥ 320/Pn101 [ms]
- Position Loop Gain (Pn102 [/s]) and Speed Loop Integral Time Constant (Pn101 [ms])
  Stable gain: Pn102 [/s] ≤ 320/Pn101 [ms]

Information

Selecting the Speed Loop Control Method (PI Control or I-P Control)
Usually, I-P control is effective for high-speed positioning and high-speed, high-precision processing applications. With I-P control, you can use a lower position loop gain than for PI control to reduce the positioning time and reduce arc radius reduction. However, if you can use mode switching to change to proportional control to achieve the desired application, then using PI control would be the normal choice.

◆ Decimal Points in Parameter Settings

For the SGD7S SERVOPACKs, decimal places are given for the settings of parameters on the Digital Operator, Panel Operator, and in the manual. For example with Pn100 (Speed Loop Gain), Pn100 = 40.0 is used to indicate a setting of 40.0 Hz. In the following adjusted value guidelines, the decimal places are also given.

Example

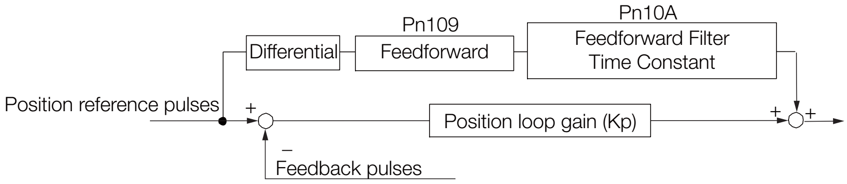
- Speed Loop Gain (Pn100 [Hz]) and Speed Loop Integral Time Constant (Pn101 [ms])
  Stable gain: Pn101 [ms] ≥ 4,000/(2π × Pn100 [Hz]), therefore
  If Pn100 = 40.0 [Hz], then Pn101 = 4,000/(2π × 40.0) ≈ 15.92 [ms].

8.10.2 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.

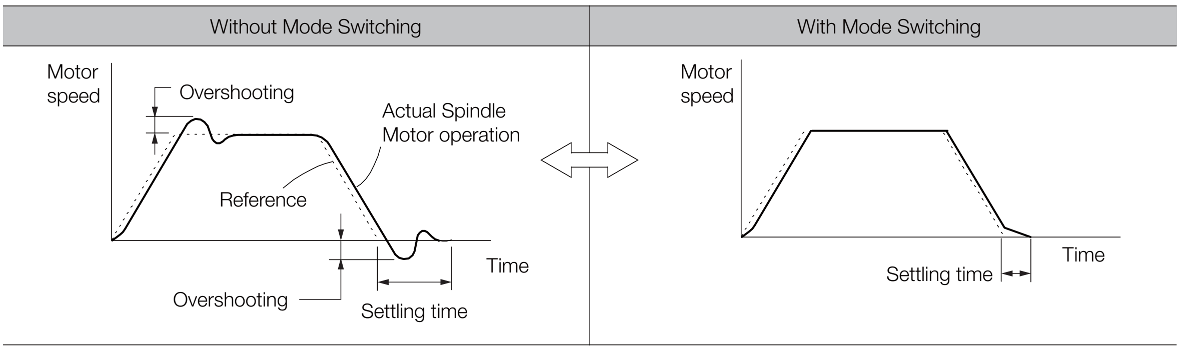


Pn109	Feedforward				Position
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	1%	0	Immediately	Tuning
Pn10A	Feedforward Filter Time Constant				Position
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 6,400	0.01 ms	0	Immediately	Tuning

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 PI Control)

You can use mode switching to automatically change between proportional control and PI control.
Overshooting caused by acceleration and deceleration can be suppressed and the settling time can be reduced by setting the switching condition and switching levels.



◆ Related Parameters

Select the switching condition for mode switching with Pn10B = n.□□□X.

Parameter		Mode Switching Selection	Parameter That Sets the Level	When Enabled	Classification
Pn10B	n.□□□0	Use the internal torque reference as the condition.	Pn10C	Immediately	Setup
	n.□□□1	Use the speed reference as the condition.	Pn10D		
	n.□□□2	Use the acceleration reference as the condition.	Pn10E		
	n.□□□3	Use the position deviation as the condition.	Pn10F		
	n.□□□4 (default setting)	Do not use mode switching.	–		

■ Parameters That Set the Switching Levels

Pn10C	Mode Switching Level for Torque Reference			Speed	Position
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%	200	Immediately	Tuning

Pn10D	Mode Switching Level for Speed Reference			Speed	Position
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 min^{-1}	0	Immediately	Tuning

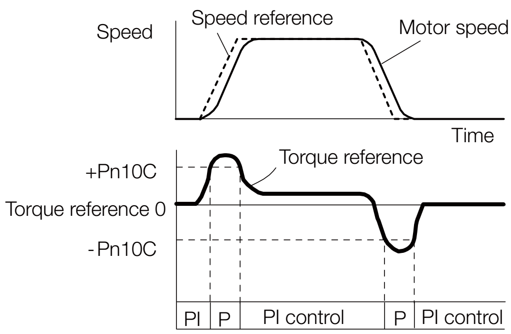
Pn10E	Mode Switching Level for Acceleration			Speed	Position
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 30,000	1 min^{-1}/s	0	Immediately	Tuning

Pn10F	Mode Switching Level for Position Deviation				Position
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 reference unit	0	Immediately	Tuning

■ Using the Torque Reference as the Mode Switching Condition (Default Setting)

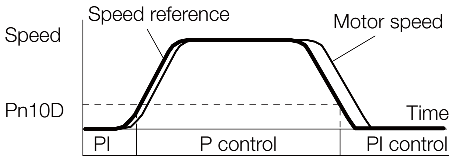
When the torque reference equals or exceeds the torque set for the mode switching level for torque reference (Pn10C), the speed loop is changed to P control.

The default setting for the torque reference level is 200%.



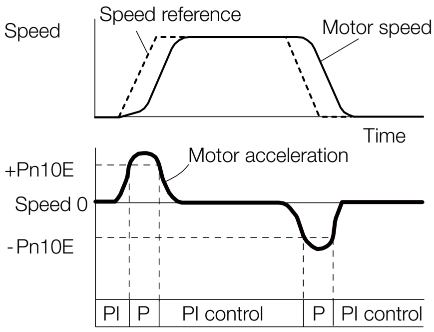
■ Using the Speed Reference as the Mode Switching Condition

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.



■ Using the Acceleration as the Mode Switching Condition

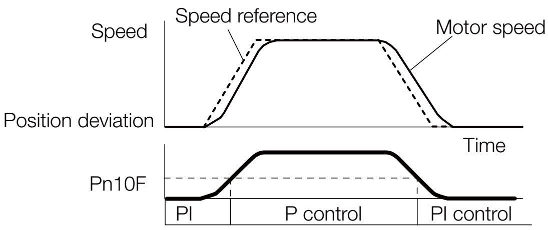
When the speed reference equals or exceeds the acceleration rate set for the mode switching level for acceleration (Pn10E), the speed loop is changed to P control.



◆ 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.



Monitoring

9

This chapter provides information on monitoring SERVOPACK product information and SERVOPACK status.

9.1 Monitoring Product Information

9.1.1 Items That You Can Monitor

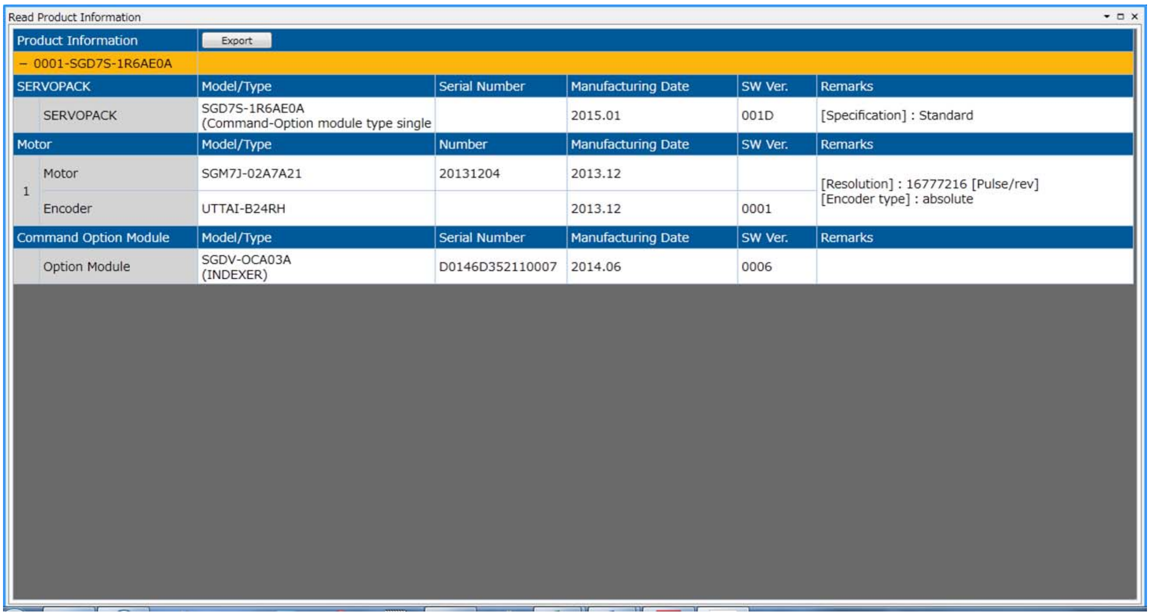
Monitor Items	
Information on SERVOPACKs	• SERVOPACK model • SERVOPACK software version • SERVOPACK special specifications • SERVOPACK serial number • SERVOPACK manufacturing date
Information on Spindle Motors	• Spindle Motor model • Spindle Motor serial number* • Spindle Motor manufacturing date*
Information on Encoders	• Encoder model • Encoder resolution • Encoder type • Encoder software version* • Encoder serial number* • Encoder manufacturing date*
Information on Option Modules	• Option Module model • Option Module software version • Option Module special specifications • Option Module serial number • Option Module manufacturing date

* These items are not displayed when using a pulse encoder.

9.1.2 Operating Procedures

Use the following procedure to display the Servo Drive product information.

- Select ***Read Product Information*** in the Menu Dialog Box of the SigmaWin+. The Read Product Information Window will be displayed.



Information

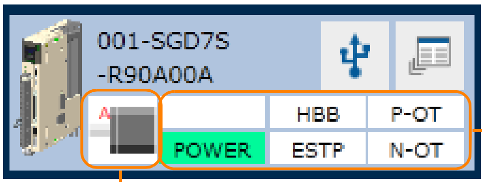
- With the Digital Operator, you can use Fn011, Fn012, and Fn01E to monitor this information.
  Refer to the following manual for the differences in the monitor items compared with the SigmaWin+.
  Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)

9.2 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 Operation, Status, and I/O

Items That You Can Monitor

The items that you can monitor on the Operation Pane, Status Pane, and I/O Pane are listed below.

- Operation Pane

Monitor Items	
• Motor Speed • Speed Reference • Internal Torque Reference • Angle of Rotation 1 (number of encoder pulses from encoder phase C) • Angle of Rotation 2 (electrical angle from polarity origin) • Input Reference Pulse Speed • Deviation Counter (Position Deviation)	• Cumulative Load • Regenerative Load • Power Consumption • Consumed Power • Cumulative Power Consumption • DB Resistor Consumption Power • Input Reference Pulse Counter • Feedback Pulse Counter • Fully Closed Feedback Pulse Counter • Total Operating Time

- Status Pane

Monitor Items	
• Main Circuit • Encoder (PGRDY) • Motor Power (Request) • Motor Power ON • Rotation (Movement) Direction • Mode Switch • Speed Reference (V-Ref) • Torque Reference (T-Ref)	• Position Reference (PULS) • Position Reference Direction • Surge Current Limiting Resistor Short Relay • Regenerative Transistor • Regenerative Error Detection • AC Power ON • Overcurrent • Origin Not Passed

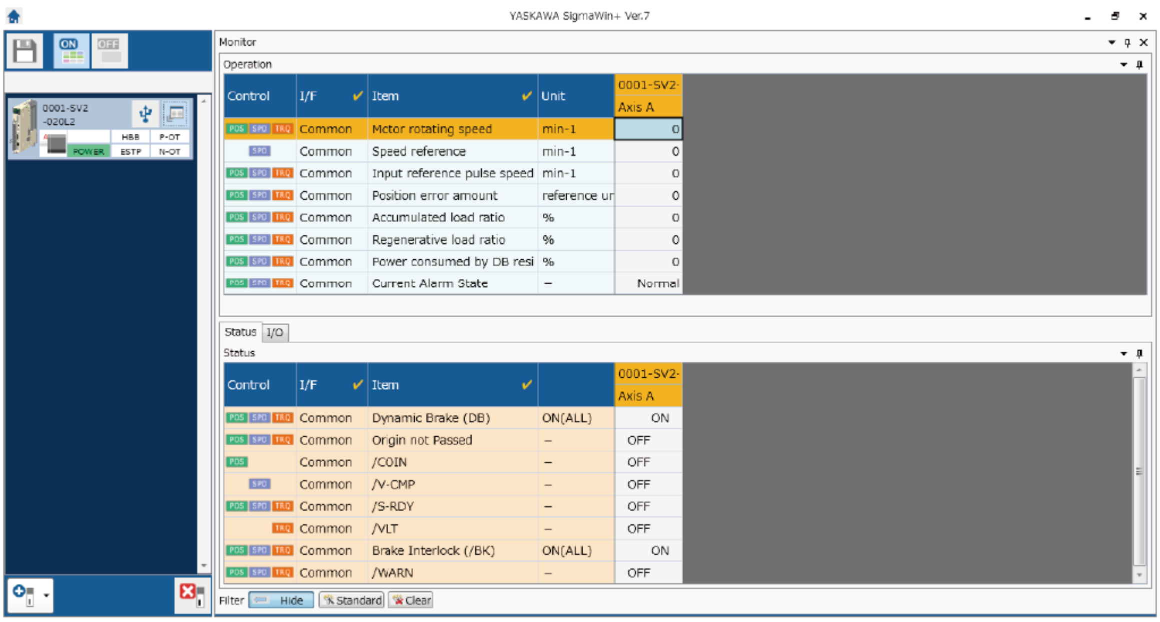
• I/O Pane

Monitor Items			
Input Signal Status	• 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) • /G-SEL (Gain Selection 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)	Output Signal Status	• 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) Signal • /VLT (Speed Limit Detection Output Signal) • /BK (Brake Output Signal) • /WARN (Warning Output Signal) • /NEAR (Near 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) • /PM (Preventative Maintenance Output Signal)

Operating Procedure

Use the following procedure to display the Operation Monitor, Status Monitor, and I/O Monitor for the SERVOPACK.

• Select **Monitor** in the SigmaWin+ Menu Dialog Box.
  The Operation Pane, Status Pane, and I/O Pane will be displayed in the Monitor Window.

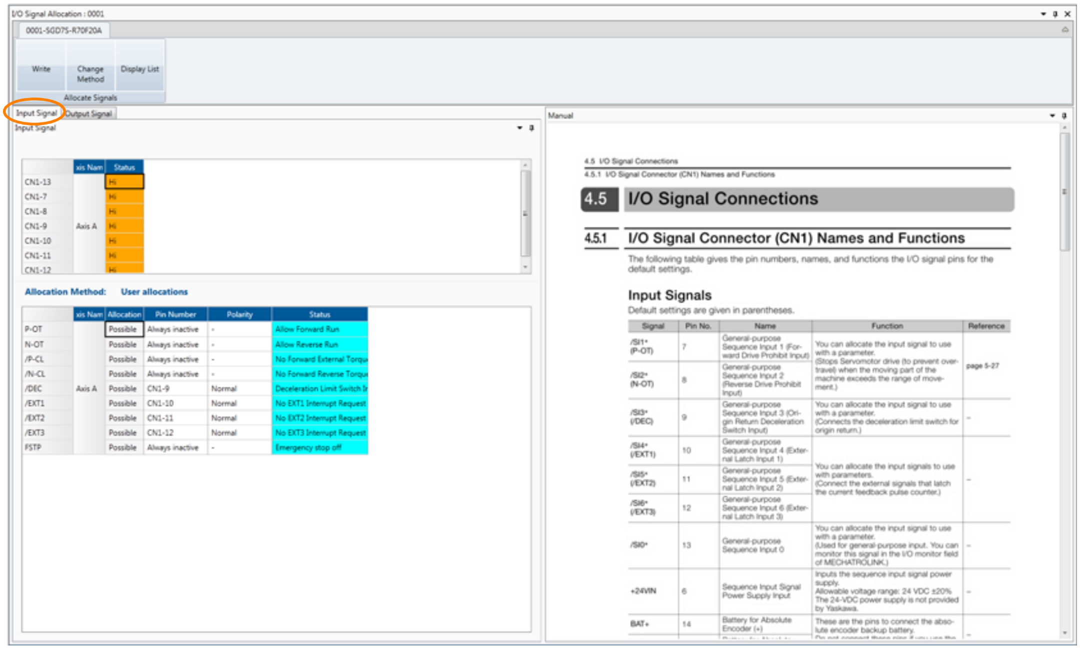


Information You can flexibly change the contents that are displayed in the Monitor Window. Refer to the following manual for details.
📖 Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

9.2.3 I/O Signals Status Monitor

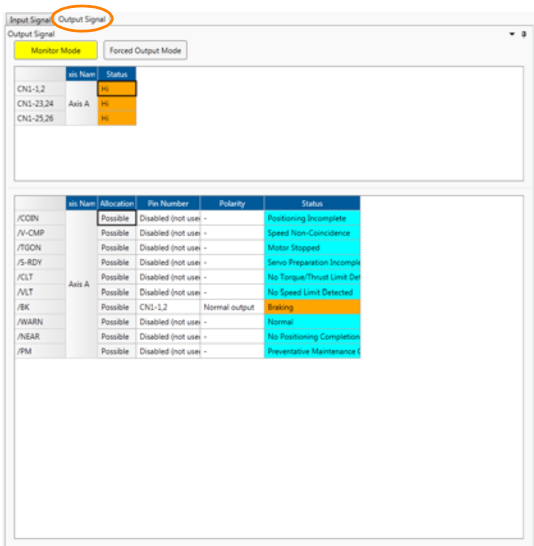
Use the following procedure to check the status of the I/O signals.

1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
2. Select **I/O Signal Allocation** in the Menu Dialog Box.
   The I/O Signal Allocation Window will be displayed.
3. Click the **Input Signal** Tab.



Check the status of the input signals.

4. Click the **Output Signal** Tab.



Check the status of the output signals.

Information

You can also use the above window to check wiring.

- Checking Input Signal Wiring
  Change the signal status at the host controller. If the input signal status on the window changes accordingly, then the wiring is correct.
- Checking Output Signal Wiring
  Click the **Force Output Mode** Button. This will force the output signal status to change. If the signal status at the host controller changes accordingly, then the wiring is correct.
  You cannot use the **Force Output Mode** Button while the servo is ON.

For details, refer to the following manual.

AC Servo Drive Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

9.2.4 Spindle Axis Load Meter

Use a load meter to determine how much of the capacity of the spindle motor is being used. The load meter displays a percentage. Set the Load Ratio Output Base Selection (Pn01C = n.□□□X) based on that percentage.
Set the load meter base setting, for example, to operate the spindle axis for only a short period of time to perform cutting or to perform continuous cutting with the spindle axis, according to your needs.
Determine how to display the information from the spindle axis load meter at the host controller so that it is easy to view, i.e., as numerical data, in the form of a bar graph, or as a traditional needle-type display.
The load meter's monitor value changes on a short interval. Set the Load Meter Filter Time Constant (Pn43F) to smooth out changes in the monitor value.

Load Meter Monitor Selection

There are the following two methods of load meter monitoring.

- Using analog monitor 1/2
  Refer to the following section for details.
  9.3.3 Using a Measuring Instrument on page 9-12
- Using MECHATROLINK command optional monitor 1/2
  Set Optional Monitor 1 as a load meter monitor (Pn824 = 003E) or Optional Monitor 2 as a load meter monitor (Pn825 = 003E).
  Use SEL_MON1, SEL_MON2, or SEL_MON3 in the MECHATROLINK command SVCMD_CTRL area to select Optional Monitor 1 or Optional Monitor 2.
  Refer to the following manual for MECHATROLINK command details.
  Σ-7-Series MECHATROLINK-III Communications Standard Servo Profile Command Manual (Manual No.: SIEP S800001 31)

Setting Example to Monitor the Load Meter with SEL_MON3

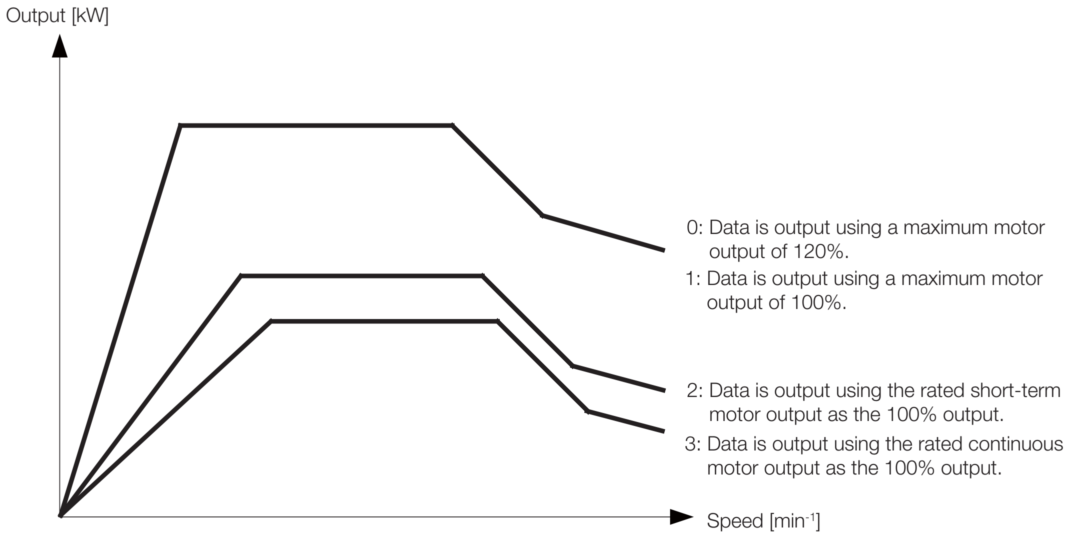
Pn824 = 003E (Selects a load meter for Optional Monitor 1.)
SVCMD_CTRL.SEL_MON3 = 0E (Selects Optional Monitor 1 for Monitor Selection 3.)

Load Meter Base Selection

You can set a parameter to specify the base for the load meter according to the output characteristics of the Spindle Motor.

Parameter		Meaning	When Enabled	Classification
Pn01C	n.□□□0 (default setting)	Outputs the load ratio using the 10-second rated output of the motor as the 120% output.	After restart	Setup
	n.□□□1	Outputs the load ratio using the 10-second rated output of the motor as the 100% output.		
	n.□□□2	Outputs the load ratio using the rated short-term motor output (50% ED) as the 100% output.		
	n.□□□3	Outputs the load ratio using the rated continuous motor output as the 100% output.		

The relationship between the Spindle Motor output characteristics and load meter base is shown below.



Load Meter Monitor Value Update Interval Selection

The load meter reflects the output of the Spindle Motor, so the monitor value is in a state of constant change. When displayed by a host controller, the monitor value may be difficult to read.

You can set the SERVOPACK's Load Meter Filter Time Constant (Pn43F) to smooth out changes in the monitor value.

The load meter reflects the output of the Spindle Motor, so it is in a state of constant change. Therefore, a filter must be applied to the load meter monitor value when it is displayed on the host controller.
You can use the following SERVOPACK parameter to set a filter.

Pn43F	Load Meter Filter Time Constant			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 5,000	1 ms	100	Immediately	Tuning

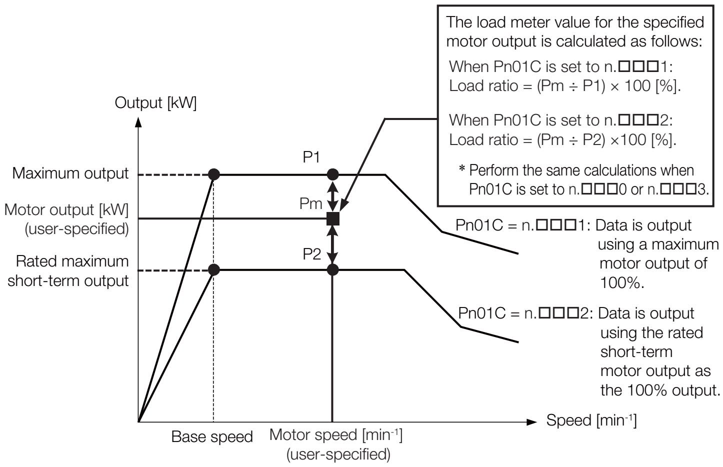
Note: Set this parameter to 0 to disable the filter.

Monitoring

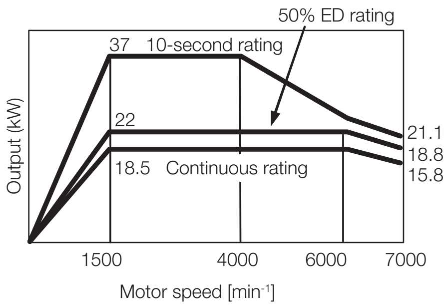
9

Load Meter Output Example

The following example uses the UAKAJ-22C Spindle Motor and shows the load meter output calculations.



UAKAJ-22C Output Characteristic



If the motor output is 26 kW when the Spindle Motor is rotating at 3,000 min^{-1}, the load meter monitor value for each load meter base setting is as follows:

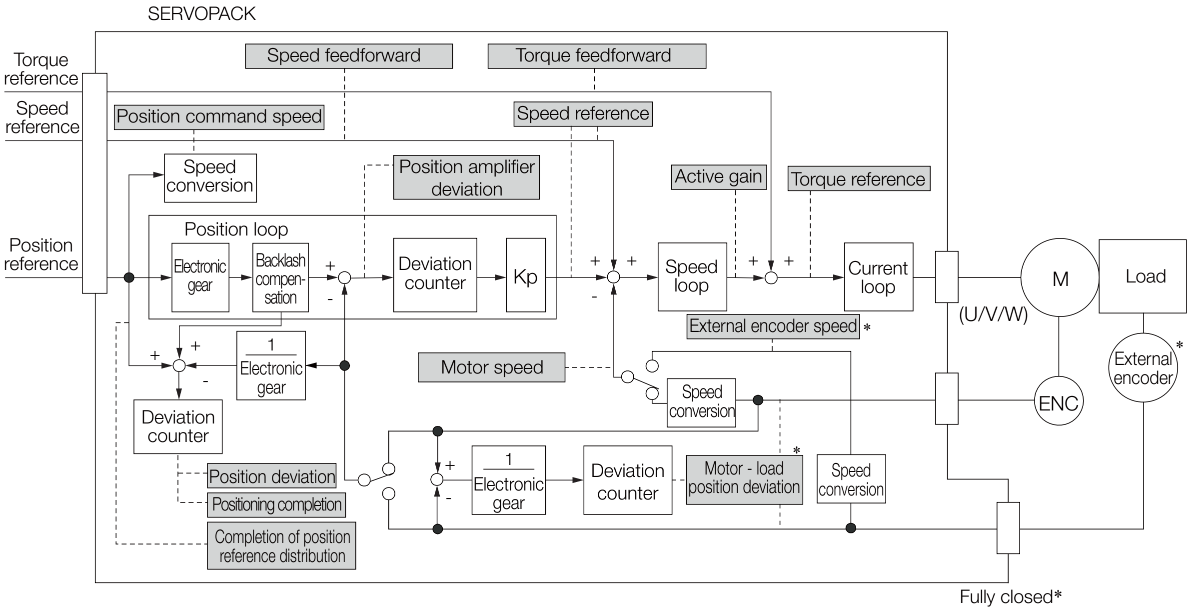
- Pn01C = n.□□□0: Data is output using a maximum motor output of 120%.
  Load meter = (26 [kW] ÷ 37 [kW]) × 120 [%] = 84.3 [%] → 843 [0.1%] → 34B hex
- Pn01C = n.□□□1: Data is output using a maximum motor output of 100%.
  Load meter = (26 [kW] ÷ 37 [kW]) × 100 [%] = 70.3 [%] → 703 [0.1%] → 2BF hex
- Pn01C = n.□□□2: Data is output using the rated short-term motor output (50% ED) as the 100% output.
  Load meter = (26 [kW] ÷ 22 [kW]) × 100 [%] = 118.2 [%] → 1182 [0.1%] → 49E hex
- Pn01C = n.□□□3: Data is output using the rated continuous motor output as the 100% output.
  Load meter = (26 [kW] ÷ 18.5 [kW]) × 100 [%] = 140.5 [%] → 1405 [0.1%] → 57D hex

9.3 Monitoring Machine Operation Status and Signal Waveforms

To monitor waveforms, use the SigmaWin+ trace function or a measuring instrument, such as a memory recorder.

9.3.1 Items That You Can Monitor

You can use the SigmaWin+ or a measuring instrument to monitor the shaded items in the following block diagram.



* This speed is available when fully-closed loop control is being used.

9.3.2 Using the SigmaWin+

This section describes how to trace data and I/O with the SigmaWin+.

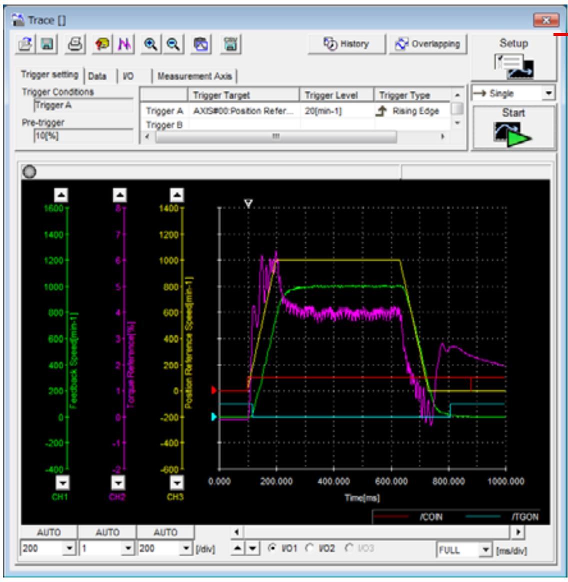
Refer to the following manual for detailed operating procedures for the SigmaWin+.

Engineering Tool SigmaWin+ Operation (Manual No.: SIEP S800001 34)

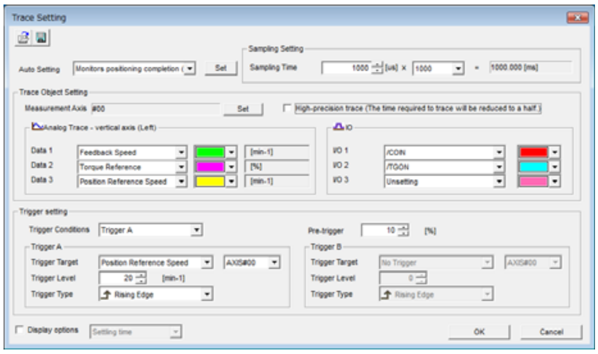
Operating Procedure

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.



Click this button to display the Trace Setting Dialog Box shown below, and set the data to trace and the trace conditions.



Trace Objects

You can trace the following items.

- Data Tracing

Trace Objects	
• Torque Reference • Feedback Speed • Reference Speed • Position Reference Speed • Position Error (Deviation) • Position Amplifier Error (Deviation) • Motor - Load Position Deviation	• Speed Feedforward • Torque Feedforward • Effective (Active) Gain • Main Circuit DC Voltage • External Encoder Speed • Control Mode • Load Meter

• I/O Tracing

Trace Objects			
Input Signals	• P-OT (Forward Drive Prohibit Input Signal) • N-OT (Reverse Drive Prohibit Input Signal) • /G-SEL (Gain Selection 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) • SEN (Absolute Data Request 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) • /BK (Brake Output Signal) • /WARN (Warning Output Signal) • /NEAR (Near 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) • PSET (Positioning Completion Output Signal) • CMDRDY (Command Ready Signal)

9.3.3 Using a Measuring Instrument

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.

☞ *4.7.3 Analog Monitor Connector (CN5)* on page 4-28

Setting the Monitor Object

Use Pn006 = n.□□XX and Pn007 = n.□□XX (Analog Monitor 1 and 2 Signal Selections) to set the items to monitor.

Line Color	Signal	Parameter Setting
White	Analog monitor 1	Pn006 = n.□□XX
Red	Analog monitor 2	Pn007 = n.□□XX
Black (2 lines)	GND	–

Parameter		Description		
		Monitor Signal	Output Unit	Remarks
Pn006 or Pn007	n.□□00 (default setting of Pn007)	Motor Speed	1 V/1,000 min^{-1}	–
	n.□□01	Speed Reference	1 V/1,000 min^{-1}	–
	n.□□02 (default setting of Pn006)	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
	n.□□05	Position Reference Speed	1 V/1,000 min^{-1}	–
	n.□□06	Reserved Setting (Do not change.)	–	–
	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	1 V/1,000 min^{-1}	–
	n.□□0A	Torque Feedforward	1 V/100% rated torque	–
	n.□□0B	Active Gain	1st gain: 1 V 2nd gain: 2 V 3rd gain: 3 V 4th gain: 4 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)	–
	n.□□46	Load Meter	6 V/100%	–

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:

$$\begin{array}{c}\text{Analog monitor 1}\\\text{output voltage}\end{array} = (-1) \times \left\{ \begin{array}{c}\text{Analog Monitor 1 Signal}\\\text{Selection (Pn006 = n.}\square\square\text{XX)}\end{array} \times \begin{array}{c}\text{Analog Monitor 1}\\\text{Magnification (Pn552)}\end{array} + \begin{array}{c}\text{Analog Monitor 1}\\\text{Offset Voltage (Pn550)}\end{array} \right\}$$

$$\begin{array}{c}\text{Analog monitor 2}\\\text{output voltage}\end{array} = (-1) \times \left\{ \begin{array}{c}\text{Analog Monitor 2 Signal}\\\text{Selection (Pn007 = n.}\square\square\text{XX)}\end{array} \times \begin{array}{c}\text{Analog Monitor 2}\\\text{Magnification (Pn553)}\end{array} + \begin{array}{c}\text{Analog Monitor 2}\\\text{Offset Voltage (Pn551)}\end{array} \right\}$$

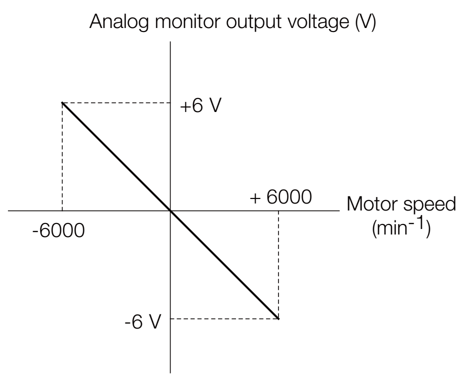
The following parameters are set.

Pn550	Analog Monitor 1 Offset Voltage				Speed Position Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-10,000 to 10,000	0.1 V	0	Immediately	Setup
Pn551	Analog Monitor 2 Offset Voltage				Speed Position Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-10,000 to 10,000	0.1 V	0	Immediately	Setup
Pn552	Analog Monitor 1 Magnification				Speed Position Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-10,000 to 10,000	×0.01	100	Immediately	Setup
Pn553	Analog Monitor 2 Magnification				Speed Position Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-10,000 to 10,000	×0.01	100	Immediately	Setup

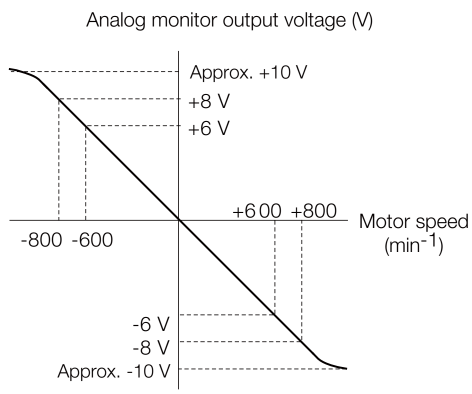
Example

- Example for Setting the Item to Monitor to the Motor Speed (Pn006 = n.□□00)

When Pn552 = 100 (Setting Unit: ×0.01)



When Pn552 = 1,000 (Setting Unit: ×0.01)



Note: The effective linearity range is ±8 V.
The resolution is 16 bits.

Monitoring

9

Adjusting the Analog Monitor Output

You can manually adjust the offset and gain for the analog monitor outputs for the torque reference monitor and motor speed monitor.

The offset is adjusted to compensate for offset in the zero point caused by output voltage drift or noise in the monitoring system.

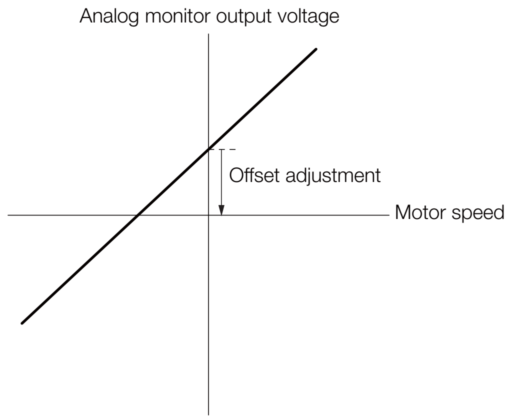
The gain is adjusted to match the sensitivity of the measuring system.

The offset and gain are adjusted at the factory. You normally do not need to adjust them.

◆ Adjustment Example

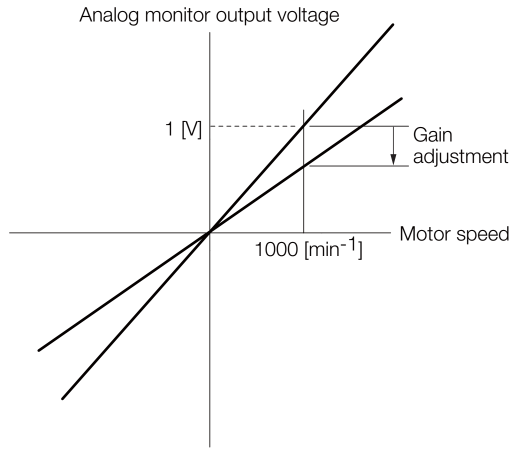
An example of adjusting the output of the motor speed monitor is provided below.

Offset Adjustment



Item	Specification
Offset Adjustment Range	-2.4 V to 2.4 V
Adjustment Unit	18.9 mV/LSB

Gain Adjustment



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 × 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 motor, set the monitor signal to the torque reference.
  - In speed control, set the monitor signal to the position deviation.

◆ Preparations

Always check the following before you adjust the analog monitor output.
- The parameters must not be write prohibited.

◆ Applicable Tools

You can use the following tools to adjust analog monitor outputs.

- Offset Adjustment

Tool	Fn No./Function Name	Operating Procedure Reference
Digital Operator	Fn00C	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Others - Adjust Offset***	◆ *Operating Procedure* on page 9-15

- Gain Adjustment

Tool	Fn No./Function Name	Operating Procedure Reference
Digital Operator	Fn00D	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Others - Adjust Offset***	◆ *Operating Procedure* on page 9-15

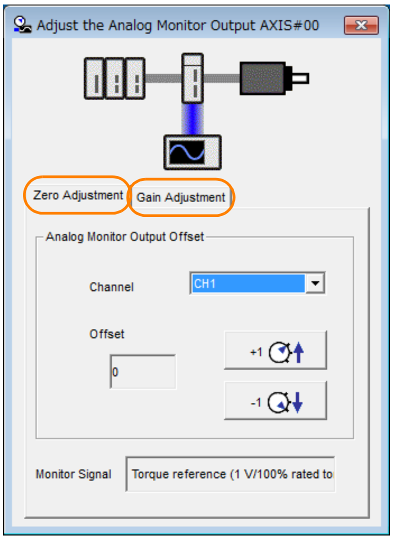
◆ Operating Procedure

Use the following procedure to adjust the analog monitor output.

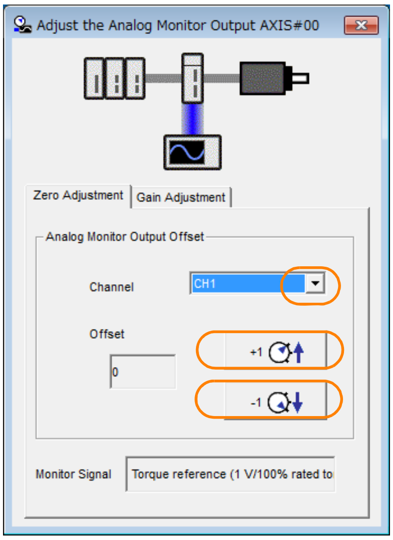
1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.

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.

9.4 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.
Spindle Motor Installation Environment	The operating status of the Spindle Motor 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. *11.1.2 Guidelines for Part Replacement* on page 11-2
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. *11.1.2 Guidelines for Part Replacement* on page 11-2
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. *11.1.2 Guidelines for Part Replacement* on page 11-2
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. *11.1.2 Guidelines for Part Replacement* on page 11-2

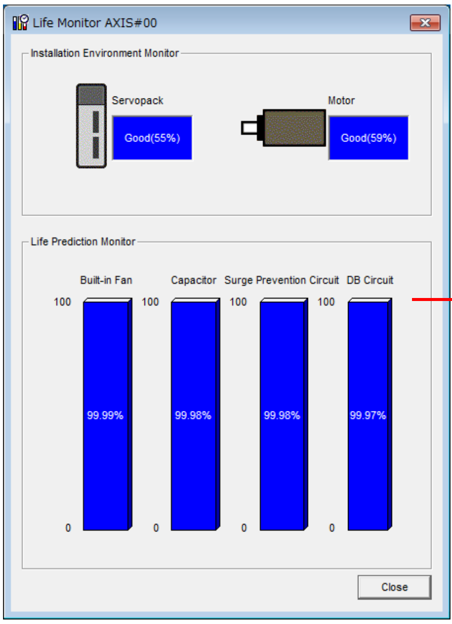
9.4.2 Operating Procedure

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.

9.4.3 Preventative Maintenance

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.□□□X to enable or disable these warnings.

Parameter		Description	When Enabled	Classification
Pn00F	n.□□□0 (default setting)	Do not detect preventative maintenance warnings.	After restart	Setup
	n.□□□1	Detect preventative maintenance warnings.		

/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.□□□0), the /PM signal will still be output as long as it is allocated.

Classification	Signal	Connector Pin No.	Signal Status	Description
Output	/PM	Must be allocated.	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.
			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.□X□□ (/PM (Preventative Maintenance Output) Signal Allocation) to allocate the signal to connector pins. Refer to the following section for details.
☞ *6.1.2 Output Signal Allocations* on page 6-4

9.5 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.
- Alarms that occur while the data tracing function of the SigmaWin+ is 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.

Tool	Fn No./Function Name	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+	***Troubleshooting - Alarm Trace***	Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

Fully-Closed Loop Control

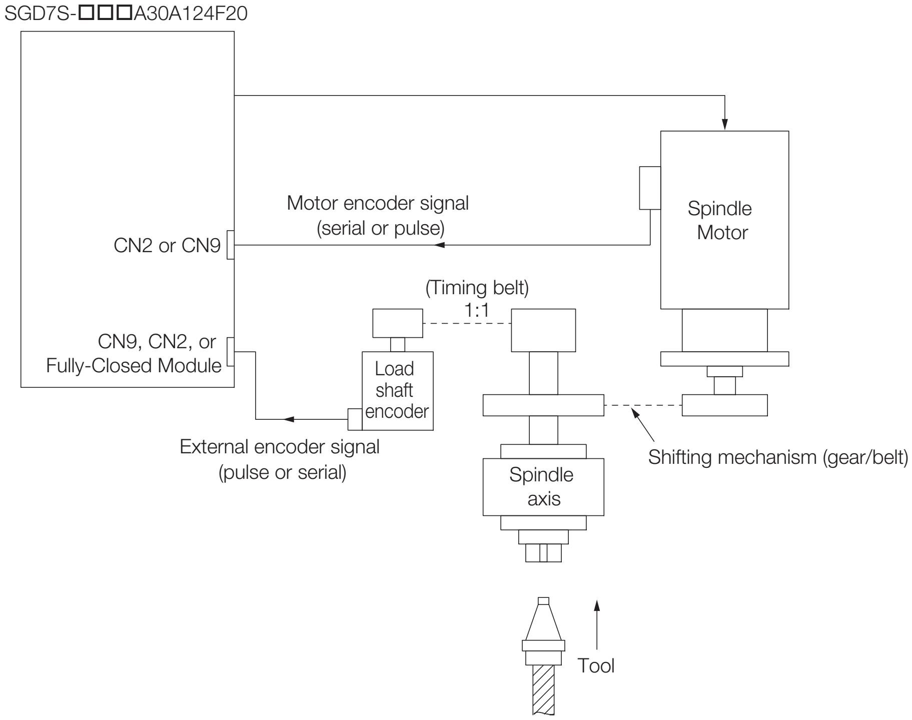
10

This chapter provides detailed information on performing fully-closed loop control with the SERVOPACK.

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.

The following figure shows an example of the system configuration.



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 2-11

The parameters that must be set depend on the Spindle Motor encoder type and external encoder type. Make sure that the parameters are set correctly for the encoder type that you are using.

Spindle Motor Encoder Type	External Encoder Type	Required Parameter Settings
Serial encoder	External pulse encoder	Pn01F = n.□□□2, and Pn002 = n.5□□□ or n.7□□□
Serial encoder	External serial encoder (using a Fully-closed Module)	Pn01F = n.□□□2, and Pn002 = n.1□□□ or n.3□□□
Pulse encoder	External serial encoder	Pn01F = n.□□□1, and Pn002 = n.1□□□ or n.3□□□

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 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 • Spindle Motor wiring • Encoder wiring • Wiring of I/O signal lines from the host controller • Spindle Motor rotation direction, motor speed, and multiturn data • Operation of safety mechanisms, such as 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 SERVOPACK? • Does jogging function correctly when you operate the Spindle Motor without a load? • Do the I/O signals turn ON and OFF correctly? • Is power supplied to the Spindle Motor when the SV_ON (Servo ON) command is sent from the host controller? • Does the Spindle Motor operate correctly when a position reference is input by the host controller?	• Pn000 (Basic Function Selections 0) • Pn001 (Application Function Selections 1) • Pn002 = n.X□□□ (External Encoder Usage) • Pn20E (Electronic Gear Ratio (Numerator)) • Pn210 (Electronic Gear Ratio (Denominator)) • Pn50A, Pn50B, Pn511, and Pn516 (Input Signal Selections) • Pn50E, Pn50F, Pn510, and Pn514 (Output Signal Selections)	SERVO-PACK or host controller
2	Check operation with the Spindle Motor 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 Spindle Motor 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

Continued on next page.

Continued from previous page.

Step	Description	Operation	Required Parameter Settings	Controlling Device
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 Spindle Motor. Check the following status with the Digital Operator or SigmaWin+. • Does the fully-closed feedback pulse counter count up when the Spindle Motor 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 Encoder Scale Pitches) when using a serial encoder or Pn20A (Number of External Encoder Pulses) when using a pulse encoder • Pn23E (Number of External Encoder Pulses) when using an external pulse encoder • Pn20E (Electronic Gear Ratio (Numerator)) • Pn210 (Electronic Gear Ratio (Denominator)) • Pn281 (Encoder Output Resolution) when using a serial encoder or Pn212 (Number of Encoder Output Pulses) when using a pulse encoder • Pn51B (Motor-Load Position Deviation Overflow Detection Level) • Pn522 (Positioning Completed Width) • Pn52A (Multiplier per Fully-closed Rotation) • Pn830 (Number of Reference Units per Machine Revolution)	–
4	Perform a program jogging operation. Items to Check Does the fully-closed system operate correctly for the Spindle Motor 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)	SERVOPACK
5	Operate the SERVOPACK. 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

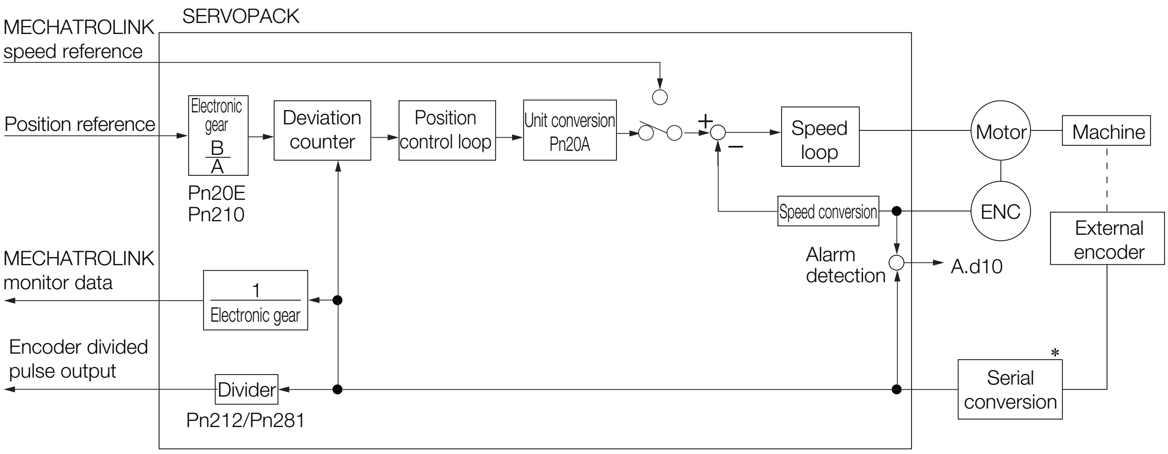
10.3 Parameter Settings for Fully-Closed Loop Control

This section describes the parameter settings that are related to fully-closed loop control.

Parameter to Set	Setting	Position Control	Speed Control	Torque Control	Reference
Pn000 = n.□□□X	Motor direction	√	√	√	page 10-6
Pn002 = n.X□□□	External encoder usage method	√	√	√	
Pn20A	Number of External Encoder Scale Pitches when using a serial encoder or Number of External Encoder Pulses when using a pulse encoder	√	√	√	page 10-7
Pn212	Encoder divided pulse output signals (PAO, PBO, and PCO) from the SERVOPACK when using a pulse encoder	√	√	√	–
Pn281	Encoder divided pulse output signals (PAO, PBO, and PCO) from the SERVOPACK when using a serial encoder	√	√	√	page 10-8
–	External absolute encoder data reception sequence	√	√	√	–
Pn20E and Pn210	Electronic gear ratio	√	–	–	page 5-26
Pn51B	Excessive deviation level between motor and load positions	√	–	–	page 10-9
Pn52A	Multiplier for one fully-closed rotation	√	–	–	
Pn006/Pn007	Analog monitor signal	√	√	√	page 10-10

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.

Fully-Closed Loop Control

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10.3.2 Setting the Motor Direction and the Machine Movement Direction

You must set the motor direction and the machine movement direction. To perform fully-closed loop control, you must set the motor rotation direction with both Pn000 = n.□□□X (Rotation Direction Selection) and Pn002 = n.X□□□ (External Encoder Usage).

Parameter			Pn002 = n.X□□□ (External Encoder Usage)			
			n.1□□□ (When Using Serial Encoder), n.5□□□ (When Using Pulse Encoder)		n.3□□□ (When Using Serial Encoder), n.7□□□ (When Using Pulse Encoder)	
Pn000 =n.□□□X (Rotation Direction Selection)	n.□□□0	Reference direction	Forward reference	Reverse reference	Forward reference	Reverse reference
		Motor direction	CCW	CW	CCW	CW
		External encoder	Forward movement	Reverse movement	Reverse movement	Forward movement
	n.□□□1	Reference direction	Forward reference	Reverse reference	Forward reference	Reverse reference
		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

◆ Pn000 = n.□□□X

Refer to the following section for details.

☞ *5.4 Motor Direction Setting* on page 5-17

◆ Pn002 = n.X□□□

When you perform fully-closed loop control with a Fully-Closed Option Module, set Pn002 to n.1□□□ or n.3□□□.

When you perform fully-closed loop control with a pulse encoder, set Pn002 to n.5□□□ or n.7□□□.

Parameter		Name	Meaning	When Enabled	Classification
Pn002	n.0□□□ (default setting)	External Encoder Usage	Do not use an external encoder.	After restart	Setup
	n.1□□□		External encoder moves in forward direction for CCW motor rotation.		
	n.2□□□		Reserved parameter (Do not change.)		
	n.3□□□		External encoder moves in reverse direction for CCW motor rotation.		
	n.4□□□		Reserved parameter (Do not change.)		
	n.5□□□		External pulse encoder moves in forward direction for CCW motor rotation.		
	n.6□□□		Reserved parameter (Do not change.)		
	n.7□□□		External pulse encoder moves in reverse direction for CCW motor rotation.		
	n.8□□□		Reserved parameter (Do not change.)		

Information

Determine the setting of Pn002 = n.X□□□ as described below.

- Set Pn000 to n.□□□0 (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 when you use a Fully-Closed Option Module, set Pn002 to n.1□□□.
- If the fully-closed feedback pulse counter counts down when you use a Fully-Closed Option Module, set Pn002 to n.3□□□.
- If the fully-closed feedback pulse counter counts up when you use a pulse encoder, set Pn002 to n.5□□□.
- If the fully-closed feedback pulse counter counts down when you use a pulse encoder, set Pn002 to n.7□□□.

10.3.3 Setting the Number of External Encoder Scale Pitches and Number of External Encoder Pulses per Motor Rotation

Set Pn20A to the number of scale pitches when using a serial encoder or the number of pulses when using a pulse encoder to output from the external encoder per motor rotation.

Note: 1. If there is a fraction, round off the digits below the decimal point.
2. If the number of external encoder scale pitches or number of external encoder pulses per motor 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

◆ When Using a Serial Encoder

Pn20A	Number of External Encoder Scale Pitches			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	4 to 1,048,576	1 scale pitch/revolution	32,768	After restart	Setup

◆ When Using a Pulse Encoder

Pn20A	Number of External Encoder Pulses			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	4 to 1,048,576	1 pulse/Rev	32,768	After restart	Setup

Note: Set the number of pulses after multiplying by 4.

10.3.4 Number of External Encoder Pulses

When using a pulse encoder for the external encoder, set the number of external encoder pulses before multiplying by 4 in Pn23E. This is a different setting from Pn20A.

Related Parameters

Pn23E	Number of External Encoder Pulses			Position	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	100 to 1,048,576	1P/Rev	1,024	After restart	Setup

10.3.5 Setting the Number of Reference Units per Machine Revolution

Set the number of reference units per machine revolution.

“Machine” refers to the following:

- For semi-closed loop control: Motor shaft
- For fully-closed loop control: Load shaft

Related Parameters

Pn830	Number of Reference Units per Machine Revolution		Speed Position		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,823	1 reference unit	4,096	After restart	Setup

10.3.6 Setting the PAO, PBO, and PCO (Encoder Divided Pulse Output) Signals

Set the position resolution in Pn281 (Encoder Output Resolution) and Pn212 (Number of Encoder Output Pulses).

Enter the number of phase A and phase B edges for the setting.

Related Parameters

◆ When Using a Serial Encoder

Pn281	Encoder Output Resolution		Speed Position Torque		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 4,096	1 edge/pitch	20	After restart	Setup

Note: 1. The maximum setting for the encoder output resolution is 4,096.
If the resolution of the external encoder exceeds 4,096, pulse output is not possible.
2. If the setting of Pn281 exceeds the resolution of the external encoder, the A.041 alarm (Encoder Output Pulse Setting Error) will be output.

◆ When Using a Pulse Encoder

Pn212	Number of Encoder Output Pulses		Speed Position Torque		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	16 to 1,073,741,824	1P/Rev	512	After restart	Setup

10.3.7 Electronic Gear Setting

Refer to the following section for details.

☞ *5.8 Electronic Gear Settings* on page 5-26

10.3.8 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 motor 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.

Pn51B	Motor-Load Position Deviation Overflow Detection Level				Position
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,073,741,824	1 reference unit	1000	Immediately	Setup

Note: If this parameter is set to 0, the machine may be damaged because an A.d10 alarm will not be output.

Pn52A (Multiplier per Fully-closed Rotation)

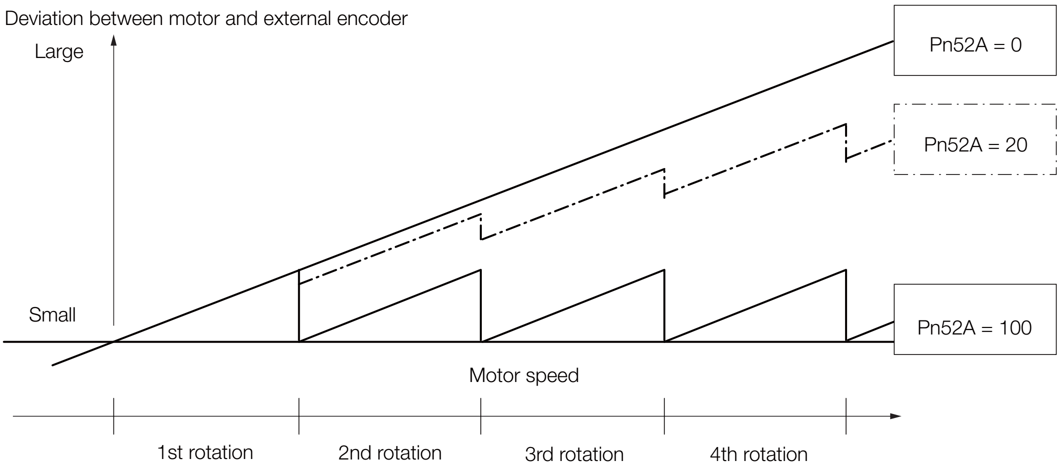
Set the coefficient of the deviation between the motor and the external encoder per motor rotation.
This setting can be used to prevent the motor from running out of control due to damage to the external encoder or to detect belt slippage.

◆ 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 motor rotation multiplied by 0.8.



◆ Related Parameters

Pn52A	Multiplier per Fully-closed Rotation				Position
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	1%	20	Immediately	Setup

10.3.9 Analog Monitor Signal Settings

You can monitor the position deviation between the motor and load with an analog monitor.

Parameter		Name	Meaning	When Enabled	Classification
Pn006	n.□□07	Analog Monitor 1 Signal Selection	Position deviation between motor and load (output unit: 0.01 V/reference unit).	Immediately	Setup
Pn007	n.□□07	Analog Monitor 2 Signal Selection	Position deviation between motor and load (output unit: 0.01 V/reference unit).		

Maintenance

11

This chapter provides information on the meaning of, causes of, and corrections for alarms and warnings.

11.1 Inspections and Part Replacement

This section describes inspections and part replacement for SERVOPACKs.

11.1.1 Inspections

Perform the inspections given in the following table at least once every year for the SERVOPACK. Daily inspections are not required.

Item	Frequency	Inspection	Correction
Exterior	At least once a year	Check for dust, dirt, and oil on the surfaces.	Clean with compressed air or a cloth.
Loose Screws		Check for loose terminal block and connector screws and for other loose parts.	Tighten any loose screws or other loose parts.

11.1.2 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 9-17
- Use the following table.

Part	Standard Replacement Period	Remarks
Cooling Fan	4 to 5 years	The standard replacement periods given on the left are for the following operating conditions. • Surrounding air temperature: Annual average of 30°C • Load factor: 80% max. • Operation rate: 20 hours/day max.
Electrolytic Capacitor	10 years	
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.

Important

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.

11.2 Alarm Displays

If an error occurs in the SERVOPACK, an alarm number will be displayed on the panel display.

However, if no alarm number appears on the panel display, this indicates a SERVOPACK system error. Replace the SERVOPACK.

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

Example: Alarm A.E60

Status Indications → Not lit. → A. → Not lit. → E → Not lit. → 6 → Not lit. → 0 → Not lit.

This section provides a list of the alarms that may occur and the causes of and corrections for those alarms.

11.2.1 List of Alarms

The list of alarms gives the alarm name, alarm meaning, alarm stopping method, and alarm reset possibility in order of the alarm numbers.

Motor Stopping Method for Alarms

Refer to the following section for information on the stopping method for alarms.

☞ *5.6.2 Motor Stopping Method for Alarms* on page 5-22

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 Number	Alarm Name	Alarm Meaning	Motor Stopping Method	Alarm Reset Possible?
A.020	Parameter Checksum Error	There is an error in the parameter data in the SERVOPACK.	Gr.1	No
A.021	Parameter Format Error	There is an error in the parameter data format in the SERVOPACK.	Gr.1	No
A.022	System Checksum Error	There is an error in the parameter data in the SERVOPACK.	Gr.1	No
A.024	System Alarm	An internal program error occurred in the SERVOPACK.	Gr.1	No
A.025	System Alarm	An internal program error occurred in the SERVOPACK.	Gr.1	No
A.030	Main Circuit Detector Error	There is an error in the detection data for the main circuit.	Gr.1	Yes
A.040	Parameter Setting Error	A parameter setting is outside of the setting range.	Gr.1	No
A.041	Encoder Output Pulse Setting Error	The setting of Pn212 (Number of Encoder Output Pulses/Number of External Pulse Encoder Output Pulses) or Pn281 (Encoder Output Resolution) is outside of the setting range or does not satisfy the setting conditions.	Gr.1	No

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Alarm Number	Alarm Name	Alarm Meaning	Motor Stopping Method	Alarm Reset Possible?
A.042	Parameter Combination Error	The combination of some parameters exceeds the setting range.	Gr.1	No
A.044	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
A.04A	Parameter Setting Error 2	There is an error in the bank members or bank data settings.	Gr.1	No
A.050	Combination Error	The capacities of the SERVOPACK and motor do not match.	Gr.1	Yes
A.051	Unsupported Device Alarm	An unsupported device was connected.	Gr.1	No
A.057	Motor Type Setting Mismatch	The Motor Type and Application Selection (Pn01E = n.☐☐☐X) was written in the SERVOPACK, but the settings do not match the motor parameters.	Gr.1	No
A.05A	IM Combination Error	The capacity of the Spindle Motor is outside the combinable range.	Gr.1	No
A.0b0	Invalid Servo ON Command Alarm	The SV_ON (Servo ON) command was sent from the host controller after a utility function that turns ON the motor was executed.	Gr.1	Yes
A.100	Overcurrent Detected	An overcurrent flowed through the power transformer or the heat sink overheated.	Gr.1	No
A.101	Motor Overcurrent Detected	The current to the motor exceeded the allowable current.	Gr.1	No
A.300	Regeneration Error	There is an error related to regeneration.	Gr.1	Yes
A.320	Regenerative Overload	A regenerative overload occurred.	Gr.2	Yes
A.330	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
A.400	Overvoltage	The main circuit DC voltage is too high.	Gr.1	Yes
A.410	Undervoltage	The main circuit DC voltage is too low.	Gr.2	Yes
A.510	Overspeed	The motor exceeded the maximum speed.	Gr.1	Yes
A.511	Encoder Output Pulse Overspeed	The pulse output speed for the setting of Pn212 (Number of Encoder Output Pulses/Number of External Pulse Encoder Output Pulses) was exceeded.	Gr.1	Yes
A.520	Vibration Alarm	Abnormal oscillation was detected in the motor speed.	Gr.1	Yes
A.531	Speed Deviation Overflow	The deviation between the speed reference and the motor speed became excessive.	Gr.1	Yes
A.710	Instantaneous Overload	The motor was operating for several seconds to several tens of seconds under a torque that largely exceeded the rating.	Gr.2	Yes
A.720	Continuous Overload	The motor was operating continuously under a torque that exceeded the rating.	Gr.1	Yes
A.740	Inrush Current Limiting Resistor Overload	The main circuit power supply was frequently turned ON and OFF.	Gr.1	Yes
A.790	Motor Overheat	The motor exceeded the upper limit to the temperature.	Gr.1	Yes
A.791	Motor Temperature Detection Error	The motor's thermistor is disconnected or broken.	Gr.1	No
A.7A1	Internal Temperature Error 1 (Control Board Temperature Error)	The surrounding temperature of the control PCB is abnormal.	Gr.2	Yes

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Alarm Number	Alarm Name	Alarm Meaning	Motor Stop-ping Method	Alarm Reset Possi-ble?
A.7A2	Internal Temperature Error 2 (Power Board Tempera-ture Error)	The surrounding temperature of the power PCB is abnormal.	Gr.2	Yes
A.7A3	Internal Temperature Sen-sor Error	An error occurred in the temperature sensor cir-cuit.	Gr.2	No
A.7Ab	SERVOPACK Built-in Fan Stopped	The fan inside the SERVOPACK stopped.	Gr.1	Yes
A.820	Encoder Checksum Alarm	There is an error in the checksum results for encoder memory.	Gr.1	No
A.840	Encoder Data Alarm	There is an internal data error in the encoder.	Gr.1	No
A.850	Encoder Overspeed	The encoder was operating at high speed when the power was turned ON.	Gr.1	No
A.8A0	External Encoder Error	An error occurred in the external encoder.	Gr.1	Yes
A.8A1	External Encoder Module Error	An error occurred in the Serial Converter Unit.	Gr.1	Yes
A.8A2	External Incremental Encoder Sensor Error	An error occurred in the external encoder.	Gr.1	Yes
A.8A3	External Absolute Encoder Position Error	An error occurred in the position data of the external encoder.	Gr.1	Yes
A.8A5	External Encoder Over-speed	An overspeed error occurred in the external encoder.	Gr.1	Yes
A.8A6	External Encoder Over-heated	An overheating error occurred in the external encoder.	Gr.1	Yes
A.b33	Current Detection Error 3	An error occurred in the current detection circuit.	Gr.1	No
A.b6A	MECHATROLINK Commu-nications ASIC Error 1	ASIC error 1 occurred in MECHATROLINK com-munications.	Gr.1	No
A.b6b	MECHATROLINK Commu-nications ASIC Error 2	ASIC error 2 occurred in MECHATROLINK com-munications.	Gr.2	No
A.bF0	System Alarm 0	Internal program error 0 occurred in the SERVO-PACK.	Gr.1	No
A.bF1	System Alarm 1	Internal program error 1 occurred in the SERVO-PACK.	Gr.1	No
A.bF2	System Alarm 2	Internal program error 2 occurred in the SERVO-PACK.	Gr.1	No
A.bF3	System Alarm 3	Internal program error 3 occurred in the SERVO-PACK.	Gr.1	No
A.bF4	System Alarm 4	Internal program error 4 occurred in the SERVO-PACK.	Gr.1	No
A.C10	Motor Out of Control	Spindle Motor Out of Control	Gr.1	Yes
A.C2A	Pulse Encoder Phase C Error/Pulse Error	The number of pulses per revolution exceeded the setting range.	Gr.1	No
A.C39	Pulse Encoder Phase C Not Detected Error	After turning ON the power supply, phase C was not detected after more than 2 revolutions.	Gr.1	No
A.C3A	Pulse Encoder Phase A Disconnection	The phase A signal of the pulse encoder is dis-connected.	Gr.1	No
A.C3B	Pulse Encoder Phase B Disconnection	The phase B signal of the pulse encoder is dis-connected.	Gr.1	No
A.C3C	Pulse Encoder Phase C Disconnection	The phase C signal of the pulse encoder is dis-connected.	Gr.1	No
A.C90	Encoder Communications Error	Communications between the encoder and SER-VOPACK is not possible.	Gr.1	No

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Alarm Number	Alarm Name	Alarm Meaning	Motor Stop-ping Method	Alarm Reset Possi-ble?
A.C91	Encoder Communications Position Data Acceleration Rate Error	An error occurred in calculating the position data of the encoder.	Gr.1	No
A.C92	Encoder Communications Timer Error	An error occurred in the communications timer between the encoder and SERVOPACK.	Gr.1	No
A.CA0	Encoder Parameter Error	The parameters in the encoder are corrupted.	Gr.1	No
A.Cb0	Encoder Echoback Error	The contents of communications with the encoder are incorrect.	Gr.1	No
A.CF1	Reception Failed Error in Feedback Option Module Communications	Receiving data from the Feedback Option Module failed.	Gr.1	No
A.CF2	Timer Stopped Error in Feedback Option Module Communications	An error occurred in the timer for communications with the Feedback Option Module.	Gr.1	No
A.d00	Position Deviation Overflow	The setting of Pn520 (Position Deviation Overflow Alarm Level) was exceeded by the position deviation.	Gr.1	Yes
A.d01	Position Deviation Overflow Alarm at Servo ON	The servo was turned ON after the position deviation exceeded the setting of Pn526 (Position Deviation Overflow Alarm Level at Servo ON) while the servo was OFF.	Gr.1	Yes
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) limits 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 before the limit is cleared.	Gr.2	Yes
A.d10	Motor-Load Position Deviation Overflow	There was too much position deviation between the motor and load during fully-closed loop control.	Gr.2	Yes
A.d30	Position Data Overflow	The position feedback data exceeded ±1,879,048,192.	Gr.1	No
A.E02	MECHATROLINK Internal Synchronization Error 1	A synchronization error occurred during MECHATROLINK communications with the SERVOPACK.	Gr.1	Yes
A.E40	MECHATROLINK Transmission Cycle Setting Error	The setting of the MECHATROLINK communications transmission cycle is not correct.	Gr.2	Yes
A.E41	MECHATROLINK Communications Data Size Setting Error	The setting of the MECHATROLINK communications data size is not correct.	Gr.2	Yes
A.E42	MECHATROLINK Station Address Setting Error	The setting of the MECHATROLINK station address is not correct.	Gr.2	No
A.E50*	MECHATROLINK Synchronization Error	A synchronization error occurred during MECHATROLINK communications.	Gr.2	Yes
A.E51	MECHATROLINK Synchronization Failed	Synchronization failed during MECHATROLINK communications.	Gr.2	Yes
A.E60*	Reception Error in MECHATROLINK Communications	Communications errors occurred continuously during MECHATROLINK communications.	Gr.2	Yes
A.E61	Synchronization Interval Error in MECHATROLINK Transmission Cycle	An error occurred in the transmission cycle during MECHATROLINK communications.	Gr.2	Yes

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Alarm Number	Alarm Name	Alarm Meaning	Motor Stopping Method	Alarm Reset Possible?
A.E63	MECHATROLINK Synchronization Frame Not Received	Synchronization frames were continuously not received during MECHATROLINK communications.	Gr.2	Yes
A.EC8	Gate Drive Error 1	An error occurred in the gate drive circuit.	Gr.1	No
A.EC9	Gate Drive Error 2	An error occurred in the gate drive circuit.	Gr.1	No
A.Ed1	Command Execution Timeout	A timeout error occurred for a MECHATROLINK command.	Gr.2	Yes
A.F10	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*	System Alarm	An internal program error occurred in the SERVOPACK.	–	No
FL-2*				
FL-3*				
FL-4*				
FL-5*				
CPF00	Digital Operator Communications Error 1	Communications were not possible between the Digital Operator (model: JUSP-OP05A-1-E) and the SERVOPACK (e.g., a CPU error occurred).	–	No
CPF01	Digital Operator Communications Error 2			

* These alarms are not stored in the alarm history. They are only displayed on the panel display.

11.2.2 Troubleshooting Alarms

The causes of and corrections for the alarms are given in the following table. Contact your Yaskawa representative if you cannot solve a problem with the correction given in the table.

Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.020: Parameter Checksum Error (There is an error in the parameter data in the SERVOPACK.)	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 5-14
	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.	
	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 SERVOPACK. Reconsider the method for writing the parameters.	–
	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 4-5
	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 SERVOPACK.	–
	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 SERVOPACK.	–
A.021: Parameter Format Error (There is an error in the parameter data format in the SERVOPACK.)	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
	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.022: System Checksum Error (There is an error in the parameter data in the SERVOPACK.)	The power supply voltage suddenly dropped.	Measure the power supply voltage.	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
	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 SERVOPACK.	–
	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 SERVOPACK.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.024: System Alarm (An internal program error occurred in the SERVOPACK.)	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.025: System Alarm (An internal program error occurred in the SERVOPACK.)	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.030: Main Circuit Detector Error	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
	The jumper between the DC Reactor terminals (⊖1 and ⊖2) was removed or there is faulty contact.	–	Correct the wiring between the DC Reactor terminals.	–
	The cable between the DC Reactor and SERVOPACK is not wired correctly or there is a faulty contact.			
A.040: Parameter Setting Error (A parameter setting is outside of the setting range.)	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
	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.	–
	The electronic gear ratio is outside of the setting range.	Check the electronic gear ratio. The ratio must be within the following range: 0.001 < (Pn20E/Pn210) < 64,000.	Set the electronic gear ratio in the following range: 0.001 < (Pn20E/Pn210) < 64,000.	page 5-27
A.041: Encoder Output Pulse Setting Error	The setting of Pn212 (Number of Encoder Output Pulses/Number of External Pulse Encoder Output Pulses) or Pn281 (Encoder Output Resolution) is outside of the setting range or does not satisfy the setting conditions.	Check the setting of Pn212 or Pn281.	Set Pn212 or Pn281 to an appropriate value.	page 6-18

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.042: Parameter Combination Error	The speed of program jogging went below the setting range when the electronic gear ratio (Pn20E/ Pn210) or the Spindle Motor was changed.	Check to see if the detection conditions*1 are satisfied.	Decrease the setting of the electronic gear ratio (Pn20E/Pn210).	page 5-27
	The speed of program jogging went below the setting range when Pn533 (Program Jogging Movement Speed) was changed.	Check to see if the detection conditions*1 are satisfied.	Increase the setting of Pn533.	page 7-12
	The movement speed of advanced autotuning went below the setting range when the electronic gear ratio (Pn20E/ Pn210) or the Spindle Motor was changed.	Check to see if the detection conditions*2 are satisfied.	Decrease the setting of the electronic gear ratio (Pn20E/Pn210).	page 5-27
A.044: Semi-Closed/ Fully-Closed Loop Control Parameter Setting Error	The setting of the Fully-Closed Module does not match the setting of Pn002 = n.X□□□ (External Encoder Usage).	Check the setting of Pn002 = n.X□□□.	Make sure that the setting of the Fully-closed Module agrees with the setting of Pn002 = n.X□□□.	page 10-6
	The setting of Pn01F = n.□□□X (Encoder Type Selection) does not match the setting of Pn002 = n.X□□□ (External Encoder Usage).	Check the setting of Pn002 = n.X□□□.	Make sure that the setting of the Fully-closed Module agrees with the setting of Pn002 = n.X□□□.	page 10-6
A.04A: Parameter Setting Error 2	For 4-byte parameter bank members, there are two consecutive members with nothing registered.	–	Change the number of bytes for bank members to an appropriate value.	–
	The total amount of bank data exceeds 64 (Pn900 × Pn901 > 64).	–	Reduce the total amount of bank data to 64 or less.	–
A.050: Combination Error (The capacities of the SERVOPACK and motor do not match.)	A failure occurred in the encoder.	Replace the encoder and check to see if the alarm still occurs.	Replace the Spindle Motor (encoder).	–
	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.051: Unsupported Device Alarm	The motor parameter file was not written to the SERVOPACK.	Check to see if the motor parameter file was written to the SERVOPACK.	Write the motor parameter file.	page 5-3
	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.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.057: Motor Type Setting Mismatch	The motor type setting (Pn01E = n.□□□X) is wrong.	Check the parameter (Pn01E = n.□□□X) and combined motor.	Set the motor type (Pn01E = n.□□□X) correctly according to the combined motor.	–
	There was a mistake in writing the motor parameter file.	Check the model of the combined motor.	Write the motor parameter file for the combined motor to the SERVOPACK.	–
A.05A: IM Combination Error	The SERVOPACK and Spindle Motor capacities do not match each other.	Check the combination of the SERVOPACK and Spindle Motor and their capacities.	Select a proper combination of the SERVOPACK and Spindle Motor capacities.	–
A.0b0: Invalid Servo ON Command Alarm	The SV_ON (Servo ON) command was sent from the host controller after a utility function that turns ON the motor was executed.	–	Turn the power supply to the SERVOPACK OFF and ON again. Or, execute a software reset.	page 6-21

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.100: Overcurrent Detected (An overcurrent flowed through the power transistor or the heat sink overheated.)	The Main Circuit Cable is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	page 4-16
	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 Spindle Motor.	Check for short-circuits across motor phases U, V, and W, or between the ground and motor phases U, V, or W.	The Spindle Motor may be faulty. Replace the Spindle Motor.	
	There is a short-circuit or ground fault inside the SERVOPACK.	Check for short-circuits across the Spindle Motor connection terminals U, V, and W on the SERVOPACK, or between the ground and terminals U, V, or W.	The SERVOPACK may be faulty. Replace the SERVOPACK.	
	The regenerative resistor is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	page 4-13
	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.	*3
	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 SERVOPACK minimum allowable resistance.	
	A heavy load was applied while the Spindle Motor 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 Spindle Motor. 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 SERVOPACK's main circuit wire size.	–
	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.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.101: Motor Overcurrent Detected (The current to the motor exceeded the allowable current.)	The Main Circuit Cable is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	page 4-16
	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 Spindle Motor.	Check for short-circuits across motor phases U, V, and W, or between the ground and motor phases U, V, or W.	The Spindle Motor may be faulty. Replace the Spindle Motor.	
	There is a short-circuit or ground fault inside the SERVOPACK.	Check for short-circuits across the Spindle Motor connection terminals U, V, and W on the SERVOPACK, or between the ground and terminals U, V, or W.	The SERVOPACK may be faulty. Replace the SERVOPACK.	
	A heavy load was applied while the Spindle Motor 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 Spindle Motor. 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 SERVOPACK's main circuit wire size.	–
	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.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.300: Regeneration Error	Pn600 (Regenerative Resistor Capacity) is not set to 0 and an External Regenerative Resistor is not connected to one of the following SERVOPACKs: SGD7S-330A.	Check to see if an External Regenerative Resistor is connected and check the setting of Pn600. Note: 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.	Connect an External Regenerative Resistor, or set Pn600 (Regenerative Resistor Capacity) to 0 (setting unit: ×10 W) if no Regenerative Resistor is required.	page 5-28
	An External Regenerative Resistor is not connected to one of the following SERVOPACKs: SGD7S-780A.	Check to see if an External Regenerative Resistor or a Regenerative Resistor Unit is connected and check the setting of Pn600.	Connect an External Regenerative Resistor and set Pn600 to an appropriate value, or connect a Regenerative Resistor Unit and set Pn600 to 0.	
	The External Regenerative Resistor or Regenerative Resistor Unit is not wired correctly, or was removed or disconnected.	Check the wiring of the External Regenerative Resistor or Regenerative Resistor Unit. Note: 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.	Correct the wiring of the External Regenerative Resistor or Regenerative Resistor Unit.	page 4-13
	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 an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.320: Regenerative Overload	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 and capacity again.	Change the regenerative resistance value or capacity. Recheck the operating conditions.	*3
	There was a continuous regeneration state because a negative load was continuously applied.	Check the load applied to the Spindle Motor during operation.	Reconsider the system including the servo, machine, and operating conditions.	–
	The setting of Pn600 (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.	Correct the setting of Pn600.	page 5-28
	The setting of Pn603 (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.	Correct the setting of Pn603.	page 5-28
	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.	*3
	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.330: Main Circuit Power Supply Wiring Error (Detected when the main circuit power supply is turned ON.)	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.	–
	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.400: Overvoltage (Detected in the main circuit power supply section of the SERVOPACK.)	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 an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–
	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.	–
	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.	*3
	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 an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.410: Undervoltage (Detected in the main circuit power supply section of 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.	–
	A momentary power interruption occurred.	Measure the power supply voltage.	If you have changed the setting of Pn509 (Momentary Power Interruption Hold Time), decrease the setting.	page 6-13
	The SERVOPACK fuse is blown out.	Check the power supply wiring.	Correct the power supply wiring and replace the SERVOPACK.	page 4-12
	The SERVOPACK fuse is blown out.	–	Replace the SERVOPACK 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 SERVOPACK.	–
	The jumper between the DC Reactor terminals (⊖1 and ⊖2) was removed or there is faulty contact.	–	Correct the wiring between the DC Reactor terminals.	–
	The cable between the DC Reactor and SERVOPACK is not wired correctly or there is a faulty contact.			
A.510: Overspeed (The motor exceeded the maximum speed.)	The order of phases U, V, and W in the motor wiring is not correct.	Check the Spindle Motor wiring.	Make sure that the motor is correctly wired.	–
	A reference value that exceeded the overspeed detection level was input.	Check the input reference.	Reduce the reference value. Or, adjust the gain.	–
	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 SERVOPACK.	–
A.511: Encoder Output Pulse Overspeed	The encoder output pulse frequency exceeded the limit.	Check the encoder output pulse setting.	Decrease the setting of Pn212 (Number of Encoder Output Pulses/ Number of External Pulse Encoder Output Pulses) or Pn281 (Encoder Output Resolution).	page 6-18
	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.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.520: Vibration Alarm	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 (Speed Loop Gain).	page 8-54
	The setting of Pn103 (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.	Set Pn103 (Moment of Inertia Ratio) to an appropriate value.	–
	The vibration detection level (Pn312) is not suitable.	Check the vibration detection level (Pn312) for suitability.	Set a suitable vibration detection level (Pn312).	page 6-24
A.531: Speed Deviation Overflow	The motor 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 motor 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.	–
	The load is heavy (e.g., the cutting resistant is high).	Check for a high load friction, load moment of inertia, etc.	Remove the load.	–
A.710: Instantaneous Overload A.720: Continuous Overload	The wiring is not correct or there is a faulty contact in the motor or encoder wiring.	Check the wiring.	Make sure that the motor and encoder are correctly wired.	page 4-16
	Operation was performed that exceeded the overload protection characteristics.	Check the motor overload characteristics and Run command.	Reconsider the load and operating conditions. Or, increase the motor capacity.	–
	An excessive load was applied during operation because the motor was not driven due to mechanical problems.	Check the operation reference and motor speed.	Correct the mechanical problem.	–
	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.740: 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 SERVOPACK.	–
A.790: Motor Overheat	The temperature surrounding the motor is too high.	Check the temperature surrounding the motor.	Prevent the temperature surrounding the motor from increasing.	–
	Acceleration and deceleration were repeated frequently.	–	Accelerate and decelerate the motor more gradually or change the operation pattern.	–
A.791: Motor Temperature Detection Error	The cable between the SERVOPACK and Spindle Motor is disconnected or there is a faulty contact.	Check the wiring for disconnection or faulty contact.	Correct the wiring.	–
	The wiring of the thermistor in the Spindle Motor is disconnected.	–	The Spindle Motor may be faulty. Replace the Spindle Motor.	–
	The thermistor has failed.	–	The Spindle Motor may be faulty. Replace the Spindle Motor.	–
A.7A1: Internal Temperature Error 1 (Control Board Temperature Error)	The surrounding temperature is too high.	Check the surrounding temperature using a thermostat. 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.	–
	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 SERVOPACK.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.7A2: Internal Temperature Error 2 (Power Board Temperature Error)	The surrounding temperature is too high.	Check the surrounding temperature using a thermostat. 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.	–
	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 SERVOPACK.	–
A.7A3: 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 SERVOPACK.	–
A.7Ab: 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 an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.820: Encoder Checksum Alarm (Detected at the encoder.)	A failure occurred in the encoder.	–	The Spindle Motor may be faulty. Replace the Spindle Motor.	–
	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.840: Encoder Data Alarm (Detected at the encoder.)	The encoder malfunctioned.	–	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the Spindle Motor may be faulty. Replace the Spindle Motor.	–
	The encoder malfunctioned due to noise.	–	Correct the wiring around the encoder by separating the Encoder Cable from the Spindle Motor main circuit cable or by grounding the encoder.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.850: Encoder Overspeed (Detected at the encoder when the control power supply is turned ON.)	The motor 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 motor speed to a value less than 200 min^{-1}, and turn ON the control power supply.	–
	A failure occurred in the encoder.	–	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the Spindle Motor may be faulty. Replace the Spindle Motor.	–
	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.	–
A.8A0: External Encoder Error	A failure occurred in the external encoder.	–	Replace the external encoder.	–
A.8A1: External Encoder Module Error	A failure occurred in the external encoder.	–	Replace the external encoder.	–
	A failure occurred in the Serial Converter Unit.	–	Replace the Serial Converter Unit.	–
A.8A2: External Incremental Encoder Sensor Error	A failure occurred in the external encoder.	–	Replace the external encoder.	–
A.8A3: 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.	–
A.8A5: 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.	–
A.8A6: External Encoder Overheated	An overheating error was detected in the external encoder.	–	Replace the external encoder.	–
A.b33: Current Detection Error 3	A failure occurred in the current detection circuit.	–	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.b6A: MECHATROLINK Communications ASIC Error 1	There is a fault in the SERVOPACK MECHATROLINK communications section.	–	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.b6b: MECHATROLINK Communications ASIC Error 2	A malfunction occurred in the MECHATROLINK communications section due to noise.	–	Implement the following countermeasures against noise. • Check the MECHATROLINK Communications Cable and FG wiring. • Attach a ferrite core to the MECHATROLINK Communications Cable.	–
	There is a fault in the SERVOPACK MECHATROLINK communications section.	–	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.bF0: System Alarm 0	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.	–
A.bF1: System Alarm 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.	–
A.bF2: System Alarm 2	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.	–
A.bF3: System Alarm 3	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.	–
A.bF4: System Alarm 4	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.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.C10: Motor 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 motor wiring.	Make sure that the motor is correctly wired.	–
	A failure occurred in the encoder.	–	If the motor wiring is correct and an alarm still occurs after turning the power supply OFF and ON again, the Spindle Motor may be faulty. Replace the Spindle Motor.	–
	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.	–
A.C2A: Pulse Encoder Phase C Error/ Pulse Error	An error occurred in the number of feedback pulses from the pulse encoder.	Check the pulse encoder's signal wiring.	Correct the pulse encoder wiring.	–
	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.	Separate the pulse encoder cable from peripheral devices or attach a ferrite core.	–
A.C39: Pulse Encoder Phase C Not Detected Error	There is a problem with the phase-C signal from the pulse encoder.	Check the pulse encoder's signal wiring.	Correct the pulse encoder wiring.	–
	Pulse encoder error	Check the pulse encoder's phase-C signal.	The pulse encoder may be faulty. Replace the motor.	–
A.C3A: Pulse Encoder Phase A Disconnection	The phase A signal of the pulse encoder is disconnected.	Check the pulse encoder's signal wiring.	Correct the pulse encoder wiring.	–
A.C3B: Pulse Encoder Phase B Disconnection	The phase B signal of the pulse encoder is disconnected.	Check the pulse encoder's signal wiring.	Correct the pulse encoder wiring.	–
A.C3C: Pulse Encoder Phase C Disconnection	The phase C signal of the pulse encoder is disconnected.	Check the pulse encoder's signal wiring.	Correct the pulse encoder wiring.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.C90: Encoder Communications Error	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 4-16
	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 specified specifications.	–
	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 environmental, and replace the cable. If the alarm still occurs, replace the SERVOPACK.	page 3-2
	A malfunction was caused by noise.	–	Correct the wiring around the encoder by separating the Encoder Cable from the Spindle Motor main circuit cable or by grounding the encoder.	page 4-5
	A failure occurred in the SERVOPACK.	–	Connect the Spindle Motor to another SERVOPACK, and turn ON the control power supply. If no alarm occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–
	A failure occurred in the encoder.	–	Connect the Spindle Motor to another SERVOPACK, and turn ON the control power supply. If no alarm occurs, the Spindle Motor may be faulty. Replace the Spindle Motor.	–
A.C91: Encoder Communications Position Data Acceleration Rate Error	Noise entered on the signal lines because the Encoder Cable is bent or the sheath is damaged.	Check the condition of the Encoder Cable and connectors.	Check the Encoder Cable to see if it is installed correctly.	page 4-8
	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.	–
	There is variation in the FG potential because of the influence of machines on the motor 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.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.C92: Encoder Communications Timer Error	Noise entered on the signal line from the encoder.	–	Implement countermeasures against noise for the encoder wiring.	page 4-5
	Excessive vibration or shock was applied to the encoder.	Check the operating conditions.	Reduce machine vibration. Correctly install the Spindle Motor.	–
	A failure occurred in the encoder.	–	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the Spindle Motor may be faulty. Replace the Spindle Motor.	–
	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.	–
A.CA0: Encoder Parameter Error	A failure occurred in the encoder.	–	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the Spindle Motor may be faulty. Replace the Spindle Motor.	–
	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.	–
A.Cb0: Encoder Echoback Error	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 4-16
	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.	–
	There is variation in the FG potential because of the influence of machines on the motor 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 Spindle Motor.	–
	A failure occurred in the encoder.	–	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the Spindle Motor may be faulty. Replace the Spindle Motor.	–
	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.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.CF1: Reception Failed Error in Feedback Option Module Communications	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 SERVOPACK.	–
	A specified cable is not being used between Serial Converter Unit and SERVOPACK.	Check the wiring specifications of the external encoder.	Use a specified cable.	–
	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 SERVOPACK 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 SERVOPACK.	–
A.CF2: Timer Stopped Error in Feedback Option Module Communications	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 SERVOPACK.	–
A.d00: Position Deviation Overflow (The setting of Pn520 (Position Deviation Overflow Alarm Level) was exceeded by the position deviation.)	The Spindle Motor U, V, and W wiring is not correct.	Check the wiring of the Spindle Motor main circuit cable.	Make sure that there are no faulty contacts in the wiring for the motor and encoder.	–
	The position command speed is too fast.	Reduce the position command speed and try operating the SERVOPACK.	Reduce the position reference speed or the reference acceleration rate, or reconsider the electronic gear ratio.	page 5-27
	The acceleration of the position reference is too high.	Reduce the reference acceleration and try operating the SERVOPACK.	Reduce the acceleration of the position reference using a MECHATROLINK command. Or, smooth the position reference acceleration by selecting the position reference filter (ACCFIL) using a MECHATROLINK command.	–
	The setting of Pn520 (Position Deviation Overflow Alarm Level) is too low for the operating conditions.	Check Pn520 (Position Deviation Overflow Alarm Level) to see if it is set to an appropriate value.	Optimize the setting of Pn520.	page 8-6
	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.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.d01: Position Deviation Overflow Alarm at Servo ON	The servo was turned ON after the position deviation exceeded the setting of Pn526 (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 (Position Deviation Overflow Alarm Level at Servo ON).	page 8-6
A.d02: Position Deviation Overflow Alarm for Speed Limit at Servo ON	If position deviation remains in the deviation counter, the setting of Pn529 (Speed Limit Level at Servo ON) limits 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.	–	Optimize the setting of Pn520 (Position Deviation Overflow Alarm Level). Or, adjust the setting of Pn529 (Speed Limit Level at Servo ON).	
A.d10: Motor-Load Position Deviation Overflow	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 = n.X□□□ (External Encoder Usage) to reverse the direction.	page 10-6
	There is an error in the connection between the load (e.g., stage) and external encoder coupling.	Check the coupling of the external encoder.	Check the mechanical coupling.	–
A.d30: Position Data Overflow	The position data exceeded ±1,879,048,192.	Check the input reference pulse counter.	Reconsider the operating specifications.	–
A.E02: MECHATROLINK Internal Synchronization Error 1	The MECHATROLINK transmission cycle fluctuated.	–	Remove the cause of transmission cycle fluctuation at the host controller.	–
	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.	–
A.E40: MECHATROLINK Transmission Cycle Setting Error	The setting of MECHATROLINK transmission cycle is outside of the specified range.	Check the setting of the MECHATROLINK transmission cycle.	Set the MECHATROLINK transmission cycle to an appropriate value.	–
A.E41: MECHATROLINK Communications Data Size Setting Error	The number of transmission bytes set on DIP switch S3 is not correct.	Check the MECHATROLINK communications data size of the host controller.	Reset DIP switch S3 to change the number of transmission bytes to an appropriate value.	page 5-16

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.E42: MECHATROLINK Station Address Setting Error	The station address is outside of the setting range.	Check rotary switches S1 and S2 to see if the station address is between 03 and EF.	Check the setting of the station address of the host controller, and reset rotary switches S1 and S2 to change the address to an appropriate value between 03 and EF.	page 5-16
	Two or more stations on the communications network have the same address.	Check to see if two or more stations on the communications network have the same address.	Check the setting of the station address of the host controller, and reset rotary switches S1 and S2 to change the address to an appropriate value between 03 and EF.	
A.E50[*3]: MECHATROLINK Synchronization Error	The WDT data in the host controller was not updated normally.	Check to see if the WDT data is being updated at the host controller.	Correctly update the WDT data at the host controller.	–
	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.	–
A.E51: MECHATROLINK Synchronization Failed	The WDT data at the host controller was not updated correctly at the start of synchronous communications, so synchronous communications could not be started.	Check to see if the WDT data is being updated in the host controller.	Correctly update the WDT data at the host controller.	–
	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.	–
A.E60[*3]: Reception Error in MECHATROLINK Communications	MECHATROLINK wiring is not correct.	Check the MECHATROLINK wiring.	Correct the MECHATROLINK Communications Cable wiring.	–
	A MECHATROLINK data reception error occurred due to noise.	–	Implement countermeasures against noise. (Check the MECHATROLINK Communications Cable and FG wiring, and implement measures such as attaching a ferrite core to the MECHATROLINK Communications Cable.)	–
	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.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.E61: Synchronization Interval Error in MECHATROLINK Transmission Cycle	The MECHATROLINK transmission cycle fluctuated.	Check the setting of the MECHATROLINK transmission cycle.	Remove the cause of transmission cycle fluctuation at the host controller.	–
	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.	–
A.E63: MECHATROLINK Synchronization Frame Not Received	MECHATROLINK wiring is not correct.	Check the MECHATROLINK wiring.	Correct the MECHATROLINK Communications Cable wiring.	–
	A MECHATROLINK data reception error occurred due to noise.	–	Implement countermeasures against noise. (Check the MECHATROLINK Communications Cable and FG wiring, and implement measures such as attaching a ferrite core to the MECHATROLINK Communications Cable.)	–
	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.	–
A.E74: Unsupported Safety Option Module	A failure occurred in the Safety Option Module.	–	Replace the Safety Option Module.	–
	An unsupported Safety Option Module was connected.	Refer to the catalog of the connected Safety Option Module.	Connect a compatible Safety Option Module.	–
A.Eb1: Safety Function Signal Input Timing Error	The delay between activation of the /HWBB1 and /HWBB2 input signals for the HWBB was ten second or longer.	Measure the time delay between the /HWBB1 and /HWBB2 signals.	The output signal circuits or devices for /HWBB1 and /HWBB2 or the SERVOPACK 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 SERVOPACK.	–
A.EC8: Gate Drive Error 1 (An error occurred in the gate drive circuit.) A.EC9: 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 an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.Ed1: Command Execution Timeout	A timeout error occurred for a MECHATROLINK command.	Check the motor status when the command is executed.	Execute the SV_ON or SENS_ON command only when the motor is not operating.	–
		• For fully-closed loop control, check the status of the external encoder when the command is executed. • For other types of control, check the status of the linear encoder when the command is executed.	Execute the SENS_ON command only when an external encoder (e.g., a linear encoder) is connected.	–
A.F10: 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.)	The three-phase power supply wiring is not correct.	Check the power supply wiring.	Make sure that the power supply is correctly wired.	page 4-10
	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.	–
	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.	–
FL-1*3: System Alarm FL-2*3: System Alarm FL-3*3: System Alarm FL-4*3: System Alarm FL-5*3: System Alarm	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.	–
CPF00: Digital Operator Communications Error 1	There is a faulty contact between the Digital Operator and the SERVOPACK.	Check the connector contact.	Disconnect the connector and insert it again. Or, replace the cable.	–
	A malfunction was caused by noise.	–	Keep the Digital Operator or the cable away from sources of noise.	–
CPF01: Digital Operator Communications Error 2	A failure occurred in the Digital Operator.	–	Disconnect the Digital Operator and then connect it again. If an alarm still occurs, the Digital Operator may be faulty. Replace the Digital Operator.	–
	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.	–

*1. Detection Conditions
If either of the following conditions is detected, an alarm will occur.

- $\text{Pn533 [min}^{-1}] \times \dfrac{\text{Encoder resolution}}{6 \times 10^5} \leq \dfrac{\text{Pn20E}}{\text{Pn210}}$

- $\text{Maximum motor speed [min}^{-1}] \times \dfrac{\text{Encoder resolution}}{\text{Approx. } 3.66 \times 10^{12}} \geq \dfrac{\text{Pn20E}}{\text{Pn210}}$

*2. Detection Conditions
If either of the following conditions is detected, an alarm will occur.

- $\text{Rated motor speed [min}^{-1}] \times 1/3 \times \dfrac{\text{Encoder resolution}}{6 \times 10^5} \leq \dfrac{\text{Pn20E}}{\text{Pn210}}$

- $\text{Maximum motor speed [min}^{-1}] \times \dfrac{\text{Encoder resolution}}{\text{Approx. } 3.66 \times 10^{12}} \geq \dfrac{\text{Pn20E}}{\text{Pn210}}$

*3. Refer to the following manual for details.
Σ-7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)

*4. These alarms are not stored in the alarm history. They are only displayed on the panel display.

11.2.3 Resetting Alarms

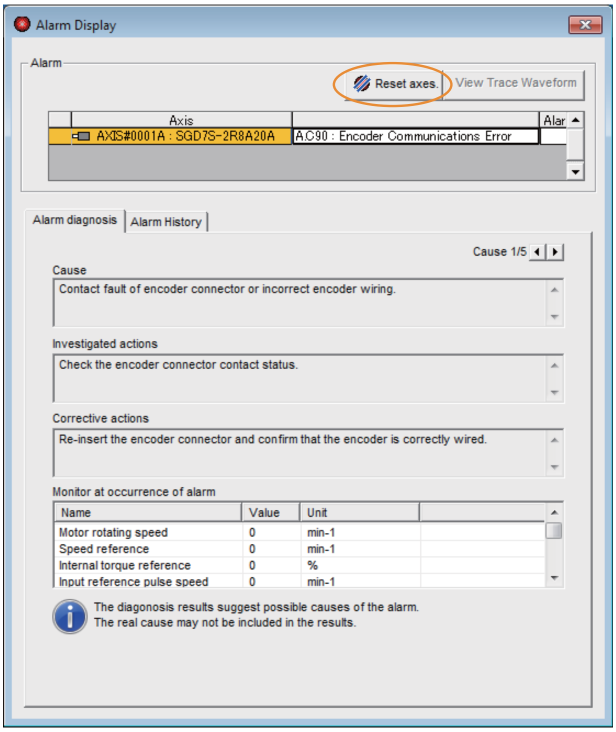
If there is an ALM (Servo Alarm) signal, use one of the following methods to reset the alarm after eliminating the cause of the alarm.

> **Important**
> Be sure to eliminate the cause of an alarm before you reset the alarm.
> If you reset the alarm and continue operation without eliminating the cause of the alarm, it may result in damage to the equipment or fire.

Resetting Alarms with the SigmaWin+

Use the following procedure to reset alarms with the SigmaWin+.

1. Click the  Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
2. Select **Display Alarm** in the Menu Dialog Box.
   The Alarm Display Dialog Box will be displayed.
3. Click the **Reset axes** Button.



The alarm will be reset, and the alarm display will be cleared.

This concludes the procedure to reset alarms.

Resetting Alarms by Sending the ALM_CLR (Clear Warning or Alarm) Command

Refer to the following manual for details.

Σ-7-Series MECHATROLINK-III Communications Standard Servo Profile Command Manual (Manual No.: SIEP S800001 31)

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)

11.2.4 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 (MECHATROLINK Synchronization Error), A.E60 (Reception Error in MECHATROLINK Communications), and FL-1 to FL-5.

Preparations

No preparations are required.

Applicable Tools

The following table lists the tools that you can use to display the alarm history.

Tool	Fn No./Function Name	Reference
Digital Operator	Fn000	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Troubleshooting – Display Alarm***	*Operating Procedure* on page 11-33

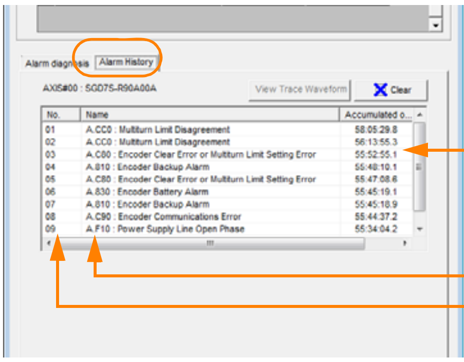
Operating Procedure

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.



Accumulated operation time
Total operation time to the point at which the alarm occurred is displayed in increments of 100 ms from when the control power supply and main circuit power supply turned ON.
For 24-hour, 365-day operation, measurements are possible for approximately 13 years.

Alarm number: Alarm name

Alarms in order of occurrence
(Older alarms have higher numbers.)

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.

11.2.5 Clearing the Alarm History

You can clear the alarm history that is recorded in the SERVOPACK.

The alarm history is not cleared when alarms are reset or when the SERVOPACK main circuit power is turned OFF. You must perform the following procedure.

Preparations

Always check the following before you clear the alarm history.

• The parameters must not be write prohibited.

Applicable Tools

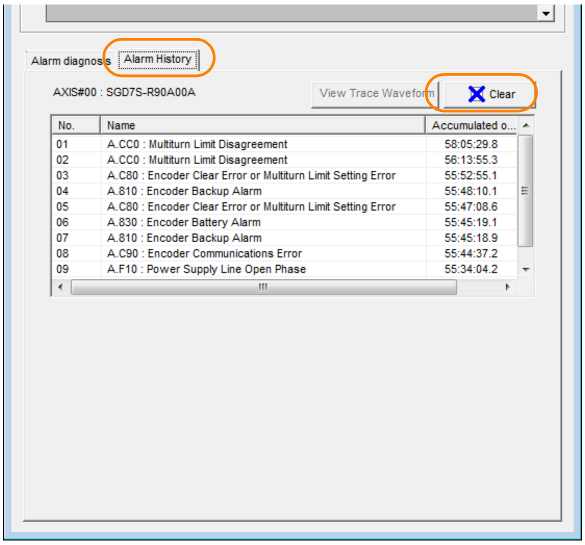
The following table lists the tools that you can use to clear the alarm history.

Tool	Fn No./Function Name	Reference
Digital Operator	Fn006	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Troubleshooting – Display Alarm***	*Operating Procedure* on page 11-34

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.

11.2.6 Resetting Alarms Detected in Option Modules

If any Option Modules are attached to the SERVOPACK, the SERVOPACK detects the presence and models of the connected Option Modules. If it finds any errors, it outputs alarms.

You can delete those alarms with this operation.

Information
- This operation is the only way to reset alarms for Option Modules. The alarms are not reset when you reset other alarms or when you turn OFF the power supply to the SERVOPACK.
- Always remove the cause of an alarm before you reset the alarm.

Preparations

Always check the following before you clear an alarm detected in an Option Module.

- The parameters must not be write prohibited.

Applicable Tools

The following table lists the tools that you can use to reset Option Module configuration errors.

Tool	Fn No./Function Name	Reference
Digital Operator	Fn014	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	***Troubleshooting – Display Alarm***	*Operating Procedure* on page 11-35

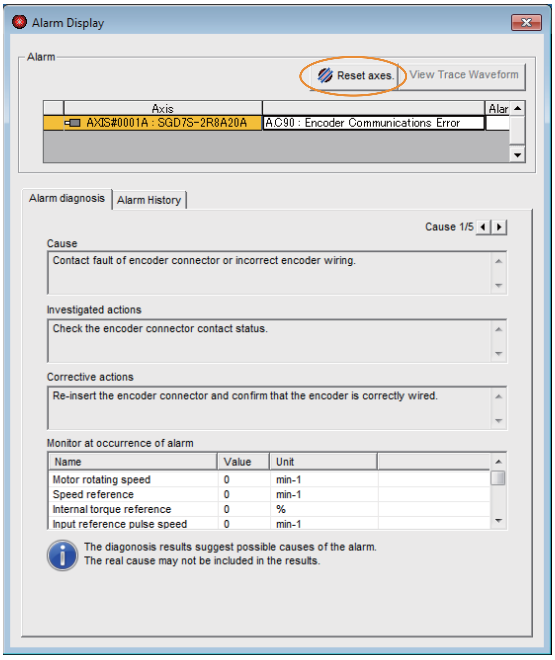
Operating Procedure

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 **Display Alarm** in the Menu Dialog Box.
   The Display Alarm Dialog Box will be displayed.

3. Click the **Reset axes** Button.



   The Reset Option Module Configuration Error Dialog Box will be displayed.

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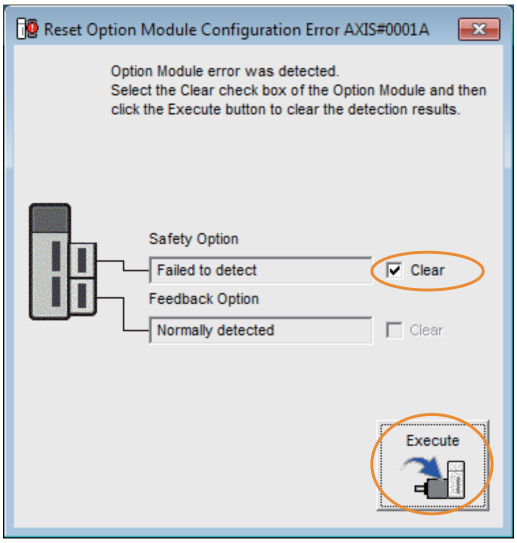
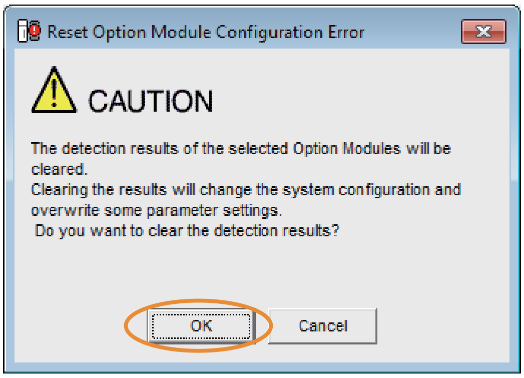
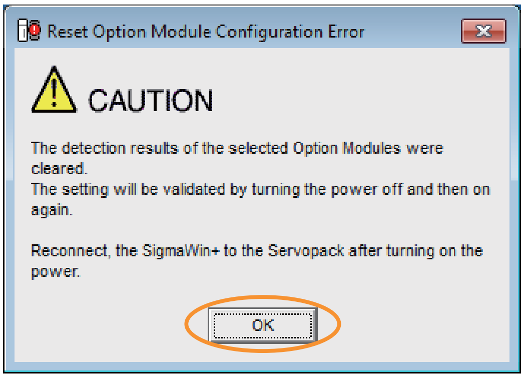
4. Select the **Clear** Check Box for the Option Module for which to reset the alarm and then click the **Execute** Button.



5. Read the precaution and then click the **OK** Button.



6. Read the precaution and then click the **OK** Button.



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

This concludes the procedure to reset alarms detected in Option Modules.

11.3 Warning Displays

If a warning occurs in the SERVOPACK, a warning number will be displayed on the panel display. Warnings are displayed to warn you before an alarm occurs.

This section provides a list of warnings and the causes of and corrections for warnings.

11.3.1 List of Warnings

The list of warnings gives the warning name and warning meaning in order of the warning numbers.

Warning Number	Warning Name	Meaning	Resetting
A.900	Position Deviation Overflow	The position deviation exceeded the percentage set with the following formula: (Pn520 × Pn51E/100)	Required.
A.901	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 × Pn528/100)	Required.
A.910	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.	Required.
A.911	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 (Vibration Detection Selections).	Required.
A.912	Internal Temperature Warning 1 (Control Board Temperature Error)	The surrounding temperature of the control PCB is abnormal.	Required.
A.913	Internal Temperature Warning 2 (Power Board Temperature Error)	The surrounding temperature of the power PCB is abnormal.	Required.
A.920	Regenerative Overload	This warning occurs before an A.320 alarm (Regenerative Overload) occurs. If the warning is ignored and operation is continued, an alarm may occur.	Required.
A.923	SERVOPACK Built-in Fan Stopped	The fan inside the SERVOPACK stopped.	Required.
A.94A	Data Setting Warning 1 (Parameter Number Error)	There is an error in the parameter number for a Data Setting Warning 1 (Parameter Number) command.	Automatically reset.*
A.94b	Data Setting Warning 2 (Out of Range)	The command data is out of range.	Automatically reset.*
A.94C	Data Setting Warning 3 (Calculation Error)	A calculation error was detected.	Automatically reset.*
A.94d	Data Setting Warning 4 (Parameter Size)	The data sizes do not match.	Automatically reset.*
A.94E	Data Setting Warning 5 (Latch Mode Error)	A latch mode error was detected.	Required.
A.95A	Command Warning 1 (Unsatisfied Command Conditions)	A command was sent when the conditions for sending a command were not satisfied.	Automatically reset.*
A.95b	Command Warning 2 (Unsupported Command)	An unsupported command was sent.	Automatically reset.*

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Warning Number	Warning Name	Meaning	Resetting
A.95d	Command Warning 4 (Command Interfer-ence)	There was command interference, particularly latch command interference.	Automatically reset.*
A.95E	Command Warning 5 (Subcommand Not Possible)	The subcommand and main command interfere with each other.	Automatically reset.*
A.95F	Command Warning 6 (Undefined Command)	An undefined command was sent.	Automatically reset.*
A.960	MECHATROLINK Communications Warning	A communications error occurred during MECHATROLINK communications.	Required.
A.971	Undervoltage	This warning occurs before an A.410 alarm (Undervolt-age) occurs. If the warning is ignored and operation is continued, an alarm may occur.	Required.
A.97A	Command Warning 7 (Phase Error)	A command that cannot be executed in the current phase was sent.	Automatically reset.*
A.97b	Data Clamp Out of Range	The set command data was clamped to the minimum or maximum value of the allowable setting range.	Automatically reset.*
A.980	Motor Overheat	This warning occurs before an A.790 alarm (Motor Overheat) occurs. If the warning is ignored and opera-tion is continued, an alarm may occur.	Required.
A.9A0	Overtravel	Overtravel was detected while the servo was ON.	Required.
A.9b0	Preventative Mainte-nance Warning	One of the consumable parts has reached the end of its service life.	Required.
A.9b2	Preventative Mainte-nance Data Error	The maximum time stamp value was reached. Or, a ser-vice life inspection data error occurred.	Required.

* The warning will automatically be cleared after the correct command is received.

Note: Use Pn008 = n.□X□□ (Warning Detection Selection) to control warning detection.
However, the following warnings are not affected by the setting of Pn008 = n.□X□□ and other parameter settings are required in addition to Pn008 = n.□X□□.

Warning	Parameters That Must Be Set to Select Warning Detection	Reference
A.911	Pn310 = n.□□□X (Vibration Detection Selection)	page 6-24
A.923	– (Not affected by the setting of Pn008 = n.□X□□.)	–
A.94A to A.960 and A.97A to A.97b	Pn800 = n.□□X□ (Warning Check Masks)	page 12-3
A.971	Pn008 = n.□□X□ (Function Selection for Undervoltage) (Not affected by the setting of Pn008 = n.□X□□.)	page 6-14
A.9A0	Pn00D = n.X□□□ (Overtravel Warning Detection Selection) (Not affected by the setting of Pn008 = n.□X□□.)	page 5-20
A.9b0	Pn00F = n.□□□X (Preventative Maintenance Warning Selection)	page 9-19

11.3.2 Troubleshooting Warnings

The causes of and corrections for the warnings are given in the following table. Contact your Yaskawa representative if you cannot solve a problem with the correction given in the table.

Warning Number: Warning Name	Possible Cause	Confirmation	Correction	Reference
A.900: Position Deviation Overflow	The Spindle Motor U, V, and W wiring is not correct.	Check the wiring of the Spindle Motor main circuit cable.	Make sure that there are no faulty connections in the wiring for the motor and encoder.	–
	A SERVOPACK gain is too low.	Check the SERVOPACK gains.	Increase the servo gain, e.g., by using autotuning without a host reference.	–
	The acceleration of the position reference is too high.	Reduce the reference acceleration and try operating the SERVOPACK.	Reduce the acceleration of the position reference using a MECHATROLINK command. Or, smooth the position reference acceleration by selecting the position reference filter (ACCFIL) using a MECHATROLINK command.	–
	The excessive position deviation alarm level (Pn520 × Pn51E/100) is too low for the operating conditions.	Check excessive position deviation alarm level (Pn520 × Pn51E/100) to see if it is set to an appropriate value.	Optimize the settings of Pn520 and Pn51E.	page 8-6
	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.	–
A.901: 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 × Pn528/100)	–	Optimize the setting of Pn528 (Position Deviation Overflow Warning Level at Servo ON).	–

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Warning Number: Warning Name	Possible Cause	Confirmation	Correction	Reference
A.910: Overload (warning before an A.710 or A.720 alarm occurs)	The wiring is not correct or there is a faulty contact in the motor or encoder wiring.	Check the wiring.	Make sure that the motor and encoder are correctly wired.	–
	Operation was performed that exceeded the overload protection characteristics.	Check the motor overload characteristics and Run command.	Reconsider the load and operating conditions. Or, increase the motor capacity.	–
	An excessive load was applied during operation because the motor was not driven because of mechanical problems.	Check the operation reference and motor speed.	Remove the mechanical problem.	–
	The overload warning level (Pn52B) is not suitable.	Check that the overload warning level (Pn52B) is suitable.	Set a suitable overload warning level (Pn52B).	page 5-24
	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.911: Vibration	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 8-33
	The setting of Pn103 (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.	Set Pn103 (Moment of Inertia Ratio) to an appropriate value.	–
	The vibration detection level (Pn312) is not suitable.	Check the vibration detection level (Pn312) for suitability.	Set a suitable vibration detection level (Pn312).	page 6-24

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Warning Number: Warning Name	Possible Cause	Confirmation	Correction	Reference
A.912: Internal Temperature Warning 1 (Control Board Temperature Error)	The surrounding temperature is too high.	Check the surrounding temperature using a thermostat. 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.	–
	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 SERVOPACK.	–
A.913: Internal Temperature Warning 2 (Power Board Temperature Error)	The surrounding temperature is too high.	Check the surrounding temperature using a thermostat. 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.	–
	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 SERVOPACK.	–

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Warning Number: Warning Name	Possible Cause	Confirmation	Correction	Reference
A.920: 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 SERVOPACK capacity, or there has been a continuous regeneration state.	Check the operating conditions and capacity again.	Change the regenerative resistance value, regenerative resistance capacity, or SERVOPACK capacity. Recheck the operating conditions.	–
	There was a continuous regeneration state because a negative load was continuously applied.	Check the load applied to the Spindle Motor during operation.	Reconsider the system including the servo, machine, and operating conditions.	–
A.923: 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 an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.94A: Data Setting Warning 1 (Parameter Number Error)	An invalid parameter number was used.	Check the command that caused the warning.	Use the correct parameter number.	page 11-45
A.94b: Data Setting Warning 2 (Out of Range)	The set command data was clamped to the minimum or maximum value of the setting range.	Check the command that caused the warning.	Set the parameter within the setting range.	page 11-45
A.94C: Data Setting Warning 3 (Calculation Error)	The calculation result of the setting is not correct.	Check the command that caused the warning.	Set the parameter within the setting range.	page 11-45
A.94d: Data Setting Warning 4 (Parameter Size)	The parameter size set in the command is not correct.	Check the command that caused the warning.	Set the correct parameter size.	page 11-45
A.94E: Data Setting Warning 5 (Latch Mode Error)	A latch mode error was detected.	Check the command that caused the warning.	Change the setting of Pn850 or the LT_MOD data for the LTMOD_ON command sent by the host controller to an appropriate value.	page 11-45
A.95A: Command Warning 1 (Unsatisfied Command Conditions)	The command conditions are not satisfied.	Check the command that caused the warning.	Send the command after the command conditions are satisfied.	page 11-45
A.95b: Command Warning 2 (Unsupported Command)	An unsupported command was received.	Check the command that caused the warning.	Do not send unsupported commands.	page 11-45

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Warning Number: Warning Name	Possible Cause	Confirmation	Correction	Reference
A.95d: Command Warning 4 (Command Interference)	The command sending conditions for latch-related commands was not satisfied.	Check the command that caused the warning.	Send the command after the command conditions are satisfied.	page 11-45
A.95E: Command Warning 5 (Subcommand Not Possible)	The command sending conditions for subcommands was not satisfied.	Check the command that caused the warning.	Send the command after the conditions are satisfied.	page 11-45
A.95F: Command Warning 6 (Undefined Command)	An undefined command was sent.	Check the command that caused the warning.	Do not send undefined commands.	page 11-45
A.960: MECHATROLINK Communications Warning	The MECHATROLINK Communications Cable is not wired correctly.	Check the wiring conditions.	Correct the MECHATROLINK communications cable wiring.	page 4-26
	A MECHATROLINK data reception error occurred due to noise.	Confirm the installation conditions.	Implement the following countermeasures against noise. • Check the MECHATROLINK Communications Cable and FG wiring and implement countermeasures to prevent noise from entering. • Attach a ferrite core to the MECHATROLINK Communications Cable.	–
	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.971: Undervoltage	For a 200-V SERVOPACK, the AC power supply voltage dropped below 140 V.	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.	–
	A momentary power interruption occurred.	Measure the power supply voltage.	If you have changed the setting of Pn509 (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 4-15
	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.97A: Command Warning 7 (Phase Error)	A command that cannot be executed in the current phase was sent.	–	Send the command after the command conditions are satisfied.	–

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Warning Number: Warning Name	Possible Cause	Confirmation	Correction	Reference
A.97b: Data Clamp Out of Range	The set command data was clamped to the minimum or maximum value of the setting range.	–	Set the command data within the setting ranges.	–
A.980 Motor Overheat	The temperature surrounding the motor is too high.	Check the temperature surrounding the motor.	Prevent the temperature surrounding the motor from increasing.	–
	Acceleration and deceleration were repeated frequently.	–	Accelerate and decelerate the motor more gradually or change the operation pattern.	–
A.9A0: Overtravel (Overtravel 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 5-20
A.9b0: Preventative Maintenance Warning	One of the consumable parts has reached the end of its service life.	–	Replace the part. Contact your Yaskawa representative for replacement.	page 9-19
A.9b2: Preventative Maintenance Data Error	Preventative Maintenance Data Error	Check monitors related to service life inspection.	Replace the SERVOPACK. Contact your Yaskawa representative for replacement.	–

11.4 Monitoring Communications Data during Alarms or Warnings

You can monitor the command data that is received when an alarm or warning occurs, such as a data setting warning (A.94□) or a command warning (A.95□) by using the following parameters. The following is an example of the data when an alarm or warning has occurred in the normal state.

Command Data during Alarms and Warnings: Pn890 to Pn8A6
Response Data during Alarms and Warnings: Pn8A8 to Pn8BE

Command Byte Sequence	Command Data Storage When an Alarm or Warning Occurs	
	CMD	RSP
0	Pn890 = n.□□□□□□XX	Pn8A8 = n.□□□□□□XX
1	Pn890 = n.□□□□XX□□	Pn8A8 = n.□□□□XX□□
2	Pn890 = n.□□XX□□□□	Pn8A8 = n.□□XX□□□□
3	Pn890 = n.XX□□□□□□	Pn8A8 = n.XX□□□□□□
4 to 7	Pn892	Pn8AA
8 to 11	Pn894	Pn8AC
12 to 15	Pn896	Pn8AE
16 to 19	Pn898	Pn8B0
20 to 23	Pn89A	Pn8B2
24 to 27	Pn89C	Pn8B4
28 to 31	Pn89E	Pn8B6
32 to 35	Pn8A0	Pn8B8
36 to 39	Pn8A2	Pn8BA
40 to 43	Pn8A4	Pn8BC
44 to 47	Pn8A6	Pn8BE

Note: 1. Data is stored in little endian byte order and displayed in the hexadecimal.
2. Refer to the following manual for command details.
Σ-7-Series MECHATROLINK-III Communications Standard Servo Profile Command Manual (Manual No.: SIEP S800001 31)

Maintenance

11

11.5 Troubleshooting Based on the Operation and Conditions of the Spindle Motor

This section provides troubleshooting based on the operation and conditions of the Spindle Motor, including causes and corrections.

Problem	Possible Cause	Confirmation	Correction	Reference
Spindle Motor Does Not Start	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 4-21, page 9-5
	The wiring for the Spindle Motor main circuit cable or Encoder Cable is disconnected.	Check the wiring conditions.	Turn OFF the power supply to the servo system. Wire the cable correctly.	–
	There is an overload on the Spindle Motor.	Operate the Spindle Motor with no load and check the load status.	Turn OFF the power supply to the servo system. Reduce the load or replace the Spindle Motor with a Spindle Motor with a larger capacity.	–
	The type of Spindle Motor that is being used does not agree with the setting of Pn01E = n.□□□X (Motor Type and Application Selection).	Check the type of the Spindle Motor that is being used and the setting of Pn01E = n.□□□X.	Set Pn01E = n.□□□X according to the type of the Spindle Motor that is being used.	–
	A failure occurred in the SERVOPACK.	–	Turn OFF the power supply to the servo system. Replace the SERVOPACK.	–
Spindle Motor Moves Instantaneously, and Then Stops	There is a mistake in the Spindle Motor wiring.	Turn OFF the power supply to the servo system. Check the wiring.	Wire the motor correctly.	–
	There is a mistake in the encoder wiring.	Turn OFF the power supply to the servo system. Check the wiring.	Wire the cable correctly.	–

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Problem	Possible Cause	Confirmation	Correction	Reference
Spindle Motor Operation Is Unstable	There is a faulty connection in the Spindle Motor wiring.	Turn OFF the power supply to the servo system. The connector connections for the power line (U, V, and W phases) and the encoder or Serial Converter Unit may be unstable. Check the wiring.	Tighten any loose terminals or connectors and correct the wiring.	–
Spindle Motor Moves without a Reference Input	A failure occurred in the SERVOPACK.	–	Turn OFF the power supply to the servo system. Replace the SERVOPACK.	–
Abnormal Noise from Spindle Motor	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.	–
		Turn OFF the power supply to the servo system. Check to see if there is misalignment in the coupling.	Align the coupling.	–
		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 Spindle Motor.	–
	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 cables or screened twisted-pair cables with conductors of at least 0.12 mm^2 (stranded wire).	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.	–
	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 twisted-pair cable or a screened twisted-pair cable with a conductors of at least 0.12 mm^2 (stranded wire).	Use cables that satisfy the specifications.	–

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Problem	Possible Cause	Confirmation	Correction	Reference
Abnormal Noise from Spindle Motor	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.	The Encoder Cable must be no longer than 20 m.	–
	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 environment.	–
	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 layout 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 Spindle Motor 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 Spindle Motor installation (mounting surface precision, securing state, and alignment).	Reduce machine vibration. Improve the installation condition of the Spindle Motor.	–
	A failure occurred in the encoder.	–	Turn OFF the power supply to the servo system. Replace the Spindle Motor.	–
Spindle Motor Vibrates at Frequency of Approx. 200 to 400 Hz.	The servo gains are not balanced.	Check to see if the servo gains have been correctly tuned.	Tune the servo gains.	–
	The setting of Pn100 (Speed Loop Gain) is too high.	Check the setting of Pn100. The default setting is Kv = 40.0 Hz.	Set Pn100 to an appropriate value.	–
	The setting of Pn101 (Speed Loop Integral Time Constant) is not appropriate.	Check the setting of Pn101. The default setting is Ti = 20.0 ms.	Set Pn101 to an appropriate value.	–
	The setting of Pn103 (Moment of Inertia Ratio or Mass Ratio) is not appropriate.	Check the setting of Pn103.	Set Pn103 to an appropriate value.	–

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Problem	Possible Cause	Confirmation	Correction	Reference
Large Motor Speed Overshoot on Starting and Stopping	The servo gains are not balanced.	Check to see if the servo gains have been correctly tuned.	Tune the servo gains.	–
	The setting of Pn100 (Speed Loop Gain) is too high.	Check the setting of Pn100. The default setting is Kv = 40.0 Hz.	Set Pn100 to an appropriate value.	–
	The setting of Pn101 (Speed Loop Integral Time Constant) is not appropriate.	Check the setting of Pn101. The default setting is Ti = 20.0 ms.	Set Pn101 to an appropriate value.	–
	The setting of Pn103 (Moment of Inertia Ratio or Mass Ratio) is not appropriate.	Check the setting of Pn103.	Set Pn103 to an appropriate value.	–
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 it satisfies specifications. Use a shielded twisted-pair cable or a screened twisted-pair cable with conductors of at least 0.12 mm^2 (stranded wire).	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.	The Encoder Cable must be no longer than 20 m.	–
	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 environment.	–
	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 layout so that no surge is applied by high-current lines.	–

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Problem	Possible Cause	Confirmation	Correction	Reference
Position Deviation (without Alarm)	There is variation in the FG potential because of the influence of machines on the Spindle Motor 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 signal line from the encoder or Serial Converter Unit.	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 Spindle Motor installation (mounting surface precision, securing state, and alignment).	Reduce machine vibration. Improve the mounting state of the Spindle Motor.	–
	The coupling between the machine and Spindle Motor is not appropriate.	Turn OFF the power supply to the servo system. Check to see if position offset occurs at the coupling between machine and Spindle Motor.	Correctly secure the coupling between the machine and Spindle Motor.	–
	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 cable or a screened twisted-pair cable with conductors of at least 0.12 mm^2 (stranded wire).	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.	–
	A failure occurred in the encoder. (The pulse count does not change.)	–	Turn OFF the power supply to the servo system. Replace the Spindle Motor.	–
	A failure occurred in the SERVOPACK.	–	Turn OFF the power supply to the servo system. Replace the SERVOPACK.	–
Spindle Motor Overheated	The surrounding air temperature is too high.	Measure the surrounding temperature around the Spindle Motor.	Reduce the surrounding air temperature to 40°C or less.	–
	The surface of the Spindle Motor 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 Spindle Motor.	Check the load status with a monitor.	If the motor is overloaded, reduce the load or replace the SERVOPACK and Spindle Motor with models with larger capacities.	–

Parameter Lists

12

This chapter provides information on the parameters.

12.1 List of Servo Parameters

12.1.1 Interpreting the Parameter Lists

"After restart" indicates parameters that will be effective after one of the following is executed.
- The power supply is turned OFF and ON again.
- The CONFIG command is sent.
- A software reset is executed.

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn000	2	Basic Function Selections 0	0000h to 10B1h	–	0000h	After restart	Setup	–

There are the following two classifications.
- Setup
- Tuning

Refer to the following section for details.
5.2.1 Parameter Classification on page 5-8

n.□□□X	Rotation Direction Selection		Reference
	0	Use CCW as the forward direction.	page 5-17
	1	Use CW as the forward direction. (Reverse Rotation Mode)	

n.□□X□	Reserved parameter (Do not change.)

n.□X□□	Reserved parameter (Do not change.)

n.X□□□	Rotary/Linear Servomotor Startup Selection When Encoder Is Not Connected		Reference
	0	When an encoder is not connected, start as SERVOPACK for Rotary Servomotor.	–
	1	When an encoder is not connected, start as SERVOPACK for Linear Servomotor.	

12.1.2 List of Servo Parameters

The following table lists the parameters.

Note: Do not change the following parameters from their default settings.
- Reserved parameters
- Parameters not given in this manual
- Parameters that are not valid for the Spindle Motor that you are using, as given in the parameter table

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn000	2	Basic Function Selections 0	0000h to 10B1h	–	0000h	After restart	Setup	–

Pn000	Rotation Direction Selection		Reference
n.□□□X	0	Use CCW as the forward direction.	page 5-17
	1	Use CW as the forward direction. (Reverse Rotation Mode)	
n.□□X□	Reserved parameter (Do not change.)		
n.□X□□	Reserved parameter (Do not change.)		
n.X□□□	Reserved parameter (Do not change.)		

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn001	2	Application Function Selections 1	0000h to 1242h	–	0002h	After restart	Setup	–

Pn001	Motor Stopping Method for Servo OFF and Group 1 Alarms		Reference
n.□□□X	0	Reserved setting (Do not use.)	page 5-22
	1	Reserved setting (Do not use.)	
	2	Coast the motor to a stop.	

Pn001	Overtravel Stopping Method		Reference
n.□□X□	0	Coast the motor to a stop.	page 5-19
	1	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then servo-lock the motor.	
	2	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then let the motor coast.	
	3	Decelerate the motor to a stop using the deceleration time set in Pn30A and then servo-lock the motor.	
	4	Decelerate the motor to a stop using the deceleration time set in Pn30A and then let the motor coast.	

Pn001	Main Circuit Power Supply AC/DC Input Selection		Reference
n.□X□□	0	Input AC power as the main circuit power supply using the L1, L2, and L3 terminals (do not use shared converter).	–
	1	Input DC power as the main circuit power supply using the B1/⊕ and ⊖ 2 terminals or the B1 and ⊖ 2 terminals (use an external converter or the shared converter).	
n.X□□□	Reserved parameter (Do not change.)		

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn002	2	Application Function Selections 2	0000h to 8214h	–	0014h	After restart	Setup	–

n.□□□X	MECHATROLINK Command Position and Speed Control Option		Reference
	0 to 3	Reserved settings (Do not use.)	*1
	4	Use TLIM as the torque limit input.	

n.□□X□	Torque Control Option		Reference
	0	Reserved setting (Do not use.)	*1
	1	Use the speed limit for torque control (VLIM) as the speed limit.	

n.□X□□	Encoder Usage		Reference
	0	Use the encoder according to encoder specifications.	–
	1	Use the encoder as an incremental encoder.	
	2	Use the encoder as a single-turn absolute encoder.	

n.X□□□	External Encoder Usage		Reference
	0	Do not use an external encoder.	page 10-6
	1	The external encoder moves in the forward direction for CCW motor rotation.	
	2	Reserved setting (Do not use.)	
	3	The external encoder moves in the reverse direction for CCW motor rotation.	
	4	Reserved setting (Do not use.)	
	5	The external pulse encoder moves in the forward direction for CCW motor rotation.	
	6	Reserved setting (Do not use.)	
	7	The external pulse encoder moves in the reverse direction for CCW motor rotation.	
	8	Reserved setting (Do not use.)	

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn006	2	Application Function Selections 6	0000h to 105Fh	–	0002h	Immediately	Setup	page 9-12

n.□□XX	Analog Monitor 1 Signal Selection	
	00	Motor speed (1 V/1,000 min^{-1})
	01	Speed reference (1 V/1,000 min^{-1})
	02	Torque reference (1 V/100% rated torque)
	03	Position deviation (0.05 V/reference unit)
	04	Position amplifier deviation (after electronic gear) (0.05 V/encoder pulse unit)
	05	Position reference speed (1 V/1,000 min^{-1})
	06	Reserved setting (Do not use.)
	07	Load-motor position deviation (0.01 V/reference unit)
	08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)
	09	Speed feedforward (1 V/1,000 min^{-1})
	0A	Torque feedforward (1 V/100% rated torque)
	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 44	Reserved settings (Do not use.)
	46	Load Meter (6 V/100%)
	47 to 5F	Reserved settings (Do not use.)
n.□X□□	Reserved parameter (Do not change.)	
n.X□□□	Reserved parameter (Do not change.)	

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn007	2	Application Function Selections 7	0000h to 105Fh	–	0000h	Immediately	Setup	page 9-12

Pn007		
n.□□XX	Analog Monitor 2 Signal Selection	
	00	Motor speed (1 V/1,000 min^{-1})
	01	Speed reference (1 V/1,000 min^{-1})
	02	Torque reference (1 V/100% rated torque)
	03	Position deviation (0.05 V/reference unit)
	04	Position amplifier deviation (after electronic gear) (0.05 V/encoder pulse unit)
	05	Position reference speed (1 V/1,000 min^{-1})
	06	Reserved setting (Do not use.)
	07	Load-motor position deviation (0.01 V/reference unit)
	08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)
	09	Speed feedforward (1 V/1,000 min^{-1})
	0A	Torque feedforward (1 V/100% rated torque)
	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 44	Reserved settings (Do not use.)
	46	Load Meter (6 V/100%)
	47 to 5F	Reserved settings (Do not use.)
n.□X□□	Reserved parameter (Do not change.)	
n.X□□□	Reserved parameter (Do not change.)	

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn008	2	Application Function Selections 8	0000h to 7120h	–	4000h	After restart	Setup	–

Pn008			
n.□□□X	Reserved parameter (Do not change.)		
n.□□X□	Function Selection for Undervoltage		Reference
	0	Do not detect undervoltage.	page 6-14
	1	Detect undervoltage warning and limit torque at host controller.	
	2	Detect undervoltage warning and limit torque with Pn424 and Pn425 (i.e., only in SERVOPACK).	
n.□X□□	Warning Detection Selection		Reference
	0	Detect warnings.	page 11-37
	1	Do not detect warnings except for A.971.	
n.X□□□	Reserved parameter (Do not change.)		

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn009	2	Reserved parameter (Do not change.)	–	–	0000h	–	–	–
Pn00A	2	Application Function Selections A	0000h to 0044h	–	0001h	After restart	Setup	–

Pn00A:

n.□□□X	Motor Stopping Method for Group 2 Alarms		Reference
	0	Coast the motor to a stop (use the stopping method set in Pn001 = n.□□□X).	page 5-22
	1	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque. Use the setting of Pn001 = n.□□□X for the status after stopping.	
	2	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then let the motor coast.	
	3	Decelerate the motor to a stop using the deceleration time set in Pn30A. Use the setting of Pn001 = n.□□□X for the status after stopping.	
	4	Decelerate the motor to a stop using the deceleration time set in Pn30A and then let the motor coast.	

n.□□X□	Stopping Method for Forced Stops		Reference
	0	Coast the motor to a stop (use the stopping method set in Pn001 = n.□□□X).	page 6-31
	1	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque. Use the setting of Pn001 = n.□□□X for the status after stopping.	
	2	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then let the motor coast.	
	3	Decelerate the motor to a stop using the deceleration time set in Pn30A. Use the setting of Pn001 = n.□□□X for the status after stopping.	
	4	Decelerate the motor to a stop using the deceleration time set in Pn30A and then let the motor coast.	

n.□X□□	Reserved parameter (Do not change.)
n.X□□□	Reserved parameter (Do not change.)

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn00B	2	Application Function Selections B	0000h to 1021h	–	0001h	After restart	Setup	–

Pn00B:

n.□□□X	Reserved parameter (Do not change.)

n.□□X□	Motor Stopping Method for Group 2 Alarms		Reference
	0	Stop the motor by setting the speed reference to 0.	page 5-22
	1	Coast the motor to a stop (use the stopping method set in Pn001 = n.□□□X).	
	2	Set the stopping method with Pn00A = n.□□□X.	

n.□X□□	Reserved parameter (Do not change.)
n.X□□□	Reserved parameter (Do not change.)

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn00C	2	Reserved parameter (Do not change.)	–	–	0000h	After restart	Setup	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn00D	2	Application Function Selections D	0000h to 1001h	–	0000h	Immediately	Setup	page 5-20

n.□□□X	Reserved parameter (Do not change.)	
n.□□X□	Reserved parameter (Do not change.)	
n.□X□□	Reserved parameter (Do not change.)	
n.X□□□	Overtravel Warning Detection Selection	
	0	Do not detect overtravel warnings.
	1	Detect overtravel warnings.

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn00F	2	Application Function Selections F	0000h to 2011h	–	0000h	After restart	Setup	–

n.□□□X	Preventative Maintenance Warning Selection		Reference
	0	Do not detect preventative maintenance warnings.	page 9-19
	1	Detect preventative maintenance warnings.	
n.□□X□	Reserved parameter (Do not change.)		
n.□X□□	Reserved parameter (Do not change.)		
n.X□□□	Reserved parameter (Do not change.)		

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn01C	2	Application Function Selections 1C	0000h to 0003h	–	0000h	After restart	Setup	–

n.□□□X	Load Ratio Output Base Selection	
	0	Outputs the load ratio using the 10-second rated output of the motor as the 120% output.
	1	Outputs the load ratio using the 10-second rated output of the motor as the 100% output.
	2	Outputs the load ratio using the rated short-term motor output (50% ED) as the 100% output.
	3	Outputs the load ratio using the rated continuous motor output as the 100% output.
n.□□X□	Reserved parameter (Do not change.)	
n.□X□□	Reserved parameter (Do not change.)	
n.X□□□	Reserved parameter (Do not change.)	

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn01E	2	Application Function Selections 1E	0000h to 0006h	–	0003h	After restart	Setup	–

Pn01E		
n.□□□X	Motor Type and Application Selection	
	0	Reserved setting (Do not use.)
	1	Reserved setting (Do not use.)
	2	Reserved setting (Do not use.)
	3	IM Spindle Motor
	4	Reserved setting (Do not use.)
	5	Reserved setting (Do not use.)
	6	Reserved setting (Do not use.)
n.□□X□	Reserved parameter (Do not change.)	
n.□X□□	Reserved parameter (Do not change.)	
n.X□□□	Reserved parameter (Do not change.)	

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn01F	2	Application Function Selections 1F	0000h to 0002h	–	0002h	After restart	Setup	–

Pn01F		
n.□□□X	Encoder Type Selection	
	0	Reserved setting (Do not use.)
	1	Pulse encoder on Spindle Motor
	2	Serial encoder on Spindle Motor
n.□□X□	Reserved parameter (Do not change.)	
n.□X□□	Reserved parameter (Do not change.)	
n.X□□□	Reserved parameter (Do not change.)	

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn021	2	Reserved parameter (Do not change.)	–	–	0000h	–	–	–
Pn040	2	Reserved parameter (Do not change.)	–	–	0000h	–	–	–
Pn080	2	Reserved parameter (Do not change.)	–	–	0000h	–	–	–
Pn081	2	Application Function Selections 81	0000h to 1111h	–	0000h	After restart	Setup	page 6-17

Pn081		
n.□□□X	Phase-C Pulse Output Selection	
	0	Output phase-C pulses only in the forward direction.
	1	Output phase-C pulses in both the forward and reverse directions.
n.□□X□	Reserved parameter (Do not change.)	
n.□X□□	Reserved parameter (Do not change.)	
n.X□□□	Reserved parameter (Do not change.)	

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn100	2	Speed Loop Gain	10 to 20,000	0.1 Hz	400	Immediately	Tuning	page 8-54
Pn101	2	Speed Loop Integral Time Constant	15 to 51,200	0.01 ms	2000	Immediately	Tuning	page 8-54
Pn102	2	Position Loop Gain	10 to 20,000	0.1/s	400	Immediately	Tuning	page 8-54
Pn103	2	Moment of Inertia Ratio	0 to 20,000	1%	100	Immediately	Tuning	page 8-54

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn104	2	Second Speed Loop Gain	10 to 20,000	0.1 Hz	400	Immediately	Tuning	–
Pn105	2	Second Speed Loop Integral Time Constant	15 to 51,200	0.01 ms	2000	Immediately	Tuning	–
Pn106	2	Second Position Loop Gain	10 to 20,000	0.1/s	400	Immediately	Tuning	–
Pn109	2	Feedforward	0 to 100	1%	0	Immediately	Tuning	page 8-62
Pn10A	2	Feedforward Filter Time Constant	0 to 6,400	0.01 ms	0	Immediately	Tuning	page 8-62
Pn10B	2	Gain Application Selections	0000h to 5334h	–	0004h	–	Setup	–

Pn10B:

n.□□□X	Mode Switching Selection		When Enabled	Reference
	0	Use the internal torque reference as the condition (level setting: Pn10C).	Immediately	page 8-62
	1	Use the speed reference as the condition (level setting: Pn10D).		
		Use the speed reference as the condition (level setting: Pn181).		
	2	Use the acceleration reference as the condition (level setting: Pn10E).		
		Use the acceleration reference as the condition (level setting: Pn182).		
	3	Use the position deviation as the condition (level setting: Pn10F).		
	4	Do not use mode switching.		

n.□□X□	Speed Loop Control Method		When Enabled	Reference
	0	PI control	After restart	page 8-54
	1	I-P control		
	2 to 3	Reserved settings (Do not use.)		

n.□X□□	Reserved parameter (Do not change.)
n.X□□□	Reserved parameter (Do not change.)

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn10C	2	Mode Switching Level for Torque Reference	0 to 800	1%	200	Immediately	Tuning	page 8-62
Pn10D	2	Mode Switching Level for Speed Reference	0 to 10,000	1 min^{-1}	0	Immediately	Tuning	page 8-62
Pn10E	2	Mode Switching Level for Acceleration	0 to 30,000	1 min^{-1}/s	0	Immediately	Tuning	page 8-62
Pn10F	2	Mode Switching Level for Position Deviation	0 to 10,000	1 reference unit	0	Immediately	Tuning	page 8-62
Pn11F	2	Position Integral Time Constant	0 to 50,000	0.1 ms	0	Immediately	Tuning	–
Pn12B	2	Third Speed Loop Gain	10 to 20,000	0.1 Hz	400	Immediately	Tuning	page 8-54
Pn12C	2	Third Speed Loop Integral Time Constant	15 to 51,200	0.01 ms	2000	Immediately	Tuning	page 8-54
Pn12D	2	Third Position Loop Gain	10 to 20,000	0.1/s	400	Immediately	Tuning	page 8-54
Pn12E	2	Fourth Speed Loop Gain	10 to 20,000	0.1 Hz	400	Immediately	Tuning	page 8-54
Pn12F	2	Fourth Speed Loop Integral Time Constant	15 to 51,200	0.01 ms	2000	Immediately	Tuning	page 8-54
Pn130	2	Fourth Position Loop Gain	10 to 20,000	0.1/s	400	Immediately	Tuning	page 8-54
Pn131 to Pn15A	2	Reserved parameter (Do not change.)	–	–	–	–	–	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn160	2	Anti-Resonance Control-Related Selections	0000h to 0011h	–	0000h	Immediately	Tuning	–

Pn160:

		Anti-Resonance Control Selection	Reference
n.□□□X	0	Do not use anti-resonance control.	page 8-42
	1	Use anti-resonance control.	

n.□□X□	Anti-Resonance Control Adjustment Selection
n.□X□□	Reserved parameter (Do not change.)
n.X□□□	Reserved parameter (Do not change.)

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn161	2	Anti-Resonance Frequency	10 to 20,000	0.1 Hz	1000	Immediately	Tuning	page 8-42
Pn162	2	Anti-Resonance Gain Correction	1 to 1,000	1%	100	Immediately	Tuning	page 8-42
Pn163	2	Anti-Resonance Damping Gain	0 to 300	1%	0	Immediately	Tuning	page 8-42
Pn164	2	Anti-Resonance Filter Time Constant 1 Correction	-1,000 to 1,000	0.01 ms	0	Immediately	Tuning	page 8-42
Pn165	2	Anti-Resonance Filter Time Constant 2 Correction	-1,000 to 1,000	0.01 ms	0	Immediately	Tuning	page 8-42
Pn166	2	Anti-Resonance Damping Gain 2	0 to 1,000	1%	0	Immediately	Tuning	page 8-42
Pn170	2	Reserved parameter (Do not change.)	–	–	1400h	–	–	–
Pn205	2	Multiturn Limit	0 to 65,535	1 rev	65535	After restart	Setup	–
Pn207	2	Position Control Function Selections	0000h to 2210h	–	0010h	After restart	Setup	–

Pn207:

n.□□□X	Reserved parameter (Do not change.)
n.□□X□	Reserved parameter (Do not change.)
n.□X□□	Reserved parameter (Do not change.)

		/COIN (Positioning Completion Output) Signal Output Timing	Reference
n.X□□□	0	Output when the absolute value of the position deviation is the same or less than the setting of Pn522 (Positioning Completed Width).	page 6-9
	1	Output when the absolute value of the position error is the same or less than the setting of Pn522 (Positioning Completed Width) and the reference after the position reference filter is 0.	
	2	Output when the absolute value of the position error is the same or less than the setting of Pn522 (Positioning Completed Width) and the reference input is 0.	

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn20A	4	Number of External Encoder Scale Pitches/ Pulse	4 to 1,048,576	Siral Encoder: 1 scale pitch/ revolution Pulse encoder: 1 pulse/ revolution	32768	After restart	Setup	page 10-7
Pn20E	4	Electronic Gear Ratio (Numerator)	1 to 1,073,741,824	1	2	After restart	Setup	page 5-26
Pn210	4	Electronic Gear Ratio (Denominator)	1 to 1,073,741,824	1	1	After restart	Setup	page 5-26

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn212	4	Number of Encoder Output Pulses/Number of External Pulse Encoder Output Pulses	16 to 1,073,741,824	1 P/Rev	512	After restart	Setup	page 6-18
Pn22A	2	Fully-closed Control Selections	0000h to 1003h	–	0000h	After restart	Setup	–
		n.□□□X: Reserved parameter (Do not change.)						
		n.□□X□: Reserved parameter (Do not change.)						
		n.□X□□: Reserved parameter (Do not change.)						
		n.X□□□: Fully-closed Control Speed Feedback Selection 0: Use motor encoder speed. 1: Use external encoder speed.						
Pn230	2	Position Control Expansion Function Selections	0000h to 0001h	–	0000h	After restart	Setup	page 8-48
		n.□□□X: Backlash Compensation Direction 0: Compensate forward references. 1: Compensate reverse references.						
		n.□□X□: Reserved parameter (Do not change.)						
		n.□X□□: Reserved parameter (Do not change.)						
		n.X□□□: Reserved parameter (Do not change.)						
Pn231	4	Backlash Compensation	-500,000 to 500,000	0.1 reference units	0	Immediately	Setup	page 8-48
Pn233	2	Backlash Compensation Time Constant	0 to 65,535	0.01 ms	0	Immediately	Setup	page 8-48
Pn234	2	Reserved parameter (Do not change.)	–	–	0	–	–	–
Pn23A	4	Number of Encoder Pulses	100 to 1,048,576	1 P/Rev	1024	After restart	Tuning	–
Pn23C	2	Phase-C Width Setting	-200 to 200	1 P	0	After restart	Tuning	–
Pn23D	2	Polarity Origin Compensation	-18,000 to 18,000	0.01 deg	0	After restart	Tuning	–
Pn23E	4	Number of External Encoder Pulses	100 to 1,048,576	1 P/Rev	1024	After restart	Tuning	–
Pn250	2	Reserved parameter (Do not change.)	–	–	0020h	–	–	–
Pn281	2	Encoder Output Resolution	1 to 4,096	1 edge/pitch	20	After restart	Setup	page 6-18
Pn304	2	Jogging Speed	0 to 10,000	1 min^{-1}	500	Immediately	Setup	page 7-5
Pn305	2	Soft Start Acceleration Time	0 to 10,000	1 ms	0	Immediately	Setup	*1
Pn306	2	Soft Start Deceleration Time	0 to 10,000	1 ms	0	Immediately	Setup	*1
Pn308	2	Speed Feedback Filter Time Constant	0 to 65,535	0.01 ms	0	Immediately	Setup	page 8-54
Pn30A	2	Deceleration Time for Servo OFF and Forced Stops	0 to 10,000	1 ms	0	Immediately	Setup	page 5-19
Pn30C	2	Speed Feedforward Average Movement Time	0 to 5,100	0.1 ms	0	Immediately	Setup	page 8-62

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn310	2	Vibration Detection Selections	0000h to 0002h	–	0000h	Immediately	Setup	page 6-24

Pn310			
n.□□□X	Vibration Detection Selection		
	0	Do not detect vibration.	
	1	Output a warning (A.911) if vibration is detected.	
	2	Output an alarm (A.520) if vibration is detected.	
n.□□X□	Reserved parameter (Do not change.)		
n.□X□□	Reserved parameter (Do not change.)		
n.X□□□	Reserved parameter (Do not change.)		

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn311	2	Vibration Detection Sensitivity	50 to 500	1%	100	Immediately	Tuning	page 6-24
Pn312	2	Vibration Detection Level	0 to 5,000	1 min^{-1}	50	Immediately	Tuning	page 6-24
Pn316	2	Maximum Motor Speed	0 to 65,535	1 min^{-1}	10000	After restart	Setup	page 6-16
Pn324	2	Moment of Inertia Calculation Starting Level	0 to 20,000	1%	300	Immediately	Setup	–
Pn401	2	First Stage First Torque Reference Filter Time Constant	0 to 65,535	0.01 ms	100	Immediately	Tuning	page 8-57
Pn404	2	Reserved parameter (Do not change.)	–	–	100	–	–	–
Pn405	2	Reserved parameter (Do not change.)	–	–	100	–	–	–
Pn406	2	Emergency Stop Torque	0 to 800	1%*2	800	Immediately	Setup	page 5-19
Pn407	2	Speed Limit during Torque Control	0 to 10,000	1 min^{-1}	10000	Immediately	Setup	page 6-11
Pn408	2	Torque-Related Function Selections	0000h to 1111h	–	0000h	–	Setup	–

Pn408			When Enabled	Reference
n.□□□X	Notch Filter Selection 1		When Enabled	Reference
	0	Disable first stage notch filter.	Immediately	page 8-57
	1	Enable first stage notch filter.		
n.□□X□	Speed Limit Selection		When Enabled	Reference
	0	Use the smaller of the maximum motor speed and the setting of Pn407 as the speed limit.	After restart	page 6-11
		Use the smaller of the maximum motor speed and the setting of Pn480 as the speed limit.		
	1	Use the smaller of the overspeed alarm detection speed and the setting of Pn407 as the speed limit.		
		Use the smaller of the overspeed alarm detection speed and the setting of Pn480 as the speed limit.		
n.□X□□	Notch Filter Selection 2		When Enabled	Reference
	0	Disable second stage notch filter.	Immediately	page 8-57
	1	Enable second stage notch filter.		
n.X□□□	Reserved parameter (Do not change.)			

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn409	2	First Stage Notch Filter Frequency	50 to 5,000	1 Hz	5000	Immediately	Tuning	page 8-57

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn40A	2	First Stage Notch Filter Q Value	50 to 1,000	0.01	70	Immediately	Tuning	page 8-57
Pn40B	2	First Stage Notch Filter Depth	0 to 1,000	0.001	0	Immediately	Tuning	page 8-57
Pn40C	2	Second Stage Notch Filter Frequency	50 to 5,000	1 Hz	5000	Immediately	Tuning	page 8-57
Pn40D	2	Second Stage Notch Filter Q Value	50 to 1,000	0.01	70	Immediately	Tuning	page 8-57
Pn40E	2	Second Stage Notch Filter Depth	0 to 1,000	0.001	0	Immediately	Tuning	page 8-57
Pn40F	2	Second Stage Second Torque Reference Filter Frequency	100 to 5,000	1 Hz	5000	Immediately	Tuning	page 8-57
Pn410	2	Second Stage Second Notch Filter Q Value	50 to 100	0.01	50	Immediately	Tuning	page 8-57
Pn412	2	First Stage Second Torque Reference Filter Time Constant	0 to 65,535	0.01 ms	100	Immediately	Tuning	–
Pn413	2	First Stage Third Torque Reference Filter Time Constant	0 to 65,535	0.01 ms	100	Immediately	Tuning	–
Pn414	2	First Stage Fourth Torque Reference Filter Time Constant	0 to 65,535	0.01 ms	100	Immediately	Tuning	–
Pn416	2	Torque-Related Function Selections 2	0000h to 1111h	–	0000h	Immediately	Setup	page 8-59

Pn416		
n.□□□X	Notch Filter Selection 3	
	0	Disable third stage notch filter.
	1	Enable third stage notch filter.
n.□□X□	Notch Filter Selection 4	
	0	Disable fourth stage notch filter.
	1	Enable fourth stage notch filter.
n.□X□□	Notch Filter Selection 5	
	0	Disable fifth stage notch filter.
	1	Enable fifth stage notch filter.
n.X□□□	Reserved parameter (Do not change.)	

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn417	2	Third Stage Notch Filter Frequency	50 to 5,000	1 Hz	5000	Immediately	Tuning	page 8-59
Pn418	2	Third Stage Notch Filter Q Value	50 to 1,000	0.01	70	Immediately	Tuning	page 8-59
Pn419	2	Third Stage Notch Filter Depth	0 to 1,000	0.001	0	Immediately	Tuning	page 8-59
Pn41A	2	Fourth Stage Notch Filter Frequency	50 to 5,000	1 Hz	5000	Immediately	Tuning	page 8-59
Pn41B	2	Fourth Stage Notch Filter Q Value	50 to 1,000	0.01	70	Immediately	Tuning	page 8-59
Pn41C	2	Fourth Stage Notch Filter Depth	0 to 1,000	0.001	0	Immediately	Tuning	page 8-59
Pn41D	2	Fifth Stage Notch Filter Frequency	50 to 5,000	1 Hz	5000	Immediately	Tuning	page 8-59
Pn41E	2	Fifth Stage Notch Filter Q Value	50 to 1,000	0.01	70	Immediately	Tuning	page 8-59
Pn41F	2	Fifth Stage Notch Filter Depth	0 to 1,000	0.001	0	Immediately	Tuning	page 8-58
Pn423	2	Reserved parameter (Do not change.)	–	–	0000h	–	–	–
Pn424	2	Torque Limit at Main Circuit Voltage Drop	0 to 100	1%[*2]	50	Immediately	Setup	page 6-14

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn425	2	Release Time for Torque Limit at Main Circuit Voltage Drop	0 to 1,000	1 ms	100	Immediately	Setup	page 6-14
Pn426	2	Torque Feedforward Average Movement Time	0 to 5,100	0.1 ms	0	Immediately	Setup	page 8-62
Pn427	2	Reserved parameter (Do not change.)	–	–	0	–	–	–
Pn430	2	Powering Torque Limit	0 to 800	1%	150	Immediately	Setup	–
Pn431	2	Regeneration Torque Limit	0 to 800	1%	150	Immediately	Setup	–
Pn432	2	Motor Flux Lower Limit Level	10 to 100	1%	15	Immediately	Tuning	–
Pn433	2	Servo Mode Flux Level for High-Speed Winding	30 to 100	1%	100	Immediately	Tuning	–
Pn434	2	Servo Mode Base Speed Ratio for High-Speed Winding	100 to 500	1%	100	Immediately	Tuning	–
Pn435	2	Reserved parameter (Do not change.)	–	–	100	–	–	–
Pn436	2	Reserved parameter (Do not change.)	–	–	100	–	–	–
Pn43F	2	Load Meter Filter Time Constant	0 to 5,000	1 ms	100	Immediately	Tuning	–
Pn456	2	Sweep Torque Reference Amplitude	1 to 800	1%	15	Immediately	Tuning	–
Pn460	2	Notch Filter Adjustment Selections 1	0000h to 0101h	–	0101h	Immediately	Tuning	page 8-33

Pn460		
n.□□□X	Notch Filter Adjustment Selection 1	
	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.
	1	Adjust the first stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.
n.□□X□	Reserved parameter (Do not change.)	
n.□X□□	Notch Filter Adjustment Selection 2	
	0	Do not adjust the second stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.
	1	Adjust the second stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.
n.X□□□	Reserved parameter (Do not change.)	

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn501	2	Reserved parameter (Do not change.)	–	–	10	–	–	–
Pn502	2	Reserved parameter (Do not change.)	–	–	20	–	–	–
Pn503	2	Speed Coincidence Signal Detection Width	0 to 100	1 min^{-1}	10	Immediately	Setup	page 6-8
Pn506	2	Brake Reference-Servo OFF Delay Time	0 to 50	10 ms	0	Immediately	Setup	–
Pn507	2	Brake Reference Output Speed Level	0 to 10,000	1 min^{-1}	100	Immediately	Setup	–
Pn508	2	Servo OFF-Brake Command Waiting Time	10 to 100	10 ms	50	Immediately	Setup	–
Pn509	2	Momentary Power Interruption Hold Time	20 to 50,000	1 ms	20	Immediately	Setup	page 6-13

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn50A	2	Input Signal Selections 1	0000h to FFF2h	–	8881h	After restart	Setup	–

n.□□□X	Reserved parameter (Do not change.)

n.□□X□	Reserved parameter (Do not change.)

n.□X□□	Reserved parameter (Do not change.)

	P-OT (Forward Drive Prohibit) Signal Allocation		Reference
n.X□□□	0	Enable forward drive when CN1-13 input signal is ON (closed).	page 5-18
	1	Enable forward drive when CN1-7 input signal is ON (closed).	
	2	Enable forward drive when CN1-8 input signal is ON (closed).	
	3	Enable forward drive when CN1-9 input signal is ON (closed).	
	4	Enable forward drive when CN1-10 input signal is ON (closed).	
	5	Enable forward drive when CN1-11 input signal is ON (closed).	
	6	Enable forward drive when CN1-12 input signal is ON (closed).	
	7	Set the signal to always prohibit forward drive.	
	8	Set the signal to always enable forward drive.	
	9	Enable forward drive when CN1-13 input signal is OFF (open).	
	A	Enable forward drive when CN1-7 input signal is OFF (open).	
	B	Enable forward drive when CN1-8 input signal is OFF (open).	
	C	Enable forward drive when CN1-9 input signal is OFF (open).	
	D	Enable forward drive when CN1-10 input signal is OFF (open).	
	E	Enable forward drive when CN1-11 input signal is OFF (open).	
	F	Enable forward drive when CN1-12 input signal is OFF (open).	

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn50B	2	Input Signal Selections 2	0000h to FFFFh	–	8888h	After restart	Setup	–

		N-OT (Reverse Drive Prohibit) Signal Allocation	Reference
n.□□□X	0	Enable reverse drive when CN1-13 input signal is ON (closed).	page 5-18
	1	Enable reverse drive when CN1-7 input signal is ON (closed).	
	2	Enable reverse drive when CN1-8 input signal is ON (closed).	
	3	Enable reverse drive when CN1-9 input signal is ON (closed).	
	4	Enable reverse drive when CN1-10 input signal is ON (closed).	
	5	Enable reverse drive when CN1-11 input signal is ON (closed).	
	6	Enable reverse drive when CN1-12 input signal is ON (closed).	
	7	Set the signal to always prohibit reverse drive.	
	8	Set the signal to always enable reverse drive.	
	9	Enable reverse drive when CN1-13 input signal is OFF (open).	
	A	Enable reverse drive when CN1-7 input signal is OFF (open).	
	B	Enable reverse drive when CN1-8 input signal is OFF (open).	
	C	Enable reverse drive when CN1-9 input signal is OFF (open).	
	D	Enable reverse drive when CN1-10 input signal is OFF (open).	
	E	Enable reverse drive when CN1-11 input signal is OFF (open).	
	F	Enable reverse drive when CN1-12 input signal is OFF (open).	

n.□□X□	Reserved parameter (Do not change.)

		/P-CL (Forward External Torque Limit Input) Signal Allocation	Reference
n.□X□□	0	Active when CN1-13 input signal is ON (closed).	–
	1	Active when CN1-7 input signal is ON (closed).	
	2	Active when CN1-8 input signal is ON (closed).	
	3	Active when CN1-9 input signal is ON (closed).	
	4	Active when CN1-10 input signal is ON (closed).	
	5	Active when CN1-11 input signal is ON (closed).	
	6	Active when CN1-12 input signal is ON (closed).	
	7	The signal is always active.	
	8	The signal is always inactive.	
	9	Active when CN1-13 input signal is OFF (open).	
	A	Active when CN1-7 input signal is OFF (open).	
	B	Active when CN1-8 input signal is OFF (open).	
	C	Active when CN1-9 input signal is OFF (open).	
	D	Active when CN1-10 input signal is OFF (open).	
	E	Active when CN1-11 input signal is OFF (open).	
	F	Active when CN1-12 input signal is OFF (open).	

		/N-CL (Reverse External Torque Limit Input) Signal Allocation	Reference
n.X□□□	0 to F	The allocations are the same as the /P-CL (Forward External Torque Limit Input) signal allocations.	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn50E	2	Output Signal Selections 1	0000h to 6666h	–	0000h	After restart	Setup	–

Pn50E		/COIN (Positioning Completion Output) Signal Allocation	Reference
n.□□□X	0	Disabled (the above signal output is not used).	page 6-9
	1	Output the signal from the CN1-1 or CN1-2 output terminal.	
	2	Output the signal from the CN1-23 or CN1-24 output terminal.	
	3	Output the signal from the CN1-25 or CN1-26 output terminal.	
	4 to 6	Reserved setting (Do not use.)	
n.□□X□		/V-CMP (Speed Coincidence Detection Output) Signal Allocation	Reference
	0 to 6	The allocations are the same as the /COIN (Positioning Completion) signal allocations.	page 6-8
n.□X□□		/TGON (Rotation Detection Output) Signal Allocation	Reference
	0 to 6	The allocations are the same as the /COIN (Positioning Completion) signal allocations.	page 6-6
n.X□□□		/S-RDY (Servo Ready) Signal Allocation	Reference
	0 to 6	The allocations are the same as the /COIN (Positioning Completion) signal allocations.	page 6-7

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn50F	2	Output Signal Selections 2	0000h to 6666h	–	0100h	After restart	Setup	–

Pn50F		/CLT (Torque Limit Detection Output) Signal Allocation	Reference
n.□□□X	0	Disabled (the above signal output is not used).	–
	1	Output the signal from the CN1-1 or CN1-2 output terminal.	
	2	Output the signal from the CN1-23 or CN1-24 output terminal.	
	3	Output the signal from the CN1-25 or CN1-26 output terminal.	
	4 to 6	Reserved setting (Do not use.)	
n.□□X□		/VLT (Speed Limit Detection) Signal Allocation	Reference
	0 to 6	The allocations are the same as the /CLT (Torque Limit Detection Output) signal allocations.	page 6-11
n.□X□□		/BK (Brake Output) Signal Allocation	Reference
	0 to 6	The allocations are the same as the /CLT (Torque Limit Detection Output) signal allocations.	–
n.X□□□		/WARN (Warning Output) Signal Allocation	Reference
	0 to 6	The allocations are the same as the /CLT (Torque Limit Detection Output) signal allocations.	page 6-6

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn510	2	Output Signal Selections 3	0000h to 0666h	–	0000h	After restart	Setup	–

	/NEAR (Near Output) Signal Allocation		Reference
n.□□□X	0	Disabled (the above signal output is not used).	page 6-10
	1	Output the signal from the CN1-1 or CN1-2 output terminal.	
	2	Output the signal from the CN1-23 or CN1-24 output terminal.	
	3	Output the signal from the CN1-25 or CN1-26 output terminal.	
	4 to 6	Reserved setting (Do not use.)	

n.□□X□	Reserved parameter (Do not change.)
n.□X□□	Reserved parameter (Do not change.)
n.X□□□	Reserved parameter (Do not change.)

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn511	2	Input Signal Selections 5	0000h to FFFFh	–	6543h	After restart	Setup	page 6-3

	/DEC (Origin Return Deceleration Switch Input) Signal Allocation	
n.□□□X	0	Active when CN1-13 input signal is ON (closed).
	1	Active when CN1-7 input signal is ON (closed).
	2	Active when CN1-8 input signal is ON (closed).
	3	Active when CN1-9 input signal is ON (closed).
	4	Active when CN1-10 input signal is ON (closed).
	5	Active when CN1-11 input signal is ON (closed).
	6	Active when CN1-12 input signal is ON (closed).
	7	The signal is always active.
	8	The signal is always inactive.
	9	Active when CN1-13 input signal is OFF (open).
	A	Active when CN1-7 input signal is OFF (open).
	B	Active when CN1-8 input signal is OFF (open).
	C	Active when CN1-9 input signal is OFF (open).
	D	Active when CN1-10 input signal is OFF (open).
	E	Active when CN1-11 input signal is OFF (open).
	F	Active when CN1-12 input signal is OFF (open).

	/EXT1 (External Latch Input 1) Signal Allocation	
n.□□X□	0 to 3	The signal is always inactive.
	4	Active when CN1-10 input signal is ON (closed).
	5	Active when CN1-11 input signal is ON (closed).
	6	Active when CN1-12 input signal is ON (closed).
	D	Active when CN1-10 input signal is OFF (open).
	E	Active when CN1-11 input signal is OFF (open).
	F	Active when CN1-12 input signal is OFF (open).
	7 to C	The signal is always inactive.

	/EXT2 (External Latch Input 2) Signal Allocation	
n.□X□□	0 to F	The allocations are the same as the /EXT1 (External Latch Input 1) signal allocations.

	/EXT3 (External Latch Input 3) Signal Allocation	
n.X□□□	0 to F	The allocations are the same as the /EXT1 (External Latch Input 1) signal allocations.

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn512	2	Output Signal Inverse Settings	0000h to 1111h	–	0000h	After restart	Setup	page 6-4

Pn512

n.□□□X	Output Signal Inversion for CN1-1 and CN1-2 Terminals	
	0	The signal is not inverted.
	1	The signal is inverted.

n.□□X□	Output Signal Inversion for CN1-23 and CN1-24 Terminals	
	0	The signal is not inverted.
	1	The signal is inverted.

n.□X□□	Output Signal Inversion for CN1-25 and CN1-26 Terminals	
	0	The signal is not inverted.
	1	The signal is inverted.

n.X□□□	Reserved parameter (Do not change.)

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn514	2	Output Signal Selections 4	0000h to 0666h	–	0000h	After restart	Setup	–

Pn514

n.□□□X	Reserved parameter (Do not change.)

n.□□X□	Reserved parameter (Do not change.)

n.□X□□	/PM (Preventative Maintenance Output) Signal Allocation		Reference
	0	Disabled (the above signal output is not used).	page 9-19
	1	Output the signal from the CN1-1 or CN1-2 output terminal.	
	2	Output the signal from the CN1-23 or CN1-24 output terminal.	
	3	Output the signal from the CN1-25 or CN1-26 output terminal.	
	4 to 6	Reserved setting (Do not use.)	

n.X□□□	Reserved parameter (Do not change.)

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn516	2	Input Signal Selections 7	0000h to FFFFh	–	8888h	After restart	Setup	–

Pn516:

		FSTP (Forced Stop Input) Signal Allocation	Reference
n.□□□X	0	Enable drive when CN1-13 input signal is ON (closed).	page 6-31
	1	Enable drive when CN1-7 input signal is ON (closed).	
	2	Enable drive when CN1-8 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 CN1-12 input signal is ON (closed).	
	7	Set the signal to always prohibit drive (always force the motor to stop).	
	8	Set the signal to always enable drive (always disable forcing the motor to stop).	
	9	Enable drive when CN1-13 input signal is OFF (open).	
	A	Enable drive when CN1-7 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).	
	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.)

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn51B	4	Motor-Load Position Deviation Overflow Detection Level	0 to 1,073,741,824	1 reference unit	1000	Immediately	Setup	page 10-9
Pn51E	2	Position Deviation Overflow Warning Level	10 to 100	1%	100	Immediately	Setup	page 11-37
Pn520	4	Position Deviation Overflow Alarm Level	1 to 1,073,741,823	1 reference unit	5242880	Immediately	Setup	page 8-6, page 11-3
Pn522	4	Positioning Completed Width	0 to 1,073,741,824	1 reference unit	7	Immediately	Setup	page 6-9
Pn524	4	Near Signal Width	1 to 1,073,741,824	1 reference unit	1073741824	Immediately	Setup	page 6-10
Pn526	4	Position Deviation Overflow Alarm Level at Servo ON	1 to 1,073,741,823	1 reference unit	5242880	Immediately	Setup	page 8-6
Pn528	2	Position Deviation Overflow Warning Level at Servo ON	10 to 100	1%	100	Immediately	Setup	page 8-6
Pn529	2	Speed Limit Level at Servo ON	0 to 10,000	1 min^{-1}	10000	Immediately	Setup	page 8-6
Pn52A	2	Multiplier per Fully-closed Rotation	0 to 100	1%	20	Immediately	Tuning	page 10-9
Pn52B	2	Overload Warning Level	1 to 100	1%	20	Immediately	Setup	page 5-24
Pn52C	2	Base Current Derating at Motor Overload Detection	10 to 100	1%	100	After restart	Setup	page 5-24

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn530	2	Program Jogging-Related Selections	0000h to 0005h	–	0000h	Immediately	Setup	page 7-12

Pn530		
n.□□□X	Program Jogging Operation Pattern	
	0	(Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536
	1	(Waiting time in Pn535 → Reverse by travel distance in Pn531) × 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
	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 → Forward by travel distance in Pn531 → Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536
	5	(Waiting time in Pn535 → Reverse by travel distance in Pn531 → Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536
n.□□X□	Reserved parameter (Do not change.)	
n.□X□□	Reserved parameter (Do not change.)	
n.X□□□	Reserved parameter (Do not change.)	

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn531	4	Program Jogging Travel Distance	1 to 1,073,741,824	1 reference unit	32768	Immediately	Setup	page 7-12
Pn533	2	Program Jogging Movement Speed	1 to 10,000	1 min^{-1}	500	Immediately	Setup	page 7-12
Pn534	2	Program Jogging Acceleration/Deceleration Time	2 to 10,000	1 ms	100	Immediately	Setup	page 7-12
Pn535	2	Program Jogging Waiting Time	0 to 10,000	1 ms	100	Immediately	Setup	page 7-12
Pn536	2	Program Jogging Number of Movements	0 to 1,000	Times	1	Immediately	Setup	page 7-12
Pn541	2	Rated Speed Setting	100 to 65,535	1 min^{-1}	65535	After restart	Tuning	–
Pn542	2	Speed Coincidence Detection Width	10 to 50	1%	15	Immediately	Tuning	–
Pn543	2	Speed Detection Level	0 to 10,000	0.01%	1000	Immediately	Tuning	–
Pn544	2	Speed Detection Hysteresis	0 to 10,000	0.01%	100	Immediately	Tuning	–

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<table>
<tr><th>Parameter No.</th><th>Size</th><th>Name</th><th>Setting Range</th><th>Setting Unit</th><th>Default Setting</th><th>When Enabled</th><th>Classification</th><th>Reference</th></tr>
<tr><td rowspan="2">Pn545</td><td>2</td><td>Speed Deviation Overflow Protection Selection Switches</td><td>0000h to 0031h</td><td>–</td><td>0000h</td><td>Immediately</td><td>Setup</td><td>–</td></tr>
<tr><td colspan="8">
<table>
<tr><td rowspan="3">n.□□□X</td><td colspan="2">Speed Deviation Overflow Protection Operation Sensitivity Selection</td></tr>
<tr><td>0</td><td>Half of the speed reference or less</td></tr>
<tr><td>1</td><td>A quarter of the speed reference or less</td></tr>
<tr><td rowspan="5">n.□□X□</td><td colspan="2">Speed Deviation Overflow Protection Operation Delay Time Selection</td></tr>
<tr><td>0</td><td>0 ms</td></tr>
<tr><td>1</td><td>300 ms</td></tr>
<tr><td>2</td><td>400 ms</td></tr>
<tr><td>3</td><td>500 ms</td></tr>
<tr><td>n.□X□□</td><td colspan="2">Reserved parameter (Do not change.)</td></tr>
<tr><td>n.X□□□</td><td colspan="2">Reserved parameter (Do not change.)</td></tr>
</table>
</td></tr>
<tr><td>Pn548</td><td>2</td><td>Specified Alarm Number for Tracing</td><td>0000h to FFFFh</td><td>–</td><td>0000h</td><td>Immediately</td><td>Tuning</td><td>–</td></tr>
<tr><td>Pn550</td><td>2</td><td>Analog Monitor 1 Offset Voltage</td><td>-10,000 to 10,000</td><td>0.1 V</td><td>0</td><td>Immediately</td><td>Setup</td><td>page 9-6</td></tr>
<tr><td>Pn551</td><td>2</td><td>Analog Monitor 2 Offset Voltage</td><td>-10,000 to 10,000</td><td>0.1 V</td><td>0</td><td>Immediately</td><td>Setup</td><td>page 9-6</td></tr>
<tr><td>Pn552</td><td>2</td><td>Analog Monitor 1 Magnification</td><td>-10,000 to 10,000</td><td>× 0.01</td><td>100</td><td>Immediately</td><td>Setup</td><td>page 9-6</td></tr>
<tr><td>Pn553</td><td>2</td><td>Analog Monitor 2 Magnification</td><td>-10,000 to 10,000</td><td>× 0.01</td><td>100</td><td>Immediately</td><td>Setup</td><td>page 9-6</td></tr>
<tr><td>Pn55A</td><td>2</td><td>Power Consumption Monitor Unit Time</td><td>1 to 1,440</td><td>1 min</td><td>1</td><td>Immediately</td><td>Setup</td><td>–</td></tr>
<tr><td>Pn560 to Pn561</td><td>2</td><td>Reserved parameter (Do not change.)</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Pn600</td><td>2</td><td>Regenerative Resistor Capacity[*3]</td><td>Depends on model.[*4]</td><td>10 W</td><td>0</td><td>Immediately</td><td>Setup</td><td>page 5-28</td></tr>
<tr><td>Pn601</td><td>2</td><td>Reserved parameter (Do not change.)</td><td>–</td><td>–</td><td>0</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>Pn603</td><td>2</td><td>Regenerative Resistance</td><td>0 to 65,535</td><td>10 mΩ</td><td>0</td><td>Immediately</td><td>Setup</td><td>page 5-28</td></tr>
<tr><td>Pn604</td><td>2</td><td>Reserved parameter (Do not change.)</td><td>–</td><td>–</td><td>0</td><td>–</td><td>–</td><td>–</td></tr>
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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn800	2	Communications Controls	0000h to 1FF3h	–	1040h	Immediately	Setup	–

Pn800		
n.□□□X	MECHATROLINK Communications Check Mask for Debugging	
	0	Do not mask.
	1	Ignore MECHATROLINK communications errors (A.E60).
	2	Ignore WDT errors (A.E50).
	3	Ignore both MECHATROLINK communications errors (A.E60) and WDT errors (A.E50).
n.□□X□	Warning Check Masks	
	0	Do not mask.
	1	Ignore data setting warnings (A.94□).
	2	Ignore command warnings (A.95□).
	3	Ignore both A.94□ and A.95□ warnings.
	4	Ignore communications warnings (A.96□).
	5	Ignore both A.94□ and A.96□ warnings.
	6	Ignore both A.95□ and A.96□ warnings.
	7	Ignore A.94□, A.95□, and A.96□ warnings.
	8	Ignore data setting warnings (A.97A and A.97b).
	9	Ignore A.94□, A.97A, and A.97b warnings.
	A	Ignore A.95□, A.97A, and A.97b warnings.
	B	Ignore A.94□, A.95□, A.97A, and A.97b warnings.
	C	Ignore A.96□, A.97A, and A.97b warnings.
	D	Ignore A.94□, A.96□, A.97A, and A.97b warnings.
	E	Ignore A.95□, A.96□, A.97A, and A.97b warnings.
	F	Ignore A.94□, A.95□, A.96□, A.97A, and A.97b warnings.
n.□X□□	Reserved parameter (Do not change.)	
n.X□□□	Automatic Warning Clear Selection for Debugging	
	0	Retain warnings for debugging.
	1	Automatically clear warnings (MECHATROLINK-III specification).

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn801	2	Application Function Selections 6 (Software Limits)	0000h to 0103h	–	0003h	Immediately	Setup	page 6-19

Pn801		
n.□□□X	Software Limit Selection	
	0	Enable both forward and reverse software limits.
	1	Disable forward software limit.
	2	Disable reverse software limit.
	3	Disable both forward and reverse software limits.
n.□□X□	Reserved parameter (Do not change.)	
n.□X□□	Software Limit Check for References	
	0	Do not perform software limit checks for references.
	1	Perform software limit checks for references.
n.X□□□	Reserved parameter (Do not change.)	

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn803	2	Origin Range	0 to 250	1 reference unit	10	Immediately	Setup	*1
Pn804	4	Forward Software Limit	-1,073,741,823 to 1,073,741,823	1 reference unit	1073741823	Immediately	Setup	page 6-19

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn806	4	Reverse Software Limit	-1,073,741,823 to 1,073,741,823	1 reference unit	-1073741823	Immediately	Setup	page 6-19
Pn808	4	Reserved parameter (Do not change.)	–	–	0	–	–	–
Pn80A	2	First Stage Linear Acceleration Constant	1 to 65,535	10,000 reference units/s²	100	Immediately *5	Setup	*1
Pn80B	2	Second Stage Linear Acceleration Constant	1 to 65,535	10,000 reference units/s²	100	Immediately *5	Setup	*1
Pn80C	2	Acceleration Constant Switching Speed	0 to 65,535	100 reference units/s	0	Immediately *5	Setup	*1
Pn80D	2	First Stage Linear Deceleration Constant	1 to 65,535	10,000 reference units/s²	100	Immediately *5	Setup	*1
Pn80E	2	Second Stage Linear Deceleration Constant	1 to 65,535	10,000 reference units/s²	100	Immediately *5	Setup	*1
Pn80F	2	Deceleration Constant Switching Speed	0 to 65,535	100 reference units/s	0	Immediately *5	Setup	*1
Pn810	2	Exponential Acceleration/ Deceleration Bias	0 to 65,535	100 reference units/s	0	Immediately *6	Setup	*1
Pn811	2	Exponential Acceleration/ Deceleration Time Constant	0 to 5,100	0.1 ms	0	Immediately *6	Setup	*1
Pn812	2	Movement Average Time	0 to 5,100	0.1 ms	0	Immediately *6	Setup	*1
Pn814	4	External Positioning Final Travel Distance	-1,073,741,823 to 1,073,741,823	1 reference unit	100	Immediately	Setup	*1
Pn816	2	Reserved parameter (Do not change.)	–	–	0000h	–	–	–
Pn817 *7	2	Origin Approach Speed 1	0 to 65,535	100 reference units/s	50	Immediately *5	Setup	*1
Pn818 *8	2	Origin Approach Speed 2	0 to 65,535	100 reference units/s	5	Immediately *5	Setup	*1
Pn819	4	Final Travel Distance for Origin Return	-1,073,741,823 to 1,073,741,823	1 reference unit	100	Immediately	Setup	*1
Pn81E	2	Reserved parameter (Do not change.)	–	–	0000h	–	–	–
Pn81F	2	Reserved parameter (Do not change.)	–	–	0010h	–	–	–
Pn820	4	Forward Latching Area	-2,147,483,648 to 2,147,483,647	1 reference unit	0	Immediately	Setup	*1
Pn822	4	Reverse Latching Area	-2,147,483,648 to 2,147,483,647	1 reference unit	0	Immediately	Setup	*1

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn824	2	Option Monitor 1 Selection	0000h to FFFFh	–	0000h	Immediately	Setup	*1

Setting	Monitor
High-Speed Monitor Region	
0000h	Motor speed [overspeed detection speed/1000000h]
0001h	Speed reference [overspeed detection speed/1000000h]
0002h	Torque [maximum torque/1000000h]
0003h	Position deviation (lower 32 bits) [reference units]
0004h	Position deviation (upper 32 bits) [reference units]
0005h	Reserved setting (Do not use.)
0006h	Reserved setting (Do not use.)
000Ah	Encoder count (lower 32 bits) [reference units]
000Bh	Encoder count (upper 32 bits) [reference units]
000Ch	FPG count (lower 32 bits) [reference units]
000Dh	FPG count (upper 32 bits) [reference units]
Low-Speed Monitor Region	
0010h	Un000: Motor speed [min^{-1}]
0011h	Un001: Speed Reference [min^{-1}]
0012h	Un002: Torque Reference [%]
0013h	Un003: Rotational Angle 1 [encoder pulses] Number of encoder pulses from encoder phase C displayed in decimal
0014h	Un004: Rotational Angle 2 [deg] Electrical angle from polarity origin
0015h	Un005: Input Signal Monitor
0016h	Un006: Output Signal Monitor
0017h	Un007: Input Reference Speed [min^{-1}]
0018h	Un008: Position Deviation [reference units]
0019h	Un009: Accumulated Load Ratio [%]
001Ah	Un00A: Regenerative Load Ratio [%]
001Bh	Un00B: Dynamic Brake Resistor Power Consumption [%]
001Ch	Un00C: Input Reference Pulse Counter [reference units]
001Dh	Un00D: Feedback Pulse Counter [encoder pulses]
001Eh	Un00E: Fully-closed Loop Feedback Pulse Counter [external encoder resolution]
0023h	Initial multiturn data [Rev]
0024h	Initial incremental data [pulses]
003Eh	Load Meter Monitor
0040h	Un025: SERVOPACK Installation Environment Monitor
0041h	Un026: Servomotor Installation Environment Monitor
0042h	Un027: Built-in Fan Remaining Life Ratio
0043h	Un028: Capacitor Remaining Life Ratio
0044h	Un029: Surge Prevention Circuit Remaining Life Ratio
0045h	Un02A: Dynamic Brake Circuit Remaining Life Ratio
0046h	Un032: Instantaneous Power
0047h	Un033: Power Consumption
0048h	Un034: Cumulative Power Consumption

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn824		Setting: Monitor						
		Low-Speed Monitor Region (Communications Module only)						
		0080h: Previous value of latched feedback position (LPOS1) [encoder pulses]						
		0081h: Previous value of latched feedback position (LPOS2) [encoder pulses]						
		0084h: Continuous Latch Status (EX STATUS)						
		All Areas						
		Other values: Reserved settings (Do not use.)						
Pn825	2	Option Monitor 2 Selection	0000h to FFFFh	–	0000h	Immediately	Setup	*1
		0000h to 0084h: The settings are the same as those for the Option Monitor 1 Selection.						
Pn827	2	Linear Deceleration Constant 1 for Stopping	1 to 65,535	10,000 reference units/s²	100	Immediately *5	Setup	*1
Pn829	2	SVOFF Waiting Time (for SVOFF at Deceleration to Stop)	0 to 65,535	10 ms	0	Immediately *5	Setup	*1
Pn82A	2	Reserved parameter (Do not change.)	–	–	1813h	–	–	–
Pn82B	2	Reserved parameter (Do not change.)	–	–	1D1Ch	–	–	–
Pn82C	2	Reserved parameter (Do not change.)	–	–	1F1Eh	–	–	–
Pn82D	2	Reserved parameter (Do not change.)	–	–	0000h	–	–	–
Pn82E	2	Reserved parameter (Do not change.)	–	–	0000h	–	–	–
Pn830	4	Number of Reference Units per Machine Revolution	1 to 20,971,520	1 reference unit	4096	After restart	Setup	–
Pn833	2	Motion Settings	0000h to 0001h	–	0000h	After restart	Setup	*1
		n.□□□X: Linear Acceleration/Deceleration Constant Selection						
		0: Use Pn80A to Pn80F and Pn827. (The settings of Pn834 to Pn840 are ignored.)						
		1: Use Pn834 to Pn840. (The settings of Pn80A to Pn80F and Pn827 are ignored.)						
		n.□□X□: Reserved parameter (Do not change.)						
		n.□X□□: Reserved parameter (Do not change.)						
		n.X□□□: Reserved parameter (Do not change.)						
Pn834	4	First Stage Linear Acceleration Constant 2	1 to 20,971,520	10,000 reference units/s²	100	Immediately *5	Setup	*1
Pn836	4	Second Stage Linear Acceleration Constant 2	1 to 20,971,520	10,000 reference units/s²	100	Immediately *5	Setup	*1
Pn838	4	Acceleration Constant Switching Speed 2	0 to 2,097,152,000	1 reference unit/s	0	Immediately *5	Setup	*1

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn83A	4	First Stage Linear Deceleration Constant 2	1 to 20,971,520	10,000 reference units/s^2	100	Immediately *5	Setup	*1
Pn83C	4	Second Stage Linear Deceleration Constant 2	1 to 20,971,520	10,000 reference units/s^2	100	Immediately *5	Setup	*1
Pn83E	4	Deceleration Constant Switching Speed 2	0 to 2,097,152,000	1 reference unit/s	0	Immediately *5	Setup	*1
Pn840	4	Linear Deceleration Constant 2 for Stopping	1 to 20,971,520	10,000 reference units/s^2	100	Immediately *5	Setup	*1
Pn842 *7	4	Second Origin Approach Speed 1	0 to 20,971,520	100 reference units/s	0	Immediately *5	Setup	*1
Pn844 *8	4	Second Origin Approach Speed 2	0 to 20,971,520	100 reference units/s	0	Immediately *5	Setup	*1
Pn846	2	Reserved parameter (Do not change.)	–	–	0	–	–	–
Pn850	2	Number of Latch Sequences	0 to 8	–	0	Immediately	Setup	*1
Pn851	2	Continuous Latch Sequence Count	0 to 255	–	0	Immediately	Setup	*1
Pn852	2	Latch Sequence 1 to 4 Settings	0000h to 3333h	–	0000h	Immediately	Setup	*1

Pn852:

n.□□□X	Latch Sequence 1 Signal Selection	
	0	Phase C
	1	EXT1 signal
	2	EXT2 signal
	3	EXT3 signal
n.□□X□	Latch Sequence 2 Signal Selection	
	0 to 3	The settings are the same as those for the Latch Sequence 1 Signal Selection.
n.□X□□	Latch Sequence 3 Signal Selection	
	0 to 3	The settings are the same as those for the Latch Sequence 1 Signal Selection.
n.X□□□	Latch Sequence 4 Signal Selection	
	0 to 3	The settings are the same as those for the Latch Sequence 1 Signal Selection.

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn853	2	Latch Sequence 5 to 8 Settings	0000h to 3333h	–	0000h	Immediately	Setup	*1

n.□□□X	Latch Sequence 5 Signal Selection	
	0	Phase C
	1	EXT1 signal
	2	EXT2 signal
	3	EXT3 signal
n.□□X□	Latch Sequence 6 Signal Selection	
	0 to 3	The settings are the same as those for the Latch Sequence 5 Signal Selection.
n.□X□□	Latch Sequence 7 Signal Selection	
	0 to 3	The settings are the same as those for the Latch Sequence 5 Signal Selection.
n.X□□□	Latch Sequence 8 Signal Selection	
	0 to 3	The settings are the same as those for the Latch Sequence 5 Signal Selection.

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn860	2	SVCMD_IO Input Signal Monitor Allocations 1	0000h to 1717h	–	0000h	Immediately	Setup	*1

n.□□□X	Input Signal Monitor Allocation for CN1-13 (SVCMD_IO)	
	0	Allocate bit 24 (IO_STS1) to CN1-13 input signal monitor.
	1	Allocate bit 25 (IO_STS2) to CN1-13 input signal monitor.
	2	Allocate bit 26 (IO_STS3) to CN1-13 input signal monitor.
	3	Allocate bit 27 (IO_STS4) to CN1-13 input signal monitor.
	4	Allocate bit 28 (IO_STS5) to CN1-13 input signal monitor.
	5	Allocate bit 29 (IO_STS6) to CN1-13 input signal monitor.
	6	Allocate bit 30 (IO_STS7) to CN1-13 input signal monitor.
	7	Allocate bit 31 (IO_STS8) to CN1-13 input signal monitor.
n.□□X□	CN1-13 Input Signal Monitor Enable/Disable Selection	
	0	Disable allocation for CN1-13 input signal monitor.
	1	Enable allocation for CN1-13 input signal monitor.
n.□X□□	Input Signal Monitor Allocation for CN1-7 (SVCMD_IO)	
	0 to 7	The settings are the same as the CN1-13 allocations.
n.X□□□	CN1-7 Input Signal Monitor Enable/Disable Selection	
	0	Disable allocation for CN1-7 input signal monitor.
	1	Enable allocation for CN1-7 input signal monitor.

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn861	2	SVCMD_IO Input Signal Monitor Allocations 2	0000h to 1717h	–	0000h	Immediately	Setup	*1
	n.□□□X: Input Signal Monitor Allocation for CN1-8 (SVCMD_IO) 0 to 7: The settings are the same as the CN1-13 allocations. n.□□X□: CN1-8 Input Signal Monitor Enable/Disable Selection 0: Disable allocation for CN1-8 input signal monitor. 1: Enable allocation for CN1-8 input signal monitor. n.□X□□: Input Signal Monitor Allocation for CN1-9 (SVCMD_IO) 0 to 7: The settings are the same as the CN1-13 allocations. n.X□□□: CN1-9 Input Signal Monitor Enable/Disable Selection 0: Disable allocation for CN1-9 input signal monitor. 1: Enable allocation for CN1-9 input signal monitor.							
Pn862	2	SVCMD_IO Input Signal Monitor Allocations 3	0000h to 1717h	–	0000h	Immediately	Setup	*1
	n.□□□X: Input Signal Monitor Allocation for CN1-10 (SVCMD_IO) 0 to 7: The settings are the same as the CN1-13 allocations. n.□□X□: CN1-10 Input Signal Monitor Enable/Disable Selection 0: Disable allocation for CN1-10 input signal monitor. 1: Enable allocation for CN1-10 input signal monitor. n.□X□□: Input Signal Monitor Allocation for CN1-11 (SVCMD_IO) 0 to 7: The settings are the same as the CN1-13 allocations. n.X□□□: CN1-11 Input Signal Monitor Enable/Disable Selection 0: Disable allocation for CN1-11 input signal monitor. 1: Enable allocation for CN1-11 input signal monitor.							
Pn863	2	SVCMD_IO Input Signal Monitor Allocations 4	0000h to 1717h	–	0000h	Immediately	Setup	*1
	n.□□□X: Input Signal Monitor Allocation for CN1-12 (SVCMD_IO) 0 to 7: The settings are the same as the CN1-13 allocations. n.□□X□: CN1-12 Input Signal Monitor Enable/Disable Selection 0: Disable allocation for CN1-12 input signal monitor. 1: Enable allocation for CN1-12 input signal monitor. n.□X□□: Reserved parameter (Do not change.) n.X□□□: Reserved parameter (Do not change.)							
Pn864 to Pn866	2	Reserved parameters (Do not change.)	–	–	0000h	–	–	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn868	2	SVCMD_IO Output Signal Monitor Allocations 1	0000h to 1717h	–	0000h	Immediately	Setup	*1

n.□□□X	Output Signal Monitor Allocation for CN1-1 and CN1-2 (SVCMD_IO)
0	Allocate bit 24 (IO_STS1) to CN1-1/CN1-2 output signal monitor.
1	Allocate bit 25 (IO_STS2) to CN1-1/CN1-2 output signal monitor.
2	Allocate bit 26 (IO_STS3) to CN1-1/CN1-2 output signal monitor.
3	Allocate bit 27 (IO_STS4) to CN1-1/CN1-2 output signal monitor.
4	Allocate bit 28 (IO_STS5) to CN1-1/CN1-2 output signal monitor.
5	Allocate bit 29 (IO_STS6) to CN1-1/CN1-2 output signal monitor.
6	Allocate bit 30 (IO_STS7) to CN1-1/CN1-2 output signal monitor.
7	Allocate bit 31 (IO_STS8) to CN1-1/CN1-2 output signal monitor.

n.□□X□	CN1-1/CN1-2 Output Signal Monitor Enable/Disable Selection
0	Disable allocation for CN1-1/CN1-2 output signal monitor.
1	Enable allocation for CN1-1/CN1-2 output signal monitor.

n.□X□□	Output Signal Monitor Allocation for CN1-23 and CN1-24 (SVCMD_IO)
0 to 7	The settings are the same as the CN1-1/CN1-2 allocations.

n.X□□□	CN1-23/CN1-24 Output Signal Monitor Enable/Disable Selection
0	Disable allocation for CN1-23/CN1-24 output signal monitor.
1	Enable allocation for CN1-23/CN1-24 output signal monitor.

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn869	2	SVCMD_IO Output Signal Monitor Allocations 2	0000h to 1717h	–	0000h	Immediately	Setup	*1

n.□□□X	Output Signal Monitor Allocation for CN1-25 and CN1-26 (SVCMD_IO)
0 to 7	The settings are the same as the CN1-1/CN1-2 allocations.

n.□□X□	CN1-25/CN1-26 Output Signal Monitor Enable/Disable Selection
0	Disable allocation for CN1-25/CN1-26 output signal monitor.
1	Enable allocation for CN1-25/CN1-26 output signal monitor.

n.□X□□	Reserved parameter (Do not change.)
n.X□□□	Reserved parameter (Do not change.)

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn878	2	Function Selections	0000h to 0011h	–	0000h	After restart	Setup	–

n.□□□X	Auto Servo Mode Selection
0	Disable servo mode automatic switching (enable manual switching).
1	Enable servo mode automatic switching (disable manual switching).

n.□□X□	Orientation Shortest Path Selection
0	Disable near course positioning during orientation.
1	Enable near course positioning during orientation.

n.□X□□	Reserved parameter (Do not change.)
n.X□□□	Reserved parameter (Do not change.)

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn880	2	Station Address Monitor (for maintenance, read only)	03h to EFh	–	–	Immediately	Setup	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classifi-cation	Refer-ence
Pn881	2	Set Transmission Byte Count Monitor [bytes] (for maintenance, read only)	17h, 32h, 48h	–	–	Immediately	Setup	–
Pn882	2	Transmission Cycle Setting Monitor [× 0.25 µs] (for maintenance, read only)	0h to FFFFh	–	–	Immediately	Setup	–
Pn883	2	Communications Cycle Setting Monitor [transmission cycles] (for maintenance, read only)	0 to 32	–	–	Immediately	Setup	–
Pn88A	2	MECHATROLINK Receive Error Counter Monitor (for maintenance, read only)	0 to 65,535	–	0	Immediately	Setup	–
Pn890 to Pn8A6	4	Command Data Monitor during Alarm/Warning (for maintenance, read only)	0h to FFFFFFFFh	–	0h	Immediately	Setup	*1
Pn8A8 to Pn8BE	4	Response Data Monitor during Alarm/Warning (for maintenance, read only)	0h to FFFFFFFFh	–	0h	Immediately	Setup	*1
Pn900	2	Number of Parameter Banks	0 to 16	–	0	After restart	Setup	*1
Pn901	2	Number of Parameter Bank Members	0 to 15	–	0	After restart	Setup	*1
Pn902 to Pn910	2	Parameter Bank Member Definition	0000h to 08FFh	–	0000h	After restart	Setup	*1
Pn920 to Pn95F	2	Parameter Bank Data (Not saved in nonvolatile memory.)	0000h to FFFFh	–	0000h	Immediately	Setup	*1

*1. Refer to the following manual for details.
Σ-7-Series AC Servo Drive MECHATROLINK-III Communications Standard Servo Profile Command Manual (Manual No.: SIEP S800001 31)

*2. Set a percentage of the motor rated torque.

*3. Normally set this parameter to 0. If you use an External Regenerative Resistor, set the capacity (W) of the External Regenerative Resistor.

*4. The upper limit is the maximum output capacity (W) of the SERVOPACK.

*5. The parameter setting is enabled after SENS_ON command execution is completed.

*6. Change the setting when the reference is stopped (i.e., while DEN is set to 1). If you change the setting during operation, the reference output will be affected.

*7. The setting of Pn842 is valid while Pn817 is set to 0.

*8. The setting of Pn844 is valid while Pn818 is set to 0.

Note: The setting will not be enabled even if the settings of Pn002 n.X□□□ and Pn00C are changed and CONFIG command is sent.
Be sure to turn the power supply OFF and ON again after changing the settings of Pn002 n.X□□□ and Pn00C.

12.2 List of MECHATROLINK-III Common Parameters

12.2.1 Interpreting the Parameter Lists

Indicates when a change to the parameter will be effective.
"After restart" indicates parameters that will be effective after one of the following is executed.
- The power supply is turned OFF and ON again.
- The CONFIG command is sent.
- A software reset is executed.

Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classi-fication
61 PnAC2	4	Speed Loop Gain	1,000 to 2,000,000	0.001 Hz [0.1 Hz]	40000	Immediately	Tuning

You can set the parameter in increments of the setting unit.
However, if a unit is given in square brackets, the setting is automatically converted to the resolution given in the square brackets.

12.2.2 List of MECHATROLINK-III Common Parameters

The following table lists the common MECHATROLINK-III parameters. These common parameters are used to make settings from the host controller via MECHATROLINK communications. Do not change the settings with the Digital Operator or any other device.

Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classi-fication
01 PnA02	4	Encoder Type Selection (read only)	0h or 1h	–	–	–	Device information
	0000h	Absolute encoder					
	0001h	Incremental encoder					
02 PnA04	4	Motor Type Selection (read only)	0h or 1h	–	–	–	
	0000h	Rotary motor					
03 PnA06	4	Semi-closed/Fully-closed Type Selection (read only)	0h or 1h	–	–	–	
	0000h	Semi-closed					
	0001h	Fully-closed					
04 PnA08	4	Rated Speed (read only)	0h to FFFFFFFFh	x10^PnA0C min^{-1}	–	–	
05 PnA0A	4	Maximum Output Speed (read only)	0h to FFFFFFFFh	x10^PnA0C min^{-1}	–	–	

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Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classi-fication
06 PnA0C	4	Speed Multiplier (read only)	-3FFFFFFFh to 3FFFFFFFh	–	–	–	Device information
07 PnA0E	4	Rated Torque (read only)	0h to FFFFFFFFh	x10^PnA12 N·m	–	–	
08 PnA10	4	Maximum Output Torque (read only)	0h to FFFFFFFFh	x10^PnA12 N·m	–	–	
09 PnA12	4	Torque Multiplier (read only)	-3FFFFFFFh to 3FFFFFFFh	–	–	–	
0A PnA14	4	Resolution (read only)	0h to FFFFFFFFh	1 P/Rev	–	–	
21 PnA42	4	Electronic Gear Ratio (Numerator)	1 to 1,073,741,824	–	2	After restart	Machine specifications
22 PnA44	4	Electronic Gear Ratio (Denominator)	1 to 1,073,741,824	–	1	After restart	
23 PnA46	4	Reserved parameter (Do not change.)	–	–	0	–	
24 PnA48	4	Multiturn Limit	0 to 65,535	1 Rev	65535	After restart	
25 PnA4A	4	Limit Setting	0h to 33h	–	0003h	After restart	
		Bit 0	P-OT (0: Enabled, 1: Disabled)				
		Bit 1	N-OT (0: Enabled, 1: Disabled)				
		Bit 2	Reserved.				
		Bit 3	Reserved.				
		Bit 4	P-SOT (0: Disabled, 1: Enabled)				
		Bit 5	N-SOT (0: Disabled, 1: Enabled)				
		Bits 6 to 31	Reserved.				
26 PnA4C	4	Forward Software Limit	-1,073,741,823 to 1,073,741,823	1 reference unit	1073741823	Immediately	
27 PnA4E	4	Reserved parameter (Do not change.)	–	–	0	Immediately	
28 PnA50	4	Reverse Software Limit	-1,073,741,823 to 1,073,741,823	1 reference unit	-1073741823	Immediately	
29 PnA52	4	Reserved parameter (Do not change.)	–	–	0	Immediately	

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Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classification
41 PnA82	4	Speed Unit Selection*1	0h to 4h	–	0h	After restart	Unit settings
		0000h: Reference units/s 0001h: Reference units/min 0002h: Percentage (%) of rated speed*2, *3 0003h: min^{-1} *3 0004h: Maximum motor speed/40000000h*4					Unit settings
42 PnA84	4	Speed Base Unit Selection*2, *3, *4 (Set the value of n from the following formula: Speed unit selection (41 PnA82) $\times 10^n$)	-3 to 3	–	0	After restart	Unit settings
43 PnA86	4	Position Unit Selection	0h	–	0h	After restart	Unit settings
		0000h: Reference units					Unit settings
44 PnA88	4	Position Base Unit Selection (Set the value of n from the following formula: Position unit selection (43 PnA86) $\times 10^n$)	0	–	0	After restart	Unit settings
45 PnA8A	4	Acceleration Unit Selection	0h	–	0h	After restart	Unit settings
		0000h: Reference units/s^2					Unit settings
46 PnA8C	4	Acceleration Base Unit Selection (Set the value of n from the following formula: Acceleration unit selection (45 PnA8A) $\times 10^n$)	4 to 6	–	4	After restart	Unit settings
47 PnA8E	4	Torque Unit Selection	1h to 2h	–	1h	After restart	Unit settings
		0001h: Percentage (%) of rated torque*5 0002h: Maximum torque/40000000h*6					Unit settings
48 PnA90	4	Torque Base Unit Selection*5, *6 (Set the value of n from the following formula: Torque unit selection (47 PnA8E) $\times 10^n$)	-5 to 0	–	0	After restart	Unit settings

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Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classi-fication
49 PnA92	4	Supported Unit (read only)	–	–	0601011Fh	–	Unit settings

Speed Units	
Bit 0	Reference units/s (1: Enabled)
Bit 1	Reference units/min (1: Enabled)
Bit 2	Percentage (%) of rated speed (1: Enabled)
Bit 3	min^{-1} (rpm) (1: Enabled)
Bit 4	Maximum motor speed/4000000h (1: Enabled)
Bits 5 to 7	Reserved (0: Disabled).
Position Units	
Bit 8	Reference units (1: Enabled)
Bits 9 to 15	Reserved (0: Disabled).
Acceleration Units	
Bit 16	Reference units/s^2 (1: Enabled)
Bit 17	ms (acceleration time required to reach rated speed) (0: Disabled)
Bits 18 to 23	Reserved (0: Disabled).
Torque Units	
Bit 24	N·m (0: Disabled)
Bit 25	Percentage (%) of rated torque (1: Enabled)
Bit 26	Maximum torque/40000000h
Bits 27 to 31	Reserved (0: Disabled).

Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classi-fication
61 PnAC2	4	Speed Loop Gain	1,000 to 2,000,000	0.001 Hz [0.1 Hz]	40000	Immediately	Tuning
62 PnAC4	4	Speed Loop Integral Time Constant	150 to 512,000	1 µs [0.01 ms]	20000	Immediately	
63 PnAC6	4	Position Loop Gain	1,000 to 2,000,000	0.001/s [0.1/s]	40000	Immediately	
64 PnAC8	4	Feed Forward Com-pensation	0 to 100	1%	0	Immediately	
65 PnACA	4	Position Loop Inte-gral Time Constant	0 to 5,000,000	1 µs [0.1 ms]	0	Immediately	
66 PnACC	4	In-position Range	0 to 1,073,741,824	1 reference unit	7	Immediately	
67 PnACE	4	Near-position Range	1 to 1,073,741,824	1 reference unit	1073741824	Immediately	
81 PnB02	4	Exponential Func-tion Acceleration/ Deceleration Time Constant	0 to 510,000	1 µs [0.1 ms]	0	Immediately*7	
82 PnB04	4	Movement Average Time	0 to 510,000	1 µs [0.1 ms]	0	Immediately*7	
83 PnB06	4	Final Travel for Exter-nal Input Positioning	-1,073,741,823 to 1,073,741,823	1 reference unit	100	Immediately	
84 PnB08	4	Zero Point Return Approach Speed	0h to 3FFFFFFFh	10^{-3} min^{-1}	× 5,000h ref-erence units/s converted to 10^{-3} min^{-1}	Immediately	

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Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classi-fication
85 PnB0A	4	Zero Point Return Creep Speed	0h to 3FFFFFFFh	10^{-3} min^{-1}	× 500h reference units/s converted to 10^{-3} min^{-1}	Immediately	Tuning
86 PnB0C	4	Final Travel for Zero Point Return	-1,073,741,823 to 1,073,741,823	1 reference unit	100	Immediately	Tuning
87 PnB0E	4	Monitor Select 1	0h to Fh	–	1h	Immediately	Tuning
88 PnB10	4	Monitor Select 2	0h to Fh	–	0h	Immediately	Command-related parameters

87 PnB0E (Monitor Select 1) settings:

0000h	APOS
0001h	CPOS
0002h	PERR
0003h	LPOS1
0004h	LPOS2
0005h	FSPD
0006h	CSPD
0007h	TRQ
0008h	ALARM
0009h	MPOS
000Ah	Reserved (undefined value).
000Bh	Reserved (undefined value).
000Ch	CMN1 (common monitor 1)
000Dh	CMN2 (common monitor 2)
000Eh	OMN1 (optional monitor 1)
000Fh	OMN2 (optional monitor 2)

88 PnB10 (Monitor Select 2) settings:

0000 to 000Fh	The settings are the same as those for Fixed Monitor Selection 1.

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Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classification
89 PnB12	4	Monitor Select for SEL_MON1	0h to 6h	–	0h	Immediately	Command-related parameters

0000h	TPOS (target position in reference coordinate system)
0001h	IPOS (reference position in reference coordinate system)
0002h	POS_OFFSET (offset set in POS_SET (Set Coordinate System) command)
0003h	TSPD (target speed)
0004h	SPD_LIM (speed limit)
0005h	TRQ_LIM (torque limit)
0006h	SV_STAT (servo actual operating status) Monitor Description Byte 1: Current communications phase 00h: Phase 0 01h: Phase 1 02h: Phase 2 03h: Phase 3 Byte 2: Current control mode 00h: Position control mode 01h: Speed control mode 02h: Torque control mode Byte 3: Reserved Byte 4: Expansion signal monitor

Bit	Name	Description	Value	Setting
Bit 0	LT_RDY1	Processing status for latch detection for LT_REQ1 in SVCMD_CTRL region	0	Latch detection not yet processed.
			1	Processing latch detection in progress.
Bit 1	LT_RDY1	Processing status for latch detection for LT_REQ2 in SVCMD_CTRL region	0	Latch detection not yet processed.
			1	Processing latch detection in progress.
Bits 2 and 3	LT_SEL1R	Latch signal	0	Phase C
			1	External input signal 1
			2	External input signal 2
			3	External input signal 3
Bits 4 and 5	LT_SEL2R	Latch signal	0	Phase C
			1	External input signal 1
			2	External input signal 2
			3	External input signal 3
Bit 6	Reserved (0).			

Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classification
8A PnB14	4	Monitor Select for SEL_MON2	0h to 6h	–	0h	Immediately	Command-related parameters

0000h to 0006h	The settings are the same as those for SEL_MON Monitor Selection 1.

Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classification
8B PnB16	4	Zero Point Detection Range	0 to 250	1 reference unit	10	Immediately	Command-related parameters

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Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classi-fication
8C PnB18	4	Forward Torque Limit	0 to 800	1%	100	Immediately	Command-related parameters
8D PnB1A	4	Reverse Torque Limit	0 to 800	1%	100	Immediately	
8E PnB1C	4	Zero Speed Detection Range	1,000 to 10,000,000	10^{-3} min^{-1}	20000	Immediately	
8F PnB1E	4	Speed Match Signal Detection Range	0 to 100,000	10^{-3} min^{-1}	10000	Immediately	
90 PnB20	4	SVCMD_CTRL bit Enabled/Disabled (read only)	–	–	0FFF3F3Fh	–	

Bit 0	CMD_PAUSE (1: Enabled)
Bit 1	CMD_CANCEL (1: Enabled)
Bits 2 and 3	STOP_MODE (1: Enabled)
Bits 4 and 5	ACCFIL (1: Enabled)
Bits 6 and 7	Reserved (0: Disabled).
Bit 8	LT_REQ1 (1: Enabled)
Bit 9	LT_REQ2 (1: Enabled)
Bits 10 and 11	LT_SEL1 (1: Enabled)
Bits 12 and 13	LT_SEL2 (1: Enabled)
Bits 14 and 15	Reserved (0: Disabled).
Bits 16 to 19	SEL_MON1 (1: Enabled)
Bits 20 to 23	SEL_MON2 (1: Enabled)
Bits 24 to 27	SEL_MON3 (1: Enabled)
Bits 28 to 31	Reserved (0: Disabled).

Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classi-fication
91 PnB22	4	SVCMD_STAT bit Enabled/Disabled (read only)	–	–	0FFF3F33h	–	Command-related parameters

Bit 0	CMD_PAUSE_CMP (1: Enabled)
Bit 1	CMD_CANCEL_CMP (1: Enabled)
Bit 2 and 3	Reserved (0: Disabled).
Bits 4 and 5	ACCFIL (1: Enabled)
Bits 6 and 7	Reserved (0: Disabled).
Bit 8	L_CMP1 (1: Enabled)
Bit 9	L_CMP2 (1: Enabled)
Bit 10	POS_RDY (1: Enabled)
Bit 11	PON (1: Enabled)
Bit 12	M_RDY (1: Enabled)
Bit 13	SV_ON (1: Enabled)
Bits 14 and 15	Reserved (0: Disabled).
Bits 16 to 19	SEL_MON1 (1: Enabled)
Bits 20 to 23	SEL_MON2 (1: Enabled)
Bits 24 to 27	SEL_MON3 (1: Enabled)
Bits 28 to 31	Reserved (0: Disabled).

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Parameter No.	Size	Name	Setting Range	Setting Unit [Resolution]	Default Setting	When Enabled	Classi-fication
92 PnB24	4	I/O Bit Enabled /Disabled (Output) (read only)	–	–	C0F00FD0h	–	Command-related parameters
	Bits 0 to 3: Reserved (0: Disabled). Bit 4: V_PPI (1: Enabled) Bit 5: P_PPI (1: Enabled) Bit 6: P_CL (1: Enabled) Bit 7: N_CL (1: Enabled) Bit 8: G_SEL (1: Enabled) Bits 9 to 11: G_SEL (0: Disabled) Bits 12 to 15: Reserved (0: Disabled). Bits 16 to 19: BANK_SEL (1: Enabled) Bits 20 to 22: SO1 to SO3 (1: Enabled) Bit 23: Reserved (0: Disabled). Bits 24 to 29: Reserved (0: Disabled). Bit 30: SV_CHG (1: Enabled) Bit 31: Reserved (0: Disabled).						
93 PnB26	4	I/O Bit Enabled /Disabled (Input) (read only)	–	–	800FF2FCh	–	
	Bit 0: Reserved (0: Disabled). Bit 1: DEC (1: Enabled) Bit 2: P-OT (1: Enabled) Bit 3: N-OT (1: Enabled) Bit 4: EXT1 (1: Enabled) Bit 5: EXT2 (1: Enabled) Bit 6: EXT3 (1: Enabled) Bit 7: ESTP (1: Enabled) Bit 8: Reserved (0: Disabled). Bit 9: BRK_ON (1: Enabled) Bit 10: P-SOT (1: Enabled) Bit 11: N-SOT (1: Enabled) Bit 12: DEN (1: Enabled) Bit 13: NEAR (1: Enabled) Bit 14: PSET (1: Enabled) Bit 15: ZPOINT (1: Enabled) Bit 16: T_LIM (1: Enabled) Bit 17: V_LIM (1: Enabled) Bit 18: V_CMP (1: Enabled) Bit 19: ZSPD (1: Enabled) Bits 20 to 23: Reserved (0: Disabled). Bits 24 to 31: I0_STS1 to I0_STS8 (1: Enabled)						

*1. When using fully-closed loop control, set the reference units/s.

*2. If you set the Speed Unit Selection (parameter 41: PnA82) to 0002h adjust the Speed Base Unit Selection (parameter 42: PnA84) to satisfy the following formula.
Rotary Servomotor: 1.28 × Rated speed [min^{-1}] × 10^{PnA84} < Maximum speed [min^{-1}]
Linear Servomotor: 1.28 × Rated speed [mm/s] × 10^{PnA84} < Maximum speed [mm/s]

*3. If you set the Speed Unit Selection (parameter 41: PnA82) to either 0002h or 0003h, set the Speed Base Unit Selection (parameter 42: PnA84) to a number between -3 and 0.

*4. If you set the Speed Unit Selection (parameter 41: PnA82) to 0004h, set the Speed Base Unit Selection (parameter 42: PnA84) to 0.

*5. If you set the Torque Unit Selection (parameter 47: PnA8E) to 0001h, adjust the Torque Base Unit Selection (parameter 48: PnA90) to satisfy the following formula.
128×10^{PnA90} < Maximum torque [%]

*6. If you set the Torque Unit Selection (parameter 47: PnA8E) to 0002h, set the Torque Base Unit Selection (parameter 48: PnA90) to 0.

*7. Change the setting when the reference is stopped (i.e., while DEN is set to 1). If you change the setting during operation, the reference output will be affected.

12.3 Parameter Recording Table

Use the following table to record the settings of the parameters.

Parameter No.	Default Setting					Name	When Enabled
Pn000	0000h					Basic Function Selections 0	After restart
Pn001	0002h					Application Function Selections 1	After restart
Pn002	0014h					Application Function Selections 2	After restart
Pn006	0002h					Application Function Selections 6	Immediately
Pn007	0000h					Application Function Selections 7	Immediately
Pn008	4000h					Application Function Selections 8	After restart
Pn009	0000h					Reserved parameter	–
Pn00A	0001h					Application Function Selections A	After restart
Pn00B	0001h					Application Function Selections B	After restart
Pn00C	0000h					Reserved parameter	–
Pn00D	0000h					Application Function Selections D	Immediately
Pn00F	0000h					Application Function Selections F	After restart
Pn01C	0000h					Application Function Selections 1C	After restart
Pn01E	0003h					Application Function Selections 1E	After restart
Pn01F	0002h					Application Function Selections 1F	After restart
Pn021	0000h					Reserved parameter	–
Pn040	0000h					Reserved parameter	–
Pn080	0000h					Reserved parameter	–
Pn081	0000h					Application Function Selections 81	After restart
Pn100	400					Speed Loop Gain	Immediately
Pn101	2000					Speed Loop Integral Time Constant	Immediately
Pn102	400					Position Loop Gain	Immediately
Pn103	100					Moment of Inertia Ratio	Immediately
Pn104	400					Second Speed Loop Gain	Immediately
Pn105	2000					Second Speed Loop Integral Time Constant	Immediately
Pn106	400					Second Position Loop Gain	Immediately
Pn109	0					Feedforward	Immediately
Pn10A	0					Feedforward Filter Time Constant	Immediately
Pn10B	0004h					Gain Application Selections	*1
Pn10C	200					Mode Switching Level for Torque Reference	Immediately
Pn10D	0					Mode Switching Level for Speed Reference	Immediately
Pn10E	0					Mode Switching Level for Acceleration	Immediately

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Parameter No.	Default Setting					Name	When Enabled
Pn10F	0					Mode Switching Level for Position Deviation	Immediately
Pn11F	0					Position Integral Time Constant	Immediately
Pn12B	400					Third Speed Loop Gain	Immediately
Pn12C	2000					Third Speed Loop Integral Time Constant	Immediately
Pn12D	400					Third Position Loop Gain	Immediately
Pn12E	400					Fourth Speed Loop Gain	Immediately
Pn12F	2000					Fourth Speed Loop Integral Time Constant	Immediately
Pn130	400					Fourth Position Loop Gain	Immediately
Pn131 to Pn15A	–					Reserved parameter	–
Pn160	0000h					Anti-Resonance Control-Related Selections	Immediately
Pn161	1000					Anti-Resonance Frequency	Immediately
Pn162	100					Anti-Resonance Gain Correction	Immediately
Pn163	0					Anti-Resonance Damping Gain	Immediately
Pn164	0					Anti-Resonance Filter Time Constant 1 Correction	Immediately
Pn165	0					Anti-Resonance Filter Time Constant 2 Correction	Immediately
Pn166	0					Anti-Resonance Damping Gain 2	Immediately
Pn170	1400h					Reserved parameter	–
Pn205	65535					Multiturn Limit	After restart
Pn207	0010h					Position Control Function Selections	After restart
Pn20A	32768					Number of External Encoder Scale Pitches	After restart
Pn20E	2					Electronic Gear Ratio (Numerator)	After restart
Pn210	1					Electronic Gear Ratio (Denominator)	After restart
Pn212	512					Number of Encoder Output Pulses/Number of External Pulse Encoder Output Pulses	After restart
Pn22A	0000h					Fully-closed Control Selections	After restart
Pn230	0000h					Position Control Expansion Function Selections	After restart
Pn231	0					Backlash Compensation	Immediately
Pn233	0					Backlash Compensation Time Constant	Immediately
Pn234	0					Reserved parameter	–
Pn23A	1024					Number of Encoder Pulses	After restart
Pn23C	0					Phase-C Width Setting	After restart
Pn23D	0					Polarity Origin Compensation	After restart
Pn23E	1024					Number of External Encoder Pulses	After restart

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Parameter No.	Default Setting					Name	When Enabled
Pn250	0020h					Reserved parameter	–
Pn281	20					Encoder Output Resolution	After restart
Pn304	500					Jogging Speed	Immediately
Pn305	0					Soft Start Acceleration Time	Immediately
Pn306	0					Soft Start Deceleration Time	Immediately
Pn308	0					Speed Feedback Filter Time Constant	Immediately
Pn30A	0					Deceleration Time for Servo OFF and Forced Stops	Immediately
Pn30C	0					Speed Feedforward Average Movement Time	Immediately
Pn310	0000h					Vibration Detection Selections	Immediately
Pn311	100					Vibration Detection Sensitivity	Immediately
Pn312	50					Vibration Detection Level	Immediately
Pn316	10000					Maximum Motor Speed	After restart
Pn324	300					Moment of Inertia Calculation Starting Level	Immediately
Pn401	100					First Stage First Torque Reference Filter Time Constant	Immediately
Pn404	100					Reserved parameter	–
Pn405	100					Reserved parameter	–
Pn406	800					Emergency Stop Torque	Immediately
Pn407	10000					Speed Limit during Torque Control	Immediately
Pn408	0000h					Torque-Related Function Selections	*1
Pn409	5000					First Stage Notch Filter Frequency	Immediately
Pn40A	70					First Stage Notch Filter Q Value	Immediately
Pn40B	0					First Stage Notch Filter Depth	Immediately
Pn40C	5000					Second Stage Notch Filter Frequency	Immediately
Pn40D	70					Second Stage Notch Filter Q Value	Immediately
Pn40E	0					Second Stage Notch Filter Depth	Immediately
Pn40F	5000					Second Stage Second Torque Reference Filter Frequency	Immediately
Pn410	50					Second Stage Second Notch Filter Q Value	Immediately
Pn412	100					First Stage Second Torque Reference Filter Time Constant	Immediately
Pn413	100					First Stage Third Torque Reference Filter Time Constant	Immediately

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Parameter No.	Default Setting					Name	When Enabled
Pn414	100					First Stage Fourth Torque Reference Filter Time Constant	Immediately
Pn416	0000h					Torque-Related Function Selections 2	Immediately
Pn417	5000					Third Stage Notch Filter Frequency	Immediately
Pn418	70					Third Stage Notch Filter Q Value	Immediately
Pn419	0					Third Stage Notch Filter Depth	Immediately
Pn41A	5000					Fourth Stage Notch Filter Frequency	Immediately
Pn41B	70					Fourth Stage Notch Filter Q Value	Immediately
Pn41C	0					Fourth Stage Notch Filter Depth	Immediately
Pn41D	5000					Fifth Stage Notch Filter Frequency	Immediately
Pn41E	70					Fifth Stage Notch Filter Q Value	Immediately
Pn41F	0					Fifth Stage Notch Filter Depth	Immediately
Pn423	0000h					Reserved parameter	–
Pn424	50					Torque Limit at Main Circuit Voltage Drop	Immediately
Pn425	100					Release Time for Torque Limit at Main Circuit Voltage Drop	Immediately
Pn426	0					Torque Feedforward Average Movement Time	Immediately
Pn427	0					Reserved parameter	–
Pn430	150					Powering Torque Limit	Immediately
Pn431	150					Regeneration Torque Limit	Immediately
Pn432	15					Motor Flux Lower Limit Level	Immediately
Pn433	100					Servo Mode Flux Level for High-Speed Winding	Immediately
Pn434	100					Servo Mode Base Speed Ratio for High-Speed Winding	Immediately
Pn435	100					Reserved parameter	–
Pn436	100					Reserved parameter	–
Pn43F	100					Load Meter Filter Time Constant	Immediately
Pn456	15					Sweep Torque Reference Amplitude	Immediately
Pn460	0101h					Notch Filter Adjustment Selections 1	Immediately
Pn501	10					Reserved parameter	–
Pn502	20					Reserved parameter	–
Pn503	10					Speed Coincidence Signal Detection Width	Immediately
Pn506	0					Brake Reference-Servo OFF Delay Time	Immediately

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Parameter No.	Default Setting					Name	When Enabled
Pn507	100					Brake Reference Output Speed Level	Immediately
Pn508	50					Servo OFF-Brake Command Waiting Time	Immediately
Pn509	20					Momentary Power Interruption Hold Time	Immediately
Pn50A	8881h					Input Signal Selections 1	After restart
Pn50B	8888h					Input Signal Selections 2	After restart
Pn50E	0000h					Output Signal Selections 1	After restart
Pn50F	0100h					Output Signal Selections 2	After restart
Pn510	0000h					Output Signal Selections 3	After restart
Pn511	6543h					Input Signal Selections 5	After restart
Pn512	0000h					Output Signal Inverse Settings	After restart
Pn514	0000h					Output Signal Selections 4	After restart
Pn516	8888h					Input Signal Selections 7	After restart
Pn51B	1000					Motor-Load Position Deviation Overflow Detection Level	Immediately
Pn51E	100					Position Deviation Overflow Warning Level	Immediately
Pn520	5242880					Position Deviation Overflow Alarm Level	Immediately
Pn522	7					Positioning Completed Width	Immediately
Pn524	1073741824					Near Signal Width	Immediately
Pn526	5242880					Position Deviation Overflow Alarm Level at Servo ON	Immediately
Pn528	100					Position Deviation Overflow Warning Level at Servo ON	Immediately
Pn529	10000					Speed Limit Level at Servo ON	Immediately
Pn52A	20					Multiplier per Fully-closed Rotation	Immediately
Pn52B	20					Overload Warning Level	Immediately
Pn52C	100					Base Current Derating at Motor Overload Detection	After restart
Pn530	0000h					Program Jogging-Related Selections	Immediately
Pn531	32768					Program Jogging Travel Distance	Immediately
Pn533	500					Program Jogging Movement Speed	Immediately
Pn534	100					Program Jogging Acceleration/Deceleration Time	Immediately
Pn535	100					Program Jogging Waiting Time	Immediately
Pn536	1					Program Jogging Number of Movements	Immediately
Pn541	65535					Rated Speed Setting	After restart
Pn542	15					Speed Coincidence Detection Width	Immediately
Pn543	1000					Speed Detection Level	Immediately

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Parameter No.	Default Setting					Name	When Enabled
Pn544	100					Speed Detection Hysteresis	Immediately
Pn545	0000h					Speed Deviation Overflow Protection Selection Switches	Immediately
Pn548	0000h					Specified Alarm Number for Tracing	Immediately
Pn550	0					Analog Monitor 1 Offset Voltage	Immediately
Pn551	0					Analog Monitor 2 Offset Voltage	Immediately
Pn552	100					Analog Monitor 1 Magnification	Immediately
Pn553	100					Analog Monitor 2 Magnification	Immediately
Pn55A	1					Power Consumption Monitor Unit Time	Immediately
Pn560	400					Reserved parameter	–
Pn561	100					Reserved parameter	–
Pn600	0					Regenerative Resistor Capacity	Immediately
Pn601	0					Reserved parameter	–
Pn603	0					Regenerative Resistance	Immediately
Pn604	0					Reserved parameter	–
Pn800	1040h					Communications Controls	Immediately
Pn801	0003h					Application Function Selections 6 (Software Limits)	Immediately
Pn803	10					Origin Range	Immediately
Pn804	1073741823					Forward Software Limit	Immediately
Pn806	-1073741823					Reverse Software Limit	Immediately
Pn808	0					Reserved parameter	–
Pn80A	100					First Stage Linear Acceleration Constant	Immediately*3
Pn80B	100					Second Stage Linear Acceleration Constant	Immediately*3
Pn80C	0					Acceleration Constant Switching Speed	Immediately*3
Pn80D	100					First Stage Linear Deceleration Constant	Immediately*3
Pn80E	100					Second Stage Linear Deceleration Constant	Immediately*3
Pn80F	0					Deceleration Constant Switching Speed	Immediately*3
Pn810	0					Exponential Acceleration/ Deceleration Bias	Immediately*3
Pn811	0					Exponential Acceleration/ Deceleration Time Constant	Immediately*3
Pn812	0					Movement Average Time	Immediately*3
Pn814	100					External Positioning Final Travel Distance	Immediately*3
Pn816	0000h					Reserved parameter	–
Pn817	50					Origin Approach Speed 1	Immediately*3

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Parameter No.	Default Setting					Name	When Enabled
Pn818	5					Origin Approach Speed 2	Immedi-ately*3
Pn819	100					Final Travel Distance for Origin Return	Immedi-ately*3
Pn81E	0000h					Reserved parameter	–
Pn81F	0010h					Reserved parameter	–
Pn820	0					Forward Latching Area	Immediately
Pn822	0					Reverse Latching Area	Immediately
Pn824	0000h					Option Monitor 1 Selection	Immediately
Pn825	0000h					Option Monitor 2 Selection	Immediately
Pn827	100					Linear Deceleration Con-stant 1 for Stopping	Immedi-ately*3
Pn829	0					SVOFF Waiting Time (for SVOFF at Deceleration to Stop)	Immediately
Pn82A	1813h					Reserved parameter	–
Pn82B	1D1Ch					Reserved parameter	–
Pn82C	1F1Eh					Reserved parameter	–
Pn82D	0000h					Reserved parameter	–
Pn82E	0000h					Reserved parameter	–
Pn830	4096					Number of Reference Units per Machine Revolution	Immediately
Pn833	0000h					Motion Settings	After restart
Pn834	100					First Stage Linear Accelera-tion Constant 2	Immedi-ately*3
Pn836	100					Second Stage Linear Acceleration Constant 2	Immedi-ately*3
Pn838	0					Acceleration Constant Switching Speed 2	Immedi-ately*3
Pn83A	100					First Stage Linear Decelera-tion Constant 2	Immedi-ately*3
Pn83C	100					Second Stage Linear Deceleration Constant 2	Immedi-ately*3
Pn83E	0					Deceleration Constant Switching Speed 2	Immedi-ately*3
Pn840	100					Linear Deceleration Con-stant 2 for Stopping	Immedi-ately*3
Pn842	0					Second Origin Approach Speed 1	Immedi-ately*3
Pn844	0					Second Origin Approach Speed 2	Immedi-ately*3
Pn846	0					Reserved parameter	–
Pn850	0					Number of Latch Sequences	Immediately
Pn851	0					Continuous Latch Sequence Count	Immediately
Pn852	0000h					Latch Sequence 1 to 4 Set-tings	Immediately
Pn853	0000h					Latch Sequence 5 to 8 Set-tings	Immediately
Pn860	0000h					SVCMD_IO Input Signal Monitor Allocations 1	Immediately

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Parameter No.	Default Setting					Name	When Enabled
Pn861	0000h					SVCMD_IO Input Signal Monitor Allocations 2	Immediately
Pn862	0000h					SVCMD_IO Input Signal Monitor Allocations 3	Immediately
Pn863	0000h					SVCMD_IO Input Signal Monitor Allocations 4	Immediately
Pn864 to Pn866	–					Reserved parameter	–
Pn868	0000h					SVCMD_IO Output Signal Monitor Allocations 1	Immediately
Pn869	0000h					SVCMD_IO Output Signal Monitor Allocations 2	Immediately
Pn878	–					Function Selections	After restart
Pn880	–					Station Address Monitor (for maintenance, read only)	Immediately
Pn881	–					Set Transmission Byte Count Monitor [bytes] (for maintenance, read only)	Immediately
Pn882	–					Transmission Cycle Setting Monitor [× 0.25 μs] (for maintenance, read only)	Immediately
Pn883	–					Communications Cycle Setting Monitor [transmission cycles] (for maintenance, read only)	Immediately
Pn88A	0					MECHATROLINK Receive Error Counter Monitor (for maintenance, read only)	Immediately
Pn890 to Pn8A6	0h					Command Data Monitor during Alarm/Warning (for maintenance, read only)	Immediately
Pn8A8 to Pn8BE	0h					Response Data Monitor during Alarm/Warning (for maintenance, read only)	Immediately
Pn900	0					Number of Parameter Banks	After restart
Pn901	0					Number of Parameter Bank Members	After restart
Pn902 to Pn910	0000h					Parameter Bank Member Definition	After restart
Pn920 to Pn95F	0000h					Parameter Bank Data (Not saved in nonvolatile memory.)	Immediately
01 PnA02	–					Encoder Type Selection (read only)	–
02 PnA04	–					Motor Type Selection (read only)	–
03 PnA06	–					Semi-closed/Fully-closed Type Selection (read only)	–
04 PnA08	–					Rated Speed (read only)	–
05 PnA0A	–					Maximum Output Speed (read only)	–
06 PnA0C	–					Speed Multiplier (read only)	–

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Parameter Lists

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Parameter No.	Default Setting					Name	When Enabled
07 PnA0E	–					Rated Torque (read only)	–
08 PnA10	–					Maximum Output Torque (read only)	–
09 PnA12	–					Torque Multiplier (read only)	–
0A PnA14	–					Resolution (read only)	–
21 PnA42	2					Electronic Gear Ratio (Numerator)	After restart
22 PnA44	1					Electronic Gear Ratio (Denominator)	After restart
23 PnA46	0					Reserved (Do not change.)	–
24 PnA48	65535					Multiturn Limit	After restart
25 PnA4A	0003h					Limit Setting	After restart
26 PnA4C	1073741823					Forward Software Limit	Immediately
27 PnA4E	0					Reserved (Do not change.)	Immediately
28 PnA50	-1073741823					Reverse Software Limit	Immediately
29 PnA52	0					Reserved (Do not change.)	Immediately
41 PnA82	0h					Speed Unit Selection	After restart
42 PnA84	0					Speed Base Unit Selection	After restart
43 PnA86	0h					Position Unit Selection	After restart
44 PnA88	0					Position Base Unit Selection	After restart
45 PnA8A	0h					Acceleration Unit Selection	After restart
46 PnA8C	4					Acceleration Base Unit Selection	After restart
47 PnA8E	1h					Torque Unit Selection	After restart
48 PnA90	0					Torque Base Unit Selection	After restart
49 PnA92	0601011Fh					Supported Unit (read only)	–
61 PnAC2	40000					Speed Loop Gain	Immediately
62 PnAC4	20000					Speed Loop Integral Time Constant	Immediately
63 PnAC6	40000					Position Loop Gain	Immediately
64 PnAC8	0					Feed Forward Compensation	Immediately
65 PnACA	0					Position Loop Integral Time Constant	Immediately

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Parameter No.	Default Setting					Name	When Enabled
66 PnACC	7					In-position Range	Immediately
67 PnACE	1073741824					Near-position Range	Immediately
81 PnB02	0					Exponential Function Acceleration/Deceleration Time Constant	Immedi-ately*3
82 PnB04	0					Movement Average Time	Immedi-ately*3
83 PnB06	100					Final Travel for External Input Positioning	Immediately
84 PnB08	× 5,000h reference units/s converted to 10^{-3} min^{-1}					Zero Point Return Approach Speed	Immediately
85 PnB0A	× 500h reference units/s converted to 10^{-3} min^{-1}					Zero Point Return Creep Speed	Immediately
86 PnB0C	100					Final Travel for Zero Point Return	Immediately
87 PnB0E	1h					Monitor Select 1	Immediately
88 PnB10	0h					Monitor Select 2	Immediately
89 PnB12	0h					Monitor Select for SEL_MON1	Immediately
8A PnB14	0h					Monitor Select for SEL_MON2	Immediately
8B PnB16	10					Zero Point Detection Range	Immediately
8C PnB18	100					Forward Torque Limit	Immediately
8D PnB1A	100					Reverse Torque Limit	Immediately
8E PnB1C	20000					Zero Speed Detection Range	Immediately
8F PnB1E	10000					Speed Match Signal Detec-tion Range	Immediately
90 PnB20	0FFF3F3Fh					SVCMD_CTRL bit Enabled/ Disabled (read only)	–
91 PnB22	0FFF3F33h					SVCMD_STAT bit Enabled/ Disabled (read only)	–
92 PnB24	C0F0H0FD0h					I/O Bit Enabled/Disabled (Output) (read only)	–
93 PnB26	B00FF2FCh					I/O Bit Enabled/Disabled (Input) (read only)	–

*1. The enable timing depends on the digit that is changed. Refer to the following section for details.
12.1 List of Servo Parameters on page 12-2

*2. The parameter setting is enabled after SENS_ON command execution is completed.

*3. Change the setting when the reference is stopped (i.e., while DEN is set to 1). If you change the setting during operation, the reference output will be affected.

Appendices

13

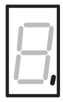
This appendix provides information on interpreting panel displays, drive capacity selection, and tables of corresponding SERVOPACK and SigmaWin+ function names.

13.1 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.

13.1.1 Interpreting Status Displays

The status is displayed as described below.

Display	Meaning	Display	Meaning
	/TGON (Rotation Detection) Signal Display Lit if the Spindle Motor speed is higher than the setting of Pn502 or Pn581 and not lit if the speed is lower than the setting. (The default setting is 20 min^{-1} or 20 mm/s.)		Reference Input Display Lit while a reference is being input.
	Base Block Display Lit during the base block state (servo OFF). Not lit while the servo is ON.		Control Power Supply ON Display Lit while the control power is being supplied.

13.1.2 Alarm and Warning Displays

If there is an alarm or warning, the display will change in the following order.
Example: Alarm A.E60

Status Display → Not lit. → A. → Not lit. → E → Not lit. → 6 → Not lit. → 0 → Not lit.

13.1.3 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 → Not lit. → H → Not lit. → b → Not lit. → b. → Not lit.

13.1.4 Overtravel Display

If overtravel has occurred, the display will change in the following order.

① Forward Overtravel (P-OT)

Status Display → P

② Reverse Overtravel (N-OT)

Status Display → n

③ Forward and Reverse Overtravel

Status Display → P → n

13.1.5 Forced Stop Display

During a forced stop, the following display will appear.

Status Display → Not lit. → F → Not lit. → S → Not lit. → t → Not lit. → P → Not lit.

13.2 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+.

13.2.1 Corresponding SERVOPACK Utility Function Names

SigmaWin+		SERVOPACK	
Button in Menu Dialog Box	Function Name	Fn No.	Function Name
Basic Functions	Initialize	Fn005	Initializing Parameters
	Software Reset	Fn030	Software Reset
	Setup Wizard	–	–
	I/O Signal Allocation	–	–
	Product Information	Fn011	Display Servomotor Model
		Fn012	Display Software Version
		Fn01E	Display SERVOPACK and Servomotor IDs
		Fn01F	Display Servomotor ID from Feedback Option Module
Encoder Setting	Reset Absolute Encoder	Fn008	Reset Absolute Encoder
	Multi-turn Limit Setup	Fn013	Multiturn Limit Setting after Multiturn Limit Disagreement Alarm
	Search Origin	Fn003	Origin Search
Trouble-shooting	Display Alarm	Fn000	Display Alarm History
		Fn006	Clear Alarm History
		Fn014	Reset Option Module Configuration Error
	Alarm Trace	–	–
Operation	Jog	Fn002	Jog
	Program JOG Operation	Fn004	Jog Program
Monitor	Trace	–	–
	Real Time Trace	–	–
	Monitor	–	–
	Life Monitor	–	–
Tuning	Tuning - Autotuning without Host Reference	Fn201	Advanced Autotuning without Reference
	Tuning - Autotuning with Host Reference	Fn202	Advanced Autotuning with Reference
	Tuning - Custom Tuning	Fn203	One-Parameter Tuning
	Tuning - Custom Tuning - Adjust Anti-resonance Control	Fn204	Adjust Anti-resonance Control
	System Tuning	–	–
	Edit Online Parameters	–	–
Diagnostic	Online Vibration Monitor	–	–

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SigmaWin+		SERVOPACK	
Button in Menu Dialog Box	Function Name	Fn No.	Function Name
Others	Adjust the Analog Monitor Output	Fn00C	Adjust Analog Monitor Output Offset
		Fn00D	Adjust Analog Monitor Output Gain
	Adjust the Motor Current Detection Offsets	Fn00E	Autotune Motor Current Detection Signal Offset
		Fn00F	Manually Adjust Motor Current Detection Signal Offset
	Initialize Vibration Detection Level	Fn01B	Initialize Vibration Detection Level
	Parameter Converter	–	–
	SERVOPACK Axis Name Setting	–	–
	Write Prohibited Setting	Fn010	Write Prohibition Setting
	Motor Parameter SERVOPACK Write	–	–

13.2.2 Corresponding SERVOPACK Monitor Display Function Names

SigmaWin+		SERVOPACK	
Menu Bar Button	Name [Unit]	Un No.	Name [Unit]
Motion Monitor	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)
	Rotational Angle 1 [encoder pulses] (number of encoder pulses from encoder phase C)	Un003	Rotational Angle 1 [encoder pulses] (number of encoder pulses from encoder phase C displayed in decimal)
	Rotational Angle 2 [deg] (electrical angle from polarity origin)	Un004	Rotational 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)
	Input Reference Pulse Counter [reference units]	Un00C	Input Reference Pulse Counter [reference units]
	Feedback Pulse Counter [encoder pulses]	Un00D	Feedback Pulse Counter [encoder pulses]
	Fully-closed Loop Feedback Pulse Counter [external encoder resolution]	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*	Upper Limit Setting of Motor Maximum Speed/ Upper Limit Setting of Encoder Output Resolution
	Total Operation Time [100 ms]	Un012	Total Operation Time [100 ms]

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SigmaWin+		SERVOPACK	
Menu Bar Button	Name [Unit]	Un No.	Name [Unit]
Motion Monitor	Feedback Pulse Counter [reference units]	Un013	Feedback Pulse Counter [reference units]
	Current Backlash Compensation Value [0.1 reference units]	Un030	Current Backlash Compensation Value [0.1 reference units]
	Backlash Compensation Value Setting Limit [0.1 reference units]	Un031	Backlash Compensation Value Setting Limit [0.1 reference units]
	Power Consumption [W]	Un032	Power Consumption [W]
	Consumed Power [0.001 Wh]	Un033	Consumed Power [0.001 Wh]
	Cumulative Power Consumption [Wh]	Un034	Cumulative Power Consumption [Wh]
	Motor Temperature [0.1°C]	Un060	Motor Temperature [0.1°C]
	Load Meter [0.1%]	Un062	Load Meter [0.1%]
Status Monitor	Active Gain Monitor	Un014	Effective Gain Monitor (gain settings 1 = 1, gain settings 2 = 2, gain settings 3 = 3, gain settings 4 = 4)
	Safety I/O Signal Monitor	Un015	Safety I/O Signal Monitor
Input Signal Monitor	Input Signal Monitor	Un005	Input Signal Monitor
Output Signal Monitor	Output Signal Monitor	Un006	Output Signal Monitor
Service Life Monitor	Installation Environment Monitor – SERVOPACK	Un025	SERVOPACK Installation Environment Monitor [%]
	Service Life Prediction Monitor – Built-in Fan	Un027	Built-in Fan Remaining Life Ratio [%]
	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 [%]
–	–	Un020	Rated Motor Speed [min^{-1}]
	–	Un021	Maximum Motor Speed [min^{-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.X□□□ (Calculation Method for Maximum Speed or Divided Output Pulses).

- If Pn080 = n.0□□□, the encoder output resolution (Pn281) that can be set is displayed.
- If Pn080 = n.1□□□, the maximum motor speed (Pn385) that can be set is displayed in mm/s.

13.3 Determining Drive Capacity

When controlling machine speed, a servo drive must supply torque to match the characteristics of the machine that makes up the motor load, as well as torque to accelerate and decelerate the drive system (couplings, machine, and motor). Consider the following points when determining the drive capacity.

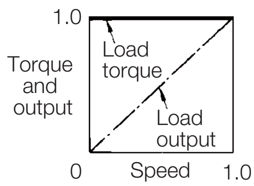
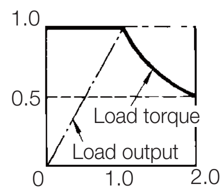
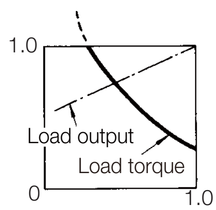
- Make clear the ratings to be used (continuous rating, short-time rating, and repetitive rating) based on the load characteristics.
- Consider the efficiency of the force transmission mechanism and the load dispersion, and select a drive capacity greater than the force required by the load.
- Select a drive capacity that can sufficiently provide the startup torque and maximum torque required by the load. Use the following equation to select the drive capacity.

  Drive capacity ≥ Force to drive the load mechanism + Force to accelerate and decelerate the load mechanism to the required speed

The methods to use to calculate the load drive force and acceleration/deceleration force are given below.

13.3.1 Load Drive Capacity

The following table shows the torque-speed characteristics of the load mechanism that uses the servo drive.

Load Characteristics		Load Examples	Speed-Torque Characteristics	Motor Capacity
Constant Torque Load	Load torque over speed is constant. (Usually a friction load.)	• Conveyors • Cranes • Winches • Other friction loads and gravity loads	• Load torque is constant regardless of speed. • Output is proportional to speed.  	Motor capacity is the same as the maximum speed load capacity.
Constant Output Load	Required output over speed is constant.	• Center drive constant tension winders • Spindle of machine tool • Veneer rotary lathe	Within constant torque range: • Load torque is constant regardless of speed. • Output is proportional to speed. Within constant output range: • Output required by load is constant. • Load torque is inversely proportional to speed.  	Required rated output when using a drive with constant torque characteristics is as follows: Required output = Load output × Constant output control ratio]$^{1/2}$
Reduced Output Load	• Load torque over speed is variable. • Characteristics are between constant-output load and constant-torque load characteristics.		Intermediate speed-torque and output characteristics of constant-torque load and constant-output load  	Motor capacity is the same as the maximum speed load capacity.

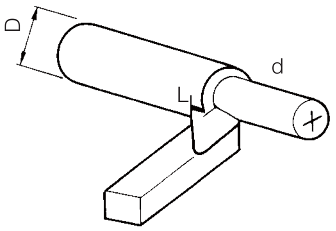
Servo Drives for Spindles of Machine Tools

The cutting force determines the required force for a Servo Drive for the spindle of a lathe or machining center. Constant output characteristics are required for cutting, and a constant output control range of 1:10 to 1:30 is required. The method to calculate the required force is given for the following lathe processing, machine center milling, and drilling examples.

Note: The cutting oil conditions, the cutting tool material and shape, the hardness of the material to be cut, and other factors that affect the cutting resistance must also be considered to accurately calculate the required force.

◆ Lathe Processing Example

For lathe processing, the object to be cut is rotated and the blade is pressed against it to cut the object, as shown in the following diagram



The force, P_C, that is required to cut the object is calculated with the following formula.

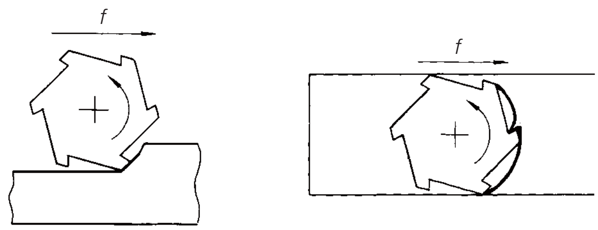
$$P_C = \frac{K_S dLV}{60 \times 1000 \times \eta_C} = \frac{dLV}{S_C \cdot \eta_C} \text{(kW)}$$

$$V = \frac{\pi D N_S}{1000} \text{(m/min)}$$

K_S: Cutting resistance (N/mm^2)
d: Cutting depth (mm)
L: Length of blade actually performing cutting (i.e., amount of feed per rotation) (mm)
D: Diameter of object to be processed (mm)
N_S: Spindle speed (min^{-1})
η_C: Machine efficiency: 0.7 to 0.85
S_C: Cutting efficiency: (i.e., cutting amount per 1 kW per minute) (CC/(kW/min.))

◆ Milling Example

For milling, the blade is mounted to the spindle and rotated to cut the object to be processed.



(a) Side Milling (b) Front Milling

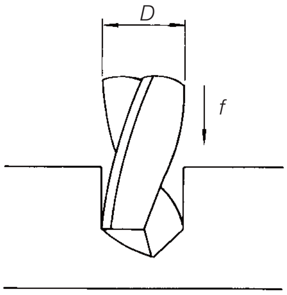
The force, P_F, that is required to cut the object is calculated with the following formula.

$$P_F = \frac{K_S \delta W f}{60 \times 1000^2 \times \eta_F} = \frac{\delta W f}{1000^2 S_F \eta_F} \text{ (kW)}$$

K_S: Cutting resistance (N/mm^2)
δ: Cutting depth (mm)
W: Cutting width (mm)
f: Feed speed (mm/min.)
S_F: Cutting efficiency (i.e., cutting amount per 1 kW per minute) (CC/(kW/min.))
η_F: Machine efficiency 0.7 to 0.8

◆ Drilling Example

For drilling, the drill is mounted to the spindle and rotated, opening a hole in the object to be processed.



The force, P_D, that is required to drill the object is calculated with the following formula.

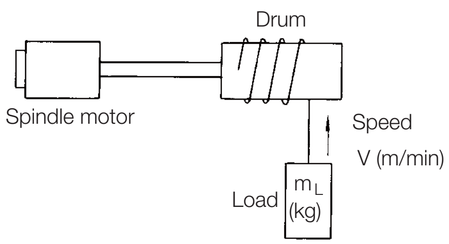
Note: The load torque, M, varies with the material, the drilling diameter (D), and the feed speed (f).

$$P_D = \frac{M \cdot 2\pi n}{60 \times 100 \times 1000 \times \eta_D} = \frac{\pi D^2 f}{4 \times 1000 \times S_D \eta_D} \text{ (kW)}$$

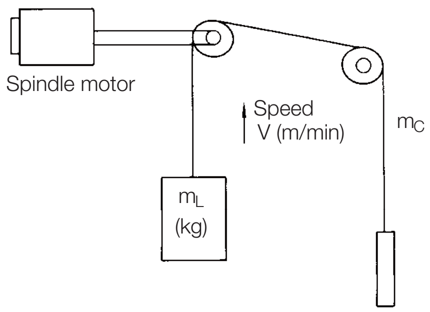
M: Drill load torque (N·cm)
n: Spindle speed (r/min)
η_D: Machine efficiency: 0.7 to 0.85
D: Drilling diameter (mm)
f: Feed speed (mm/min.)
S_D: Cutting efficiency (i.e., cutting amount per 1 kW per minute) (CC/(kW/min.))

Servo Drives with a Gravity Load

The force required to vertically move a load, such as with a crane or lifting gear, differs greatly depending on whether a counterweight is used.



(a) Without counterweight



(b) With counterweight

The force that is required for each is calculated with the following formulas.

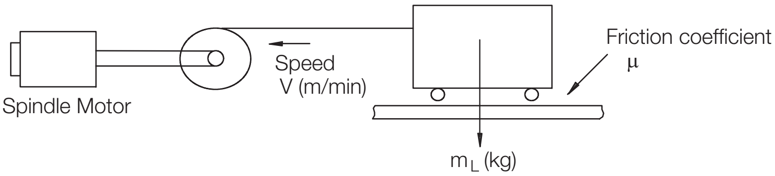
Without counterweight: $P_{GL} = \frac{m_L V}{6120\eta}$ (kW)

With counterweight: $P_{GLC} = \frac{(m_L - m_C) V}{6120\eta}$ (kW)

V: Vertical travel speed (m/min.)
η: Machine efficiency
m_L: Load mass (kg)
m_C: Counterweight mass (kg)

Servo Drives with Friction Loads

Cranes, tables, and other horizontal conveyance equipment are friction loads.

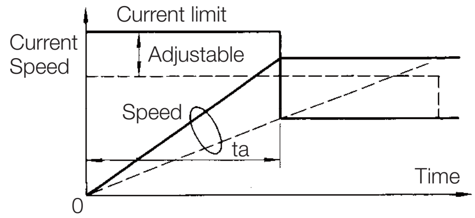
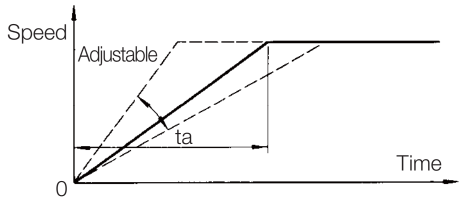
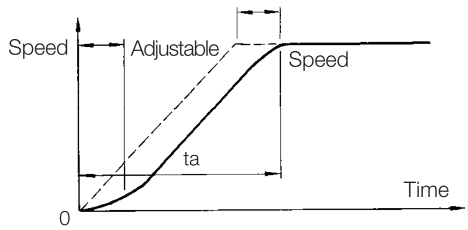


The force, P_F, that is required is calculated with the following formula, where μ is the friction coefficient.

$$P_F = \frac{\mu m_L V}{6120\eta} \text{ (kW)}$$

13.3.2 Acceleration/deceleration Capacity

When starting or stopping machine operation, you can select between a variety of acceleration methods that allow for everything from fast acceleration/deceleration to smooth acceleration/deceleration. A comparison of these acceleration methods is shown in the following table.

Accelera-tion Method	Control Method	Diagram	Remarks
Current-Limited Acceleration	This method suppresses the current during acceleration to a constant value to protect the drive unit and machine.		Generated torque from the motor during acceleration is constant.
Time-Limited Acceleration	This method suppresses the acceleration rate so that there is linear acceleration change over time, even if the speed reference changes rapidly.		The acceleration torque is constant.
S-Curve Acceleration	In addition to the above suppression in the acceleration rate, this method suppresses torque to perform smooth acceleration.		The rate of change in the torque at the start and end of acceleration is suppressed.

Calculate the acceleration/deceleration capacity using the most severe current-limited acceleration for the capacity. The formula to calculate the drive capacity required from the acceleration time *t* (s) is given below.

- Required drive capacity in the constant torque characteristics range ($0 \le N_M \le N_B$)

$$P_M = \left(\frac{2\pi}{60}\right)^2 \frac{J_M N_M^2}{1000t} \text{ (kW)}$$

- Required drive capacity for the constant torque characteristics in the constant output characteristics range ($0 \leq N_M \leq N_{MAX}$)

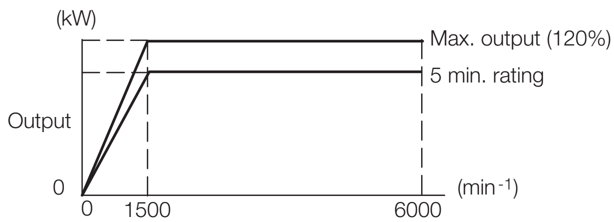
$$P_M = \left(\frac{2\pi}{60}\right)^2 \frac{J_M\,(N_M^2 + N_B^2)}{2000t} \text{ (kW)}$$

J_M: Motor axis conversion moment of inertia (kg·m^2)
P_M: Motor output at base speed (kW)
N_M: Operation speed (min^{-1})
N_B: Base speed (min^{-1})
N_{MAX}: Maximum speed (min^{-1})

◆ Calculation Conditions

An example of calculations based on standard drive and machine specifications is given below. With the actual machine, the calculated values may vary slightly due to mechanical loss, fluctuations in the power supply voltage, machine noise countermeasures, and motor magnetic field noise countermeasures.

Item	Value
Acceleration Time	2.5 s (0 to 6000 min^{-1}) 0.5 s (0 to 1500 min^{-1})
Moment of Inertia J_M	0.13 kg·m^2 Load: 0.10 kg·m^2 Spindle Motor: 0.03 kg·m^2 (assuming load to be × 0.3)
Output Characteristics (5 Min. Rating)	Base speed N_B: 1500 min^{-1}
Maximum Output During Acceleration/deceleration	120% of 5 min. rated output



◆ Calculations

As a result of performing the calculations in ◆ *Calculation Conditions* on page 13-10, the force required from the acceleration/deceleration time is as follows: Upper formula for 5 min. rating: 7.5 kW (47.7 N·m); Lower formula: 15 kW (95.0 N·m).

- At 0 to 1,500 min^{-1}

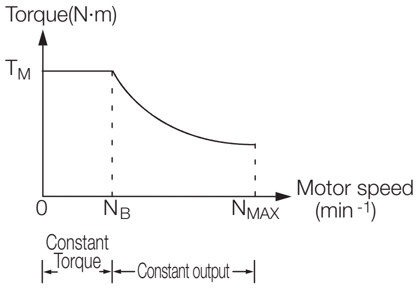
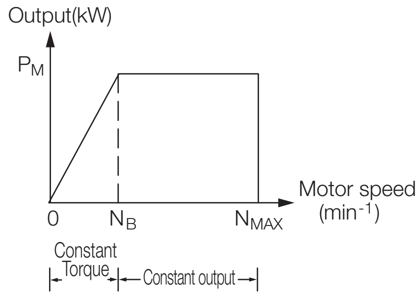
$$P_M = \left(\frac{2\pi}{60}\right)^2 \frac{0.13 \times 1500^2}{1000 \times 0.5} = 6.41 \text{ (kW)}$$

- At 0 to 6,000 min^{-1}

$$P_M = \left(\frac{2\pi}{60}\right)^2 \frac{0.13 \times (6000^2 + 1500^2)}{2000 \times 2.5} = 10.89 \text{ (kW)}$$

13.3.3 Calculating Start and Stop Times

After selecting the machine characteristics and servo drive capacity, the start and stop times can be calculated using formulas in the following table.

Item	Calculating from Torque	Calculating from Output
Motor Characteristics		
• Constant Torque Characteristics ($0 \le N_M \le N_B$) $0 \leftrightarrow N_M$ Acceleration/ Deceleration Time	$t = \frac{2\pi}{60} \cdot J_M \cdot N_M \cdot \frac{1}{T_M}$	$t = \left(\frac{2\pi}{60}\right)^2 \cdot \frac{J_M}{1000P_M} \cdot N_B \cdot N_M$
• Constant Output Characteristics ($N_B \le N_M \le N_{MAX}$) $N_B \leftrightarrow N_M$ Acceleration/ Deceleration Time	$t = \frac{2\pi}{60} \cdot J_M \cdot \frac{1}{T_M} \cdot \frac{N_M^2 - N_B^2}{2N_B}$	$t = \left(\frac{2\pi}{60}\right)^2 \cdot \frac{J_M}{1000P_M} \cdot \frac{N_M^2 - N_B^2}{2}$
• Constant Torque + Constant Output Characteristics ($N_B \le N_M \le N_{MAX}$) $0 \leftrightarrow N_M$ Acceleration/ Deceleration Time	$t = \frac{2\pi}{60} \cdot J_M \cdot \frac{1}{T_M} \cdot \frac{N_M^2 + N_B^2}{2N_B}$	$t = \left(\frac{2\pi}{60}\right)^2 \cdot \frac{J_M}{1000P_M} \cdot \frac{N_M^2 + N_B^2}{2}$

Note: An example of calculations based on standard drive and machine specifications is given below. With the actual machine, the calculated values may vary slightly due to mechanical loss, fluctuations in the power supply voltage, machine noise countermeasures, and motor magnetic field noise countermeasures.

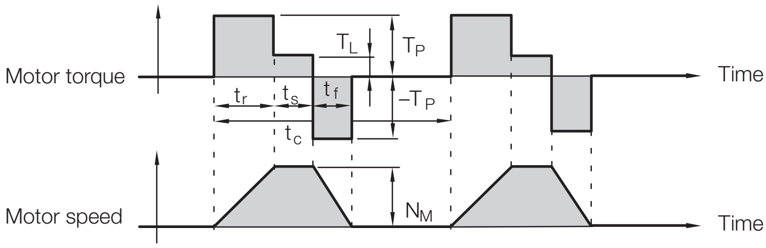
N_M: Operation speed (min^{-1})
N_B: Base speed (min^{-1})
M_{MAX}: Maximum speed (min^{-1})
J_M: Motor axis conversion moment of inertia (kg·m^2) (= Motor moment of inertia + motor axis conversion load moment of inertia)
T_M: Motor axis maximum torque at base speed (N·m) (For a standard motor, max. torque = 5 min. rated torque × 1.2)
P_M: Motor maximum output at base speed (kW) (For a standard motor, max. output = 5 min. rated output × 1.2)

13.3.4 Intermittent Load Operating Capacity

If operations such as tapping with a machine tool or driving a conveyor table are frequently reversed, care must be taken in selecting the capacity. When using an operation cycle that includes acceleration/deceleration operations such as those described below, select the capacity so that the Spindle Motor equivalent effective torque T_R is less than or equal to the servo drive continuous rated torque. (The maximum value of T_P will be 120% of the servo drive 5 min. rating.)

■ Motor Torque and Speed Timechart

$$T_R = \sqrt{\frac{T_P^2\,(t_r + t_f) + T_L^2\,t_s}{t_C}}\ (\mathrm{N\cdot m})$$



The Spindle Motor reverse rating is the rating over the load when the motor load changes cyclically. When the reverse rated output is taken to be t_1 and with no load is taken to be t_2, the α that is expressed in the following equation is called %ED (Einschalt Dauer). In this equation, $t_1 + t_2$ is always equal to 10 minutes.

$$\alpha = \frac{t_1}{t_1 + t_2} \times 100\ (\%)$$

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Σ-7-Series AC Servo Drive

Σ-7S SERVOPACK with FT/EX Specification for Processing Machine, Spindle Motor

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