YASKAWA

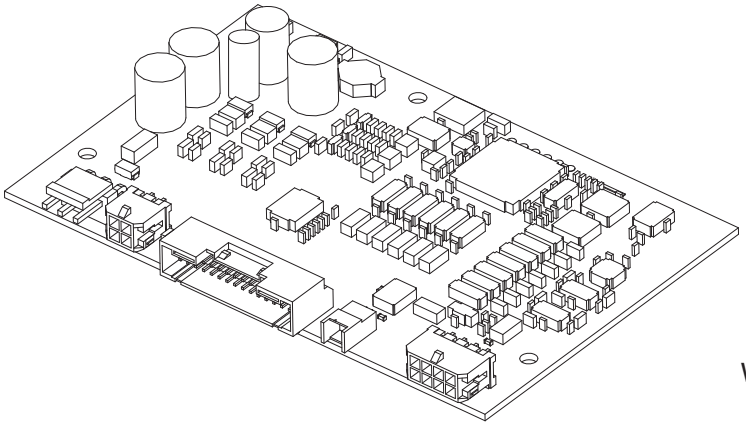
AC Servo Drives

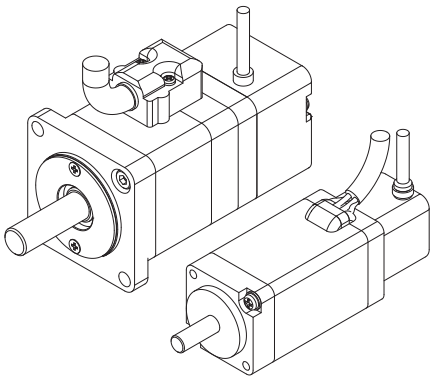
Σ-S Series

PRODUCT MANUAL

DC Power Supply Input and Pulse Train References

SGPSS SERVOPACK
SGMSL Servomotor





MANUAL NO. SIEP S800001 49C

About this Manual

This manual provides information required to select Σ-S-Series AC Servo Drives (DC power supply input and pulse train references), 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-S-Series AC Servo Drives.

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

Outline of Manual

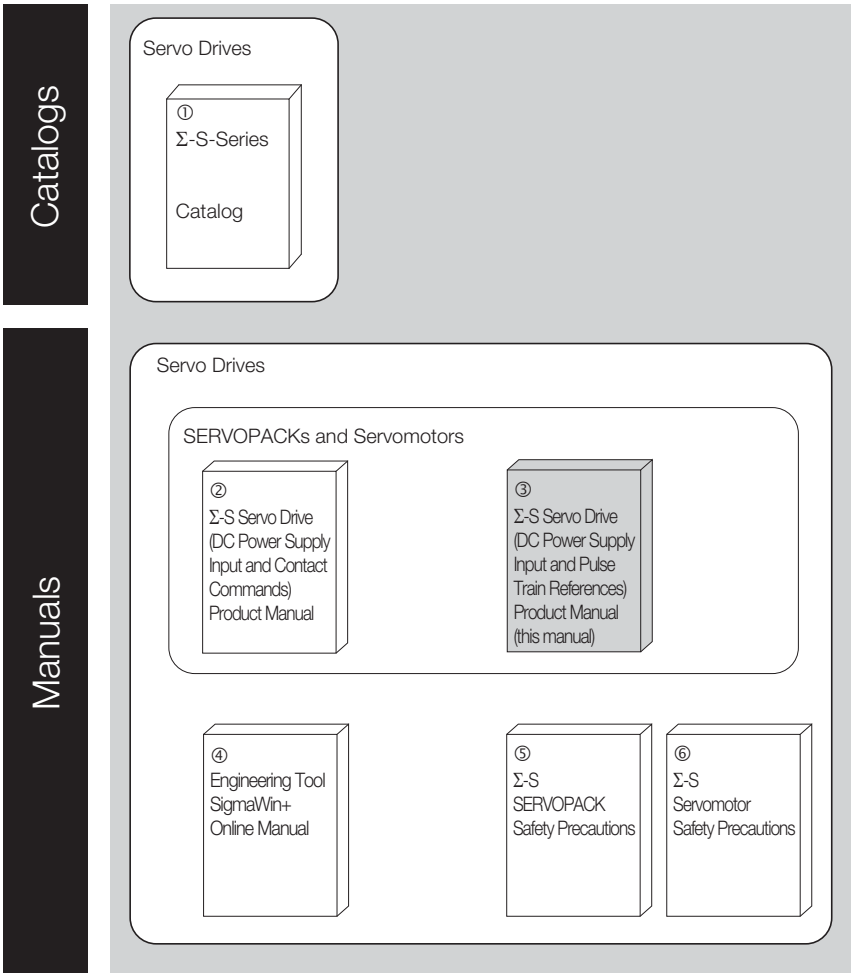
The contents of the chapters of this manual are described in the following table.

Refer to these chapters as required.

Chapter	Chapter Title	Contents
1	Basic Information	Provides information required to select Servo Drives, such as information on Servomotors and SERVOPACKs.
2	Selection	Provides information required to select SERVOPACKs, Servomotors, cables, and peripheral devices, such as specifications, dimensional drawings, and connection examples.
3	Installation	Provides information on installing SERVOPACKs and Servomotors in the required locations.
4	Wiring and Connections	Provides information on wiring and connecting Servo Drive to power supplies and peripheral devices.
5	Setup	Describes the functions that must be set before you start operation. It also describes the setting methods.
6	Trial Operation	Provides information on the flow and procedures for trial operation and convenient functions to use during trial operation.
7	Operation and Functions	Provides detailed information on positioning, homing, and ZONE outputs.
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	Maintenance	Provides information on the meaning of, causes of, and corrections for alarms and warnings.
11	Parameter List	Provides information on the parameters.

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 Number	Description
① Σ-S-Series Catalog	Σ-S Series AC Servo Drives	KAEP S800001 40	Provides information on Σ-S-Series AC Servo Drives, including features and specifications.
② Σ-S Servo Drive (Contact Commands) Product Manual	AC Servo Drive Σ-S-Series Product Manual DC Power Supply Input and Contact Commands	SIEP S800001 13	Provides detailed information on selecting, designing, connecting, setting, performing trial operation for, tuning, and monitoring the Σ-S-Series Servo Drives.
③ Σ-S Servo Drive (Pulse Train References) Product Manual	AC Servo Drive Σ-S-Series Product Manual DC Power Supply Input and Pulse Train References	This manual (SIEP S800001 49)	
④ Engineering Tool Operating Manual	AC Servo Drives Engineering Tool SigmaWin+ Online Manual Σ-S Component	SIEP S800001 06	Provides detailed operating procedures for the SigmaWin+ Engineering Tool for a Σ-S-Series Servo System.
⑤ Σ-S SERVOPACK Safety Precautions	AC SERVOPACK Σ-S-Series Safety Precautions DC Power Input	TOBP C710827 00	Describes installation, wire sizes, and inspections for Σ-S-Series SERVOPACKs.
⑥ Σ-S Servomotor Safety Precautions	AC Servo Drive Rotary Servomotor Safety Precautions	TOBP C230260 00	Describes Servomotor installation, handling precautions, and inspections.

Using This Manual

◆ Technical Terms Used in This Manual

The following terms are used in this manual.

Term	Meaning
Servomotor	A Σ-S-Series Rotary Servomotor.
SERVOPACK	A Σ-S-Series SERVOPACK.
Servo Drive	The combination of a Servomotor and SERVOPACK.
Servo System	A servo control system that includes the combination of a Servo Drive with a host controller and peripheral devices.
SERVO ON	Supplying power to the motor.
SERVO OFF	Not supplying power to the motor.
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

$\overline{\text{BUSY}}$ is written as /BUSY.

■ 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

Pn100	Speed Loop Gain				
	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
Pn140	n.□□0□ (default setting)	Do not perform vibration suppression.	Immediately	Tuning
	n.□□1□	Perform vibration suppression for a specific frequency.		
	n.□□2□	Reserved setting (Do not use.)		

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

Notation Examples for Pn008

n . 0 0 0 0

Digit Notation		Numeric Value Notation	
Notation	Meaning	Notation	Meaning
Pn008 = n.□□□X	Indicates the first digit from the right in Pn008.	Pn008 = n.□□□1	Indicates that the first digit from the right in Pn008 is set to 1.
Pn008 = n.□□X□	Indicates the second digit from the right in Pn008.	Pn008 = n.□□1□	Indicates that the second digit from the right in Pn008 is set to 1.
Pn008 = n.□X□□	Indicates the third digit from the right in Pn008.	Pn008 = n.□1□□	Indicates that the third digit from the right in Pn008 is set to 1.
Pn008 = n.X□□□	Indicates the fourth digit from the right in Pn008.	Pn008 = n.1□□□	Indicates that the fourth digit from the right in Pn008 is set to 1.

◆ Engineering Tools Used in This Manual

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

◆ Trademarks

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 cables or connectors while power is being supplied to the SERVOPACK.
  There is a risk of electric shock, operational failure of the product, or burning.

⚠ WARNING

- Always use the correct power supply specifications for the product.
  There is a risk of burning, electric shock, or fire.
- Connect the ground terminal on the SERVOPACK to a ground pole with a resistance of 100 Ω or less.
  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

- SERVOPACKs and Servomotors may 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.
- 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.
- Do not use the product in an environment that is subject to water, corrosive gases, or flammable gases, or near flammable materials.
  There is a risk of electric shock or fire.

NOTICE

- Do not attempt to use a SERVOPACK or Servomotor that is damaged or that has missing parts.
- Install external emergency stop circuits that shut OFF the power supply and stops operation immediately when an error occurs.
- Use a Noise Filter to minimize the effects of electromagnetic interference.
  Electronic devices used near the SERVOPACK may be affected by electromagnetic interference.
- Always use a Servomotor and SERVOPACK in one of the specified combinations.
- Do not touch a SERVOPACK or Servomotor with wet hands.
  There is a risk of product failure or electric shock.

■ 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 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 the product in any of the above locations, the product may fail or be damaged.

■ Transportation Precautions

⚠ CAUTION

- When you touch the SERVOPACK, hold the edges of the SERVOPACK board, and never touch the surfaces of the components or the surface of the solder.
  There is a risk of injury or malfunction.
- When you move the product after removing it from the package, take adequate measures against static electricity.
  There is a risk of electric shock or failure.
- When you handle a SERVOPACK or Servomotor, be careful of sharp parts, such as the corners.
  There is a risk of injury.
- Do not place an excessive load on the product during transportation. (Follow all instructions on the packages.)
  There is a risk of injury or damage.

NOTICE

- Discharge any static electricity from your body before you touch a SERVOPACK.
  There is a risk of equipment damage.
- A SERVOPACK or Servomotor is a precision device. Do not drop it or subject it to strong shock.
  There is a risk of failure or damage.
- Do not subject connectors to shock.
  There is a risk of faulty connections or damage.
- If disinfectants or insecticides must be used to treat packing materials such as wooden frames, plywood, or pallets, the packing materials must be treated before the product is packaged, and methods other than fumigation must be used.

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

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

■ Installation Precautions

⚠ CAUTION

- When working on the SERVOPACK, hold the edges of the SERVOPACK board, and never touch the surfaces of the components or the surface of the solder.
  There is a risk of injury or malfunction.
- During installation, take countermeasures against static electricity, such as using an anti-static wrist band.
  There is a risk of electric shock or failure.
- Install the Servomotor or SERVOPACK in a way that will support the mass given in technical documents.
- Install SERVOPACKs and Servomotors 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 allow any foreign matter to adhere to the surface of the SERVOPACK or to enter the Servomotor.
  There is a risk of failure or fire.

NOTICE

- Discharge any static electricity from your body before you touch a SERVOPACK.
  There is a risk of equipment damage.
- Do not install 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 install the product in any of the above locations, the product may fail or be damaged.
- Use the product in an environment that is appropriate for the product specifications.
  If you use the product in an environment that exceeds product specifications, the product may fail or be damaged.
- A SERVOPACK or Servomotor is a precision device. Do not drop it or subject it to strong shock.
  There is a risk of failure or damage.

■ Wiring Precautions

⚠ DANGER

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

⚠ WARNING

- Wiring and inspections must be performed only by qualified engineers.
  There is a risk of electric shock or product failure.
- Check all wiring and power supplies carefully.
  Incorrect wiring or incorrect voltage application to the input circuits or output circuits may cause short-circuit failures. Short-circuit failures can result in equipment damage or personal injury.
- Connect the power supply input (+24 V and 0 V) to the CN3 connector (power supply input connector) on the SERVOPACK.
  There is a risk of failure or fire.

⚠ CAUTION

- Even after you shut OFF the power supply, voltage may still remain in the SERVOPACK. Do not touch the SERVOPACK until the power indicator goes OFF.
  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 voltage application may cause the SERVOPACK to fail, damage the equipment, or result in personal injury.
- Check the wiring to be sure it has been performed correctly.
  There is a risk of failure or malfunction.
- Use the tools recommended by the connector manufacturer if you make any cables yourself.
  Insufficient crimping may cause wires and connectors to generate heat due to faulty contact, possibly resulting in fire.
- Turn ON the power supply to the SERVOPACK only after all wiring has been completed.
- 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.
- Insert cable connectors firmly until the lock mechanisms lock into place.
  There is a risk of cable disconnection during operation.
- Do not bundle Power Supply Input Cables or Servomotor Power Cables together with I/O Signal Cables or Encoder Cables or run them through the same duct. If you do not place the above cables 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 entering on the I/O Signal Cables or Encoder Cables.

■ Operation Precautions

⚠ WARNING

- Before starting operation with a machine connected, change the settings of the parameters to match the machine.
  Unexpected machine operation, failure, or personal injury may occur if operation is started before appropriate settings are made.
- Do not radically change the settings of the parameters.
  There is a risk of unstable operation, machine damage, or injury.
- Install limit switches or stoppers at the ends of the moving parts of the machine to prevent unexpected accidents.
  There is a risk of machine damage or injury.
- For trial operation, securely mount the Servomotor and disconnect it from the machine.
  There is a risk of injury.
- When an alarm occurs, the motor will coast to a stop. The coasting distance will change with the moment of inertia of the load and the motor speed. Check the coasting distance during trial operation and implement suitable safety measures on the machine.
- Do not enter the machine's range of motion during operation.
  There is a risk of injury.
- Do not touch the moving parts of the Servomotor or machine during operation.
  There is a risk of injury.

⚠ CAUTION

- Design the system to ensure safety even when problems, such as broken signal lines, occur. For example, the E-STP signal is 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.
- Always change to the SERVO OFF state before you turn OFF the power supply. If you turn OFF the power supply without changing to the SERVO OFF state during operation, the Servomotor will coast to a stop.

NOTICE

- When you adjust the gain during system commissioning, use the SigmaWin+ Engineering Tool to monitor the torque waveform and speed waveform and confirm that there is no vibration.
  If a high gain causes vibration, the Servomotor will be damaged quickly.
- Do not 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.
- After you complete trial operation of the machine and facilities, use the SigmaWin+ to back up the settings of the SERVOPACK parameters and tables. You can use them to reset the parameters and tables after SERVOPACK replacement.
  If you do not copy backed up parameter settings and table data, 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, removal work, and inspections must be performed only by qualified engineers.
  There is a risk of electric shock or product failure.

⚠ CAUTION

- Even after you shut OFF the power supply, voltage may still remain in the SERVOPACK. Do not touch the SERVOPACK until the power indicator goes OFF.
  There is a risk of electric shock.
- Before you replace a SERVOPACK, back up the SERVOPACK parameter settings and table data. Copy the backed up parameter settings and table data to the new SERVOPACK and confirm that they were copied correctly.
  If you do not copy backed up parameter settings and table data or if the copy operation is not completed normally, normal operation may not be possible, possibly resulting in machine or equipment damage.

NOTICE

- Discharge any static electricity from your body before you touch a SERVOPACK.
  There is a risk of equipment damage.

■ Troubleshooting Precautions

⚠ CAUTION

- When an alarm occurs, remove the cause of the alarm and ensure safety. Then reset the alarm or turn the power supply OFF and ON again to restart operation.
  There is a risk of injury or machine damage.
- If the SERVO ON signal is input to the SERVOPACK and an alarm is reset, the Servomotor may suddenly restart operation. Confirm that the system is in the SERVO OFF state and ensure safety before you reset an alarm.
  There is a risk of injury or machine damage.
- Always install a magnetic contactor or other shutoff device on the input side of the isolated 24-VDC power supply so that the power supply can be shut OFF.
  If a magnetic contactor or other shutoff device is not connected when the SERVOPACK fails, a large current may flow, possibly resulting in fire.
- If an alarm occurs, shut OFF the power supply.
  If a magnetic contactor or other shutoff device is not connected when the SERVOPACK fails, a large current may flow, possibly resulting in fire.
- 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.

■ Disposal Precautions

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

■ General Precautions

- Figures provided in this document are typical examples or conceptual representations. There may be differences between them and actual wiring, circuits, and products.
- 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 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 EU Directives

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.

Product	Model	EU Directives	Harmonized Standards
SERVOPACKs	SGPSS-3R1C	EMC Directive 2014/30/EC	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/EC	EN 61800-5-1
		RoHS Directive 2011/65/EU	EN 50581
Rotary Servomotors	SGMSL	EMC Directive 2004/108/EC	EN 55011 group 1, class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second Environment)
		Low Voltage Directive 2006/95/EC	EN 60034-1 EN 60034-5
		RoHS Directive 2011/65/EU	EN 50581

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

Contents

Basic Information

1

This chapter provides information required to select Servo Drives, such as information on Servomotors and SERVOPACKs.

1.1 The Σ-S Series

The Σ-S Series is designed to convert pneumatic equipment in industrial machines to motorized operation. Functions and performances have been reduced from those of a general-purpose AC Servo Drive to only those necessary to replace pneumatic equipment to take advantage of the control performance of an AC Servo Drive while achieving an amazingly low price. Energy usage is greatly reduced in comparison with pneumatic equipment or stepping motors to cut equipment running costs.

Main Features

◆ Increased Energy Efficiency

AC Servo Drive technology has been put to work to greatly reduce energy usage in comparison with pneumatic equipment or stepping motors.

◆ Superior Control Functions

By using the Σ-S Series in equipment, you can use the superior functions of an AC Servo Drive to increase productivity.

■ Pressing Operation and Hold-in-Place Operation

Even fragile workpieces can be held or workpieces can be held securely. The workpiece can be pressed or held in place at any force (torque), which reduces workpiece omissions and damage, and increases work quality.

■ Multi-point Positioning

You can position to different target positions. You can set the target positions required for the workpieces to eliminate the need for machine changeover operations to match workpiece size. This allows you to easily handle different types of workpieces.

■ Zone Outputs

Workpieces are detected in realtime when they reach a specified zone and a digital signal is output.

With pneumatic equipment, there is no way to tell when the workpiece has reached the target zone. Waiting time becomes necessary to allow for operating time differences that result from changes in load mass and friction to ensure that the workpiece reaches the target zone.

With the Σ-S Series, you can use a zone output to start the next operation without waiting, thereby reducing unnecessary waiting time and increasing production throughput.

■ Acceleration/Deceleration Control

Acceleration at startup and deceleration when stopping can be controlled to the required values. With traditional pneumatic equipment, rapid changes in speed when starting and stopping can have adverse effects on workpieces, which can fly out of control. By controlling acceleration and deceleration when starting and stopping, the shock when starting and stopping is reduced to prevent such problems.

◆ Simple Operation

You can use Yaskawa's SigmaWin+ Engineering Tool (free of charge) from trial operation to servo tuning and programming to easily complete setup.

◆ Compact and Lightweight

■ Servomotors

Models are available with 25 mm × 25 mm or 40 mm × 40 mm flanges to help you downsize equipment.

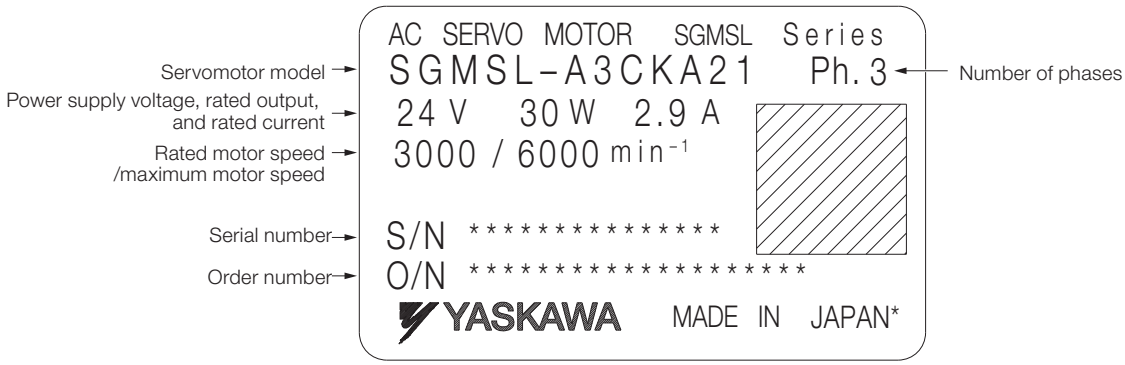
■ SERVOPACK

The PCB format (123 mm × 80 mm (H×W)) helps you downsize equipment and provides a high degree of installation freedom.

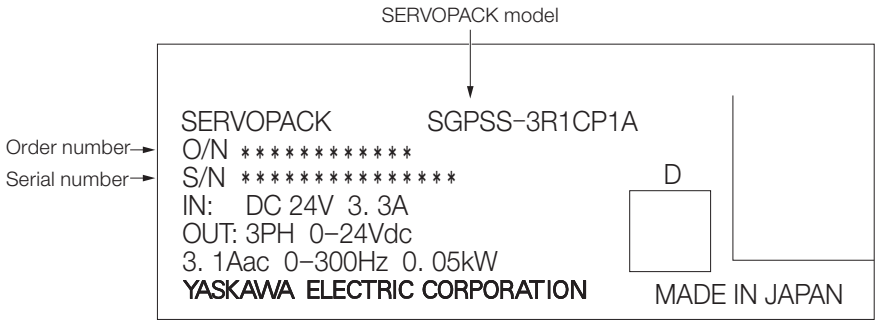
1.2 Interpreting the Nameplate

The following basic information is provided on the nameplate.

1.2.1 Servomotor Nameplate

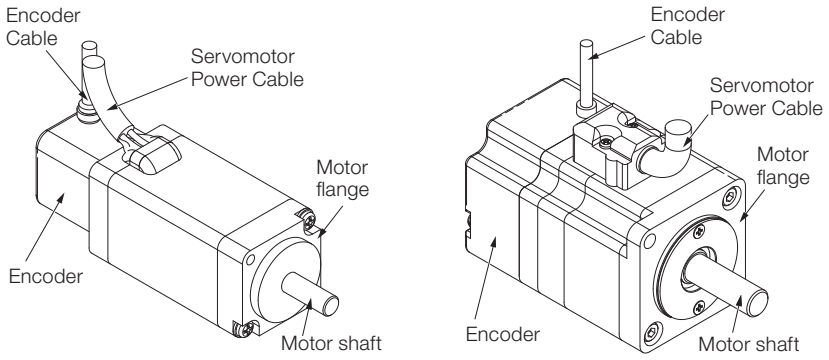


1.2.2 SERVOPACK Nameplate

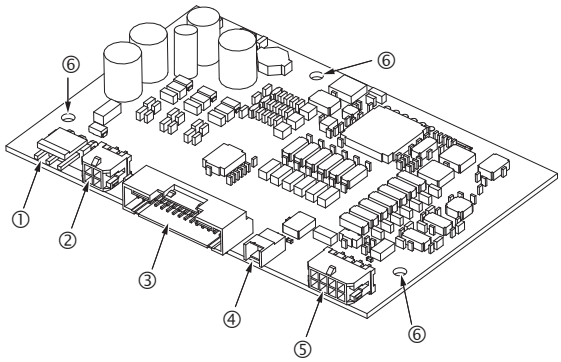


1.3 Part Names

1.3.1 Servomotor Part Names



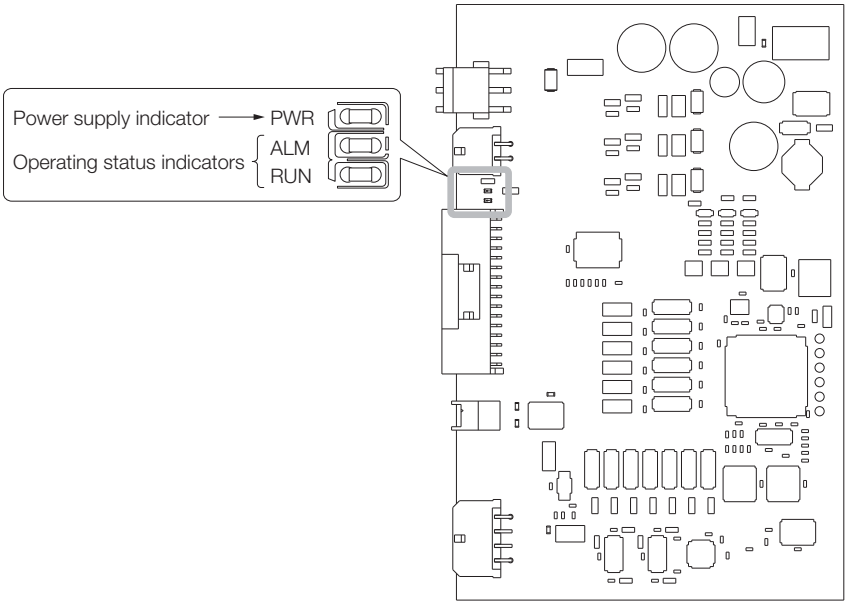
1.3.2 SERVOPACK Part Names



No.	Name	Description	Reference
①	Power Supply Input Connector (CN3)	This connector is for the power supply input.	page 4-8
②	Servomotor Power Connector (CN4)	This is the connector for the Servomotor Power Cable.	page 4-12
③	I/O Signal Connector (CN1)	This is the connector for the I/O signals.	page 4-14
④	Computer Connector (CN5)	This is the connector for the computer. Connect it to a computer to use the SigmaWin+ Engineering Tool.	page 4-19
⑤	Encoder Connector (CN2)	This is the connector for the encoder mounted on the Servomotor.	page 4-13
⑥	Mounting Holes	The mounting holes are mounted on studs to secure the SERVOPACK to the machine.	page 3-10

1.3.3 Status Indicators

The SERVOPACK provides a power supply indicator and operating status indicators.



You can use the status of the indicators to check the operating status of the SERVOPACK.

Indicator Name	Color	Description	Status	Operating Status
PWR	Orange	Power supply status	Not lit.	The power supply is OFF.
			Lit.	The power supply is ON.
ALM*	Red	Servo error status	Not lit.	Normal status
			Flashing	An alarm or warning occurred.
			Lit.	A system error (A.b□□) occurred or the initialization is in progress.
RUN	Green	Servo operating status	Not lit.	SERVO OFF
			Lit.	SERVO ON

* Refer to the following section for information on alarm and warning numbers and ALM indicator flashing patterns.
☞ *Chapter 10 Maintenance*

1.4 Model Designations

1.4.1 Interpreting Servomotor Model Numbers

SGMSL - A3 C K A 2 1

- SGMSL: Σ-S-Series Servomotors
- A3: 1st+2nd digits
- C: 3rd digit
- K: 4th digit
- A: 5th digit
- 2: 6th digit
- 1: 7th digit

1st+2nd digits Rated Output

Code	Specification
A3	30 W
A5	50 W

3rd digit Power Supply Voltage

Code	Specification
C	24 VDC

4th digit Encoder Specification

Code	Specification
K	10-bit magnetic incremental encoder

5th digit Design Revision Order

A

6th digit Shaft End

Code	Specification
2	Straight
A	Straight with flat seats

7th digit Options

Code	Specification
1	Without options

1.4.2 Interpreting SERVOPACK Model Numbers

SGPSS - 3R1 C P1 A

- SGPSS: Σ-S-Series SERVOPACKs
- 3R1: 1st+2nd+3rd digits
- C: 4th digit
- P1: 5th+6th digits
- A: 7th digit

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

Code	Specification
3R1	50 W

4th digit Voltage

Code	Specification
C	24 VDC

5th+6th digits Interface

Code	Specification
H1	Contact commands, rotary
P1	Pulse train references, rotary

7th digit Design Revision Order

A

1.4.3 Combinations of SERVOPACKs and Servomotors

Σ-S-Series Servomotor		Σ-S-Series SERVOPACK
Model	Capacity	Model
SGMSL-A3C□□□□	30 W	SGPSS-3R1C□□□
SGMSL-A5C□□□□	50 W	

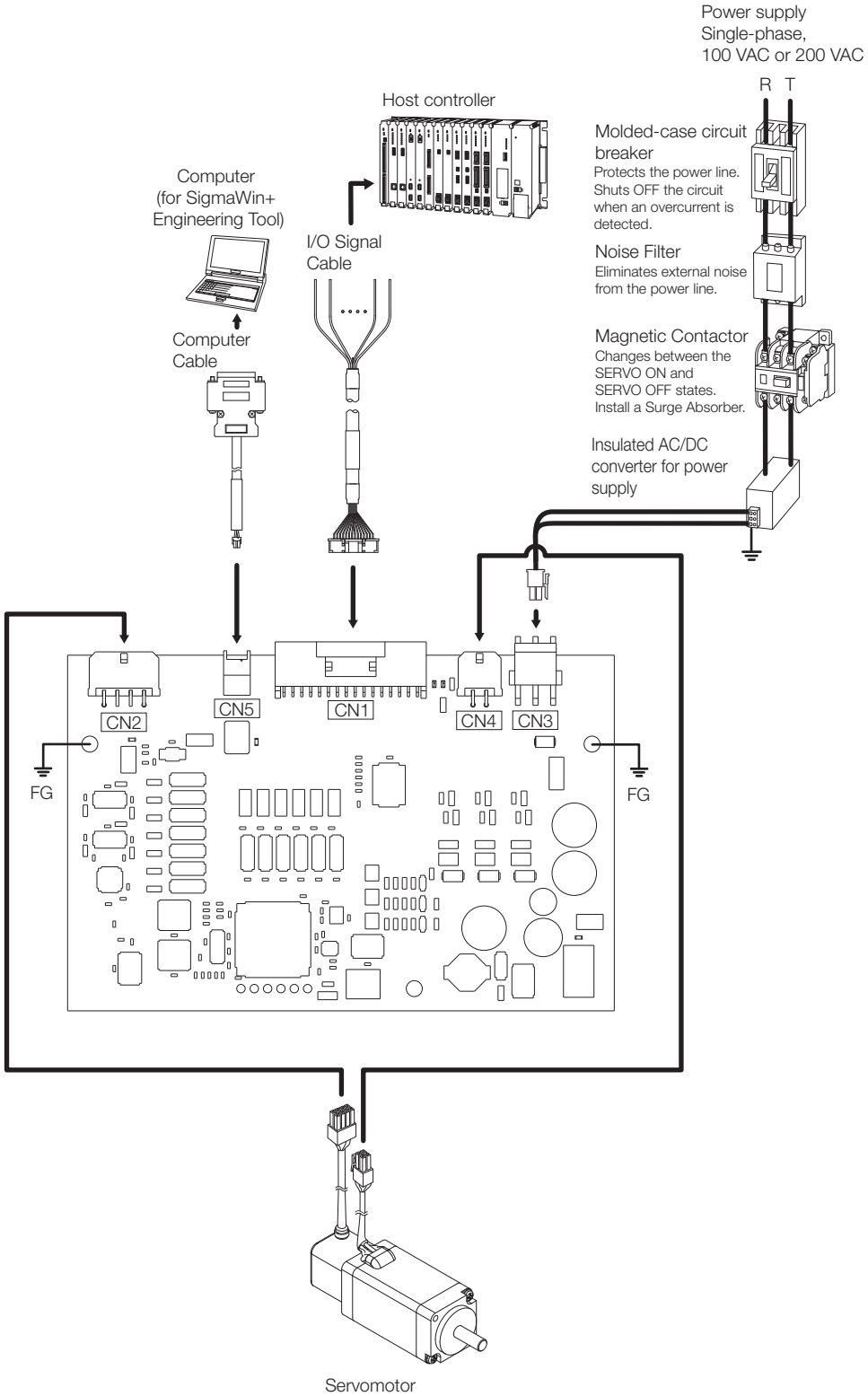
Selection

2

This chapter provides information required to select SERVOPACKs, Servomotors, cables, and peripheral devices, such as specifications, dimensional drawings, and connection examples.

2.1 System Configuration Example

This section provides a basic configuration example for a servo system.



Note: After you install the SigmaWin+ on a computer, you must then install the Σ-S Component. Contact your Yaskawa representative for information on the SigmaJunmaSize+ and Σ-S Component.

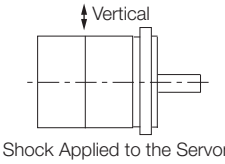
2.2 Ratings and Specifications

2.2.1 Servomotor Specifications

Voltage		24 VDC
Model SGMSL-		A3C or A5C
Time Rating		Continuous
Thermal Class		B
Insulation Resistance		500 VDC, 10 MΩ min.
Withstand Voltage		550 VAC for 1 minute
Excitation		Permanent magnet
Installation Method		Flange-mounted
Drive Method		Direct drive
Rotation Direction		Counterclockwise (CCW) for forward reference when viewed from the load side
Vibration Class*1		V30
Environmental Conditions	Surrounding Air Temperature	0°C to 40°C
	Surrounding Air Humidity	20% to 80% relative humidity (with no condensation)
	Installation Site	• Must be indoors and free of corrosive and explosive gases. • Must be well-ventilated and free of dust and moisture. • Must facilitate inspection and cleaning. • Must have an altitude of 1,000 m or less. • Must be free of strong magnetic fields.
	Storage Environment	Store the Servomotor in the following environment if you store it with the power cable disconnected. Storage temperature: -20°C to 60°C (with no freezing) Storage humidity: 20% to 80% relative humidity (with no condensation)
	Allowable External Magnetic Field	10 mT max. (near encoder cover)
Shock Resistance*2	Impact Acceleration Rate at Flange	245 m/s^2
	Number of Impacts	2 times
Vibration Resistance*3	Vibration Acceleration Rate at Flange	24.5 m/s^2

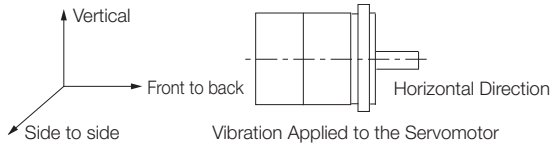
*1. A vibration class of V30 indicates a vibration amplitude of 30 μm maximum on the Servomotor without a load at the rated motor speed.

*2. The shock resistance for shock in the vertical direction when the Servomotor is mounted with the shaft in a horizontal position is given in the above table.



Shock Applied to the Servomotor

*3. The vertical, side-to-side, and front-to-back vibration resistance for vibration in three directions when the Servomotor is mounted with the shaft in a horizontal position is given in the above table.
The strength of the vibration that the Servomotor can withstand depends on the application. Always check the vibration acceleration rate that is applied to the Servomotor with the actual equipment.



Vibration Applied to the Servomotor

2.2.2 Servomotor Ratings

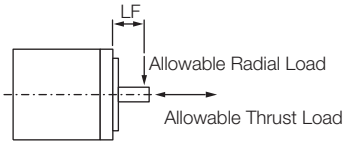
Voltage			24 VDC	
Model SGMSL-			A3C	A5C
Rated Output*1		W	30	50
Rated Torque*1, *2		N·m	0.0955	0.159
Instantaneous Maximum Torque*1		N·m	0.286	0.477
Rated Current*1		Arms	2.9	3.1
Instantaneous Maximum Current*1		Arms	8.6	9.2
Rated Motor Speed*1		min^{-1}	3000	
Maximum Motor Speed*1		min^{-1}	6000	3000
Torque Constant		N·m/Arms	0.0358	0.0579
Motor Moment of Inertia		$\times 10^{-4}$ kg·m^2	0.00629	0.0414
Rated Power Rate*1		kW/s	14.5	6.11
Rated Angular Acceleration Rate*1		rad/s^2	152000	38400
Heat Sink Size (Aluminum)		mm	250 × 250 × 6	200 × 200 × 6
Protective Structure*3			Totally enclosed, self-cooled, IP40	
Allowable Load Moment of Inertia (Motor Moment of Inertia Ratio)			30 times	
Allowable Shaft Loads*4	LF	mm	16	20
	Allowable Radial Load	N	44	78
	Allowable Thrust Load	N	14.5	54

*1. These values are for operation in combination with a SERVOPACK when the temperature of the armature winding is 100°C. The values for other items are at 20°C. These are typical values.

*2. The rated torques are the continuous allowable torque values at 40°C with an aluminum heat sink of the dimensions given in the table.

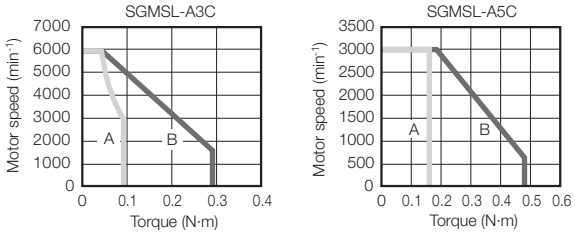
*3. This does not apply to the connectors or shaft opening. Protective structure specifications apply only when the special cable is used.

*4. The allowable shaft loads are illustrated in the following figure. Design the mechanical system so that the thrust and radial loads applied to the Servomotor shaft end during operation do not exceed the values given in the table.



2.2.3 Torque-Motor Speed Characteristics

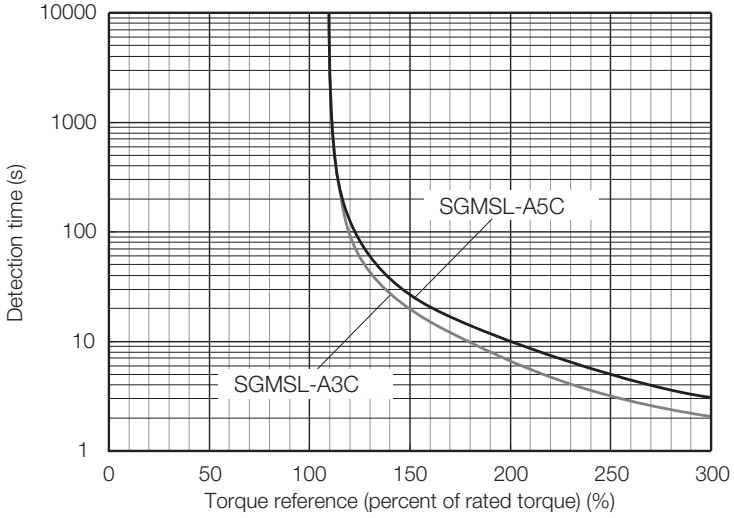
A : Continuous duty zone
B : Intermittent duty zone



Note: 1. These values are for operation in combination with a SERVOPACK when the temperature of the armature winding is 100°C. These are typical values.
2. The characteristics in the intermittent duty zone depend on the power supply voltage.
3. If the effective torque is within the allowable range for the rated torque, the Servomotor can be used within the intermittent duty zone.
4. The Servomotor Power Supply Cable may cause a voltage drop, which may reduce the intermittent duty zone of the torque-motor speed characteristics.

2.2.4 Servomotor Overload Protection Characteristics

The overload detection level is set for hot start conditions with a Servomotor ambient temperature of 40°C.



Note: The above overload protection characteristics do not mean that you can perform continuous duty operation with an output of 100% or higher.
Use the Servomotor so that the effective torque remains within the continuous duty zone given in *2.2.3 Torque-Motor Speed Characteristics* on page 2-5

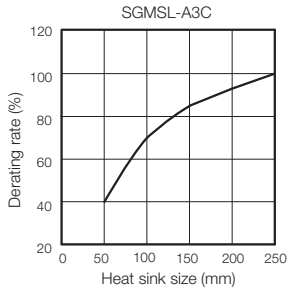
2.2.5 Servomotor Heat Dissipation Conditions

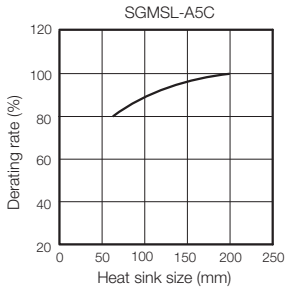
The Servomotor ratings are the continuous allowable values at an ambient temperature of 40°C when a heat sink is installed on the Servomotor. If the Servomotor is mounted on a small device component, the Servomotor temperature may rise considerably because the surface for heat dissipation becomes smaller. Refer to the following graphs for the relation between the heat sink size and derating rate.

Note: The derating rates are applicable only when the average motor speed is less than or equal to the rated motor speed. If the average motor speed exceeds the rated motor speed, consult with your Yaskawa representative.

Important

The actual temperature rise depends on how the heat sink (i.e., the Servomotor mounting section) is attached to the installation surface, what material is used for the Servomotor mounting section, and the motor speed. Always check the Servomotor temperature with the actual equipment.





2.2.6 SERVOPACK Ratings

This section gives the ratings and specifications of SERVOPACKs.

Item		Rating
Maximum Applicable Motor Capacity		50 W
Continuous Output Current		3.1 Arms
Instantaneous Maximum Output Current		9.2 Arms
Power Supply	Input Voltage	24 VDC ±15%
	Input Current *2	3.3 A
Power Supply Capacity*1		215 W
Power Loss*2		10.9 W
Overvoltage Category		I

*1. This is the value for the maximum instantaneous load.
*2. This is the net value at the rated load.

2.2.7 SERVOPACK Specifications

Item		Specification
Drive Method		PWM control, sine wave current drive
Feedback		Magnetic encoder: 10-bit (incremental encoder)
Operating Conditions	Surrounding Air Temperature	0°C to 40°C
	Storage Temperature	-20°C to 85°C
	Surrounding Air Humidity	90% relative humidity max. (with no freezing or condensation)
	Storage Humidity	90% relative humidity max. (with no freezing or condensation)
	Vibration Resistance	4.9 m/s^2
	Shock Resistance	19.6 m/s^2
	Protection Class	None
	Pollution Degree	2
	Altitude	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
Performance	Frequency Characteristics	250 Hz ($J_L=J_M$)
	Torque Control Precision*	±2%

Continued on next page.

Continued from previous page.

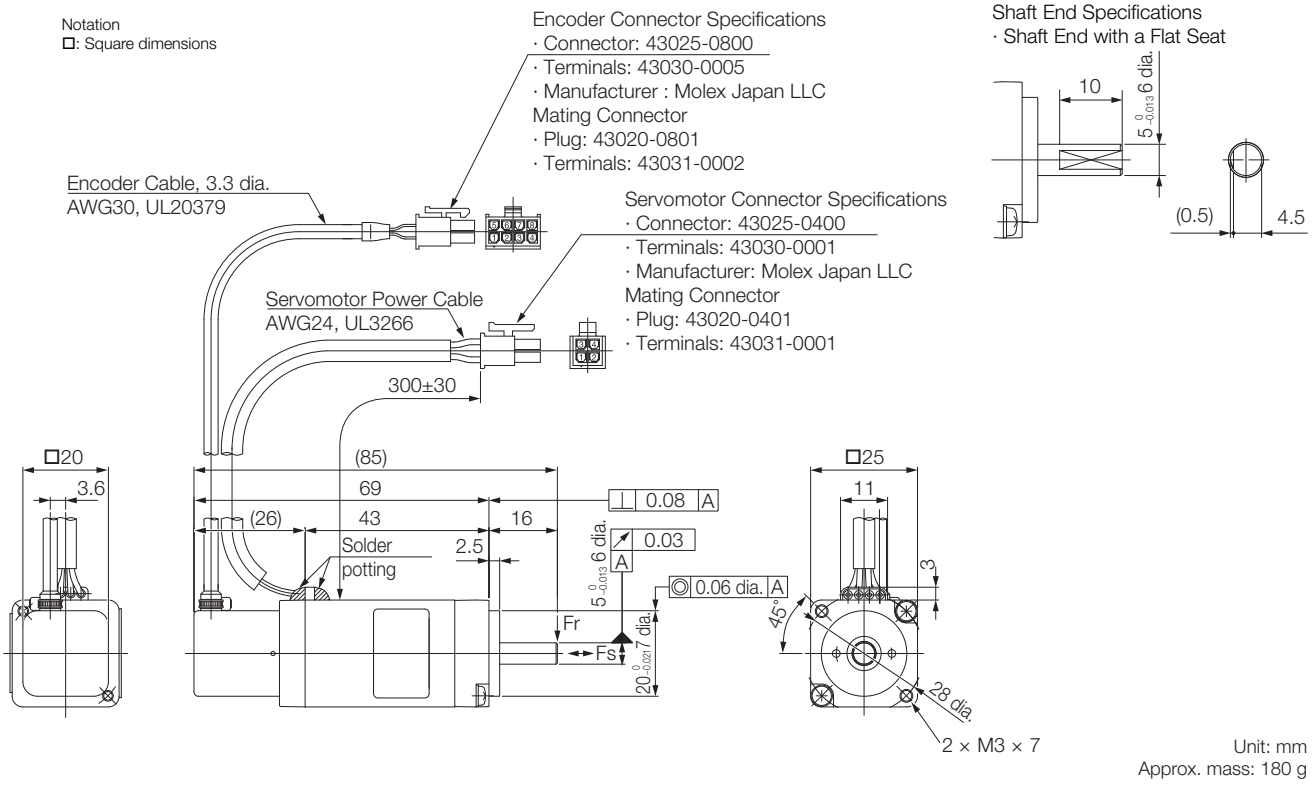
Item			Specification
I/O Signals	Sequence Input Signals	Signals That Can Be Allocated	Allowable voltage range: 24 VDC ±10% Number of input points: 8
			Input method: Sink inputs or source inputs Input Signals • /MODE (Mode Switch) signal • /STOP (Operation Stop) signal • /HOME (Homing) signal • /S-ON (SERVO ON) signal • /DEC (Homing Deceleration Switch) signal • /ALM-RST (Alarm Reset) signal • /P-CL (Forward External Torque Limit) signal • /N-CL (Reverse External Torque Limit) signal • /CLR (Position Deviation Clear) signal • E-STP (Emergency Stop) signal
	Sequence Output Signals	Fixed Output	Allowable voltage range: 24 VDC ±10% Number of output points: 1 Output signal: Servo Alarm (ALM)
		Signals That Can Be Allocated	Allowable voltage range: 24 VDC ±10% Number of output points: 10
			Output method: Photocoupler (isolated) sink outputs are used. Output Signals • /INPOSITION (Positioning Completion) signal • /WARN (Warning) signal • /BK (Brake Control) signal • /S-RDY (Servo Ready) signal • /CLT (Torque Limit Detection) signal • /TGON (Rotation Detection) signal • /NEAR (Near) signal • /POSRDY (Homing Completed) signal • /BUSY (Busy) signal • /S-ONS (SERVO ON Status) signal • E-STPS (Emergency Stop Status) signal • /PCO (Encoder Origin) signal • /ZONE0 to /ZONE3 (ZONE) signals
Communications	RS-232C Communications (CN5)		Computer (for SigmaWin+ Engineering Tool)
Indicators			3 LED indicators (PWR, ALM, and RUN)
Dynamic Brake (DB)			None (coasting to a stop)
Regenerative Processing			None
Overtravel (OT) Prevention			None
Protective Functions			Overcurrent, overvoltage, overload, position deviation overflow, overspeed, encoder error, CPU error, and parameter error
Utility Functions			Servo tuning, alarm traceback, jog operation, origin search, etc.
Control Functions	Position Control	Feedforward Compensation	0% to 100%
		Positioning Completed Width Setting	0 to 99,999 reference units
		Encoder Divided Pulse Output	None
	Reference Pulses	Input Pulse Types	Sign + pulse train, CW + CCW pulse trains, or two-phase pulse trains with 90° phase differential
		Input Pulse Forms	Line driver or open collector
		Maximum Input Pulse Frequency	120 kpps
	Homing		5 methods

* This is the repeatability of the output current from the SERVOPACK.

2.3 External Dimensions

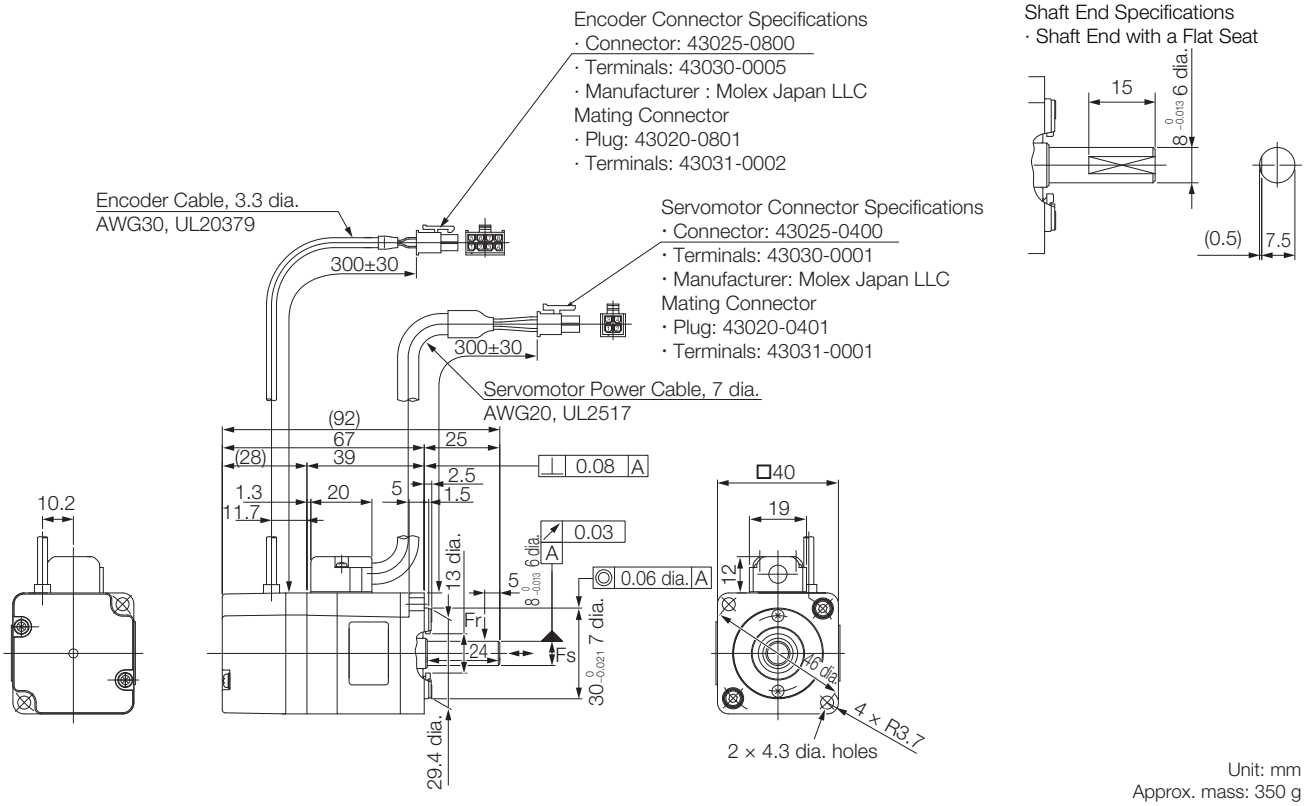
2.3.1 Servomotor External Dimensions

SGMSL-A3CKA□1



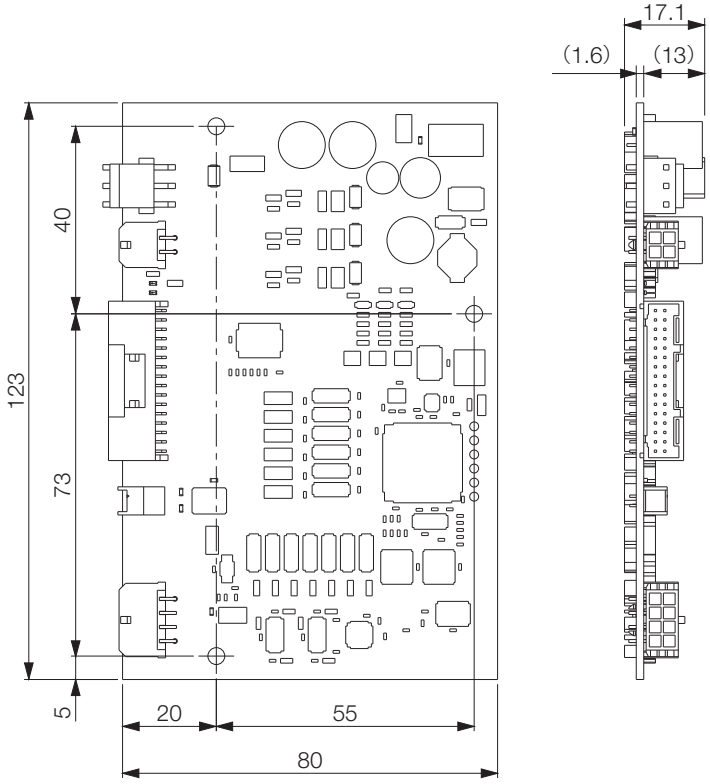
Unit: mm
Approx. mass: 180 g

SGMSL-A5CKA□1



Unit: mm
Approx. mass: 350 g

2.3.2 SERVOPACK External Dimensions



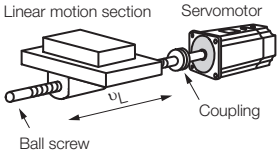
Unit: mm
Approx. mass: 50 g

2.4 Selecting the Servomotor Capacity

When you select a Servomotor capacity, refer to the following selection example procedure.

2.4.1 Example of Capacity Selection for Servomotors

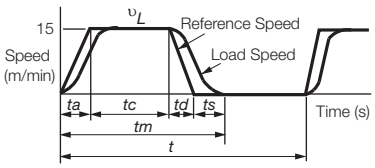
1. Machine Specifications



Item	Symbol	Value
Load Speed	v_L	15 m/min
Linear Motion Section Mass	m	20 kg
Ball Screw Length	ℓ_B	0.3 m
Ball Screw Diameter	d_B	0.008 m
Ball Screw Lead	P_B	0.005 m
Ball Screw Material Density	ρ	7.87×10^3 kg/m^3
External Force on Linear Motion Section	F	0 N
Coupling Mass	m_C	0.3 kg

Item	Symbol	Value
Coupling Outer Diameter	d_C	0.03 m
Number of Feeding Operations	n	40 rotations/min
Feeding Distance	ℓ	0.25 m
Feeding Time	tm	1.2 s max.
Electrical Stopping Precision	δ	±0.02 mm
Friction Coefficient	μ	0.2
Mechanical Efficiency	η	0.9 (90%)

2. Speed Diagram



$$t = \frac{60}{n} = \frac{60}{40} = 1.5 \text{ (s)}$$

if $ta = td$, $ts = 0.1$ (s),

$$ta = tm - ts - \frac{60\ell}{v_L} = 1.2 - 0.1 - \frac{60 \times 0.25}{15} = 0.1 \text{ (s)}$$

$$tc = 1.2 - 0.1 - 0.1 \times 2 = 0.9 \text{ (s)}$$

3. Motor speed

- Load Shaft Speed

$$n_L = \frac{v_L}{P_B} = \frac{15}{0.005} = 3000 \text{ (min}^{-1}\text{)}$$

- Motor shaft speed

Direct coupling gear ratio 1/R 1/R = 1/1
Therefore, $n_M = n_L \cdot R = 3{,}000 \times 1 = 3{,}000$ (min^{-1})

4. Load Torque

$$T_L = \frac{(9.8\mu \cdot m + F) \cdot P_B}{2\pi R \cdot \eta} = \frac{(9.8 \times 0.2 \times 20 + 0) \times 0.005}{2\pi \times 1 \times 0.9} = 0.035 \text{ (N·m)}$$

5. Load Moment of Inertia

- Linear motion section

$$J_{L1} = m\left(\frac{P_B}{2\pi R}\right)^2 = 20 \times \left(\frac{0.005}{2\pi \times 1}\right)^2 = 0.127 \times 10^{-4} \text{ (kg·m}^2\text{)}$$

- Ball screw

$$J_B = \frac{\pi}{32}\rho \cdot \ell_B \cdot d_B{}^4 = \frac{\pi}{32} \times 7.87 \times 10^3 \times 0.3 \times (0.008)^4 = 0.009 \times 10^{-4} \text{ (kg·m}^2\text{)}$$

- Coupling

$$Jc = \frac{1}{8} m_C \cdot d_C{}^2 = \frac{1}{8} \times 0.3 \times (0.03)^2 = 0.338 \times 10^{-4} \text{ (kg·m}^2\text{)}$$

- Load moment of inertia at motor shaft

$$J_L = J_{L1} + J_B + Jc = 0.474 \times 10^{-4} \text{ (kg·m}^2\text{)}$$

6. Load Moving Power

$$P_O = \frac{2\pi n_M \cdot T_L}{60} = \frac{2\pi \times 3{,}000 \times 0.035}{60} = 11.0 \text{ (W)}$$

7. Load Acceleration Power

$$Pa = \left(\frac{2\pi}{60} n_M\right)^2 \frac{J_L}{ta} = \left(\frac{2\pi}{60} \times 3{,}000\right)^2 \times \frac{0.474 \times 10^{-4}}{0.1} = 46.78 \text{ (W)}$$

8. Servomotor Provisional Selection

① Selection Conditions

- $T_L \leq$ Motor Rated Torque
- $\frac{(Po + Pa)}{2}$ < Provisionally selected Servomotor rated output < $(Po + Pa)$
- $n_M \leq$ Rated motor speed
- $J_L \leq$ Allowable load moment of inertia

The following Servomotor meets the selection conditions.

- SGMSL-A3C Servomotor

② Specifications of the Provisionally Selected Servomotor

Item	Value
Rated Output	30 (W)
Rated Motor Speed	3,000 (min^{-1})
Rated Torque	0.0955 (N·m)
Instantaneous Maximum Torque	0.286 (N·m)
Motor Moment of Inertia	0.00629×10^{-4} ($kg \cdot m^2$)
Allowable Load Moment of Inertia	$0.00629 \times 10^{-4} \times 30 = 0.189 \times 10^{-4}$ ($kg \cdot m^2$)
Encoder Resolution	1,024 (P/rev)

9. Verification of the Provisionally Selected Servomotor

- Verification of required acceleration torque:

$$T_P = \frac{2\pi n_M (J_M + J_L)}{60ta} + T_L = \frac{2\pi \times 3{,}000 \times (0.00629 + 0.474) \times 10^{-4}}{60 \times 0.1} + 0.035$$
$$\fallingdotseq 0.186 \text{ (N·m)} < \text{Maximum instantaneous torque...Satisfactory}$$

- Verification of required deceleration torque:

$$T_S = \frac{2\pi n_M (J_M + J_L)}{60td} - T_L = \frac{2\pi \times 3{,}000 \times (0.00629 + 0.474) \times 10^{-4}}{60 \times 0.1} 0.035$$
$$\fallingdotseq 0.116 \text{ (N·m)} < \text{Maximum instantaneous torque...Satisfactory}$$

- Verification of effective torque value:

$$Trms = \sqrt{\frac{T_P^2 \cdot ta + T_L^2 \cdot tc + Ts^2 \cdot td}{t}} = \sqrt{\frac{(0.186)^2 \times 0.1 + (0.035)^2 \times 0.9 + (0.115)^2 \times 0.1}{1.5}}$$
$$\fallingdotseq 0.063 \text{ (N·m)} < \text{Rated torque...Satisfactory}$$

It has been verified that the provisionally selected Servomotor is applicable in terms of capacity. Position control is considered next.

10. Positioning Resolution

The electrical stopping precision δ is ±0.02 mm, so the position detection unit $\Delta\ell$ is 0.02 mm/pulse. The number of pulses per motor rotation must be less than the encoder resolution (pulses/rev). The ball screw lead *PB* is 0.005 m, so the number of pulses per motor rotation is calculated with the following formula.

$$\text{Number of pulses per rotation (pulses)} = \frac{P_B}{\Delta\ell} = \frac{5 \text{ mm/rev}}{0.02 \text{ mm}} = 250 \text{ (pulses/rev)} < \text{Encoder resolution (1,024 (pulses/rev))}$$

The number of pulses per motor rotation is less than the encoder resolution (pulses/rev), so the provisionally selected Servomotor can be used.

11. Reference Pulse Frequency

The load speed υL is 15 m/min, or 1,000 × 15/60 mm/s and the positioning resolution (travel distance per pulse) is 0.02 mm/pulse, so the reference pulse frequency is calculated with the following formula.

$$vs = \frac{1{,}000\upsilon L}{60 \times \Delta_{\ell}} = \frac{1{,}000 \times 15}{60 \times 0.02} = 12{,}500 \text{ (pps)}$$

The reference pulse frequency is less than the maximum input pulse frequency,* so the provisionally selected Servomotor can be used.

*Refer to the following section for information on the maximum input pulse frequency.

☞ *2.2.2 Servomotor Ratings* on page 2-5

It has been verified that the provisionally selected Servomotor is applicable for position control.

2.5 Selecting Cables

2.5.1 Cable Selection Table

The following table gives the model numbers of the Cables that are required to use a SERVOPACK.

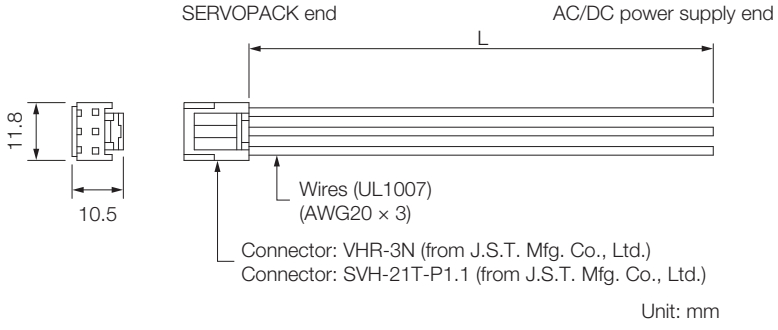
Name	Length (L)	Order Number	Reference
Power Supply Input Cables	1.5 m	JZSP-CSSG03-01P5-E	page 2-14
	3 m	JZSP-CSSG03-03-E	
Servomotor Power Cables (relay cables)	1.5 m	JZSP-CSSM00-01P5-E	page 2-16
	3 m	JZSP-CSSM00-03-E	
	5 m	JZSP-CSSM00-05-E	
	10 m	JZSP-CSSM00-10-E	
Encoder Cables (relay cables)	1.5 m	JZSP-CSSP00-01P5-E	page 2-17
	3 m	JZSP-CSSP00-03-E	
	5 m	JZSP-CSSP00-05-E	
	10 m	JZSP-CSSP00-10-E	
I/O Signal Cables	1.5 m	JZSP-CSSI103-01P5-E	page 2-18
	3 m	JZSP-CSSI103-03-E	
Computer Cable	2 m	JZSP-CPS00-02-E	page 2-19

2.5.2 Power Supply Input Cables

Selection Table

Order Number	Length (L)
JZSP-CSSG03-01P5-E	1.5 m
JZSP-CSSG03-03-E	3 m

Dimensional Drawings



Unit: mm

Wiring Specifications

Pin	Signal	Name	Voltage Specification
1	P	Power supply input terminals	24 VDC ±15%
2	N		0 VDC
3	FG	Frame ground terminal	- (This is the ground terminal.)

2.5.3 User-Assembled Wiring Materials for Power Supply Input Cable

Connectors and Wiring Materials

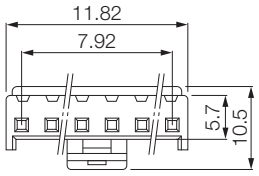
◆ Selection Table

Name	Order Number	Manufacturer	Applicable Wire Sizes
Housing	VHR-3N	J.S.T. Mfg. Co., Ltd.	AWG20 (0.52 mm^2) min.
Contacts	SVH-21T-P1.1		

Note: Refer to the following section for wire specifications.
☞ *2.6.3 SERVOPACK Power Supply and Servomotor Power Cable Wires* on page 2-20

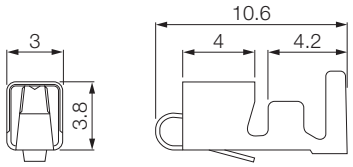
◆ Dimensional Drawings

■ Housing



Unit: mm

■ Contacts



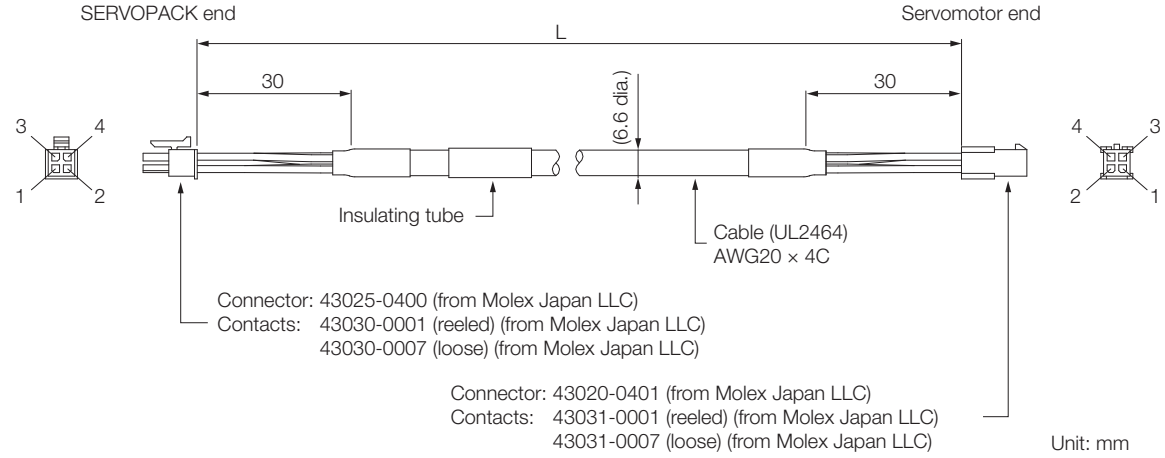
Unit: mm

2.5.4 Servomotor Power Cables

Selection Table

Order Number	Length (L)
JZSP-CSSM00-01P5-E	1.5 m
JZSP-CSSM00-03-E	3 m
JZSP-CSSM00-05-E	5 m
JZSP-CSSM00-10-E	10 m

External Dimensions



Wiring Specifications

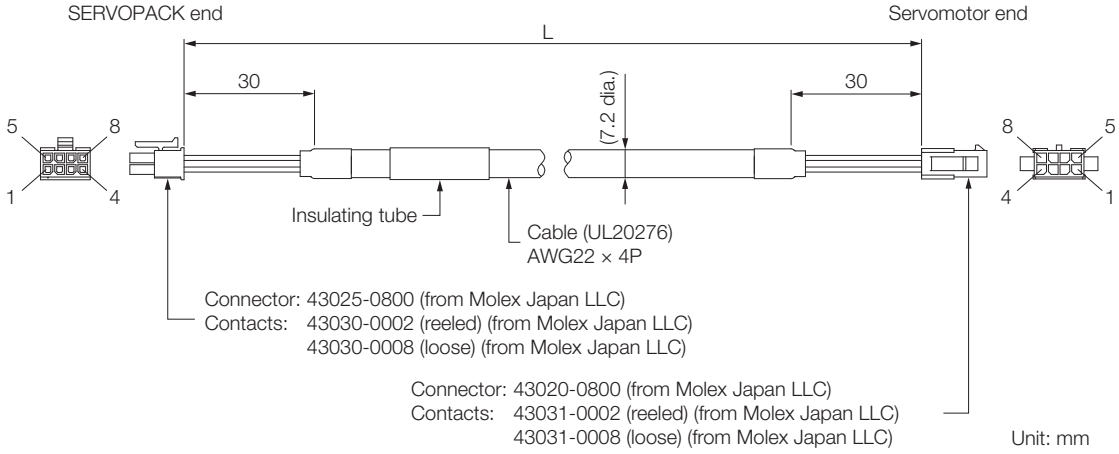
SERVOPACK end			Servomotor connector	
Pin	Wire Color	Signal	Pin	Signal
1	Red	Phase U	1	Phase U
2	White	Phase V	2	Phase V
3	Black	Phase W	3	Phase W
4	Yellow/green	FG	4	FG

2.5.5 Encoder Cable

Selection Table

Order Number	Length (L)
JZSP-CSSP00-01P5-E	1.5 m
JZSP-CSSP00-03-E	3 m
JZSP-CSSP00-05-E	5 m
JZSP-CSSP00-10-E	10 m

External Dimensions



Wiring Specifications

SERVOPACK end			Encoder (motor) end	
Pin*1	Signal		Pin*1	Wire Color
1	Encoder phase A		1	Black
5	/Encoder phase A		5	White
2	Encoder phase B		2	Red
6	/Encoder phase B		6	White
3	Encoder power supply 5 VDC		3	Green
7	GND		7	White
4	–		4	Yellow
8	FG	Shield*2	8	–

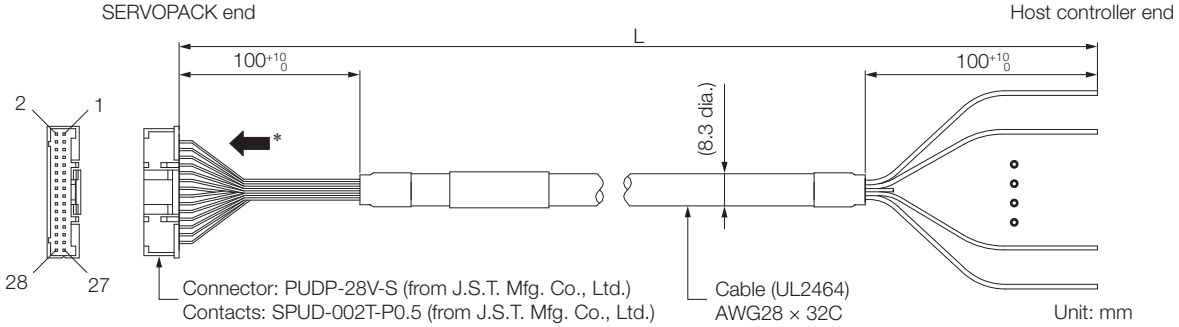
*1. Pin 4 is not used.
*2. If you make the encoder cable yourself, protect the shield wire with heat-shrinkable tube.

2.5.6 I/O Signal Cables

Selection Table

Order Number	Length (L)
JZSP-CSSI103-01P5-E	1.5 m
JZSP-CSSI103-03-E	3 m

Dimensional Drawing



* The connector pin layout shown in the above figure is when the connector is viewed from the direction of the arrow.

Wiring Specifications

Pin	Signal	Default Signals	Wire Color	Markings	
				Color	Number
1	–	–	Orange	Red	■
2	FG	–	Orange	Black	■
3	PULS	–	Gray	Red	■
4	/PULS	–	Gray	Black	■
5	SIGN	–	White	Red	■
6	/SIGN	–	White	Black	■
7	+24VIN	–	Yellow	Red	■
8	–	–	Yellow	Black	■
9	SI1	/STOP, /HOME	Pink	Red	■
10	SI2	/S-ON	Pink	Black	■
11	SI3	/DEC	Orange	Red	■■
12	SI4	/ALM-RST	Orange	Black	■■
13	SI5	/P-CL, /N-CL	Gray	Red	■■
14	SI6	/CLR	Gray	Black	■■
15	SI7	E-STP	White	Red	■■
16	SI8	–	White	Black	■■
17	COM_SG	–	Yellow	Red	■■
18	SO1	/INPOSITION	Yellow	Black	■■
19	ALM	–	Pink	Red	■■
20	SO2	/CLT	Pink	Black	■■
21	SO3	/PCO	Orange	Red	■■■
22	SO4	/BUSY	Orange	Black	■■■
23	SO5	/POSRDY	Gray	Red	■■■
24	SO6	/S-ONS	Gray	Black	■■■
25	SO7	E-STPS	White	Red	■■■
26	SO8	/ZONE0	White	Black	■■■
27	SO9	/ZONE1	Yellow	Red	■■■
28	SO10	–	Yellow	Black	■■■

2.5.7 Computer Cable

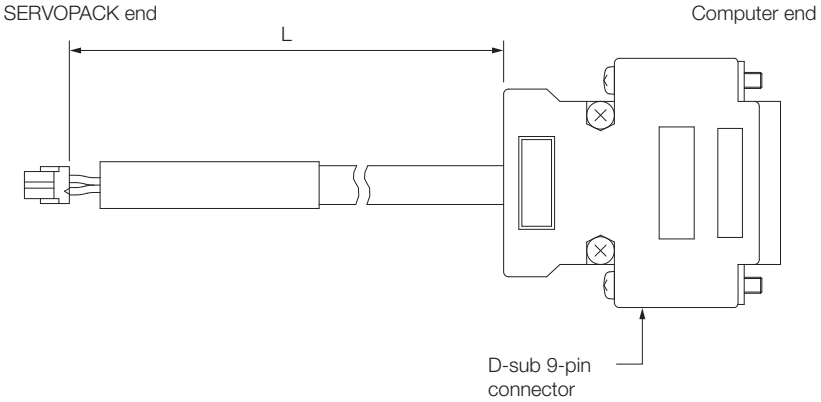
Important

Use the Yaskawa-specified cable for the Computer Cable. Operation may not be dependable with any other cable.

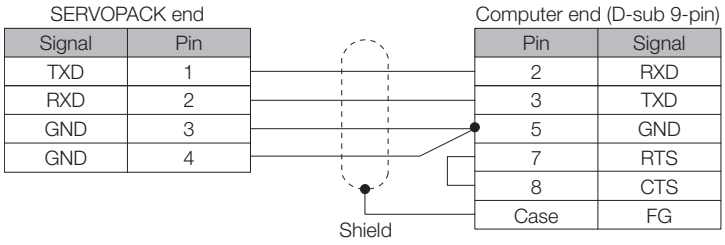
Selection Table

Order Number	Length (L)
JZSP-CPS00-02-E	2 m

Dimensional Drawing



Wiring Specifications



Signal	Pin
TXD	1
RXD	2
GND	3
GND	4

Pin	Signal
2	RXD
3	TXD
5	GND
7	RTS
8	CTS
Case	FG

2.6 Selecting Peripheral Devices

2.6.1 Recommended Power Supply

The same input power supply is used for both the main circuit power and control power. Use an input power supply that meets the following conditions.

- A 24-VDC power supply must be used.
- The power supply must have double or reinforced insulation and must also be certified for safety standards.
- The power supply must not output more than 50 A.
- Protective measures must be implemented for external branch circuits according to the NEC (National Electrical Code) or other local laws or ordinances.

Selection Table

The recommended Power Supply is given in the following table.

Input Power Supply	Order Number	Manufacturer
24 VDC	HWS300-24	TDK-Lambda Corporation

2.6.2 Molded-case Circuit Breakers and Fuse Capacity

Use a molded-case circuit breaker and fuse to protect the power supply line. They protect the power line by shutting OFF the circuit when overcurrent is detected. Select molded-case circuit breakers and fuses that have the following breaking characteristics.

Breaking Characteristics (25°C):

- Power must not be shut OFF even if the instantaneous maximum current flows to the SERVOPACK for 5 s or longer.
- Does not cut off at the inrush current value of the power supply.

Note: Connect the molded-case circuit breakers and fuses before the isolated 24-VDC power supply.

Input Power Supply	Maximum Applicable Motor Capacity [kW]	SERVOPACK Model	Power Supply Capacity per SERVOPACK [W]*1	Input Current Capacity		Inrush Current [A0-p]*2	Rated Voltage	
				Continuous Rating [A]	Instantaneous Maximum [A]		Fuse [V]	Molded-case Circuit Breaker [V]
24 VDC	0.05	SGPSS-3R1C	215	3.3	11.5	6	250	240

*1. This is the value for the maximum instantaneous load.
*2. This is the value when the recommended power supply is used.

2.6.3 SERVOPACK Power Supply and Servomotor Power Cable Wires

This section provides specifications and precautions for making your own cables for use between the SERVOPACK and the power supply and between the SERVOPACK and the Servomotor.


Important

1. If you do not use the recommended Power Supply Input Cables and Servomotor Power Cables, use the wire sizes in the following table.
2. Use copper wires with a rated temperature of 80° or higher.
3. Use copper wires with a rated withstand voltage of 100 V or higher.
4. Use a power supply input cable with a maximum length of 3 m and a Servomotor power cable with a maximum length of 10 m.

Terminal Symbols		Wire Sizes
Wires for Input Power Supply	P, N, FG	AWG20 (0.52 mm^2) min.
Servomotor Power Cable	U, V, W	AWG20 (0.52 mm^2) min.

2.6.4 Magnetic Contactors

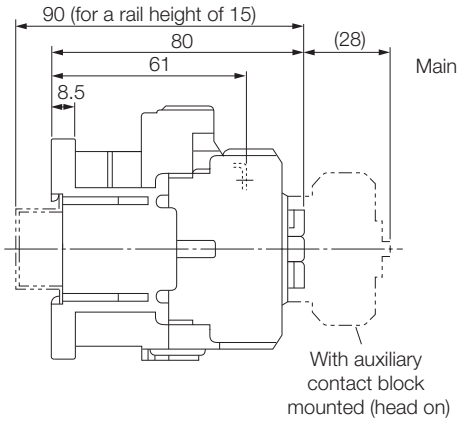
Use a Magnetic Contactor when you configure an external power supply sequence.

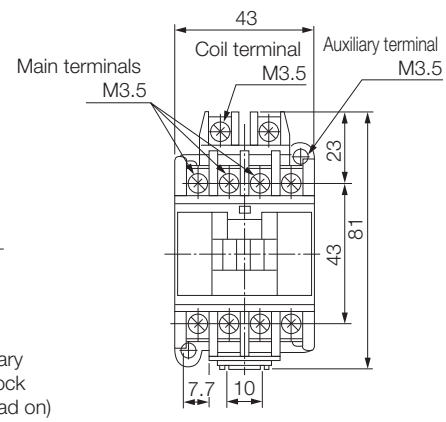
Note: Always attach a Surge Absorber (e.g., a Surge Absorber unit) to the excitation coil of the Magnetic Contactor.

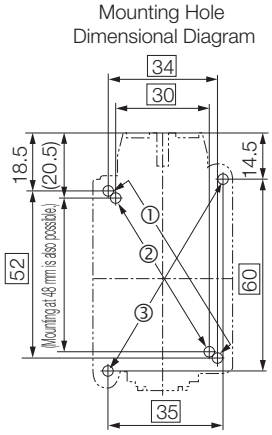
Selection Table

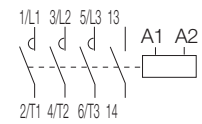
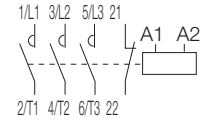
Order Number	Inquiries
SC-03	Fuji Electric FA Components & Systems Co., Ltd.

External Dimensions







Auxiliary Contacts	Contact Structure
1a	
1b	

- You can use any of the following three mounting methods.
  ①…34 × 48 to 52
  ②…30 × 48
  ③…35 × 60
- Mounting screws: 2 × M4

Use two mounting holes in diagonally opposing corners to mount the Magnetic Contactor.

Unit: mm
Approx. mass: 320 g

2.6.5 Noise Filters

Noise Filters are used to reduce external noise that can enter on the power supply line or conductive noise from the SERVOPACK.

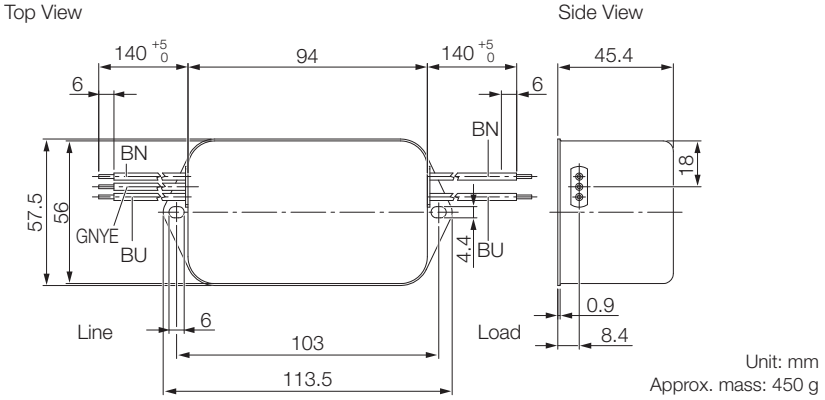
Important

Some Noise Filters have large leakage currents. The grounding conditions also affect the amount of leakage current. If necessary, select an appropriate leakage detector or leakage breaker taking into account the grounding conditions and the leakage current from the Noise Filter.
Consult Yaskawa Controls Co., Ltd. for details.

Selection Table

AC Power Supply Voltage	Order Number	Specification	Leakage Current	Manufacturer
100 VAC/200 VAC	FN2070-6-07	Single-phase 250 V, 6A	0.734 mA, 230 VAC at 50 Hz	Schaffner EMC, Inc.

External Dimensions



Unit: mm
Approx. mass: 450 g

Line Color	Terminals	
	Line	Load
Brown (BN)	P	P’
Blue (BU)	N	N’
Green/yellow (GNYE)	E	-

2.7 SigmaWin+: AC Servo Drive Engineering Tool

The SigmaWin+ Engineering Tool is used to set up and optimally tune Yaskawa Σ-series Servo Drives.

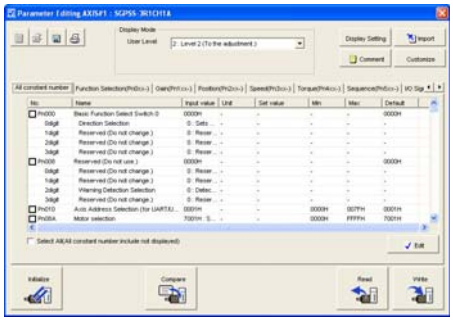
You must install the main SigmaWin+ application and the Σ-S Component.

Contact your Yaskawa representative for information on the SigmaJunmaSize+ and Σ-S Component.

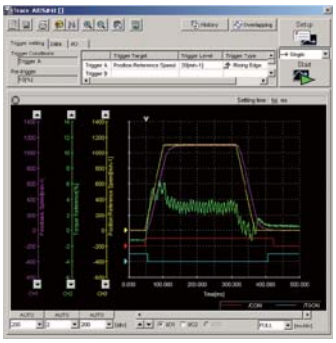
Features

- Easy-to-understand GUI to set parameters
- Displays SERVOPACK data on a computer just like on a oscilloscope.
- Estimates moments of inertia and measure vibration frequencies.
- Displays alarms and provides alarm diagnostics.

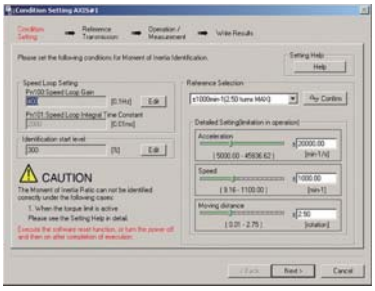
Easy-to-understand GUI to Set Parameters



Displaying SERVOPACK Data on a Computer Just Like on an Oscilloscope



Estimating Moments of Inertia and Measuring Vibration Frequencies



Displaying Alarms and Alarm Diagnostics

System Requirements

Item	System Requirement
Supported Languages	English and Japanese
OS	Windows XP, Windows Vista, or Windows 7 (32-bit or 64-bit edition)
CPU	Pentium 200 MHz min.
Memory	64 MB min. (96 MB or greater recommended)
Available Hard Disk Space	For standard setup: 350 MB min. (400 MB or greater recommended for installation)

Installation

3

This chapter provides information on installing SERVOPACKs and Servomotors in the required locations.

3.1 Servomotor Installation

The service life of a Servomotor will be shortened or unexpected problems will occur if the Servomotor is installed incorrectly or in an inappropriate environment or location. Always observe the following installation instructions.

3.1.1 Installation Precautions

- Do not hold onto the cables or motor shaft when you move the Servomotor. Doing so may result in injury or damage.
- Do not install the Servomotor in the following locations. Doing so may result in fire, electric shock, or damage.
  Outdoors or in locations subject to direct sunlight
  Locations subject to condensation as the result of extreme changes in temperature
  Locations subject to corrosive or flammable gases or near flammable objects
  Locations subject to dust, salts, or iron dust
  Locations subject to oil drops or chemicals
  Locations subject to shock or vibration
  Locations that would make it difficult to inspect or clean the Servomotor
- Mount the Servomotor to the machine so that the cables and connectors are not subjected to stress.
- Implement suitable countermeasures, such as attaching a cover, if the Servomotor is used in an application where it is subject to excessive water or oil drops. We recommend that you keep the connectors facing downward.
- Mount the Servomotor securely to the machine. If the Servomotor is not mounted securely, the machine may be damaged or injury may occur.
- Do not allow any foreign matter to enter the Servomotor.
- To prevent electric shock, ground the Servomotor securely.
- Servomotors are precision devices. Never drop the Servomotor or subject it to strong shock.
- Implement safety measures, such as installing a cover, so that the motor shaft and other rotating parts of the Servomotor cannot be touched during operation.
- Continuous operation in one direction, such as for a fan, may damage the bearings due to electrolytic corrosion. Contact your Yaskawa representative if you use a Servomotor for this type of application.
- A Servomotor that has been stored for a long period of time must be inspected before it is used. Contact your Yaskawa representative for more information.
- Using a Servomotor for oscillating rotation may reduce the service life of the bearings. (Oscillating rotation is defined as a continuous forward-reverse operation within a 150° rotation angle of the motor shaft.) Rotate the Servomotor one full turn or more at least once a day.
- Never attempt to disassemble or modify a Servomotor.

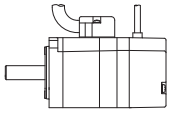
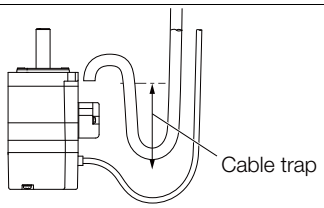
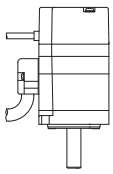
3.1.2 Installation Environment

Refer to the following section for the mechanical specifications, protective structure, and environmental conditions related to Servomotor installation.

☞ *2.2.1 Servomotor Specifications* on page 2-4

3.1.3 Installation Orientation

You can install the Servomotor either horizontally or vertically.

Installation Orientation		Figure
Horizontal		
Vertical	Shaft end up	
	Shaft end down	

3.2 Coupling to the Machine

You can couple the Servomotor to the machine with either a coupling or a belt.
Use the following procedures.

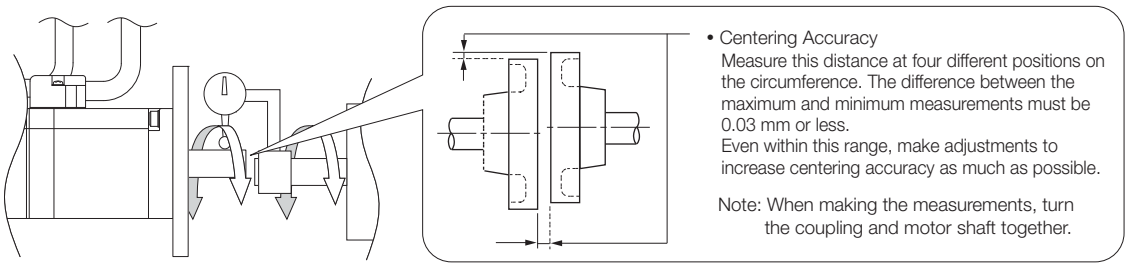
3.2.1 Using a Coupling

Important

- Use a flexible coupling that is designed for Servomotors. We recommend that you use a double-spring coupling, which provides some tolerance in eccentricity and deflection.
- Select a suitable size of coupling for the operating conditions. An inappropriate coupling may cause damage.

1. Wipe off all of the anticorrosive coating from the motor shaft.

2. Confirm that the centering accuracy is within the specified range using a dial gauge or other means.
   If a dial gauge is not available, slide the coupling along both shafts and make adjustments so that it does not catch.



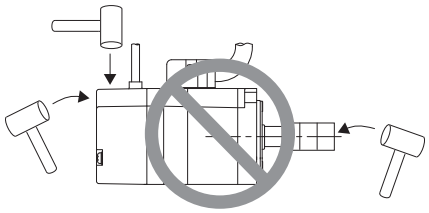
- Centering Accuracy
  Measure this distance at four different positions on the circumference. The difference between the maximum and minimum measurements must be 0.03 mm or less.
  Even within this range, make adjustments to increase centering accuracy as much as possible.

  Note: When making the measurements, turn the coupling and motor shaft together.

3. Align the shaft of the Servomotor with the shaft of the machine, and then connect the shafts with the coupling.

Important

- When you couple the shafts, make sure that the required centering accuracy is achieved. Vibration will damage the bearings and encoders if the shafts are not properly centered.
- When you attach the coupling, do not subject the shaft to direct shock. Also, do not subject the area around the encoder to shock. Shock may damage the encoder.



- If the coupling makes any abnormal noise, center the shafts again until the noise is eliminated.
- Make sure that the thrust load and radial load are within specifications. Refer to the specifications for each type of Servomotor for the thrust load and radial load.

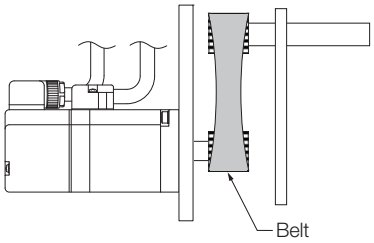
3.2.2 Using a Belt

Note

Select a coupling belt that is suitable for the allowable radial load of the Servomotor and the Servomotor output. When the Servomotor accelerates or decelerates, the counterforce from the acceleration/deceleration torque adds tension to the initial belt tension. Take this additional tension into consideration when you select the coupling belt.

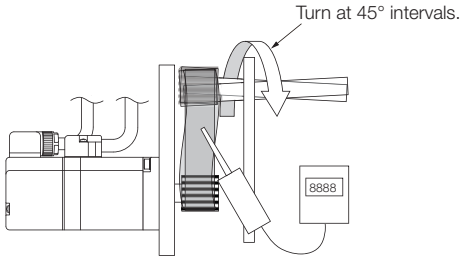
1. Wipe off all of the anticorrosive coating from the motor shaft.

2. Couple the Servomotor to the machine with a belt.
When you attach the belt, adjust the belt tension so that the allowable radial load given in the Servomotor specifications is not exceeded. For details, refer to the catalog of the belt manufacturer.



Important

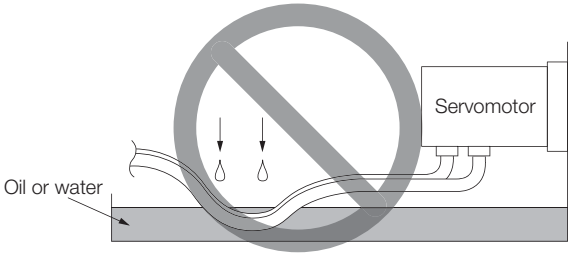
Adjust the belt tension to adjust the radial load. Measure the belt tension at 45° intervals of the machine shaft. Turn the shaft and take measurements with a belt tension meter at each point.



3.3 Oil and Water Countermeasures

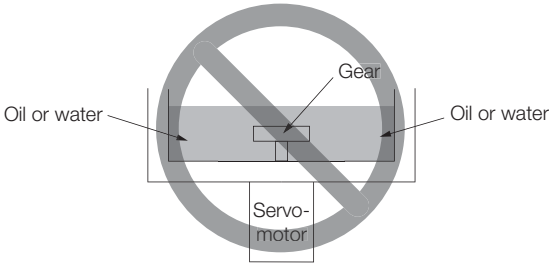
Observe the following instructions so that water, oil, or other foreign matter will not enter the Servomotor.

- Do not allow the cables to be in oil or water.



If contact with oil or water is unavoidable, use oil-resistant cables. Oil-resistant cables are not provided by Yaskawa.

- If you install the Servomotor with the end of the shaft facing up, do not use the Servomotor where oil or water from the machine, a gear box, or other source would come into contact with the Servomotor.



If contact with oil or water is unavoidable, implement countermeasures in the machine so that oil from the gear box does not enter the Servomotor.

- Do not use the Servomotor where it would come into contact with cutting fluids.
  Depending on the type of cutting fluid, sealing materials, packing, cables, or other parts may be adversely affected.
- Do not use the Servomotor where it would be continuously in contact with oil mist, water vapor, oil, water, or grease.
  If usage under the above conditions is unavoidable, implement countermeasures in the machine to protect against dirt and water.

3.4 Servomotor Temperature Increase

This section describes measures to suppress temperature increases in the Servomotor.

- When you install the Servomotor, observe the cooling conditions (heat sink sizes) that are given in the specifications for each type of Servomotor.
  The Servomotor generates heat when it operates. The heat generated by the Servomotor radiates to the heat sink through the motor mounting surface. Therefore, if the surface area of the heat sink is too small, the temperature of the Servomotor may increase abnormally.
- If the operating environment makes it difficult to use a large heat sink, or if the surrounding air temperature given in the specifications is exceeded, implement the following measures.
  - Derate the Servomotor.
    Refer to the Servomotor specifications for information on derating.
    Consider derating when you select the capacity of the Servomotor.
  - Use external forced-air cooling for the Servomotor with a cooling fan or other means.

Do not place packing or any other insulating material between the Servomotor and heat sink. Doing so will cause the motor temperature to increase, affect resistance to noise, and may cause motor failure.

Note: Refer to the following section for the relationship between the heat sink size and derating.
☞ *2.2.5 Servomotor Heat Dissipation Conditions* on page 2-6

3.5 SERVOPACK Installation

3.5.1 Installation Precautions

Environmental Conditions

Refer to the following section for the installation conditions.

☞ *2.2 Ratings and Specifications* on page 2-4

■ Surrounding Air Temperature

Design the size of the control panel, the SERVOPACK installation, and the cooling method so that the temperature surrounding the SERVOPACK does not exceed 40°C.

■ Installation Near Sources of Heat

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

■ Installation Near Sources of Vibration

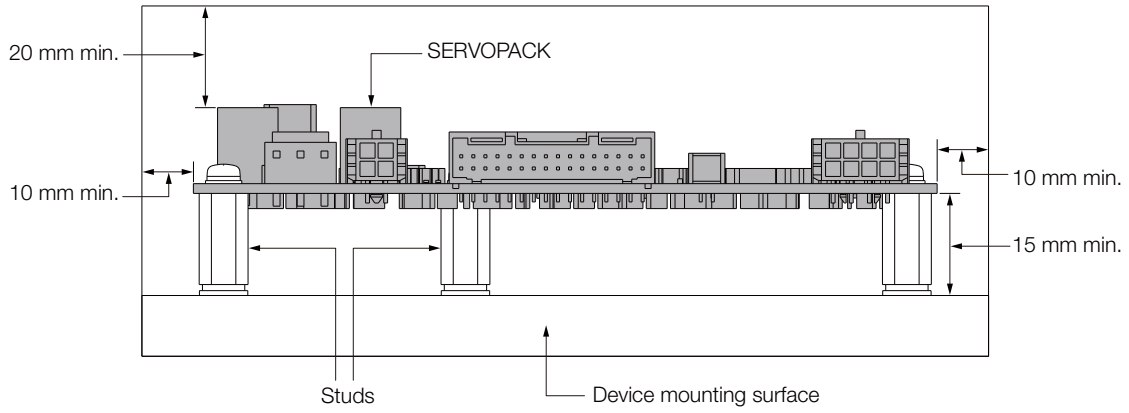
Install a vibration absorber on the installation surface of the SERVOPACK so that the SERVOPACK will not be subjected to vibration.

■ Other Conditions

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.

Installing One SERVOPACK

Observe the following mounting conditions to ensure the necessary space to cool the SERVOPACK.

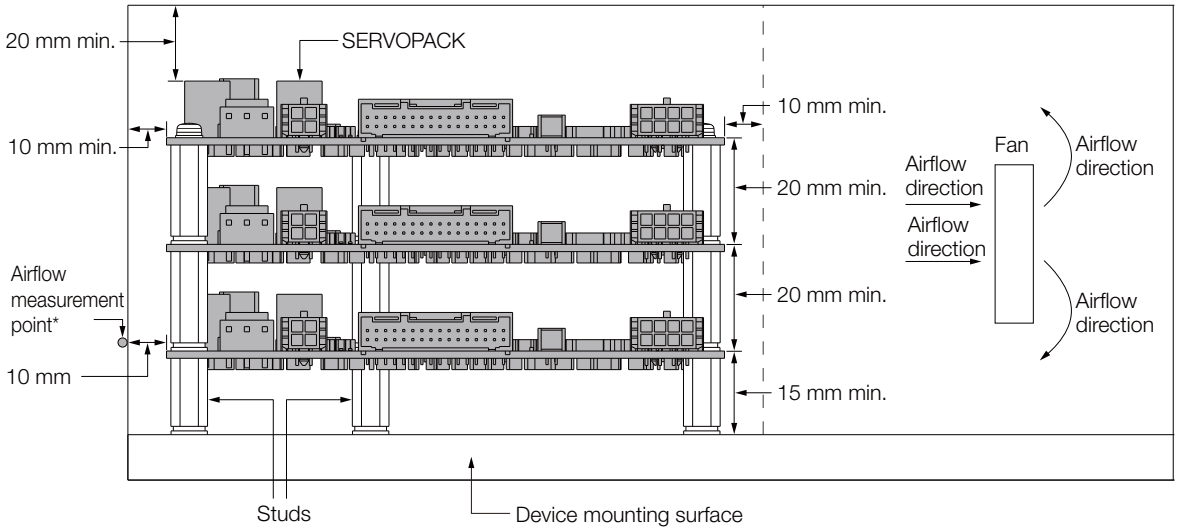


Installing More Than One SERVOPACK

If you install more than one PCB, a fan is required for cooling.

Refer to the following figure for the installation intervals and airflow direction.

Note: If you install more than one PCB, install them so that the SERVOPACKs are not subjected to vibration greater than 4.9 m/s^2.



* Design the control panel so that the airflow at the airflow measurement point is 0.5 m/s or higher.

3.5.2 Mounting and Securing SERVOPACKs

The Σ-S-Series SERVOPACKs are PCBs, so they are secured to the equipment with studs or other mounting fixtures. This section describes the installation procedure.

Required Item

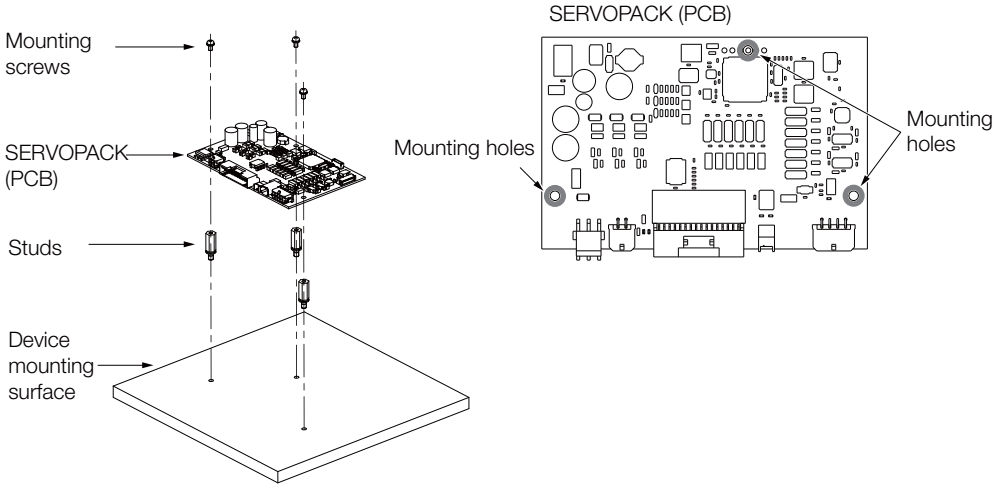
- Mounting fixtures (mounting screws, studs, etc.): M3 × 3 (made of metal)
- Screwdriver

NOTICE

- Remove all static electricity from your body before you install a PCB. Never touch the electronic components mounted to a PCB with your bare hands.
  There is a risk of equipment damage.

1. Prepare studs on the equipment that match the three mounting holes on the SERVOPACK.
2. Place the SERVOPACK on the prepared studs and secure it to the studs with screws. (Tightening torque: 0.49 N·cm)

This concludes the SERVOPACK installation procedure.



3.5.3 Installation Orientation

You can install the SERVOPACK either horizontally or vertically.

Note: Secure the cables on the equipment so that they do not place a load on the SERVOPACK.

Wiring and Connections

4

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

4.1 Wiring Precautions

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.
- Check all wiring and power supplies carefully.
  Incorrect wiring or incorrect voltage application to the input circuits or output circuits may cause short-circuit failures. Short-circuit failures can result in equipment damage or personal injury.
- Connect the power supply input (+24 V and 0 V) to the CN3 connector (power supply connector) on the SERVOPACK.
  There is a risk of failure or fire.

⚠ CAUTION

- Even after you shut OFF the power supply, voltage may still remain in the SERVOPACK. Do not touch the SERVOPACK until the power indicator goes OFF.
  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 voltage application may cause the SERVOPACK to fail, damage the equipment, or result in personal injury.
- Check the wiring to be sure it has been performed correctly.
  There is a risk of failure or malfunction.
- Use the tools recommended by the connector manufacturer if you make any cables yourself.
  Insufficient crimping may cause wires and connectors to generate heat due to faulty contact, possibly resulting in fire.
- Turn ON the power supply to the SERVOPACK only after all wiring has been completed.
- 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.
- Insert cable connectors firmly until the lock mechanisms lock into place.
  There is a risk of cable disconnection during operation.
- Do not bundle Power Supply Input Cables or Servomotor Power Cables together with I/O Signal Cables or Encoder Cables or run them through the same duct. If you do not place the above cables 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 entering on the I/O Signal Cables or Encoder Cables.

Important

- Always use a molded-case circuit breaker (1QF) 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.

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 section for information on the specified cables.
  ☞ *Chapter 2 Selection*
- Perform all wiring so that stress is not applied to the signal cables.

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.

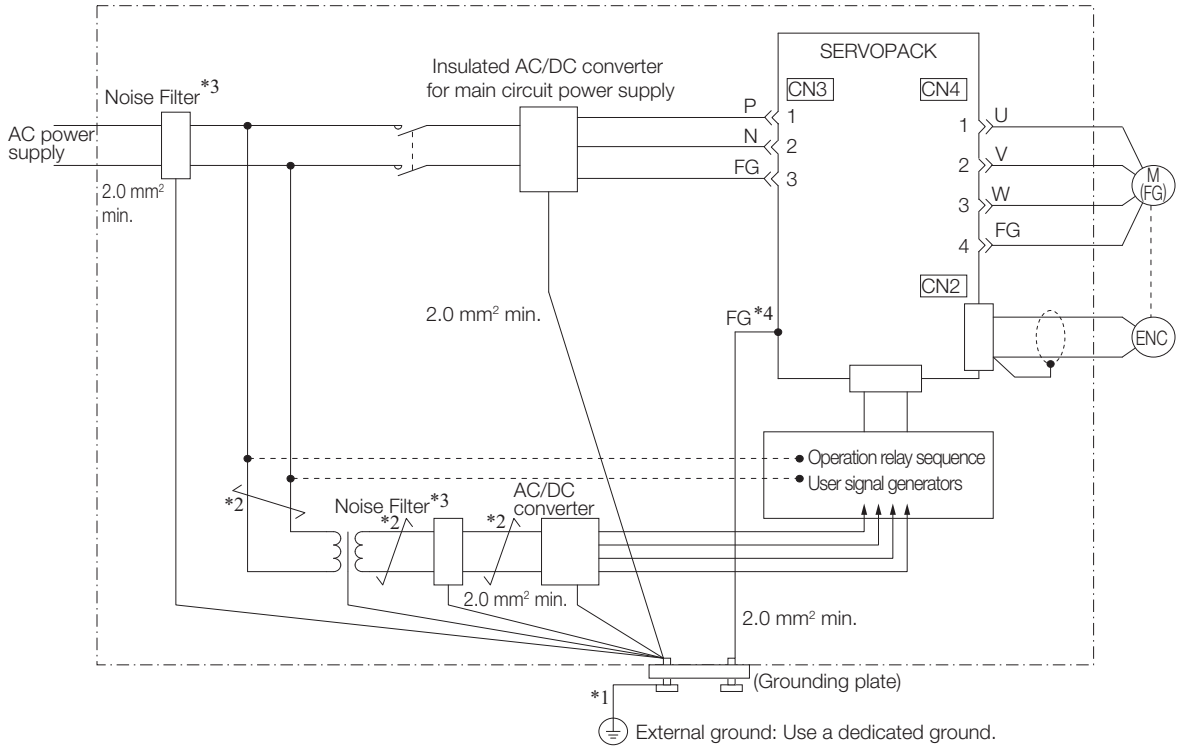
To prevent the noise from the SERVOPACK or the peripheral devices from causing malfunctions of any devices, take the following countermeasures against noise as required.

- 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 bundle Power Supply Input Cables or Servomotor Power Cables together with I/O Signal Cables or Encoder Cables or run them through the same duct. If you do not place the above cables in separate ducts, separate them by at least 30 cm.
- 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 a Noise Filter before the isolated 24-V power supply 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 4-4
- Implement suitable grounding measures. Refer to the following section for information on grounding measures.
  ☞ *4.1.3 Grounding* on page 4-6

Noise Filters

You must attach Noise Filters in appropriate places to protect the SERVOPACK from the adverse effects of noise.

The following is an example of wiring for countermeasures against noise.



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

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

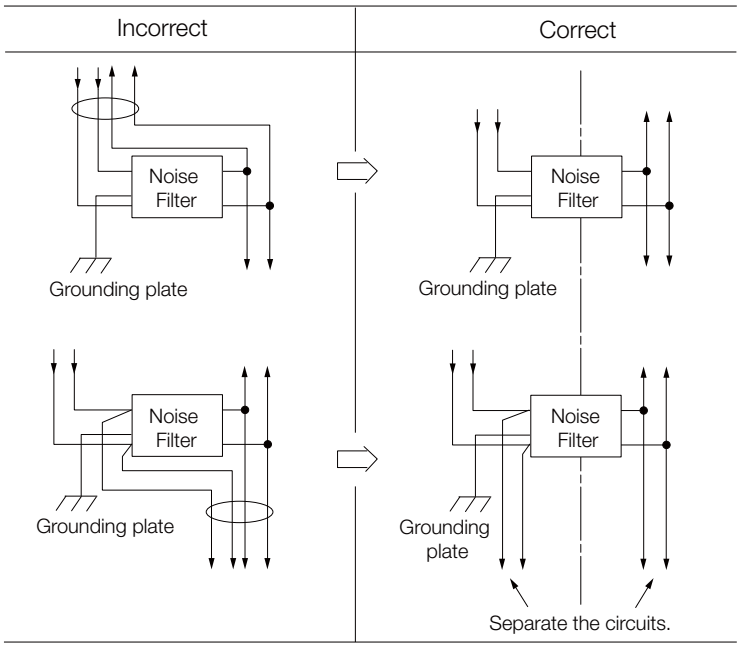
*3. Refer to the following section for precautions when using Noise Filters.
☞ *Noise Filter Wiring and Connection Precautions* on page 4-5

*4. The mounting holes on the SERVOPACK are used for the FG.

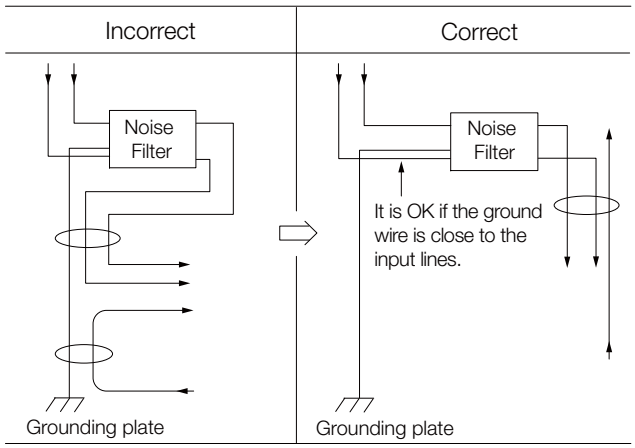
Noise Filter Wiring and Connection Precautions

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

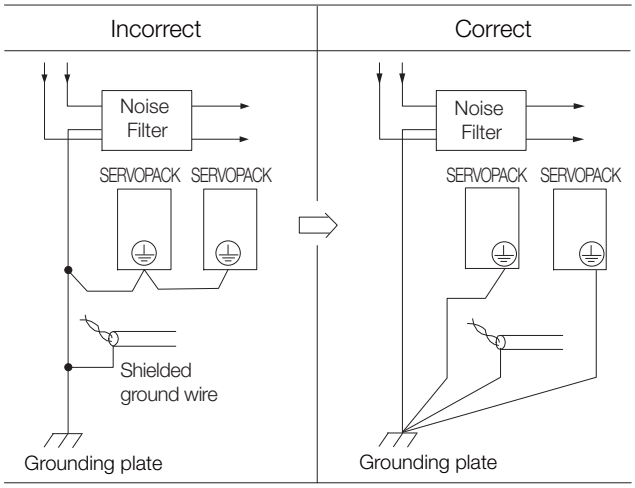
- Separate input lines from output lines. Do not place input lines and output lines in the same duct or bundle them together.



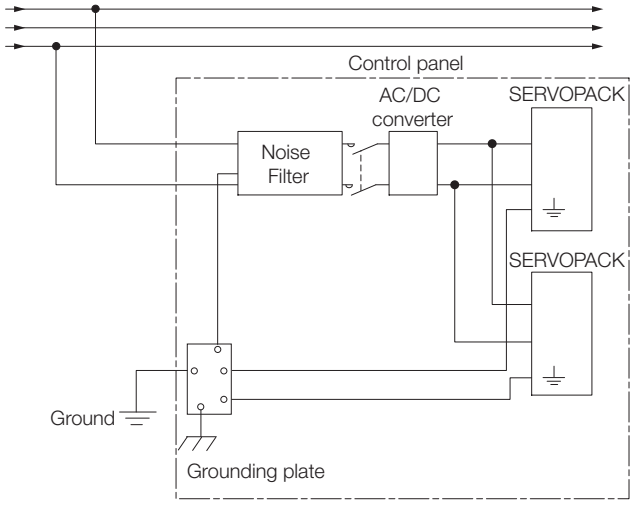
- Separate the Noise Filter ground wire from the output lines. Do not place the Noise Filter ground wire, output lines, and other signal lines in the same duct or bundle them together.



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



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



4.1.3 Grounding

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

Observe the following precautions when wiring the ground cable.

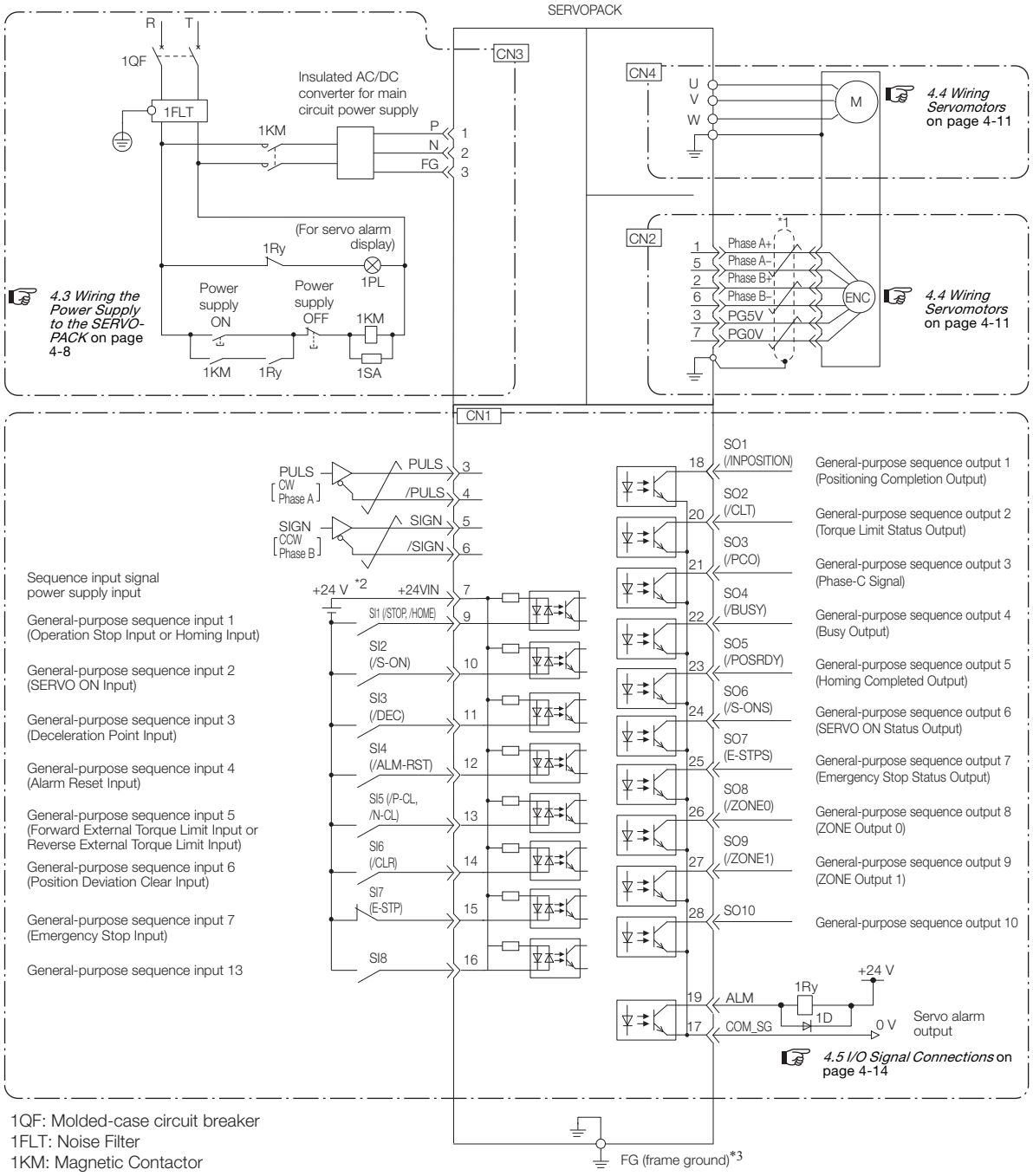
- Ground the SERVOPACK to a resistance of 100 Ω or less.
- Be sure to ground at one point only.
- Ground the Servomotor directly if the Servomotor is insulated from the machine.

Motor Frame Ground or Motor Ground

If you ground the Servomotor through the machine, switching noise current can flow from the main circuit of the SERVOPACK through the stray capacitance of the Servomotor. To prevent this, always connect the ground terminal (FG) of the Servomotor to the ground terminal on the SERVOPACK.

4.2 Basic Wiring Diagrams

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



1QF: Molded-case circuit breaker
1FLT: Noise Filter
1KM: Magnetic Contactor
1Ry: Relay
1PL: Indicator lamp
1SA: Surge Absorber
1D: Flywheel diode

*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. The FG uses the mounting holes on the SERVOPACK.

Note: Default settings are given in parentheses.

4.3 Wiring the Power Supply to the SERVOPACK

4.3.1 Power Supply Input Connector (CN3) Details

⚠ CAUTION

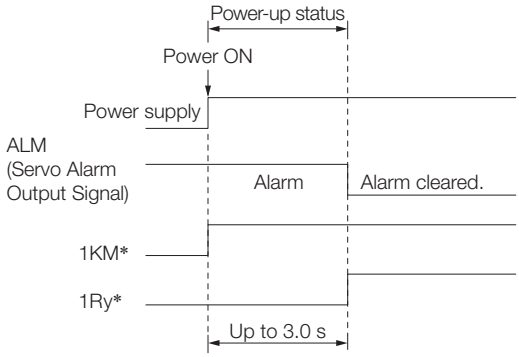
- Wire all connections correctly according to the following table.
  There is a risk of SERVOPACK failure or fire if incorrect wiring is performed.

Terminal No.	Name	Voltage Specification
1	Power supply input terminals	24 VDC ± 15%
2		0 VDC
3	Frame ground terminal	– (This is the ground terminal.)

4.3.2 Power ON Sequence

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

- The ALM (Servo Alarm) signal is output for up to three seconds when the power supply is turned ON. Take this into consideration when you design the power ON sequence, and maintain the power-up status until the ALM signal turns OFF (alarm cleared).



* This example is for the connection diagram on the next page.

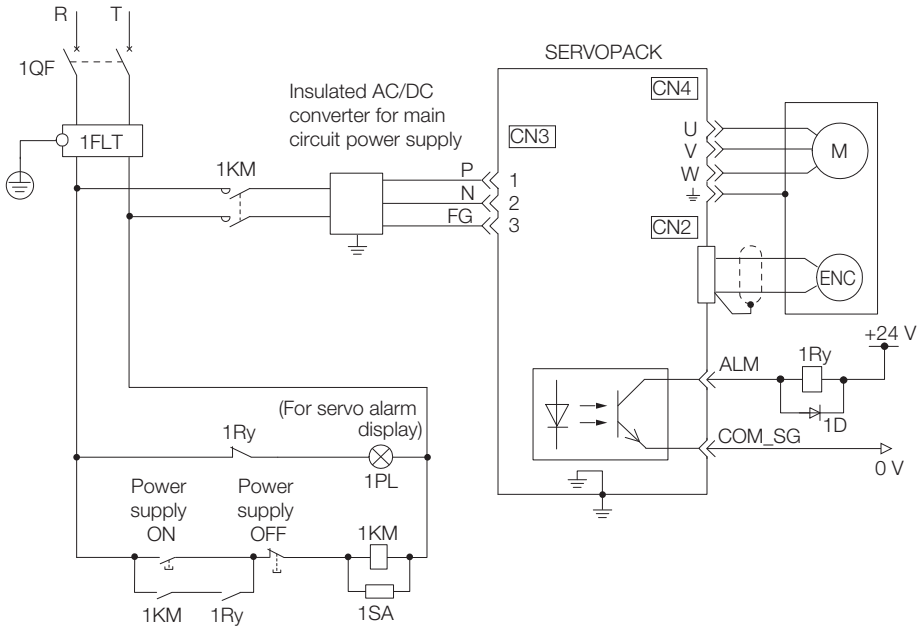
- Design the power ON sequence so that the power supply input to the SERVOPACK is turned OFF when an ALM (Servo Alarm) signal is output.

⚠ WARNING

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

4.3.3 Power Supply Wiring Diagrams

Using Only One SERVOPACK



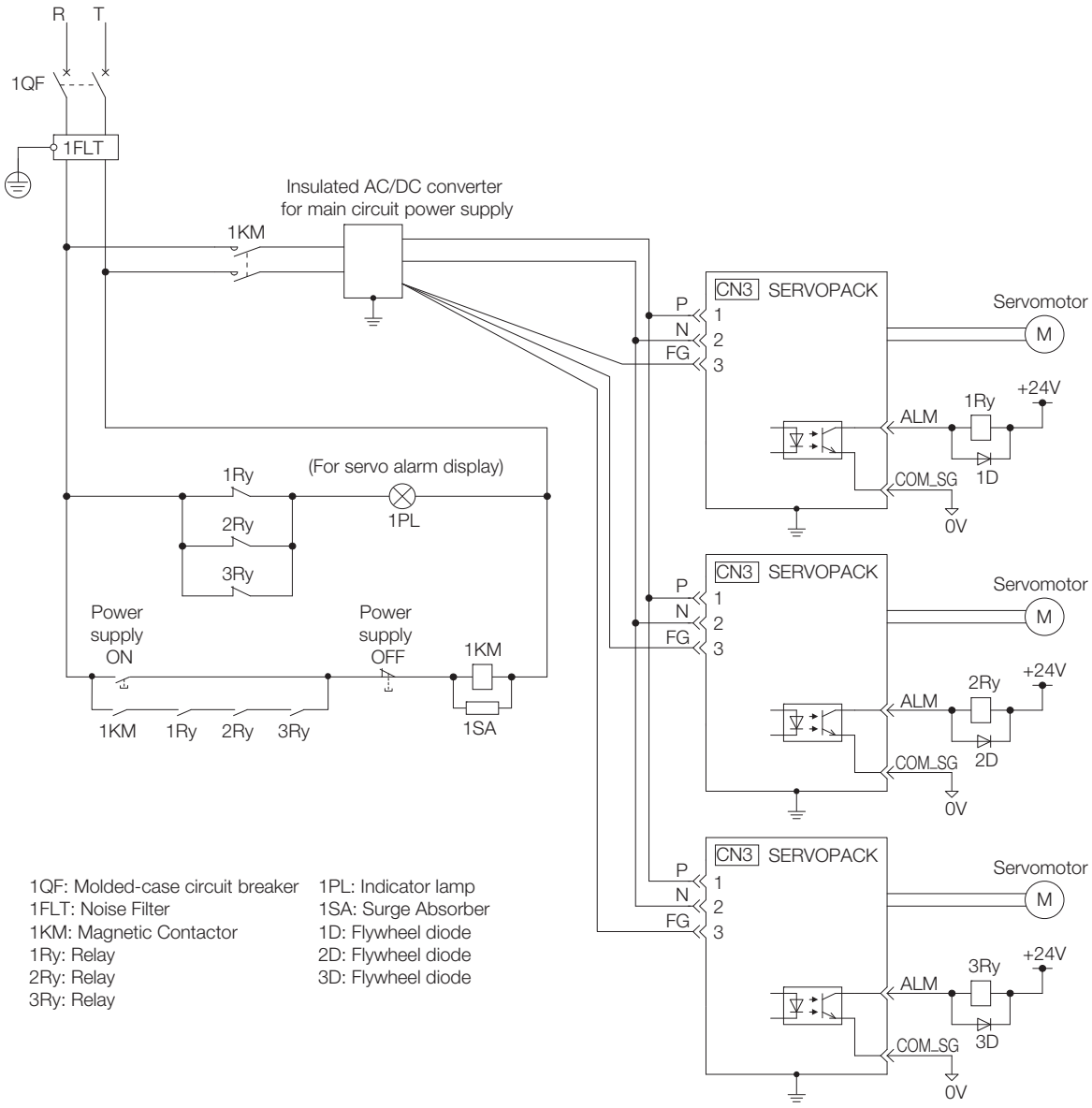
1QF: Molded-case circuit breaker
1FLT: Noise Filter
1KM: Magnetic Contactor
1Ry: Relay
1PL: Indicator lamp
1SA: Surge Absorber
1D: Flywheel diode

Note: When you shut OFF the power supply with a magnetic contactor or other device, do so before the insulated AC/DC converter for the power supply.

Using More Than One SERVOPACK

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

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



1QF: Molded-case circuit breaker
1FLT: Noise Filter
1KM: Magnetic Contactor
1Ry: Relay
2Ry: Relay
3Ry: Relay
1PL: Indicator lamp
1SA: Surge Absorber
1D: Flywheel diode
2D: Flywheel diode
3D: Flywheel diode

Note: When you shut OFF the power supply with a magnetic contactor or other device, do so before the insulated AC/DC converter for the power supply.

4.4 Wiring Servomotors

4.4.1 Wiring Precautions

⚠ CAUTION

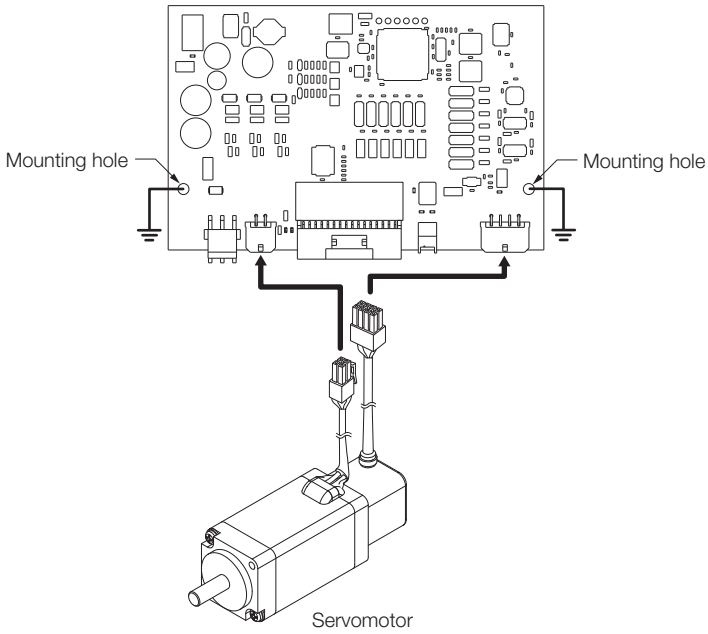
- Do not connect the Servomotor directly to an industrial power supply. Doing so will destroy the Servomotor. You cannot operate a Servomotor without a SERVOPACK that is designed for it.

General Precautions

- Never perform any wiring work while the power supply is ON.
- Always connect the Servomotor Power Cable before you connect the Encoder Cable. If you connect the Encoder Cable first, the encoder may be damaged due to the difference in electrical potential from the FG.
- Never touch the connector pins on the Servomotor directly with your hands. Particularly the encoder may be damaged by static electricity.
- Separate the Servomotor Power Cable from the I/O Signal Cables and Encoder Cable by at least 30 cm.
- Do not connect Magnetic Contactors, reactors, or other devices on the cables that connect the SERVOPACK and Servomotor. Failure to observe this caution may result in malfunction or damage.
- Do not subject the cables to excessive bending stress or tension. Perform all wiring so that stress is not applied to the Encoder Cable or Servomotor Power Cable.
- If you secure the cables with cable ties, protect the cables with cushioning material.
- Before you connect the wires, make sure that there are no mistakes in the wiring.
- Always use the connectors specified by Yaskawa and insert them correctly.
- When you connect a connector, check it to make sure there is no foreign matter, such as metal clippings, inside.
- The connectors are made of resin. To prevent damage, do not apply any strong impact.
- Perform all wiring so that stress is not applied to the connectors. The connectors may break if they are subjected to stress.
- If you move the Servomotor while the cables are connected, always hold onto the main body of the Servomotor. If you lift the Servomotor by the cables when you move it, the connectors may be damaged or the cables may be broken.

Grounding Precautions

Always use the mounting holes in the SERVOPACK to ground the PCB. The Servomotor is grounded through the Servomotor Power Cable.



Cable Precautions

Do not use the cables given in *2.5.1 Cable Selection Table* in applications that require a high degree of flexibility, such as twisting and turning, or in which the cables themselves must move. Observe the recommended bending radius given in the following table and perform wiring so that stress is not applied to the cables. Use the cables so that they are not repeatedly bent.

Cable Diameter	Recommended Bending Radius [R]
Less than 8 mm dia.	15 mm min.

4.4.2 Pin Arrangement of Servomotor Connector (CN4)

The connector pin layout that is required to connect the SERVOPACK to a Servomotor is given below.

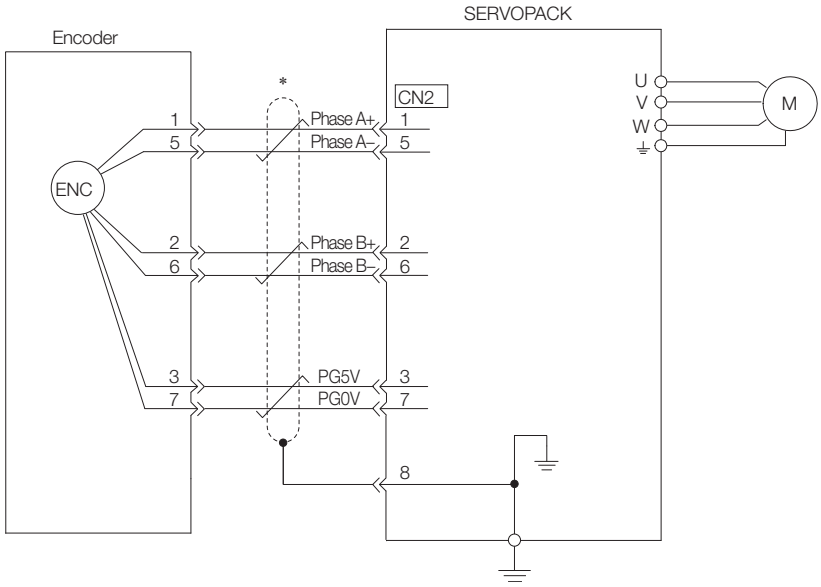
Pin	Signal	Function
1	U	Servomotor phase-U terminal
2	V	Servomotor phase-V terminal
3	W	Servomotor phase-W terminal
4	FG	Frame ground terminal

4.4.3 Pin Arrangement of Encoder Connector (CN2)

The connector pin layout that is required to connect the SERVOPACK to the encoder (Servomotor) is given below.

Pin	Signal	Function
1	Phase A+	Encoder phase A
2	Phase B+	Encoder phase B
3	PG5V	Encoder power supply, 5 VDC
4	–	–
5	Phase A–	/Encoder phase A
6	Phase B–	/Encoder phase B
7	PG0V	Signal ground
8	FG	Frame ground

4.4.4 Wiring the SERVOPACK to the Encoder



* represents a shielded twisted-pair cable.

4.5 I/O Signal Connections

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

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

Input Signals

Default settings are given in parentheses. Refer to the following section for details on changing allocations.

☞ *5.3.3 Allocating Input Signals to Pins and Parameter Settings* on page 5-17

Signal	Pin	Name	Function	Reference
FG	2	Frame Ground	Connected if the shield wire from the I/O Signal Cable is connected to the frame ground.	–
PULS /PULS	3 4	Pulse Reference Input	One of the following input pulse forms is set. • Sign + pulse train • CW and CCW pulse trains • Two-phase pulse trains with 90° phase differential	page 7-13
SIGN /SIGN	5 6	Sign Reference Input		
+24VIN	7	Sequence Input Signal Power Supply Input	Connected to the 24-V side of the sequence input signal power supply. Allowable voltage range: 24 VDC ±10% (The 24-V power supply is not provided by Yaskawa.)	–
SI1 (/STOP or /HOME)	9	General-purpose Sequence Input 1 (Operation Stop Input or Homing Input)	You can allocate the input signal to use with a parameter. (/STOP: When the signal turns ON during homing, the Servomotor is decelerated to a stop. /HOME: When the signal turns ON, homing is started.)	page 5-10, page 7-7
SI2 (/S-ON)	10	General-purpose Sequence Input 2 (SERVO ON Input)	You can allocate the input signal to use with a parameter. (Controls turning the Servomotor ON and OFF (supplying/not supplying power).)	page 5-10
SI3 (/DEC)	11	General-purpose Sequence Input 3 (Homing Deceleration Switch Input)	You can allocate the input signal to use with a parameter. (When the signal turns ON, movement at the homing approach speed is started.)	page 5-11, page 7-7
SI4 (/ALM-RST)	12	General-purpose Sequence Input 4 (Alarm Reset Input)	You can allocate the input signal to use with a parameter. (When the signal turns ON, any alarms are reset.)	page 10-17
SI5 (/P-CL, /N-CL)	13	General-purpose Sequence Input 5 (Forward External Torque Limit Input or Reverse External Torque Limit Input)	You can allocate the input signal to use with a parameter. (Activates/deactivates external torque limiting.)	page 5-11
SI6 (/CLR)	14	General-purpose Sequence Input 6 (Position Deviation Clear Input)	You can allocate the input signal to use with a parameter. (Clears the position deviation.)	page 7-15
SI7 (E-STP)	15	General-purpose Sequence Input 7 (Emergency Stop Input)	You can allocate the input signal to use with a parameter. (ON: Resets an emergency stop, OFF: Performs an emergency stop.)	page 5-11
SI8	16	General-purpose Sequence Input 8	You can allocate the input signal to use with a parameter.	–

Output Signals

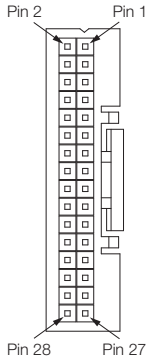
Default settings are given in parentheses. Refer to the following section for details on changing allocations.

☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

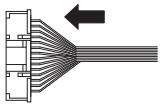
Signal	Pin	Name	Function	Reference
COM_SG	17	Signal Ground	Signal ground for sequence output signals.	–
SO1 (/INPOSITION)	18	General-purpose Sequence Output 1 (Positioning Completion Output)	You can allocate the output signal to use with a parameter. (Turns ON when the difference between the target position and the current value of the motor is within the positioning completed width.)	page 7-7
ALM	19	Servo Alarm Output	Turns OFF (opens) when an error is detected.	page 5-16
SO2 (/CLT)	20	General-purpose Sequence Output 2 (Torque Limit Status Output)	You can allocate the output signal to use with a parameter. (Turns ON while the motor output torque is being limited.)	page 7-7
SO3 (/PCO)	21	General-purpose Sequence Output 3 (Encoder Origin Output)	You can allocate the output signal to use with a parameter. (Outputs a signal when the encoder origin is passed.)	page 5-16
SO4 (/BUSY)	22	General-purpose Sequence Output 4 (Busy Output)	You can allocate the output signal to use with a parameter. (Turns ON when the motor is operating, e.g., during positioning operations.)	page 7-7
SO5 (/POSRDY)	23	General-purpose Sequence Output 5 (Homing Completed Output)	You can allocate the output signal to use with a parameter. (Turns ON when the position information is valid after homing.)	page 7-7
SO6 (/S-ONS)	24	General-purpose Sequence Output 6 (SERVO ON Status Output)	You can allocate the output signal to use with a parameter. (Turns ON when the system enters the SERVO ON state. Turns OFF when the system enters the SERVO OFF state.)	page 5-15
SO7 (E-STPS)	25	General-purpose Sequence Output 7 (Emergency Stop Status Output)	You can allocate the output signal to use with a parameter. (Turns ON when an emergency stop is released. Turns OFF when an emergency stop is in progress.)	page 5-15
SO8 (/ZONE0)	26	General-purpose Sequence Output 8 (ZONE Output 0)	You can allocate the output signal to use with a parameter. (A ZONE signal is output from /ZONE0 when the motor is in a zone specified in the ZONE table.)	page 5-16, page 7-17
SO9 (/ZONE1)	27	General-purpose Sequence Output 9 (ZONE Output 1)	You can allocate the output signal to use with a parameter. (A ZONE signal is output from /ZONE1 when the motor is in a zone specified in the ZONE table.)	
SO10	28	General-purpose Sequence Output 10	You can allocate the output signal to use with a parameter.	–

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

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



The above view is from the direction of the following arrow.



Pin	Signal	Function Name	Pin	Signal	Function Name
2	FG	Frame Ground	1	–	–
4	/PULS	Pulse Reference Input	3	PULS	Pulse Reference Input
6	/SIGN	Sign Reference Input	5	SIGN	Sign Reference Input
8	–	–	7	+24VIN	Sequence Input Signal Power Supply Input
10	SI2 (/S-ON)	General-purpose Sequence Input 2	9	SI1 (/STOP or /HOME)	General-purpose Sequence Input 1
12	SI4 (/ALM-RST)	General-purpose Sequence Input 4	11	SI3 (/DEC)	General-purpose Sequence Input 3
14	SI6 (/CLR)	General-purpose Sequence Input 6	13	SI5 (/P-CL, /N-CL)	General-purpose Sequence Input 5
16	SI8	General-purpose Sequence Input 8	15	SI7 (E-STP)	General-purpose Sequence Input 7
18	SO1 (/INPOSITION)	General-purpose Sequence Output 1	17	COM_0V	Signal Ground
20	SO2 (/CLT)	General-purpose Sequence Output 2	19	ALM	Servo Alarm Output
22	SO4 (/BUSY)	General-purpose Sequence Output 4	21	SO3 (/PCO)	General-purpose Sequence Output 3
24	SO6 (/S-ONS)	General-purpose Sequence Output 6	23	SO5 (/POSRDY)	General-purpose Sequence Output 5
26	SO8 (/ZONE0)	General-purpose Sequence Output 8	25	SO7 (E-STPS)	General-purpose Sequence Output 7
28	SO10	General-purpose Sequence Output 10	27	SO9 (/ZONE1)	General-purpose Sequence Output 9

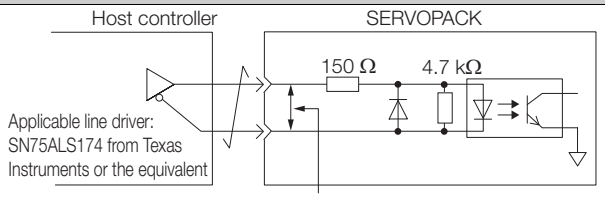
4.5.3 I/O Circuits

Position Reference Input Circuits

This section describes CN1 connector terminals 3-4 (Pulse Reference Input) and 5-6 (Sign Reference Input).

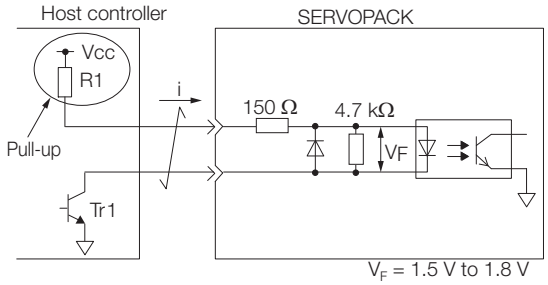
The output circuit for the reference pulses from the host controller can be either a line-driver output or open-collector output. The following diagrams show these by output type.

Line-Driver Output Circuit



2.8 V ≤ (H level) – (L level) ≤ 3.7 V
If the above formula is not satisfied, the inputs to the SERVOPACK will be unstable. Pulses may be missed from the Pulse Reference Input or reference inversion may occur for the Sign Reference Input.

Open-Collector Output Circuits



Important

- Precaution When Host Controller Uses Open-Collector Output with User-Supplied Power Supply
  The SERVOPACK may fail depending on the relationship between the pull-up voltage (Vcc) and the pull-up resistance (R1). Before you wire the circuits, confirm that the specifications of the host controller satisfy the values shown in the following table.

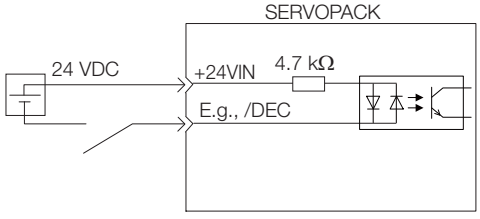
Pull-up Voltage (Vcc)	Pull-Up Resistance (R1)
24 V	1.8 kΩ to 2.7 kΩ
12 V max.	820 Ω to 1.5 kΩ
5 V max.	180 Ω to 470 Ω

Sequence Input Circuits

◆ Photocoupler Input Circuits

This section describes CN1 connector terminals 9 to 16. Relay connections are made with transistor circuits. Select a low-current relay. If you do not use a low-current relay, a faulty contact may result.

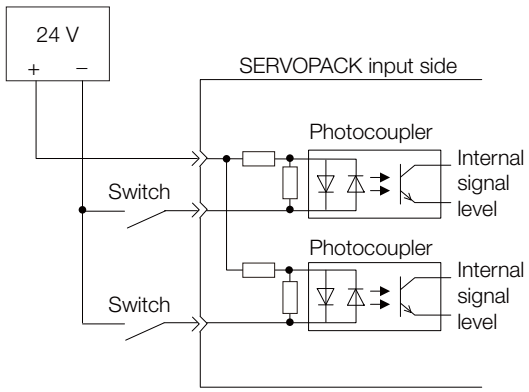
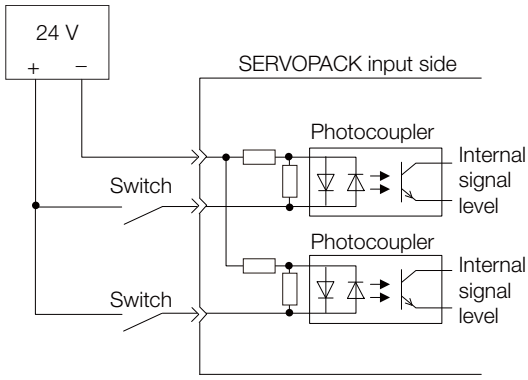
Example for Relay Circuit



■ Electrical Specifications

Item	Characteristics	Remarks
External power supply	24 VDC ± 10%	A power supply capacity of at least 50 mA is required for all 8 points.

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

Sink Circuits	Source Circuits
	

Input Signal Polarity		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

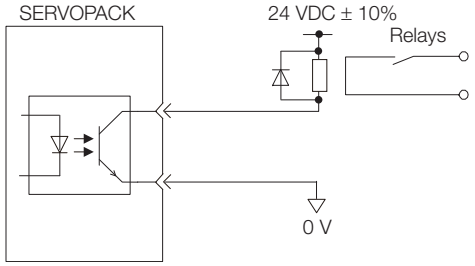
Important

Incorrect wiring or incorrect voltage application to the output to the output circuits may cause short-circuit failures.
Short-circuit failures can result in equipment damage or personal injury.

◆ Photocoupler Output Circuits

Photocoupler output circuits are used for the ALM (Servo Alarm) and other sequence output signals. They are connected to relay circuits.

Example for Relay Circuit



■ Electrical Specifications

Item	Characteristics	Remarks
External power supply	24 VDC ±10%	–
Allowable Current Range	1 mA to 10 mA DC	This is the current range per point.

4.6 Connecting to the Computer Connector (CN5)

To use the SigmaWin+ Engineering Tool, connect the computer on which the SigmaWin+ is installed to CN5 on the SERVOPACK.

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

AC Servo Drives Engineering Tool SigmaWin+ Online Manual Σ-S Component (Manual No.: SIEP S800001 06)

Setup

5

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

5.1 Manipulating Parameters (Pn□□□)

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

5.1.1 Parameter Classification

There are the following two types of SERVOPACK parameters.

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

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

Setup Parameters

You can use the SigmaWin+ to set the setup parameters individually.

Tuning Parameters

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

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

☞ *8.5 Custom Tuning* on page 8-15

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

☞ *8.8 Manual Tuning* on page 8-31

5.1.2 Notation for Parameters

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

- Parameters for Numeric Settings

Pn100	Speed Loop Gain				
	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
Pn140	n.□□0□ (default setting)	Do not perform vibration suppression.	Immediately	Tuning
	n.□□1□	Perform vibration suppression for a specific frequency.		
	n.□□2□	Reserved setting (Do not use.)		

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 functions selected with the settings.

5.1.3 Parameter Setting Methods

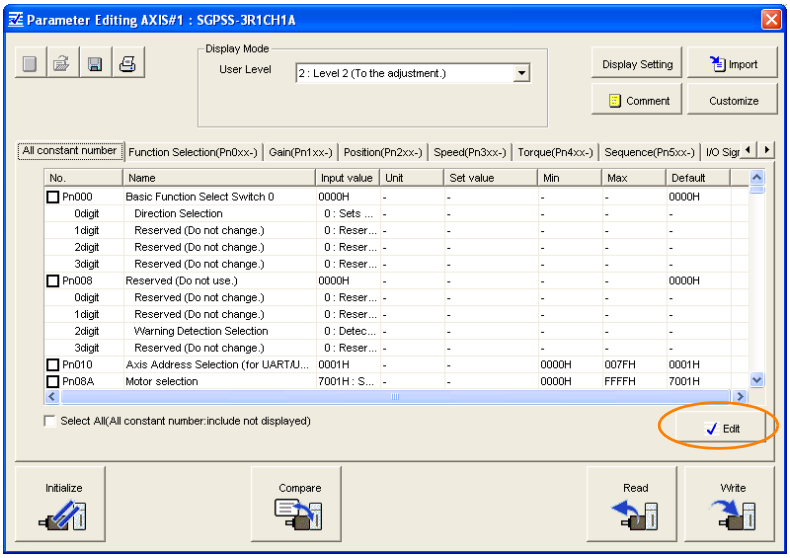
You can use the SigmaWin+ to set parameters.

A sample operating procedure is given below.

1. Select ***Parameters - Edit Parameters*** from the menu bar of the Main Window of the SigmaWin+.

2. Select 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.

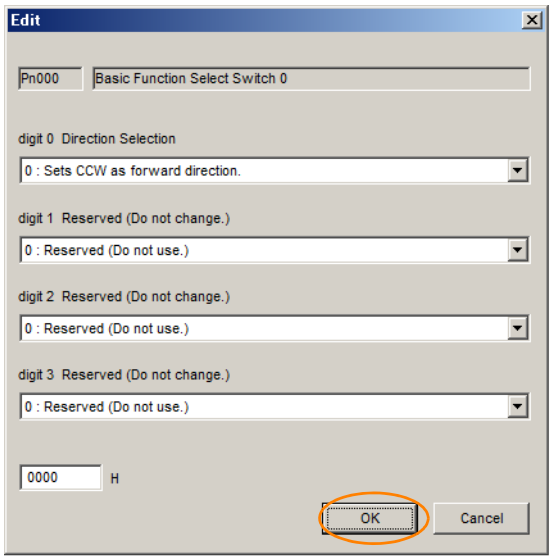
3. Click the **Edit** Button.



4. Change the setting of the parameter.

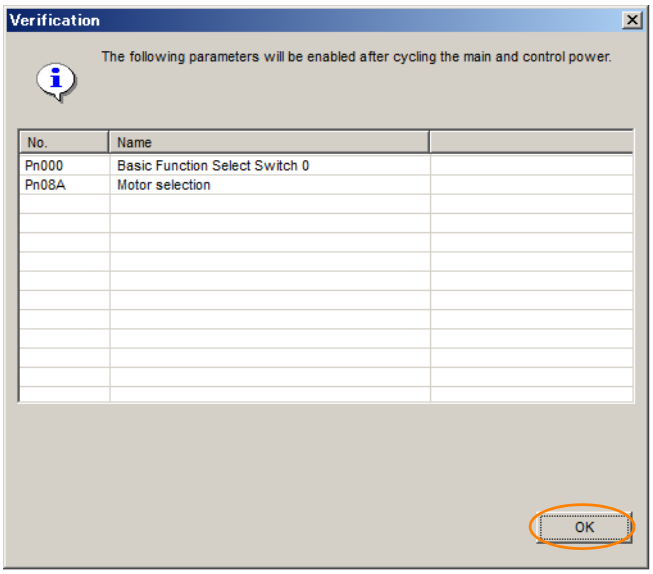
   Information
   1. For a parameter for a numeric setting, input the numeric setting.
   2. For a parameter for a function selection, select the setting from the list for the individual digit.

5. Click the **OK** Button.



6. Click the **Write** Button.
   Writing will start.
   This concludes the procedure to edit the parameter. Proceed to step 7 only when the dialog box shown in step 7 is displayed.

7. Click the **OK** Button.



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

5.1.4 Initializing Parameter Settings

You can return the parameters to their default settings.

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

Preparations

Check the following settings before you initialize the parameter settings.

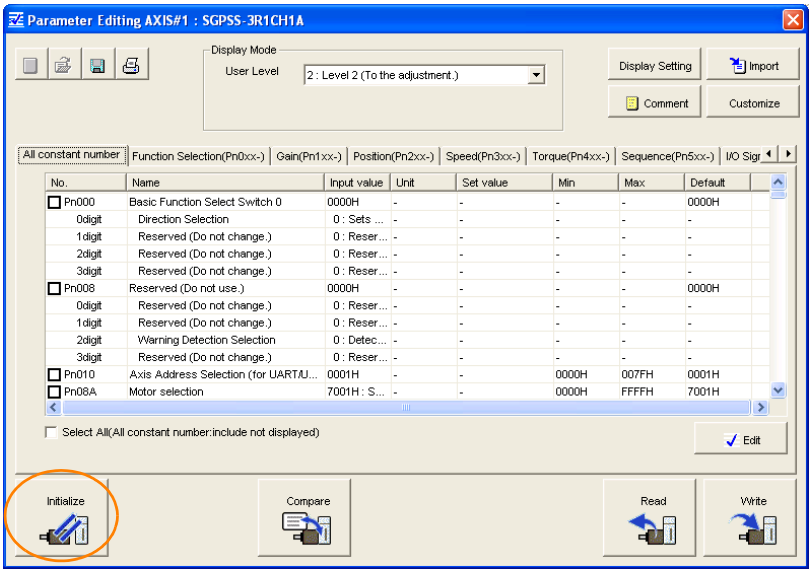
- The parameters must not be write prohibited.
- The system must be in the SERVO OFF state.

Operating Procedure

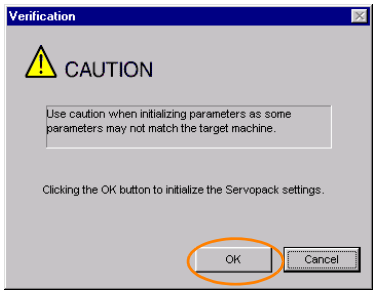
Use the following procedure.

1. Select ***Parameters - Edit Parameters*** from the menu bar of the Main Window of the SigmaWin+.

2. Click the **Initialize** Button.

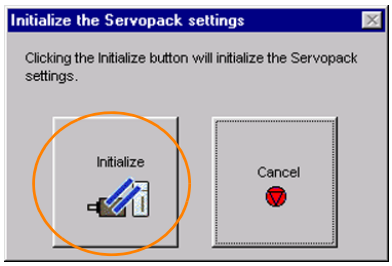


3. Click the **OK** Button.



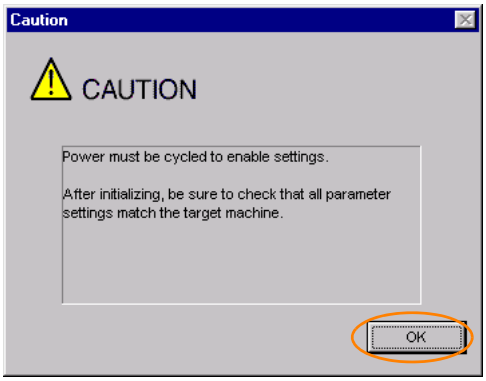
Click the **Cancel** Button to cancel initialization. The Parameter Editing Dialog Box will return.

4. Click the **Initialize** Button.



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

5. Click the **OK** Button.



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

This concludes the procedure to initialize the parameter settings.

5.2 Servomotor Selection

Use Pn08A (Motor Selection Switch) to set the motor code of the Servomotor to use. The default setting is for a 30-W motor.

⚠ DANGER

- Set the motor code correctly.
  If the motor code that you set does not agree with the connected motor, unexpected operation may occur or the Servomotor may be burnt.

■ Monitor Codes

7001h: 30 W (Servomotor model: SGMSL-A3)

7002h: 50 W (Servomotor model: SGMSL-A5)

Pn08A	Motor Selection Switch				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	7000h to FFFFh	–	7001h	After restart	Setup

5.3 Sequence I/O Signals

I/O signals for command communications with the host controller are allocated to the pins on the I/O signal connector (CN1). These I/O signals are called sequence I/O signals.

This section describes the functions and meanings of the sequence I/O signals and the parameters that are used to allocate them to the pins on the I/O signal connector (CN1).

Refer to the following section for the default I/O signal allocations.

☞ *4.5 I/O Signal Connections* on page 4-14

5.3.1 Input Signals

/STOP (Operation Stop Input) Signal

When the signal turns ON during homing, the Servomotor is decelerated to a stop.

Type	Signal	Pin	Signal Status	Meaning
Input	/STOP	9 [default setting]	ON (closed)	The Servomotor is decelerated to a stop. (This applies only during homing.)
			OFF (open)	Homing is started again from where it stopped.

Note: Use PnBA2 = n.□□X□ (/STOP (Operation Stop Input) Signal Allocation) to allocate the /STOP signal to another connector pin. Refer to the following section for details.

☞ *5.3.3 Allocating Input Signals to Pins and Parameter Settings* on page 5-17

/HOME (Homing Input) Signal

This signal functions as the homing command.

Type	Signal	Pin	Signal Status	Meaning
Input	/HOME	9 [default setting]	ON (closed)	Homing is started.
			OFF (open)	The current status is maintained. Confirm that the /BUSY signal has turned ON before you turn OFF this signal.

Note: Use PnBA5 = n.□□X□ (/HOME (Homing Input) Signal Allocation) to allocate the /HOME signal to another connector pin. Refer to the following section for details.

☞ *5.3.3 Allocating Input Signals to Pins and Parameter Settings* on page 5-17

/S-ON (SERVO ON Input) Signal

This signal enables operation of the Servomotor.

Type	Signal	Pin	Signal Status	Meaning
Input	/S-ON	10 [default setting]	ON (closed)	Power is supplied to the Servomotor to enable operation.
			OFF (open)	Power supply to the Servomotor is stopped and operation is disabled.

Note: Use PnBAF = n.□□X□ (/S-ON (SERVO ON) Signal Allocation) to allocate the /S-ON signal to another connector pin. Refer to the following section for details on input signal allocation.

☞ *5.3.3 Allocating Input Signals to Pins and Parameter Settings* on page 5-17

Input the /S-ON signal while the Servomotor is stopped. You cannot change to the SERVO ON state while the Servomotor is operating.

/DEC (Homing Deceleration Switch Input) Signal

This is the home proximity signal that is used for homing. It is used to change the homing speed.

Type	Signal	Pin	Signal Status	Meaning
Input	/DEC	11 [default setting]	ON (closed)	The homing speed is changed to the approach speed or creep speed. The operation depends on the homing method.
			OFF (open)	The speed does not change.

Note: Use PnBB2 = n.□□X□ (/DEC (Homing Deceleration Switch Input) Signal Allocation) to allocate the /DEC signal to another connector pin. You can allocate the signal only to CN1-9 to CN1-14. If you allocate it to any pin other than CN1-9 to CN1-14, an A.04A alarm (Parameter Setting Error 2) will occur.
Refer to the following section for details on allocations.
☞ *5.3.3 Allocating Input Signals to Pins and Parameter Settings* on page 5-17

/ALM-RST (Alarm Reset Input) Signal

This signal functions as the alarm reset command.

Type	Signal	Pin	Signal Status	Meaning
Input	/ALM-RST	12 [default setting]	ON (closed)	Resets alarms.
			OFF (open)	Does not reset alarms.

Note: Use PnBB4 = n.□□X□ (/ALM-RST (Alarm Reset) Signal Allocation) to allocate the /ALM-RST signal to another connector pin. Refer to the following section for details.
☞ *5.3.3 Allocating Input Signals to Pins and Parameter Settings* on page 5-17

/P-CL (Forward External Torque Limit) Signal

This signal turns the forward external torque limit ON and OFF.

Type	Signal	Pin	Signal Status	Meaning
Input	/P-CL	13 [default setting]	ON (closed)	Enables the forward external torque limit.
			OFF (open)	Disables the forward external torque limit.

Note: Use PnBB5 = n.□□X□ (/P-CL (Forward External Torque Limit Input) Signal Allocation) to allocate the /P-CL signal to another connector pin. Refer to the following section for details.
☞ *5.3.3 Allocating Input Signals to Pins and Parameter Settings* on page 5-17

/N-CL (Reverse External Torque Limit) Signal

This signal turns the reverse external torque limit ON and OFF.

Type	Signal	Pin	Signal Status	Meaning
Input	/N-CL	13 [default setting]	ON (closed)	Enables the reverse external torque limit.
			OFF (open)	Disables the reverse external torque limit.

Note: Use PnBB6 = n.□□X□ (/N-CL (Reverse External Torque Limit Input) Signal Allocation) to allocate the /N-CL signal to another connector pin. Refer to the following section for details.
☞ *5.3.3 Allocating Input Signals to Pins and Parameter Settings* on page 5-17

E-STP (Emergency Stop Input) Signal

This signal functions as the emergency stop command.

Type	Signal	Pin	Signal Status	Meaning
Input	E-STP	15 [default setting]	ON (closed)	The emergency stop is cleared.
			OFF (open)	An emergency stop is performed. (The motor is decelerated to a stop at the emergency stop torque and the system is changed to the SERVO OFF state.)

Note: Use PnBB8 = n.□□X□ (E-STP (Emergency Stop Input) Signal Allocation) to allocate the E-STP signal to another connector pin. Refer to the following section for details.
☞ *5.3.3 Allocating Input Signals to Pins and Parameter Settings* on page 5-17

5.3.2 Output Signals

/INPOSITION (Positioning Completion Output) Signal

This signal indicates that Servomotor positioning has been completed.

The /INPOSITION signal is output when the difference between the reference position from the host controller and the current position is equal to or less than the setting of PnB2D (Positioning Completed Width).

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

Type	Signal	Pin	Signal Status	Meaning
Output	/INPOSITION	18 [default setting]	ON (closed)	Positioning has been completed.
			OFF (open)	Positioning has not been completed.

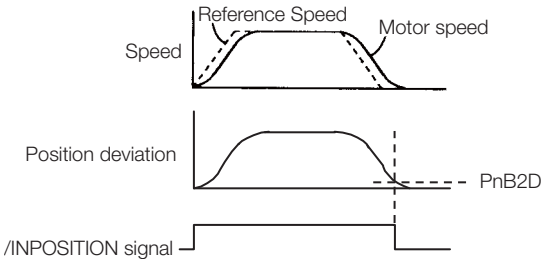
Note: Use PnBC0 = n.□□X□ (/INPOSITION (Positioning Completion Output) Signal Allocation) to allocate the /INPOSITION signal to another connector pin. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

◆ Setting the Positioning Completed Width

The /INPOSITION signal is output when the difference between the target position and the current position is equal to or less than the setting of PnB2D (Positioning Completed Width).

PnB2D	Positioning Completed Width				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 99,999	Reference units	10	Immediately	Setup

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



◆ Setting the Output Timing of the /INPOSITION (Positioning Completion Output) Signal

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

Parameter		Name	Description	When Enabled	Classification
Pn207	n. 0□□□ [default setting]	/INPOSITION (Positioning Completion Output) Signal Output Timing	Output the /INPOSITION signal when the absolute value of the position deviation is the same or less than the setting of PnB2D (Positioning Completed Width).	After restart	Setup
	n. 1□□□		Reserved setting (Do not use.)		
	n. 2□□□		Output the /INPOSITION signal when the absolute value of the position deviation is the same or less than the setting of PnB2D (Positioning Completed Width) and the reference input is 0.		

/WARN (Warning Output) Signal

This signal is for a warning issued before the occurrence of an alarm.

Type	Signal	Pin	Signal Status	Meaning
Output	/WARN	Must be allocated.	ON (closed)	Warning
			OFF (open)	Normal status

Note: 1. The SERVO OFF state is not entered when a warning occurs.
2. You must allocate the /WARN signal to use it. Use PnBC9 = n.□□X□ (/WARN (Warning Output) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

/BK (Brake Output) Signal

This signal functions as the brake operation command. Use it when it is necessary to achieve a brake system in the equipment driven by the motor.

The Servomotor does not have its own brake. Prepare a brake system in your equipment as required using this signal.

Type	Signal	Pin	Signal Status	Meaning
Output	/BK	Must be allocated.	ON (closed)	Releases the brake.
			OFF (open)	Operates the brake.

Note: You must allocate the /BK signal to use it. Use PnBCA = n.□□X□ (/BK (Brake Output) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

/S-RDY (Servo Ready Output) Signal

This signal indicates when the Servomotor is ready to receive the /S-ON (SERVO ON Input) signal.

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

- The power supply is ON.
- There are no alarms.
- Emergency stop status does not exist.

Type	Signal	Pin	Signal Status	Meaning
Output	/S-RDY	Must be allocated.	ON (closed)	Ready to receive the /S-ON (SERVO ON) signal.
			OFF (open)	Not ready to receive the /S-ON (SERVO ON) signal.

Note: You must allocate the /S-RDY signal to use it. Use PnBCB = n.□□X□ (/S-RDY (Servo Ready) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

/CLT (Torque Limit Status Output) Signal

This signal indicates whether the motor output torque is being limited.

Type	Signal	Pin	Signal Status	Meaning
Output	/CLT	20 [default setting]	ON (closed)	The motor output torque is being limited.
			OFF (open)	The motor output torque is not being limited.

Note: Use PnBCC = n.□□X□ (/CLT (Torque Limit Status Output) Signal Allocation) to allocate the /CLT signal to another connector pin. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

/TGON (Rotation Detection Output) Signal

This signal indicates that the Servomotor is operating.

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

Type	Signal	Pin	Signal Status	Meaning
Output	/TGON	Must be allocated.	ON (closed)	The Servomotor is operating at the setting of Pn502 or faster.
			OFF (open)	The Servomotor is operating at a speed that is slower than the setting of Pn502.

Note: You must allocate the /TGON signal to use it. Use PnBCD = n.□□X□ (/TGON (Rotation Detection Output) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

◆ Setting the Rotation Detection Level

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

Pn502	Rotation Detection Level				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 10,000	1 min^{-1}	30	Immediately	Setup

/NEAR (Near Output) Signal

This signal indicates when the motor position is close to the completion of positioning.

The host controller receives the /NEAR signal before it receives the /INPOSITION (Positioning Completion) signal so 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 /INPOSITION (Positioning Completion Output) signal.

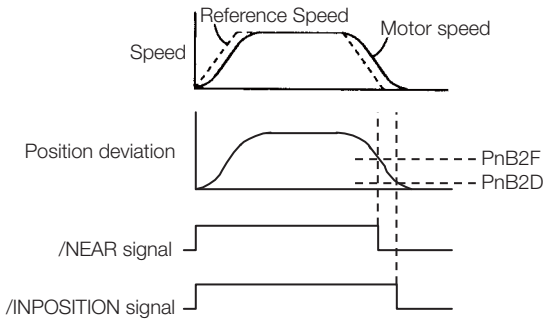
Type	Signal	Pin	Signal Status	Meaning
Output	/NEAR	Must be allocated.	ON (closed)	The Servomotor has reached a point near to positioning completion.
			OFF (open)	The Servomotor has not reached a point near to positioning completion.

Note: You must allocate the /NEAR signal to use it. Use PnBCE = n.□□X□ (/NEAR (Near Output) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

◆ Setting the Position Near Width

You set the condition for outputting the /NEAR (Near Output) signal in PnB2F (Near Width). The /NEAR signal is output when the difference between the target position and current position is equal to or less than the setting of PnB2F.

PnB2F	Near Width				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 99,999	Reference units	10	Immediately	Setup



Note: Normally, set PnB2F to a value that is larger than the setting of PnB2D (Positioning Completed Width).

/POSRDY (Homing Completed Output) Signal

This signal is output when the position information becomes valid after homing is completed.

Type	Signal	Pin	Signal Status	Meaning
Output	/POSRDY	23 [default setting]	ON (closed)	The position information is valid.
			OFF (open)	The position information is not yet valid.

Note: Use PnBD2 = n.□□X□ (/POSRDY (Homing Completed Output) Signal Allocation) to allocate the /POSRDY signal to another connector pin. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

/BUSY (Busy Output) Signal

This signal indicates that the Servomotor is performing a positioning operation, pressing operation, or other operation.

Type	Signal	Pin	Signal Status	Meaning
Output	/BUSY	22 [default setting]	ON (closed)	The Servomotor is operating.
			OFF (open)	The Servomotor is stopped.

Note: Use PnBD1 = n.□□X□ (/BUSY (Busy Output) Signal Allocation) to allocate the /BUSY signal to another connector pin. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

/S-ONS (SERVO ON Status Output) Signal

This signal indicates whether the SERVOPACK is in the SERVO ON or SERVO OFF state.

Type	Signal	Pin	Signal Status	Meaning
Output	/S-ONS	24 [default setting]	ON (closed)	SERVO ON
			OFF (open)	SERVO OFF

Note: Use PnBD4 = n.□□X□ (/S-ONS (SERVO ON Status Output) Signal Allocation) to allocate the /S-ONS signal to another connector pin. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

E-STPS (Emergency Stop Status Output) Signal

The signal indicates when an emergency stop is in effect.

Type	Signal	Pin	Signal Status	Meaning
Output	E-STPS	25 [default setting]	ON (closed)	The emergency stop was cleared.
			OFF (open)	An emergency stop is in effect.

Note: Use PnBD5 = n.□□X□ (E-STPS (Emergency Stop Status Output) Signal Allocation) to allocate the E-STPS signal to another connector pin. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

/PCO (Encoder Origin) Signal

This signal is output when the encoder origin is passed. One pulse is output for each Servomotor rotation.

Type	Signal	Pin	Signal Status	Meaning
Output	/PCO	21 [default setting]	ON (closed)	Encoder origin.
			OFF (open)	Not encoder origin.

Note: 1. Use the /PCO signal on the rising edge.
2. Use PnBD0 = n.□□X□ (/PCO (Encoder Origin Output) Signal Allocation) to allocate the /PCO signal to another connector pin. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

/ZONE0 to /ZONE3 (ZONE Output) Signals

These signals indicate when the current position is within a zone specified in the ZONE table.

Type	Signal	Pin	Signal Status	Meaning
Output	/ZONE0 to /ZONE3	Must be allocated.	ON (closed)	ON = 1, OFF = 0 The /ZONE0 to /ZONE3 signals specify a 4-bit binary number. ZONE0 to ZONE3 specify a zone.
			OFF (open)	

Note: You must allocate the /ZONE0 to /ZONE3 signals to use them. Use PnBD6 = n.□□X□ to PnBD9 = n.□□X□ (/ZONE0 to /ZONE3 (ZONE Output) Signal Allocations) to allocate the signals to connector pins. Refer to the following section for details.
☞ *5.3.4 Allocating Output Signals to Pins and Parameter Settings* on page 5-18

ALM (Servo Alarm Output) Signal

This signal is output when the SERVOPACK detects an error.

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

Type	Signal	Pin	Signal Status	Meaning
Output	ALM	19	ON (closed)	Normal SERVOPACK status
			OFF (open)	SERVOPACK alarm

Note: 1. The Servomotor changes to the SERVO OFF state when there is an alarm.
2. Refer to the following section for information on the alarm reset methods.
☞ *10.1.6 Alarm Reset* on page 10-17

5.3.3 Allocating Input Signals to Pins and Parameter Settings

Although you can use the input signals with the default settings, you can also allocate the desired input signals to pins 9 to 16 on the I/O signal connector (CN1). You set the allocations in the following parameters: n.□□X□ of PnBA2, PnBA5, PnBAF, PnBB2, and PnBB4 to PnBB8.

Important

- If you change the polarity of the /S-ON (SERVO ON Input) signal from the default setting, you may not be able to turn OFF the power supply to the Servomotor if signal lines break or other problems occur. If you must change the polarity of one of these signals, verify operation and make sure that no safety problems will exist.
- If you allocate more than one signal 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.

Input signals are allocated as shown in the following table.

Refer to *Interpreting an Input Signal Allocation Table* and change the allocations accordingly.

Interpreting an Input Signal Allocation Table

Input Signal	Parameter	CN1 Pin No.							
		9	10	11	12	13	14	15	16
/STOP	PnBA2 = n.□□X□	**0**	1	2	3	4	5	6	7

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

Input Signal	Parameter	CN1 Pin No.							
		9	10	11	12	13	14	15	16
/STOP	PnBA2 = n.□□X□	**0**	1	2	3	4	5	6	7
/HOME	PnBA5 = n.□□X□	**0**	1	2	3	4	5	6	7
/S-ON	PnBAF = n.□□X□	0	**1**	2	3	4	5	6	7
/DEC	PnBB2 = n.□□X□	0	1	**2**	3	4	5	6	7
/ALM-RST	PnBB4 = n.□□X□	0	1	2	**3**	4	5	6	7
/P-CL	PnBB5 = n.□□X□	0	1	2	3	**4**	5	6	7
/N-CL	PnBB6 = n.□□X□	0	1	2	3	**4**	5	6	7
/CLR	PnBB7 = n.□□X□	0	1	2	3	4	**5**	6	7
E-STP	PnBB8 = n.□□X□	0	1	2	3	4	5	**6**	7

Example of Changing Input Signal Allocations

The following example shows reversing the /S-ON signal allocated to CN1-10 and the /DEC signal allocated to CN1-11.

PnBAF = n.□□10 PnBB2 = n.□□20 Before change

↓ ↓

PnBAF = n.□□20 PnBB2 = n.□□10 After change

Refer to the following section for the parameter setting procedure.

☞ *5.1.3 Parameter Setting Methods* on page 5-5

Confirming Input Signals

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

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

5.3.4 Allocating Output Signals to Pins and Parameter Settings

Although you can use the output signals with the default settings, you can also allocate the output signals to pins 18 and 20 to 28 on the I/O signal connector (CN1). You set the allocations in the following parameters: n.□□X□ of PnBC0, PnBC9 to PnBCE, PnBD0 to PnBD2, and PnBD4 to PhBD9.

Important

- The signals that are not detected are considered to be OFF.
- If you allocate more than one signal to the same output circuit, a logical OR of the signals will be output.

Output signals are allocated as shown in the following table.

Refer to *Interpreting an Output Signal Allocation Table* and change the allocations accordingly.

Interpreting an Output Signal Allocation Table

Output Signal	Parameter	CN1 Pin No.									
		18	20	21	22	23	24	25	26	27	28
/INPOSITION	PnBC0 = n.□□X□	0	1	2	3	4	5	6	7	8	9

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

□ : Default settings.

Output Signal	Parameter	CN1 Pin No.									
		18	20	21	22	23	24	25	26	27	28
/INPOSITION	PnBC0 = n.□□X□	0	1	2	3	4	5	6	7	8	9
/WARN	PnBC9 = n.□□X□	0	1	2	3	4	5	6	7	8	9
/BK	PnBCA = n.□□X□	0	1	2	3	4	5	6	7	8	9
/S-RDY	PnBCB = n.□□X□	0	1	2	3	4	5	6	7	8	9
/CLT	PnBCC = n.□□X□	0	1	2	3	4	5	6	7	8	9
/TGON	PnBCD = n.□□X□	0	1	2	3	4	5	6	7	8	9
/NEAR	PnBCE = n.□□X□	0	1	2	3	4	5	6	7	8	9
/PCO	PnBD0 = n.□□X□	0	1	2	3	4	5	6	7	8	9
/BUSY	PnBD1 = n.□□X□	0	1	2	3	4	5	6	7	8	9
/POSRDY	PnBD2 = n.□□X□	0	1	2	3	4	5	6	7	8	9
/S-ONS	PnBD4 = n.□□X□	0	1	2	3	4	5	6	7	8	9
E-STPS	PnBD5 = n.□□X□	0	1	2	3	4	5	6	7	8	9
/ZONE0	PnBD6 = n.□□X□	0	1	2	3	4	5	6	7	8	9

Continued from previous page.

Output Signal	Parameter	CN1 Pin No.									
		18	20	21	22	23	24	25	26	27	28
/ZONE1	PnBD7 = n.□□X□	0	1	2	3	4	5	6	7	8	9
/ZONE2	PnBD8 = n.□□X□	0	1	2	3	4	5	6	7	8	9
/ZONE3	PnBD9 = n.□□X□	0	1	2	3	4	5	6	7	8	9

Example of Changing Output Signal Allocations

The following example shows allocating to CN1-21 the /INPOSITION signal that is allocated to CN1-18.

PnBC0 = n.□□0□ Before change

↓

PnBC0 = n.□□2□ After change

Refer to the following section for the parameter setting procedure.

☞ *5.1.3 Parameter Setting Methods* on page 5-5

Checking Output Signal Status

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

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

5.3.5 Setting I/O Signal Status with Parameters

You can use the n.□□□X digit in the parameters to change the signal polarities, make the signals always active or always inactive, or to make other settings. Refer to the following section for details.

☞ *11.1.2 List of Parameters* on page 11-2

Example

An example of changing the signal polarity of the /DEC (Homing Deceleration Switch) signal and other examples are given below.

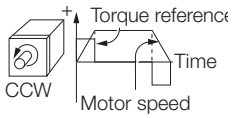
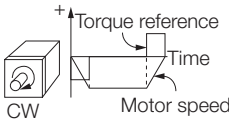
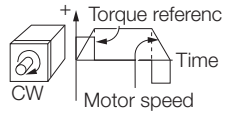
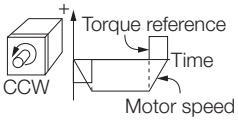
- Reversing Signal Polarity
  PnBB2 = n.□□□0 → PnBB2 = n.□□□1
- Making a Signal Always Active
  PnBB2 = n.□□□0 → PnBB2 = n.□□□2
- Making a Signal Always Inactive
  PnBB2 = n.□□□0 → PnBB2 = n.□□□3

5.4 Settings That Must Be Adjusted to the System

5.4.1 Motor Direction Setting

You can reverse the direction of Servomotor rotation by changing the setting of Pn000 = n.□□□X (Direction Selection) without changing the polarity of the position reference.

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

Parameter		Forward/ Reverse Reference	Feedback Signal from SERVOPACK
Pn000	n.□□□0 Use CCW as the forward direction. [default setting]	Forward reference	
		Reverse reference	
	n.□□□1 Use CW as the forward direction. (Reverse Rotation Mode)	Forward reference	
		Reverse reference	

5.4.2 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.

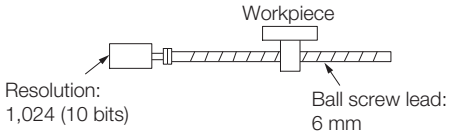
The electronic gear is used to convert the travel distances that are specified in reference units to pulses, which are required for actual movements.

With the electronic gear, one reference unit is equal to the workpiece travel distance per pulse reference 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 mm.



If you do not use the electronic gear, you must calculate the number of reference pulses for each reference.

To move a workpiece 10 mm:
①Calculate the number of revolutions.
The motor will move 6 mm for each revolution, so 10/6 revolutions are required to move 10 mm.
②Calculate the required number of reference pulses.
One revolution is 1,024 pulses, therefore
10/6 × 1,024 = 1,706.66 pulses.
③Input 1,707 pulses as the reference.

If you use the electronic gear, it is not necessary to calculate the number of reference pulses for each reference.

If you use reference units to move the workpiece when one reference unit is set to 20 μm, the travel distance is 20 μm per pulse. To move the workpiece 10 mm (10,000 μm), 10,000 ÷ 20 = 500 pulses, so 500 pulses would be input.

Electronic Gear Ratio Settings

Set the electronic gear ratio using Pn20E and Pn210.

Important

Set the electronic gear ratio within the following range.
0.01 ≤ Electronic gear ratio (B/A) ≤ 100
If the electronic gear ratio is outside of this range, an A.040 alarm (Parameter Setting Error) will occur.

	Electronic Gear Ratio (Numerator)				
Pn20E	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 65,535	1	1	After restart	Setup
	Electronic Gear Ratio (Denominator)				
Pn210	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 65,535	1	1	After restart	Setup

◆ Calculating the Settings for the Electronic Gear Ratio

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

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

■ Encoder Resolution

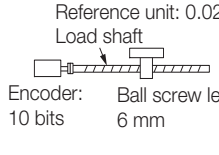
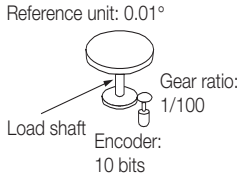
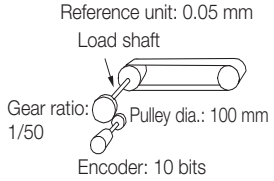
You can check the encoder resolution in the Servomotor model number.

SGMSL -□□□□□□□

Code	Specification	Encoder Resolution
K	10-bit incremental encoder	1,024

Electronic Gear Ratio Setting Examples

Setting examples are provided in this section.

Step	Description	Machine Configuration		
		Ball Screw	Rotary Table	Belt and Pulley
				
1	Machine Specifications	• Ball screw lead: 6 mm • Gear ratio: 1/1	• Rotation angle per revolution: 360° • Gear ratio: 1/100	• Pulley dia.: 100 mm (Pulley circumference: 314 mm) • Gear ratio: 1/50
2	Encoder Resolution	1,024 (10 bits)	1,024 (10 bits)	1,024 (10 bits)
3	Reference Unit	0.002 mm (20 μm)	0.01°	0.05 mm (50 μm)
4	Travel Distance per Load Shaft Revolution (Reference Units)	6 mm/0.02 mm = 300	360°/0.01° = 36,000	314 mm/0.05 mm = 6,280
5	Electronic Gear Ratio	$\frac{B}{A} = \frac{1,024}{300} \times \frac{1}{1}$	$\frac{B}{A} = \frac{1,024}{36,000} \times \frac{100}{1}$	$\frac{B}{A} = \frac{1,024}{6,280} \times \frac{50}{1}$
6	Parameters	Pn20E: 1,024	Pn20E: 10,240	Pn20E: 51,200
		Pn210: 300	Pn210: 3,600	Pn210: 6,280

5.4.3 Torque Limit Selection

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

There are two ways to limit torque.

Limit Method	Description	Reference
Internal Torque Limits	The torque is always limited with the setting of a parameter.	*Internal Torque Limits* on page 5-22
External Torque Limits	The torque is limited with an input signal from the host computer.	*External Torque Limits* on page 5-23

Note: 1. If more than one torque limit is enabled, the smallest torque limit is used.
2. If you set a value that exceeds the maximum torque of the Servomotor, the torque will be limited to the maximum torque of the Servomotor.

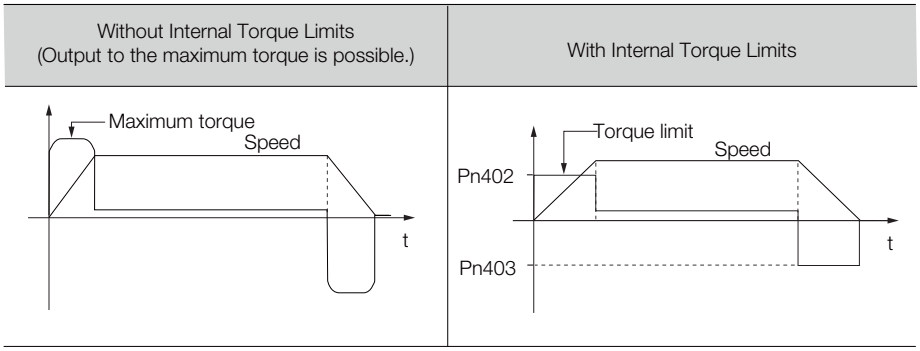
Internal Torque Limits

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

Pn402	Forward Torque Limit				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	800	Immediately	Setup
Pn403	Reverse Torque Limit				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	800	Immediately	Setup

* Set a percentage of the rated motor torque.

Note: If the setting of Pn402 or Pn403 is too low, the torque may be insufficient for acceleration or deceleration of the Servomotor.



External Torque Limits

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

◆ External Torque Limit Reference Signals

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

You must allocate the /P-CL and /N-CL signals to use them. Use PnBB5 = n.□□XX (/P-CL (Forward External Torque Limit Input) Signal Allocation) and PnBB6 = n.□□XX (/N-CL (Reverse External Torque Limit Input) Signal Allocation) to allocate the /P-CL and /N-CL signals to connector pins.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/P-CL	13 [default setting]	ON (closed)	Applies the forward external torque limit.
			OFF (open)	Cancels the forward external torque limit.
	/N-CL	13 [default setting]	ON (closed)	Applies the reverse external torque limit.
			OFF (open)	Cancels the reverse external torque limit.

◆ Setting the Torque Limits

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

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

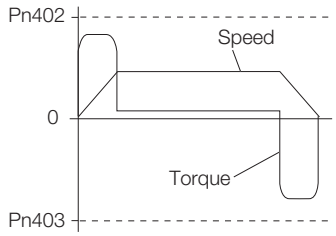
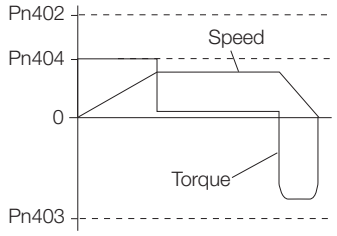
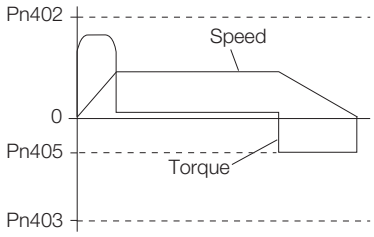
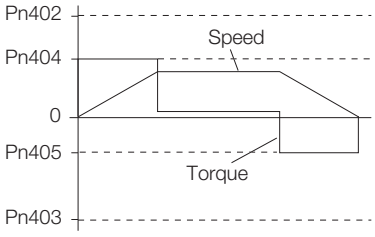
Pn404	Forward External Torque Limit				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	100	Immediately	Setup
Pn405	Reverse External Torque Limit				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	100	Immediately	Setup

* Set a percentage of the rated motor torque.

◆ Changes in the Output Torque for External Torque Limits

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

In this example, the Servomotor direction is set to Pn000 = n.□□□0 (Use CCW as the forward direction).

		/P-CL signal	
		OFF	ON
/N-CL signal	OFF		
	ON		

5.4.4 Software Limits

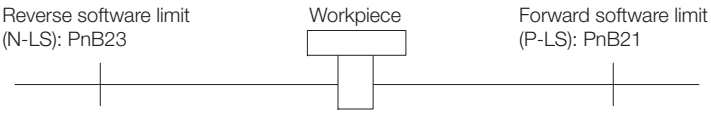
You can set software limits for safety. The Servomotor will be forced to stop if the current position exceeds the setting of the forward software limit (P-LS) (PnB21) or the setting of the reverse software limit (N-LS) (PB23).

PnB21	Forward Software Limit (P-LS)				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-99,999,999 to 99,999,999	Reference units	0	After restart	Setup
PnB23	Reverse Software Limit (N-LS)				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-99,999,999 to 99,999,999	Reference units	0	After restart	Setup
PnB25	Home Position				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-99,999,999 to 99,999,999	Reference units	0	After restart	Setup

For a ball screw or other equipment with linear motion, set the forward software limit (P-LS) in PnB21 and set the reverse software limit (N-LS) in PnB23.

An A.A9F warning (Motion Error Warning) will occur if the positioning target point exceeds a software limit. If you set both PnB21 and PnB23 to 0, the software limits are disabled.

The software limits are enabled when homing is completed. However, if PnB31 is set to 0 (operate without homing), the software limits are enabled as soon as the power supply is turned ON.



5.4.5 Motor Overload Detection Level

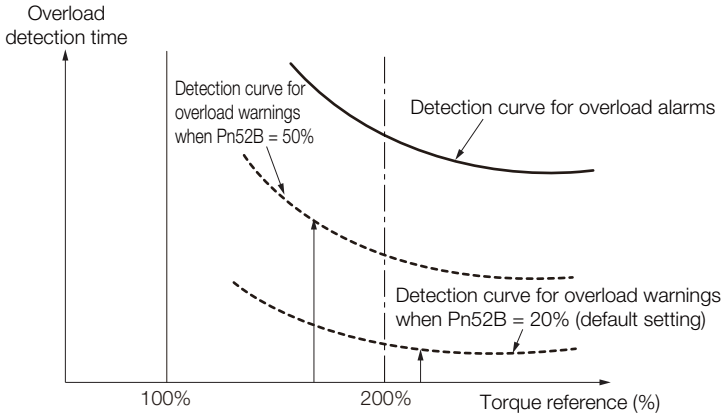
The motor overload detection level is the threshold used to detect overload alarms and overload warnings when the Servomotor is subjected to a continuous load that exceeds the Servomotor ratings.

It is designed to prevent Servomotor overheating.

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

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				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 100	1%	20	Immediately	Setup

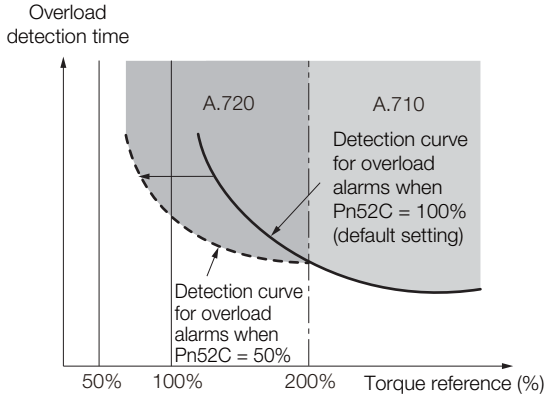
Detection Timing for Overload Alarms (A.720)

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

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

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

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



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

Refer to the relevant manual given below for a diagram that shows the relationships between the 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.

☞ *Chapter 2 Selection*

5.4.6 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 system is in the SERVO OFF state 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 three seconds.
   Before you execute a software reset, check the status of the SERVOPACK and Servomotor and make sure that no problems will occur.

Preparations

Confirm that the following conditions are met before you perform a software reset.

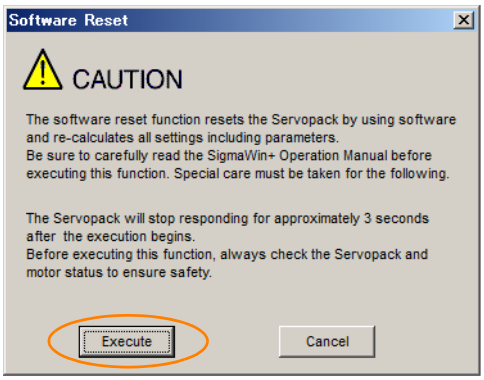
- The system must be in the SERVO OFF state.
- The motor must be stopped.

Operating Procedure

Use the following procedure to perform a software reset.

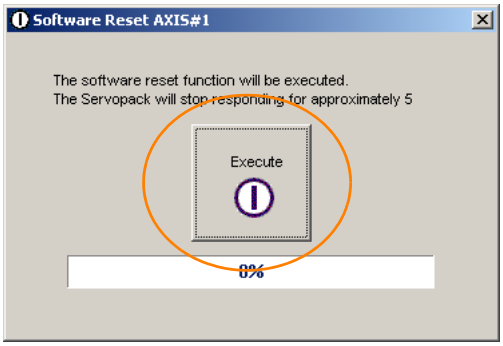
1. Select ***Setup*** - ***Software Reset*** from the menu bar of the Main Window of the SigmaWin+.

2. Click the **Execute** Button.

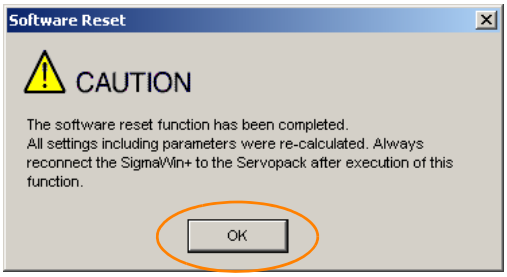


Click the **Cancel** Button to cancel the software reset. The Main Window will return.

3. Click the **Execute** Button.



4. 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.



5.4.7 Adjusting the Motor Current Detection Signal Offset

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

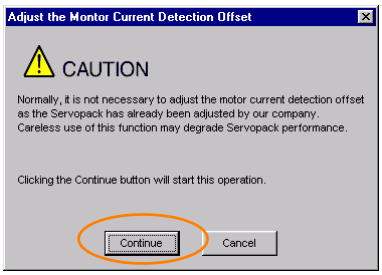
The following conditions must be met to automatically adjust the motor current detection signal offset.

- The parameters must not be write prohibited.
- The servo must be in ready status.
- The system must be in the SERVO OFF state.

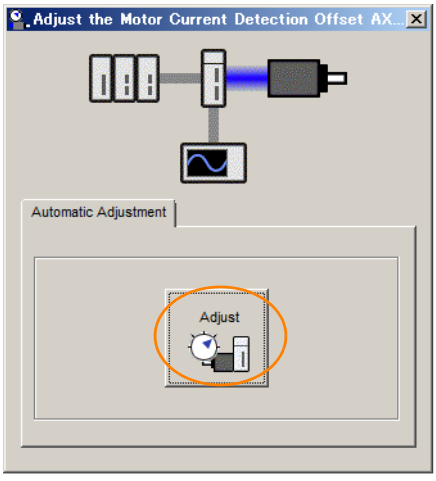
◆ Operating Procedure

Use the following procedure.

1. Select ***Setup - Adjust Offset - Adjust the Motor Current Detection Offset.*** from the menu bar of the Main Window of the SigmaWin+.
2. Click the **Continue** Button.



3. Click the **Adjust** Button.



5.5 Settings for References

5.5.1 Smoothing

Smoothing allows you to apply a filter to the position reference to produce smoother Servomotor operation.

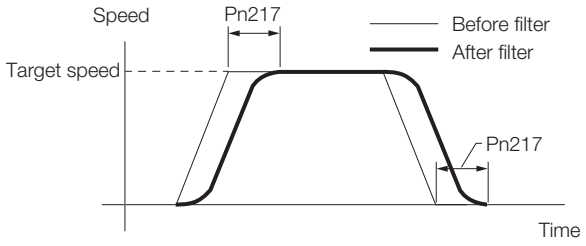
Note: Smoothing does not affect the travel distance.

The following parameters are related to smoothing.

	Average Position Reference Movement Time				
Pn217	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	0.1 ms	0*	Immediately after the motor stops	Setup

* The filter is disabled if you set the parameter to 0.

Note: Change the setting only when the motor is stopped.



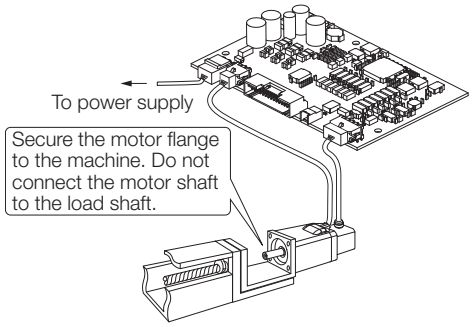
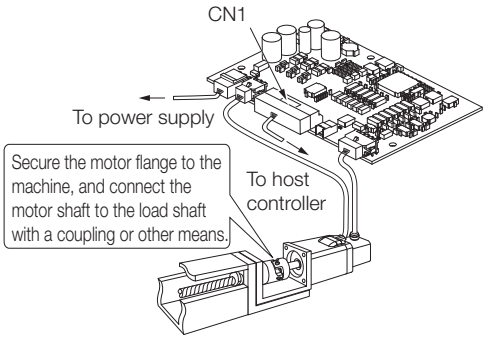
Trial Operation

6

This chapter provides information on the flow and procedures for trial operation and convenient functions to use during trial operation.

6.1 Flow of Trial Operation

The procedure for trial operation is given below.

Step		Meaning	Reference
Preparations for Trial Operation	1	Installation Install the Servomotor and SERVOPACK according to the installation conditions. First, operation is checked with no load. Do not connect the Servomotor to the machine.	*Chapter 3 Installation*
	2	Wiring and Connections Wire and connect the SERVOPACK. First, Servomotor operation is checked without a load. Do not connect the CN1 connector on the SERVOPACK.	*Chapter 4 Wiring and Connections*
	3	Confirmations before Trial Operation	*6.2 Inspections and Confirmations before Trial Operation* on page 6-3
	4	Power ON	–
Trial Operation	5	Trial Operation from the Host Controller for the Servomotor without a Load 	*6.3 Trial Operation for the Servomotor without a Load* on page 6-4
	6	Trial Operation with the Servomotor Connected to the Machine 	*6.5 Trial Operation with the Servomotor Connected to the Machine* on page 6-10

6.2 Inspections and Confirmations before Trial Operation

To ensure safe and correct trial operation, check the following items before you start trial operation.

- Make sure that the SERVOPACK and Servomotor are installed, wired, and connected correctly.
- Make sure that the correct power supply voltage is supplied to the SERVOPACK.
- Make sure that there are no loose parts in the Servomotor mounting.
- If you are performing trial operation on a Servomotor that has been stored for a long period of time, make sure that all Servomotor inspection and maintenance procedures have been completed.

6.3 Trial Operation for the Servomotor without a Load

You perform jog operation from the SigmaWin+ for trial operation of the Servomotor without a load. Jog operation from the SigmaWin+ is used to check the operation of the Servomotor without connecting the SERVOPACK to the host controller. The Servomotor is moved at the preset jog speed and acceleration/deceleration rates according to commands from the SigmaWin+.

6.3.1 Preparations

Confirm the following conditions before you jog the Servomotor.

- The parameters must not be write prohibited.
- The power supply must be ON.
- There must be no alarms.
- The system must be in the SERVO OFF sate.
- Emergency stop status must not exist.
- The motor code of the Servomotor to use must be set in Pn08A (Motor Selection Switch).
- The jog speed must be set considering the operating range of the machine.
  The jog speed is set with the following parameters.

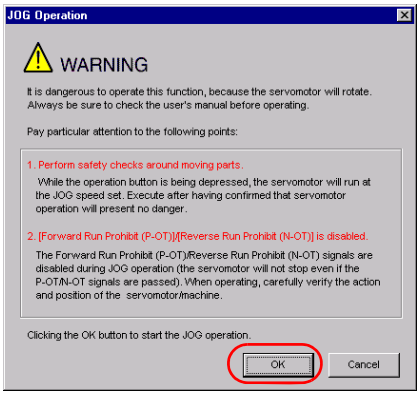
Pn304	Jog Speed				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 min^{-1}	500	Immediately	Setup
Pn305	Soft Start Acceleration Time				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup
Pn306	Soft Start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

6.3.2 Operating Procedure

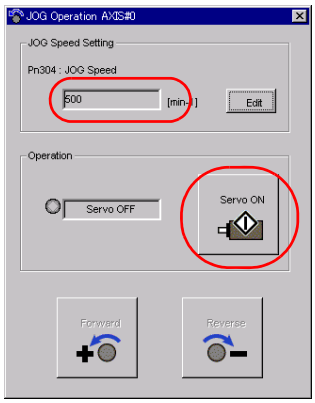
Use the following procedure.

1. Select ***Test Run - Jog*** from the menu bar of the Main Window of the SigmaWin+.
   The Jog Operation Dialog Box will be displayed.

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



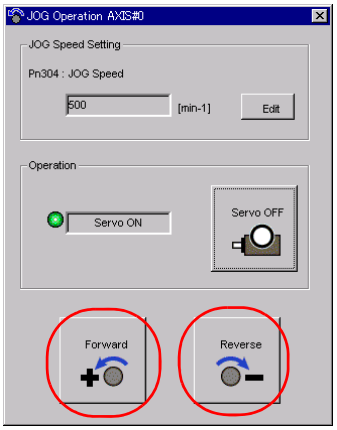
3. Check the jog speed and then click the **Servo ON** Button.



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.

4. Click the **Forward** Button or the **Reverse** Button.
Jog operation will be performed only while you hold down the mouse button.



5. After you finish jog operation, turn the power supply to the SERVOPACK OFF and ON again.

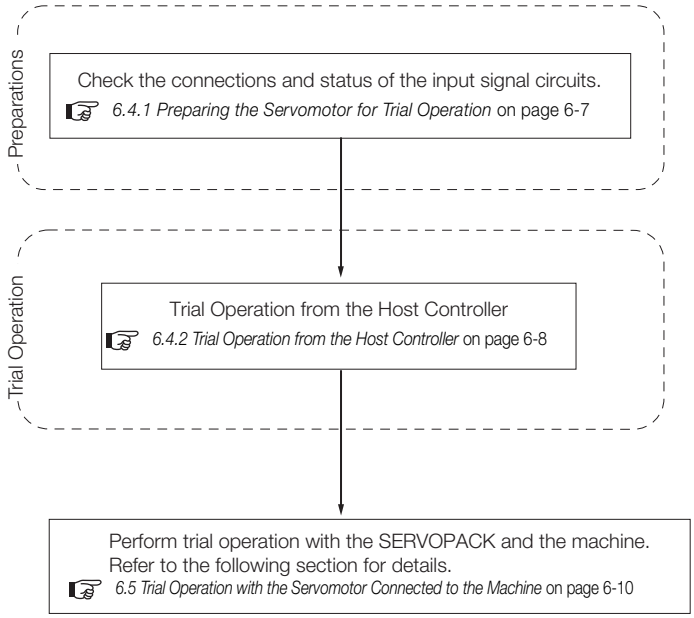
This concludes the jog operation procedure.

6.4 Trial Operation from the Host Controller for the Servomotor without a Load

Confirm the following items during trial operation from the host controller for the Servomotor without a load.

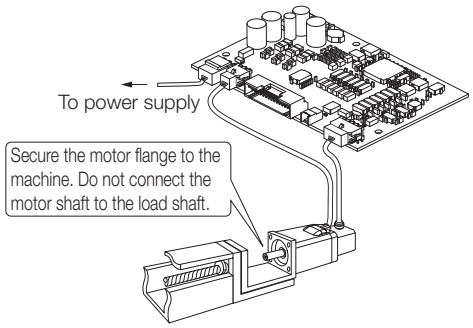
- Make sure that the Servomotor operation reference from the host controller to the SERVOPACK and the I/O signals are set up properly.
- Make sure that the wiring between the host controller and SERVOPACK and the polarity of the wiring are correct.
- Make sure that all operation settings for the SERVOPACK are correct.

The operation sequence for trial operation from the host controller for the Servomotor without a load is given below.



⚠ CAUTION

- Before you perform trial operation of the Servomotor without a load from the host controller, make sure that there is no load connected to the Servomotor (i.e., that all couplings and belts are removed from the Servomotor) to prevent unexpected accidents.



6.4.1 Preparing the Servomotor for Trial Operation

This section provides the procedure to prepare the Servomotor for trial operation.

Preparations

Confirm the following items before you perform the procedure to prepare the Servomotor for trial operation.

- Make sure that the preparations given in *6.1 Flow of Trial Operation* on page 6-2have been completed.
- Make sure that the trial operation described in *6.3 Trial Operation for the Servomotor without a Load* on page 6-4 has been completed.

Operating Procedure

The following procedure assumes that the default settings are used for the I/O signals required for trial operation. Refer to the following section for information on the default I/O signal settings.

☞ *4.2 Basic Wiring Diagrams* on page 4-7

1. Wire the I/O signals from the host controller.
   Refer to the following section for details.
   ☞ *4.2 Basic Wiring Diagrams* on page 4-7

2. Check the following items.

   ①Make sure that the /S-ON (SERVO ON) signal can be input.

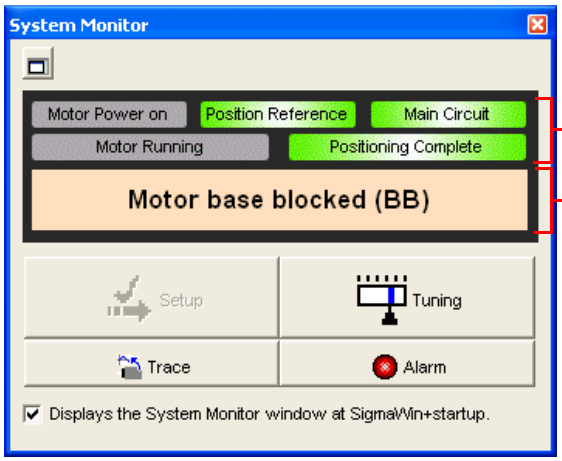
   ②Make sure that the E-STP (Emergency Stop Input) signal is ON (closed) (normal status).
   Setting Method
   - Input the signal to turn ON (close) CN1-15.
   - Set PnBB8 to n.□□□3 (Always disable emergency stops).

   ③Make sure that a reference is not being input.

3. Connect the I/O Signal Cable to the I/O signal connector (CN1).

4. Turn ON the power supply to the SERVOPACK.

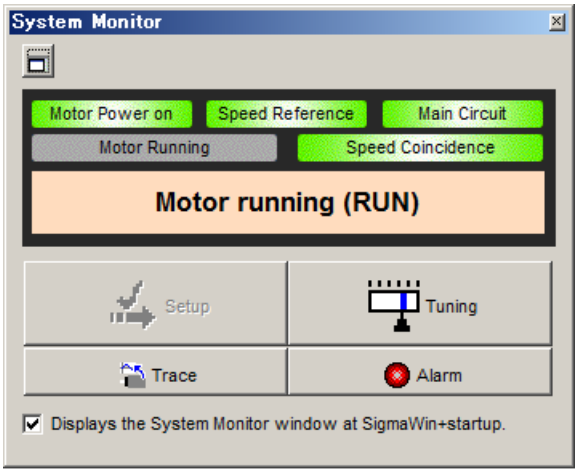
5. Confirm that the System Monitor display on the SigmaWin+ is as shown below.



6. Select ***Monitor - Check Wiring*** from the menu bar of the Main Window of the SigmaWin+ and check the status of the input signal.

7. Input the /S-ON (SERVO ON Input) signal.
   The servo will turn ON.

8. Confirm that the System Monitor display on the SigmaWin+ is as shown below.



If the above display appears, power is being supplied to the Servomotor and the servo is ON.
If an alarm is displayed, the servo is OFF and power is not being supplied to the Servomotor. Refer to the following section, clear the alarm, and repeat the procedure from step 4.

☞ *10.1.6 Alarm Reset* on page 10-17

9. If you changed the setting of PnBB8 in step 2, return the setting to its original value.

This concludes the procedure to prepare the Servomotor for trial operation.
Proceed to the following section.

☞ *6.4.2 Trial Operation from the Host Controller* on page 6-8

6.4.2 Trial Operation from the Host Controller

This section describes the procedure for trial operation from the host controller.

Preparations

Confirm the following item before you perform the procedure for trial operation from the host controller.

- Make sure that the procedure to prepare the Servomotor for trial operation described in *6.4.1 Preparing the Servomotor for Trial Operation* on page 6-7 has been completed.

Operating Procedure

In this procedure, the electronic gear is set in the SERVOPACK and not in the host controller.

1. Turn OFF the /S-ON (SERVO ON) signal from the host controller.
   The servo will turn OFF.
2. Set Pn200 = n.□□□X (Reference Pulse Form) to the reference pulse form of the host controller.
3. Set the reference unit and set the electronic gear ratio (Pn20E and Pn210) according to the host controller.
4. Turn the SERVOPACK power supply OFF and ON again.
   The new parameter settings will be enabled.
5. Input the /S-ON (SERVO ON) signal from the host controller.
   The servo will turn ON.

6. Input a low-speed pulse reference from the host controller.
   Use a travel distance (number of reference pulses) that is easy to check (for example, the number of pulses for one rotation).
   For safety, set the number of references pulses to approximately 100 min^{-1}.

7. Check the number of reference pulses that are input to the SERVOPACK from the changes in the input reference pulse counter before and after the reference.
   SigmaWin+ procedure: ***Monitor - Monitor - Motion Monitor***, **Reference Pulse Counter**

8. Check the actual number of motor rotations from the changes in the feedback pulse counter before and after the reference.
   SigmaWin+ procedure: ***Monitor - Monitor - Motion Monitor***, **Feedback Pulse Counter**

9. Confirm that the changes in the input reference pulse counter and the feedback pulse counter (i.e., the values from steps 7 and 8) satisfy the following equation.
   Change in input reference pulse counter = Change in feedback pulse counter x (Pn20E/Pn210)

10. Confirm that the Servomotor shaft is rotating in the direction specified by the reference.
    If the rotation direction does not agree with the reference direction, refer to the following section and change the rotation direction.
    ☞ *5.4.1 Motor Direction Setting* on page 5-20

11. Input a pulse reference for a comparatively large number of motor rotations from the host controller so that the Servomotor will operate at a constant speed.

12. Check the reference pulse speed input to the SERVOPACK with the input reference pulse speed monitor.
    SigmaWin+ procedure: ***Monitor - Monitor - Motion Monitor***, **Input Reference Pulse Speed**

    The input reference pulse monitor uses the following formula.

$$\text{Input reference pulse speed monitor} = \underbrace{\text{Input reference pulse speed [pulses/s]} \times 60}_{\text{Reference input pulse speed/min}} \times \underbrace{\frac{Pn20E}{Pn210}}_{\substack{\text{Electronic} \\ \text{gear ratio}}} \times \underbrace{\frac{1}{1024}}_{\text{Encoder pulses}}$$

13. Check the motor speed monitor.
    SigmaWin+ procedure: ***Monitor - Monitor - Motion Monitor***, **Motor Speed**

14. Confirm that the input reference pulse speed and the motor speed (i.e., the values from steps 12 and 13) are the same.

15. Stop the pulse reference from the host controller.

16. Turn OFF the /S-ON (SERVO ON) signal from the host controller.
    The servo will turn OFF.

This concludes the procedure for trial operation from the host controller. Proceed to the following section.

☞ *6.5 Trial Operation with the Servomotor Connected to the Machine* on page 6-10

6.5 Trial Operation with the Servomotor Connected to the Machine

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

6.5.1 Precautions

⚠ WARNING

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

Important

If you disabled the E-STP (Emergency Stop Input) signal for trial operation of the Servomotor without a load, enable the E-STP (Emergency Stop Input) signal before you preform trial operation with the Servomotor connected to the machine in order to provide protection.

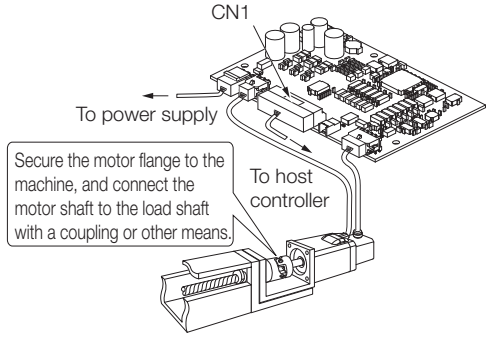
6.5.2 Preparations

Confirm the following items before you perform the trial operation procedure for both the machine and Servomotor.

- Make sure that the procedure described in *6.4 Trial Operation from the Host Controller for the Servomotor without a Load* on page 6-6 has been completed.
- Make sure that the SERVOPACK is connected correctly to both the host controller and the peripheral devices.
  - Emergency stop circuit wiring
  - Host controller wiring

6.5.3 Operating Procedure

1. Enable the E-STP (Emergency Stop Input) signal (PnBB8 = n.□□□1).
2. Set protection, such as the emergency stop.
3. Set the parameters that are required for operation.
4. Turn OFF the power supply to the SERVOPACK.
5. Couple the Servomotor to the machine.



6. Turn ON the power supplies to the machine and host controller and turn ON the power supply to the SERVOPACK.

7. Confirm that protection, such as the emergency stop, operates correctly.
   Note: Enable activating an emergency stop so that the Servomotor can be stopped safely should an error occur during the remainder of the procedure.

8. Input the /S-ON (SERVO ON) signal from the host controller.
   The servo will turn ON.

9. Perform trial operation according to *6.4 Trial Operation from the Host Controller for the Servomotor without a Load* on page 6-6 and confirm that the same results are obtained as when trial operation was performed on the Servomotor without a load.

10. Check the settings of the parameters and confirm that the Servomotor operates according to machine operating specifications.

11. If necessary, adjust the servo gain to improve the Servomotor response characteristics.
    The Servomotor and machine may not be broken in completely for the trial operation. Therefore, let the system run for a sufficient amount of time to ensure that it is properly broken in.

12. For future maintenance, save the parameter settings with one of the following methods.
    - Use the SigmaWin+ to save the parameters as a file.
    - Record the settings manually.

This concludes the procedure for trial operation with both the machine and Servomotor.

6.6 Convenient Function to Use during Trial Operation

This section describes some convenient operations that you can use during trial operation. Use them as required.

6.6.1 Program Jog Operation

You can use program jog operation to enter commands from the SigmaWin+ to perform continuous operation with an operation pattern (travel distance, movement speed, acceleration/deceleration time, waiting time, and number of movements) that you preset in the parameters.

Program jog operation is used in the same way as normal jog operation, i.e., to check Servomotor operation and for simple positioning operations.

Preparations

Confirm the following conditions before you perform program jog operation.

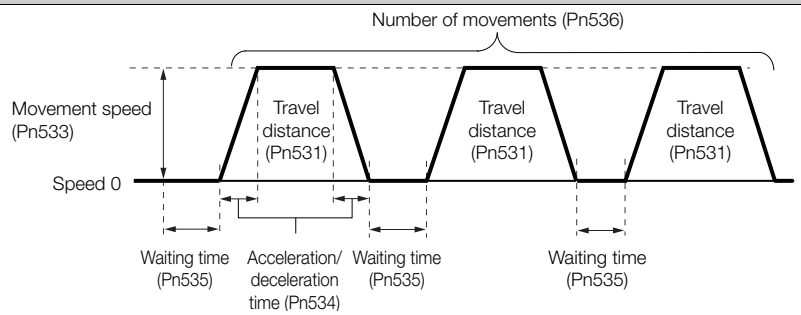
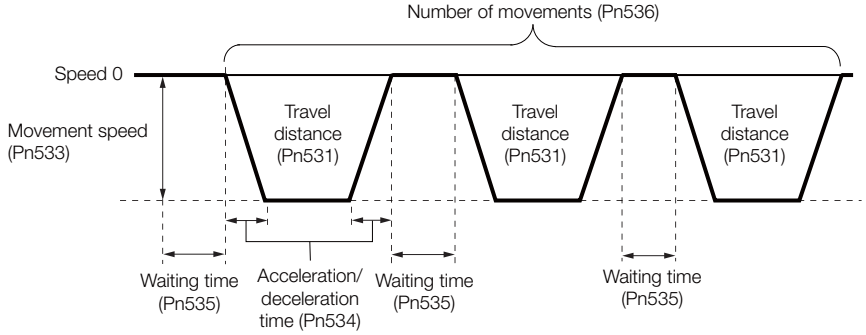
- The parameters must not be write prohibited.
- The power supply must be ON.
- There must be no alarms.
- The system must be in the SERVO OFF state.
- The range of machine motion and the safe movement speed of your machine must be considered when you set the travel distance and movement speed.

Additional Information

You can use the functions that are applicable to position control.

Program Jog Operation Pattern

An example of a program jog operation pattern is given below. In this example, the Servomotor 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	
n.□□□1	(Waiting time → Reverse by travel distance) × Number of movements	

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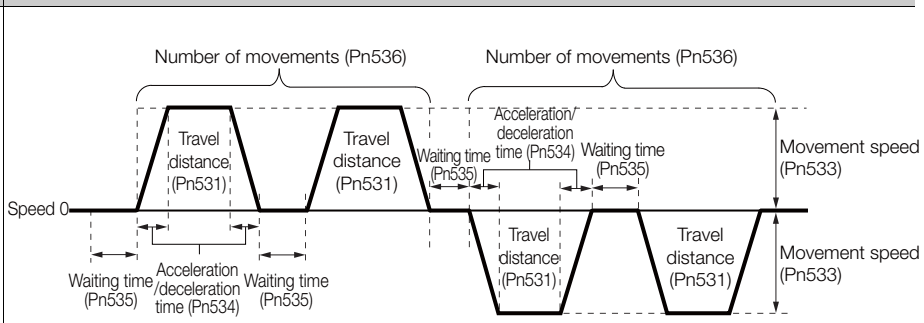
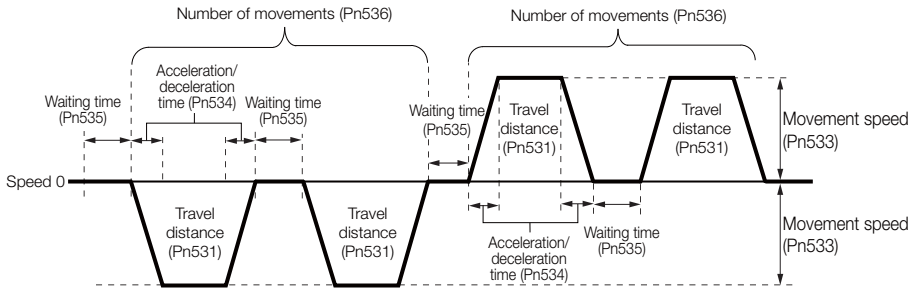
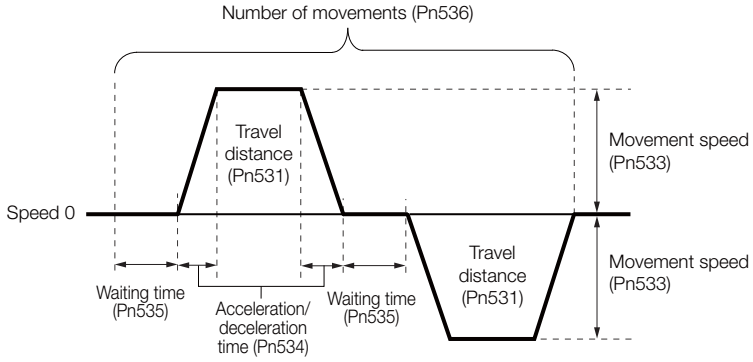
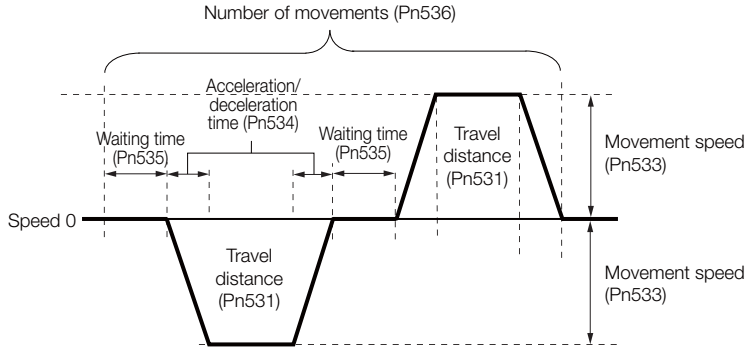
Setting of Pn530	Setting	Operation Pattern
n.□□□2	(Waiting time → Forward by travel distance) × Number of movements → (Waiting time → Reserve by travel distance) × Number of movements	
n.□□□3	(Waiting time → Reverse by travel distance) × Number of movements → (Waiting time → Forward by travel distance)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

Related Parameters

Use the following parameters to set the program jog operation pattern. Do not change the settings while the program jog operation is being executed.

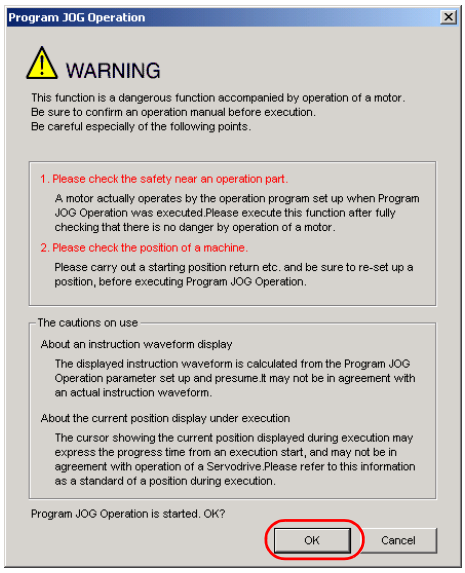
Pn530	Program Jog Operation-Related Selections				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0000 to 0005	–	0000	Immediately	Setup
Pn531	Program Jog Travel Distance				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,824	1 reference unit	1,024	Immediately	Setup
Pn533	Program Jog Movement Speed				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 10,000	1 min^{-1}	500	Immediately	Setup
Pn534	Program Jog Acceleration/Deceleration Time				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	2 to 10,000	1 ms	100	Immediately	Setup
Pn535	Program Jog Waiting Time				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	100	Immediately	Setup
Pn536	Program Jog Number of Movements				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,000	1	1	Immediately	Setup

Operating Procedure

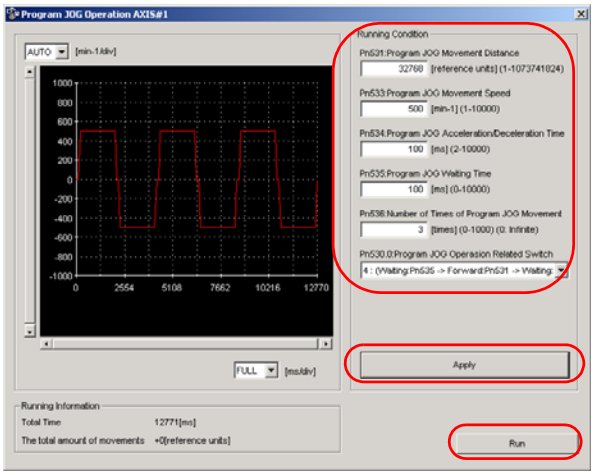
Use the following procedure.

1. Select ***Test Run - Program JOG Operation*** from the menu bar of the Main Window of the SigmaWin+.
   The Program Jog Operation Dialog Box will be displayed.

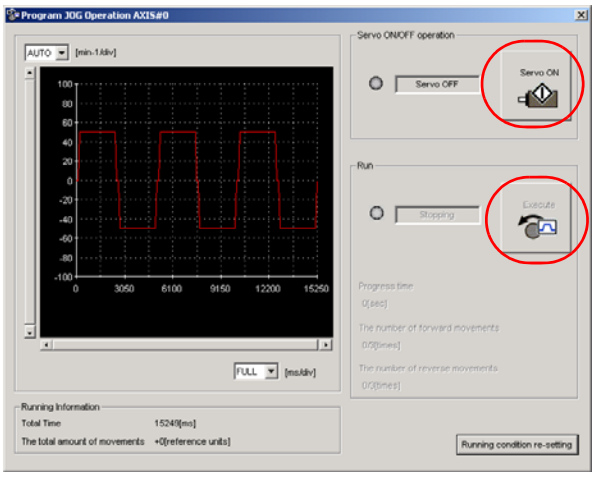
2. Read the warnings and then click the **OK** Button.



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



4. Click the **Servo ON** Button and then the **Execute** Button. The program jog operation will be executed.



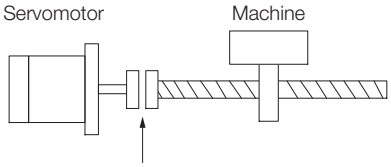
This concludes the program jog operation procedure.

6.6.2 Origin Search

⚠ CAUTION

- For an origin search, the motor will rotate until the origin is detected. Make sure that the load is not coupled when you execute an origin search.

An origin search is performed to position the motor to the encoder origin (phase C). Use an origin search when it is necessary to align the encoder origin (phase C) with the machine origin. When an origin search is performed, the motor rotates for one rotation or less at 60 min^{-1}.



To align the encoder origin (phase C) with the machine origin

Preparations

Confirm the following conditions before you start an origin search.

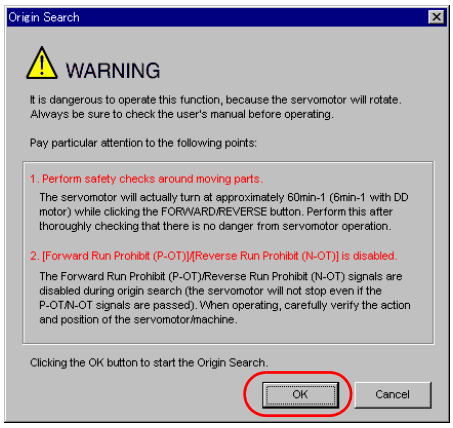
- The parameters must not be write prohibited.
- The power supply must be ON.
- There must be no alarms.
- The system must be in the SERVO OFF state.
- Emergency stop status must not exist.
- The motor code of the Servomotor to use must be set in Pn08A (Motor Selection Switch).

Operating Procedure

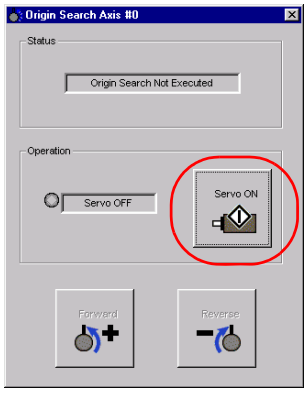
Use the following procedure.

1. Select ***Setup - Origin Search*** from the menu bar of the Main Window of the SigmaWin+.
   The Origin Search Dialog Box will be displayed.

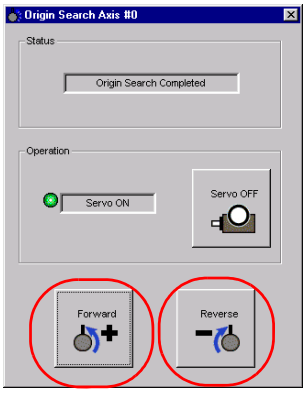
2. Read the warnings and then click the **OK** Button.



3. Click the **Servo ON** Button.



4. 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.

Operation and Functions

7

This chapter provides detailed information on positioning, homing, and ZONE outputs.

7.1 Operation Functions

The following three operation functions are provided.

- Homing
  This function is used to define the machine origin when the equipment power supply is turned ON.
- Positioning
  Positioning is used to input pulse train references from the host controller to the SERVOPACK to move to a target position. The position is controlled with the number of input pulses, and the speed is controlled with the input pulse frequency.
- ZONE Outputs
  This function outputs a zone number to indicate when the motor is within a preset zone.

7.2 Homing

Homing is used to define the machine origin when the equipment power supply is turned ON.

⚠ WARNING

- **Always perform homing before you start positioning. If you perform positioning without performing homing, positions cannot be managed so correct positioning may not be possible.** Unexpected machine operation, failure, or personal injury may occur.

7.2.1 Parameters Related to Homing

There are two types of parameters related to homing: parameters that define homing and parameters that specify conditions for executing homing.

Parameters That Define Homing

The following three parameters specify the homing method, homing direction, and startup /INPOSITION signal status.

◆ Parameter That Specifies the Homing Method

Specify the homing method with PnB31 = n.□□□X.

Parameter		Meaning	When Enabled	Classification
PnB31	n.□□□0 [default setting]	The position when power is turned ON is the origin. If the /HOME signal turns ON, an Illegal Homing Command Error (E5DE) will occur.	After restart	Setup
	n.□□□1	The /DEC signal and encoder phase C are used for homing.		
	n.□□□2	Only the /DEC signal is used for homing.		
	n.□□□3	Only the encoder phase C is used for homing.		
	n.□□□4	A pressing homing is performed.		
	n.□□□5	The /DEC signal and encoder phase C are used for homing. When the /DEC signal is detected, the homing direction is reversed.		

◆ Parameter That Specifies the Homing Direction

Specify whether to perform homing in the forward or in the reverse direction with PnB32 = n.□□□X.

Parameter		Meaning	When Enabled	Classification
PnB32	n.□□□0 [default setting]	Perform homing in the forward direction.	Immediately	Setup
	n.□□□1	Perform homing in the reverse direction.		

◆ Parameter That Specifies the Startup /INPOSITION Signal Status

Use PnB91 = n.□□□X to specify the status of the /INPOSITION signal when the power supply turns ON.

Parameter		Meaning	When Enabled	Classification
PnB91	n.□□□0 [default setting]	The /INPOSITION signal turns ON at startup. When the homing starts, the /INPOSITION signal turns OFF. It turns ON again when the homing is completed.	After restart	Setup
	n.□□□1	The /INPOSITION signal turns OFF at startup. The /INPOSITION signal turns ON when the homing is completed.		

Parameters That Specify Homing Conditions

The following nine parameters specify the homing conditions, such as the homing speeds.

◆ Parameter That Specifies the Home Position

The value specified in PnB25 will be set as the current value when homing is completed.

	Home Position				
PnB25	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-99,999,999 to 99,999,999	Reference units	0	After restart	Setup

◆ Parameters That Specify the Acceleration/Deceleration Rates

The following parameters set the acceleration and deceleration rates for homing.

	Acceleration Rate				
PnB29	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 99,999,999	Reference units/s^2	500,000	Immediately	Setup

	Deceleration Rate				
PnB2B	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 99,999,999	Reference units/s^2	500,000	Immediately	Setup

◆ Parameter That Specifies the Homing Movement Speed

The following parameter sets the movement speed for homing.

	Homing Movement Speed				
PnB33	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 99,999,999	Reference units/s	2,000	Immediately	Setup

◆ Parameter That Specifies the Homing Approach Speed

The following parameter sets the approach speed for homing. Operation details, such as changing to this speed, depends on the homing method. Refer to the following section for details.

☞ *7.2.3 Homing Procedures* on page 7-8

	Homing Approach Speed				
PnB35	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 99,999,999	Reference units/s	2,000	Immediately	Setup

◆ Parameter That Specifies the Homing Creep Speed

The following parameter sets the creep speed for homing. Behaviour, such as changing to this speed, depends on the homing method. Refer to the following section for details.

☞ *7.2.3 Homing Procedures* on page 7-8

	Homing Creep Speed				
PnB37	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 99,999,999	Reference units/s	2,000	Immediately	Setup

◆ Parameter That Specifies the Homing Final Travel Distance

This parameter sets the travel distance after the motor changes to the creep speed. The stopping position when this travel is completed is set as the setting of PnB25.

If a negative value is set, the movement direction will be reversed after the motor changes to the creep speed. For example, for pressing homing, a movement is made in the reverse direction after the pressing time elapses, so a negative value is set.

	Homing Final Travel Distance				
PnB39	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-99,999,999 to 99,999,999	Reference units	0	Immediately	Setup

◆ Parameter That Specifies the Pressing Torque for Pressing Homing

This parameter specifies the torque to apply to the object at the end of travel for pressing operation in pressing homing. Set the torque as a percentage of the rated torque.

	Pressing Torque for Pressing Homing				
PnBE1	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	%	25	Immediately	Setup

◆ Parameter That Specifies the Pressing Detection Time for Pressing Homing

This parameter specifies the time until updating the position reference is stopped during pressing operation for homing. Normally, set this parameter to the same value as PnBE3 (Pressing Time for Pressing Homing).

If a Position Deviation Overflow alarm occurs, reduce the setting of this parameter. However, if you set the parameter to a value that is too low, the motor may stop before reaching the pressed object in systems where a torque limit is applied during acceleration or other movement.

PnBE2	Pressing Detection Time for Pressing Homing				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	ms	250	Immediately	Setup

◆ Parameter That Specifies the Pressing Time for Pressing Homing

This parameter specifies the pressing time against the pressed object during an homing. When the set time elapses, the pressing operation is ended.

PnBE3	Pressing Time for Pressing Homing				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	ms	250	Immediately	Setup

7.2.2 I/O Signals Related to Homing

The following I/O signals are related to homing.

Input Signals Related to Homing

Input Signal	Description
/HOME	The /HOME signal is turned ON to start homing.
/DEC	The /DEC signal is used to change the homing speed, but its function depends on the setting of the homing method (PnB31 = n.□□□X).
/STOP	If the /STOP signal turns ON during homing when the /HOME signal is ON, homing is stopped and the motor decelerates to a stop.

Output Signals Related to Homing

Output Signal	Description
/INPOSI-TION	The /INPOSITION signal turns ON when the target position (final travel distance) is within the positioning completed width. The positioning completed width set in PnB2D (INPOSITION width) is used.
/BUSY	The /BUSY signal turns ON when the Servomotor is operating, e.g., during homing. It turns OFF when homing is completed.
/POSRDY	The /POSRDY signal turns ON when homing is completed and the home position is valid.
/CLT	The /CLT signal turns ON when a torque limit is applied.

7.2.3 Homing Procedures

There are five different homing patterns depending on the homing method that is specified in PnB31 = n.□□□X.

The homing procedure for each method is given in this section.

Using the /DEC Signal and Encoder Origin (Phase C) for Homing (PnB31 = n.□□□1)

① Turn ON the power supply.

② The ALM signal turns OFF.

③ Turn ON the /S-ON signal. The SERVO ON state is entered.

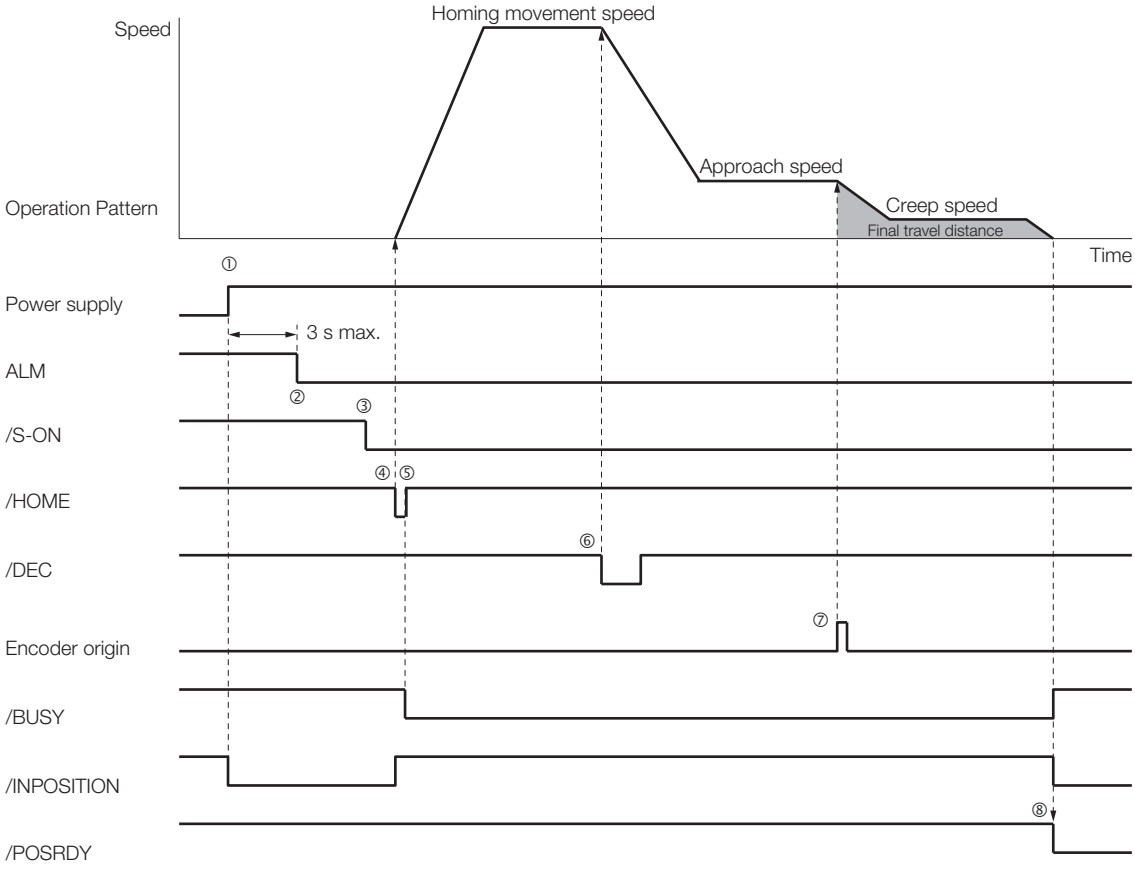
④ Turn ON the /HOME signal. Homing starts.

⑤ Turn OFF the /HOME signal after the /BUSY signal turns ON.

⑥ When the /DEC signal turns ON, the motor changes to the approach speed.

⑦ When the encoder's origin signal (phase C) is detected, the motor decelerates to the creep speed.

⑧ After the motor moves the final travel distance, homing has been completed and the /POS-RDY signal turns ON.



Using Only the /DEC Signal for Homing (PnB31 = n.□□□2)

① Turn ON the power supply.

② The ALM signal turns OFF.

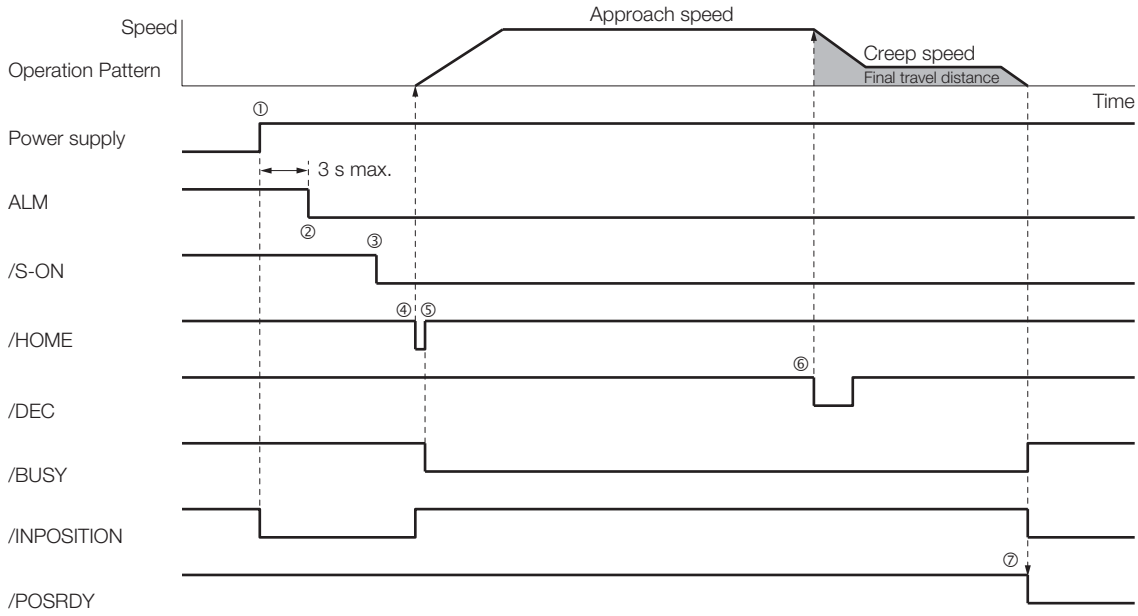
③ Turn ON the /S-ON signal. The SERVO ON state is entered.

④ Turn ON the /HOME signal. Homing starts.

⑤ Turn OFF the /HOME signal after the /BUSY signal turns ON.

⑥ When the /DEC signal turns ON, the motor changes to the creep speed.

⑦ After the motor moves the final travel distance, homing has been completed and the /POS-RDY signal turns ON.



Using Only the Encoder Origin (Phase C) for Homing (PnB31 = n.□□□3)

① Turn ON the power supply.

② The ALM signal turns OFF.

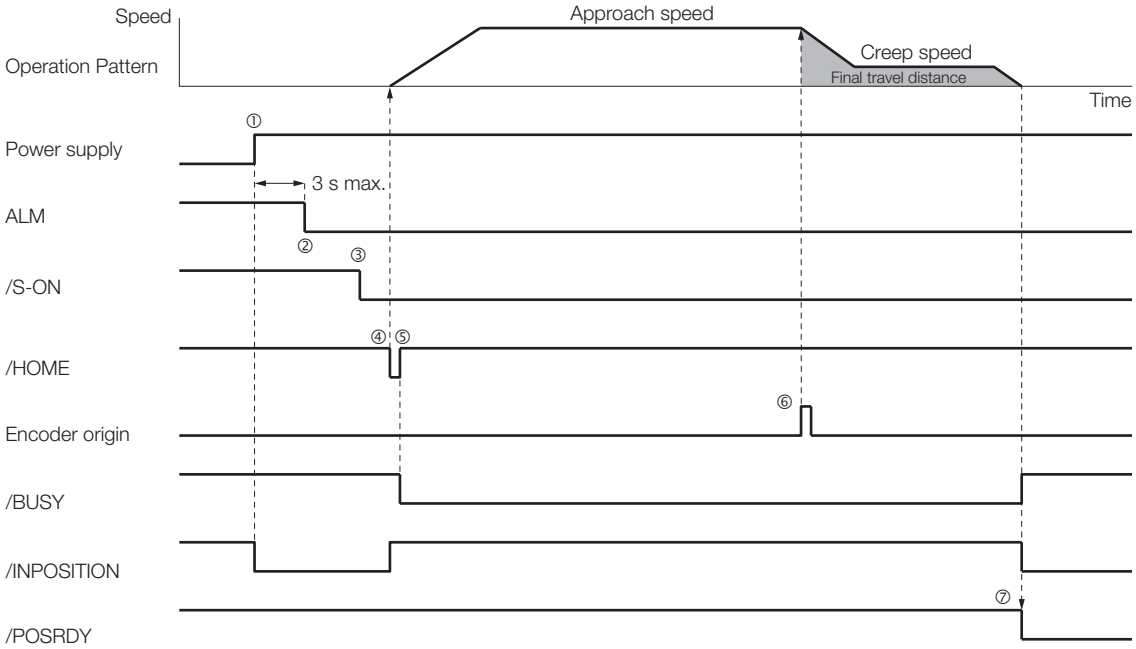
③ Turn ON the /S-ON signal. The SERVO ON state is entered.

④ Turn ON the /HOME signal. Homing starts.

⑤ Turn OFF the /HOME signal after the /BUSY signal turns ON.

⑥ When the encoder's origin signal (phase C) is detected, the motor decelerates to the creep speed.

⑦ After the motor moves the final travel distance, homing has been completed and the /POSRDY signal turns ON.



Performing Pressing Homing (PnB31 = n.□□□4)

For pressing homing, the moving part is pressed against with the pressing torque for pressing homing (PnBE1) for the pressing time for pressing homing (PnBE3) and then the motor moves the final travel distance to define the home position.

① Turn ON the power supply.

② The ALM signal turns OFF.

③ Turn ON the /S-ON signal. The SERVO ON state is entered.

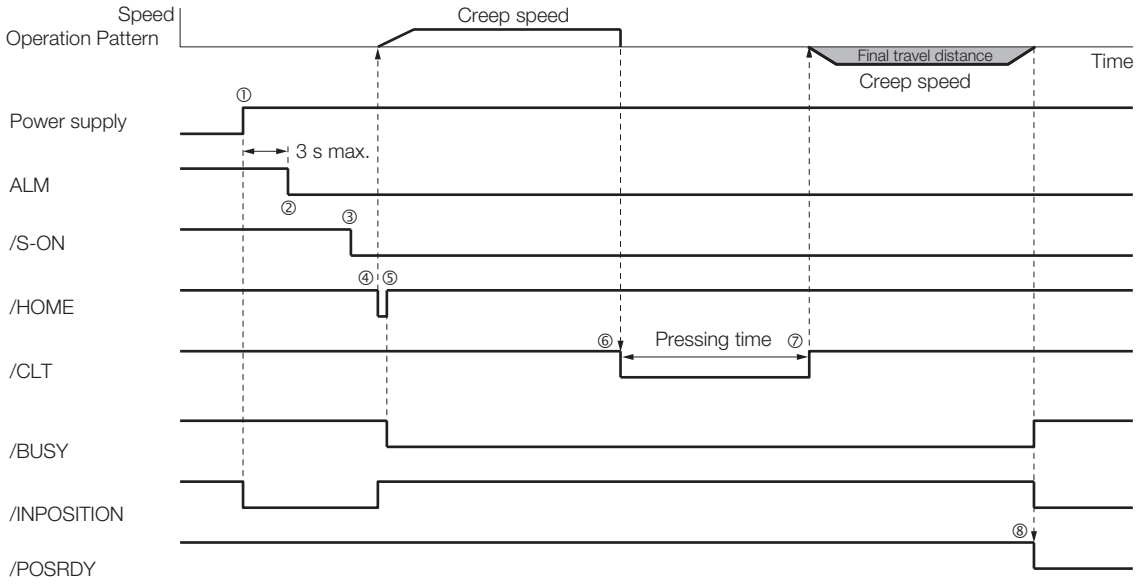
④ Turn ON the /HOME signal. Homing starts.

⑤ Turn OFF the /HOME signal after the /BUSY signal turns ON.

⑥ The motor moves to the end of travel and then performs pressing operation at the torque specified in PnBE1.

⑦ After pressing for the time set in PnBE3, the motor moves in the opposite direction.

⑧ After the motor moves the final travel distance, homing has been completed and the /POS-RDY signal turns ON.



Information Set a negative value for the homing final travel distance (PnB39).

Using the /DEC Signal and Encoder Origin (Phase C) for Homing and Reversing the Motor after /DEC Signal Detection (PnB31 = n.□□□5)

① Turn ON the power supply.

② The ALM signal turns OFF.

③ Turn ON the /S-ON signal. The SERVO ON state is entered.

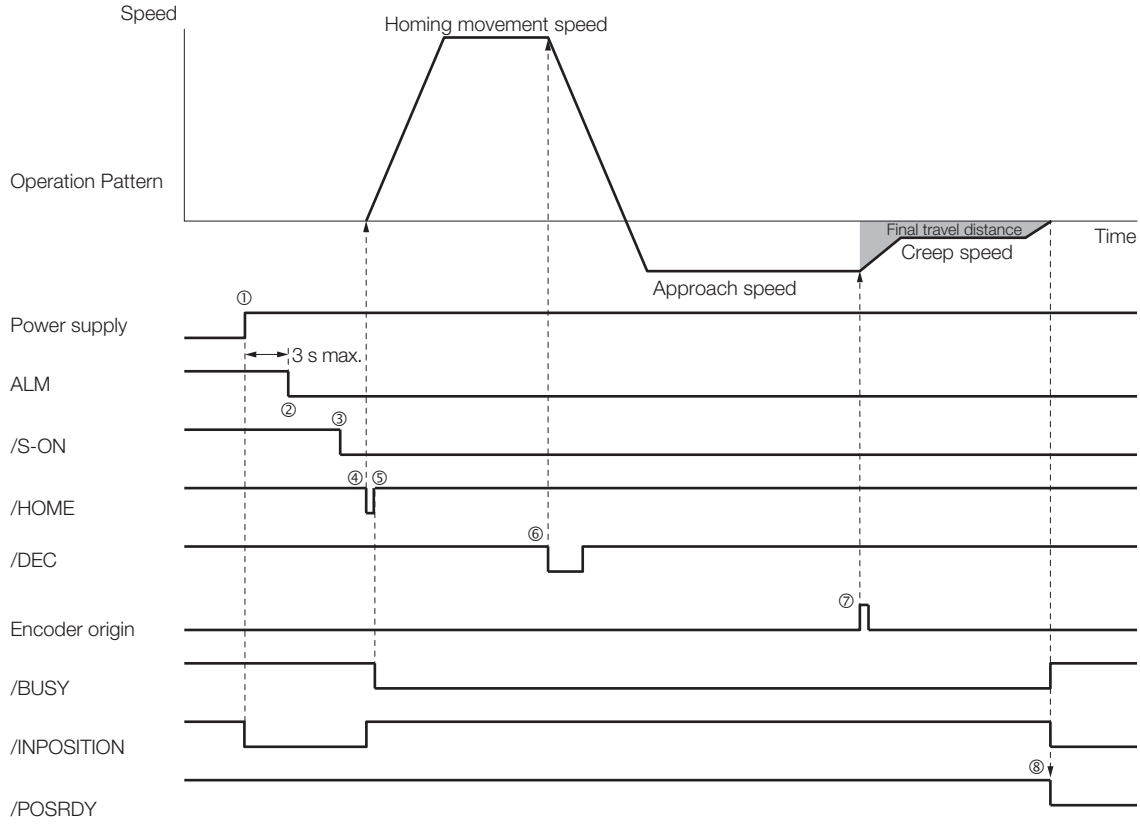
④ Turn ON the /HOME signal. Homing starts.

⑤ Turn OFF the /HOME signal after the /BUSY signal turns ON.

⑥ When the /DEC signal turns ON, the motor changes to the approach speed. The movement direction is reversed.

⑦ When the encoder's origin signal (phase C) is detected, the motor decelerates to the creep speed.

⑧ After the motor moves the final travel distance, homing has been completed and the /POS-RDY signal turns ON.



Stopping and Canceling Homing

If the /STOP signal turns ON during homing, the motor decelerates to a stop and homing is stopped. When the /STOP signal turns OFF, homing is restarted.

If operation is performed with the /JOGP or /JOGN signal while homing is stopped for the /STOP signal, homing will be canceled.

7.3 Positioning

Positioning is used to input pulse train references from the host controller to the SERVOPACK to move to a target position. The position is controlled with the number of input pulses, and the speed is controlled with the input pulse frequency.

7.3.1 Parameters and Input Signals Used for Positioning

Setting the Reference Pulse Form

This section describes the reference pulse forms.

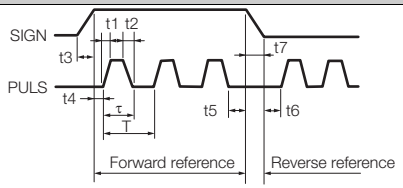
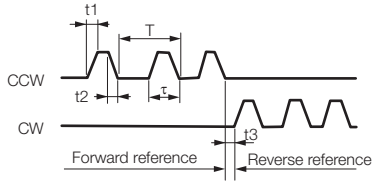
◆ Reference Pulse Forms

To perform speed control, you must specify how the references are input from the host controller (i.e., the reference pulse form). You set the reference pulse form in Pn200 (Position Control Reference Form Selections).

Parameters		Reference Pulse Form	Input Pulse Multiplier	Forward Reference	Reverse Reference
Pn200	n.□□□0 [default setting]	Sign and pulse train, positive logic.	–	PULS (CN1-3) SIGN (CN1-5) High level	PULS (CN1-3) SIGN (CN1-5) Low level
	n.□□□1	CW and CCW pulse trains, positive logic	–	CW (CN1-3) Low level CCW (CN1-5)	CW (CN1-3) CCW (CN1-5) Low level
	n.□□□2	Two-phase pulse trains with 90° phase differential	×1	90° Phase A (CN1-3) Phase B (CN1-5)	90° Phase A (CN1-3) Phase B (CN1-5)
	n.□□□3		×2		
	n.□□□4		×4		
	n.□□□5	Sign and pulse train, negative logic.	–	PULS (CN1-3) SIGN (CN1-5) Low level	PULS (CN1-3) SIGN (CN1-5) High level
	n.□□□6	CW and CCW pulse trains, negative logic	–	CW (CN1-3) High level CCW (CN1-5)	CW (CN1-3) CCW (CN1-5) High level

◆ Electrical Specifications for Pulse Train References

The following table describes the forms for pulse train references.

Pulse Train Reference Form	Electrical Specifications		Remarks
Sign and pulse train (SIGN and PLUS signals)		t1, t2, t3, t7≤0.025 μs t4, t5, t6≥0.5 μs τ≥0.125 μs T-τ≥0.125 μs	SIGN is high for a forward reference and low for a reverse reference.
CW and CCW pulse trains		t1, t2≤0.025 μs t3≥0.5 μs τ≥0.125 μs T-τ≥0.125 μs	–

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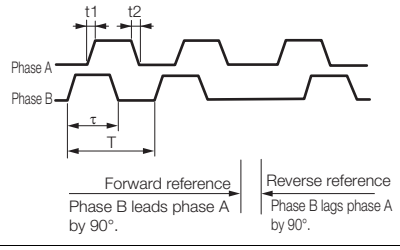
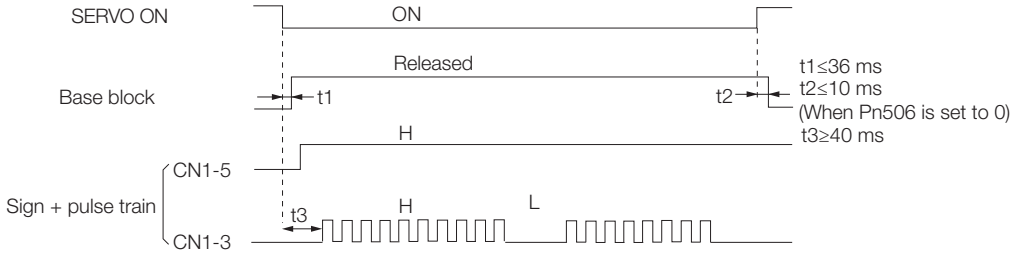
Continued from previous page.

Pulse Train Reference Form	Electrical Specifications		Remarks
Two-phase pulse trains with 90° phase differential (phases A and B)		t1≤0.1 μs t2≤0.1 μs τ≥0.5 μs T-τ≥0.5 μs	–

Note: Maximum input pulse frequency: 120 kpps

◆ Timing Example for Pulse Train References

The following example shows the timing of inputting the pulse train reference after the servo turns ON when a signal and pulse train are used.



The interval (t3) between when the servo is turned ON until the pulse train reference is input must be at least 40 ms.
If the reference is input in less than 40 ms, the reference pulses may not be received by the SERVOPACK.

/CLR (Position Deviation Clear) Signal Function and Settings

The /CLR (Position Deviation Clear) signal is used to clear the deviation counter in the SERVOPACK.
As long as the /CLR signal is ON, the deviation counter will be 0, so a position loop will not be formed.

Deviation counter
The deviation counter counts the deviation between the reference input pulses and the feedback pulses from the encoder (i.e., the accumulated pulses).

◆ /CLR (Position Deviation Clear Input Signal)

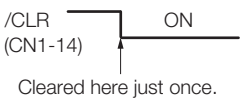
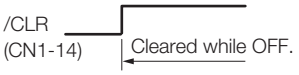
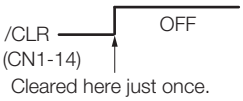
Type	Signal	Connector Pin No.	Name
Input	/CLR	CN1-14	Position Deviation Clear Input

Note: Use PnBB7 = □□X□ (/CLR (Position Deviation Clear Input) Signal Allocation) to allocate the /CLR signal to another connector pin. You can allocate the signal only to CN1-9 to CN1-14. If you allocate it to any pin other than CN1-9 to CN1-14, an A.04A alarm (Parameter Setting Error 2) will occur.
Refer to the following section for details on allocations.
☞ *5.3.3 Allocating Input Signals to Pins and Parameter Settings* on page 5-17

◆ Setting the Form of the /CLR (Position Deviation Clear) Signal

You set the /CLR signal form to use to clear the deviation counter in Pn200 = n.□□X□ (Clear Signal Form).

Note: The /CLR signal is allocated to CN1-14 by default. Use PnBB7 = n.□□X□ (/CLR (Position Deviation Clear Input) Signal Allocation) to allocate the /CLR signal to another connector pin. You can allocate the signal only to CN1-9 to CN1-14. If you allocate it to any pin other than CN1-9 to CN1-14, an A.04A alarm (Parameter Setting Error 2) will occur.

Parameter		Reference Form	Clear Timing	When Enabled	Classification
Pn200	n.□□0□ [default setting]	Clear position deviation while the signal is ON.		After restart	Setup
	n.□□1□	Clear position deviation when the signal changes from OFF to ON.			
	n.□□2□	Clear position deviation while the signal is OFF.			
	n.□□3□	Clear position deviation when the signal changes from ON to OFF.			

Information
The pulse width of the /CLR signal must meet the following conditions.
- If Pn200 = n.□□X□ is set to 0 or 2, the width of the /CLR signal must be at least 2,000 μs to reset the deviation counter.
- If Pn200 = n.□□X□ is set to 1 or 3, the width of the /CLR signal must be at least 200 μs to reset the deviation counter.

◆ Setting the Clear Operation (Pn200 = n.□X□□)

This parameter determines when the position error should be set to zero according to the condition of the SERVOPACK. Set Pn200 = n.□X□□ (Clear Operation).

Parameter		Meaning	When Enabled	Classification
Pn200	n.□0□□ [default setting]	Clear position deviation at a base block (at SERVO OFF or when alarm occurs).	After restart	Setup
	n.□1□□	Do not clear position deviation. The position deviation is cleared only with /CLR (Clear Position Deviation) signal.		
	n.□2□□	Clear position deviation when an alarm occurs.		

Smoothing Settings

Refer to the following section for information on smoothing.

☞ *5.5.1 Smoothing* on page 5-29

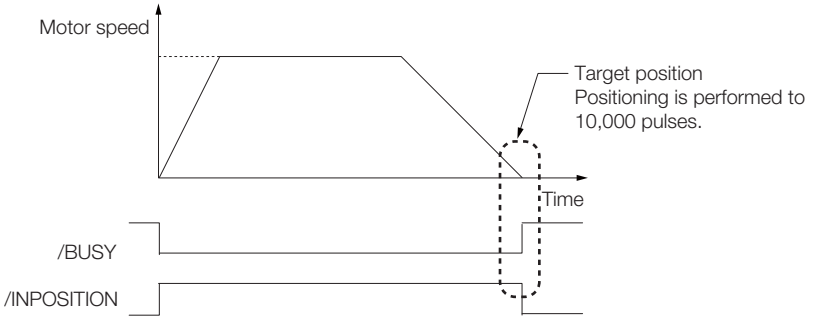
Output Signals Related to Positioning

The following output signals are related to positioning.

Output Signal	Description
/INPOSITION	The /INPOSITION signals turns ON when the difference between the target position and the current value of the motor is within the positioning completed width.
/BUSY	Turns ON when the actuator is activated, e.g., during positioning.

Operation Example

A positioning example is shown below for an input pulse frequency of 30,000 pps and a target position of 10,000 pulses.



7.4 ZONE Outputs

You can use ZONE signals to output a ZONE number to indicate when the current value is within a registered zone.

The ZONE signals (/ZONE0 to /ZONE3) are allocated to sequence outputs on the CN1 connector. Refer to the following section for details.

☞ *5.3 Sequence I/O Signals* on page 5-10

7.4.1 ZONE Table and ZONE Signals

You can register the desired zones in the ZONE table. The ZONE table consists of settings for the ZONE numbers (ZONE), ZONE N values (ZONE N), and ZONE P values (ZONE P). You can register up to 16 zones.

The ZONE numbers identify the registered zones.

ZONE N is the lower limit of the ZONE and ZONE P is the upper limit of the ZONE. The setting conditions for ZONE N and ZONE P are given in the following table.

Setting Range	Setting Unit	Default Setting
-99,999,999 to 99,999,999	Reference units	0

The ZONE signals indicate the ZONE number. If the current value is within a zone registered in the ZONE table, the corresponding ZONE number is output on the ZONE signals.

You can use the ZONE numbers as required, e.g., to trigger operations related to positioning operations.

ZONE Table			ZONE Signals			
ZONE Number (ID)	ZONE N [Reference Units]	ZONE P [Reference Units]	/ZONE3	/ZONE2	/ZONE1	/ZONE0
0	±nnnnnnnn	±pppppppp	0	0	0	0
1	±nnnnnnnn	±pppppppp	0	0	0	1
2	±nnnnnnnn	±pppppppp	0	0	1	0
3	±nnnnnnnn	±pppppppp	0	0	1	1
4	±nnnnnnnn	±pppppppp	0	1	0	0
5	±nnnnnnnn	±pppppppp	0	1	0	1
6	±nnnnnnnn	±pppppppp	0	1	1	0
7	±nnnnnnnn	±pppppppp	0	1	1	1
8	±nnnnnnnn	±pppppppp	1	0	0	0
9	±nnnnnnnn	±pppppppp	1	0	0	1
10	±nnnnnnnn	±pppppppp	1	0	1	0
11	±nnnnnnnn	±pppppppp	1	0	1	1
12	±nnnnnnnn	±pppppppp	1	1	0	0
13	±nnnnnnnn	±pppppppp	1	1	0	1
14	±nnnnnnnn	±pppppppp	1	1	1	0
15	±nnnnnnnn	±pppppppp	1	1	1	1

Note: 1: Signal is ON (active), 0: Signal is OFF (inactive).


Note

Always save the ZONE table to flash memory after you edit it. Refer to the following section for the procedure.

☞ ◆ *Saving the Program Table to Flash Memory in the SERVOPACK* on page 7-19

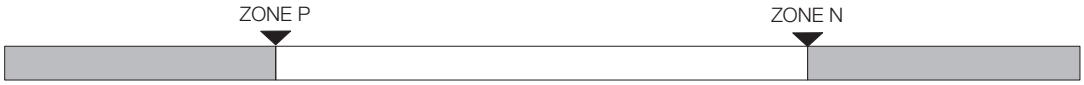
If you turn OFF the power supply before you save changes to flash memory, the changes to the ZONE table will be lost.

ZONE Table Settings and ZONE Numbers

The relationship between the ZONE table settings and the ZONE numbers is shown below.

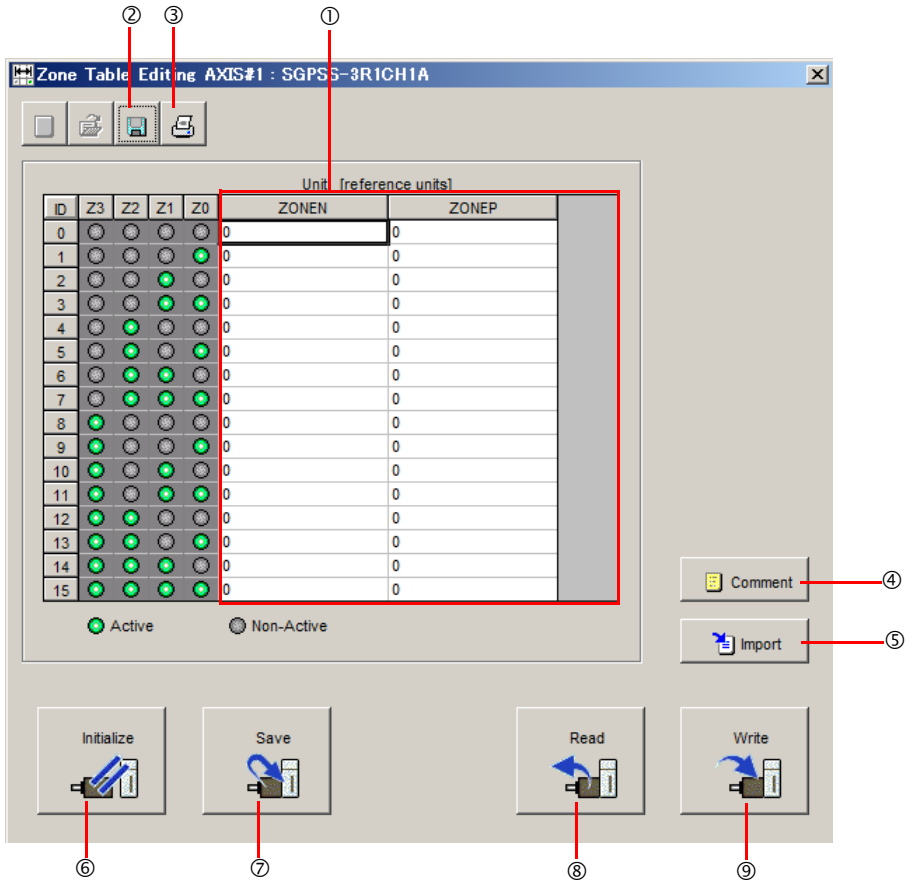
- ZONE P ≤ ZONE N
  The ZONE signals for the corresponding ZONE number is output if the current value is between ZONE N and ZONE P, inclusive (the shaded part in the following figure).

- ZONE P ≤ ZONE N
  The ZONE signals for the corresponding ZONE number is output if the current value is less than or equal to ZONE P or greater than or equal to ZONE N (the shaded parts in the following figure).



- Duplicated Settings in the ZONE Table
  The smaller ZONE number is output.
- ZONE N and ZONE P = 0
  The ZONE number is disabled and all ZONE signals will be OFF (0).
- When the Current Value Is Not In Any ZONE
  All of the ZONE signals will be OFF (0).

7.4.2 SigmaWin+ Procedures

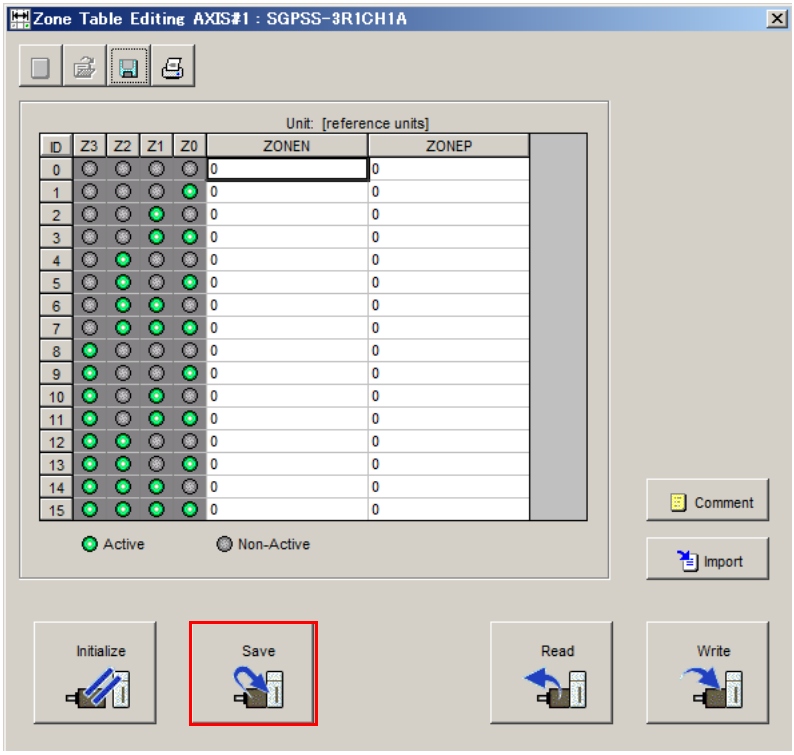


No.	Name	Description
①	Setting Area	Sets the ranges for ZONE outputs. Select the cell and enter the value directly.
②	**Save** Button	Saves the currently displayed settings to a computer file.
③	**Print** Button	Prints the currently displayed settings.
④	**Comment** Button	Lets you add a comment.
⑤	**Import** Button	Imports a ZONE table from a file saved on the computer.
⑥	**Initialize** Button	Initializes the flash memory in the SERVOPACK.
⑦	**Save** Button	Saves the settings in the SERVOPACK to flash memory.
⑧	**Read** Button	Reads the settings in the SERVOPACK to the SigmaWin+.
⑨	**Write** Button	Writes the currently displayed settings to the SERVOPACK.

◆ Saving the Program Table to Flash Memory in the SERVOPACK

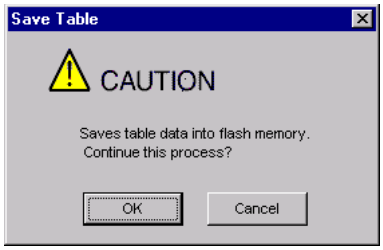
To prevent the ZONE table from being deleted when the power supply to the SERVOPACK is turned OFF, you must save it to flash memory in the SERVOPACK. The ZONE table that is saved in the flash memory is automatically loaded each time the power supply is turned ON. We recommend that you save the program that is normally used for operation in this flash memory.

1. Click the **Save** Button in the Zone Table Editing Dialog Box.



The Save Table Dialog Box will be displayed.

2. Click the **OK** Button.



This concludes the saving procedure.

7.4.3 ZONE Output Application Example

Using the ZONE Signals as Positioning Signals

The ZONE number is output when the current value enters a set ZONE. You can use the ZONE number as a trigger for a task within that ZONE.

An example of moving to the next ZONE when positioning is completed is given below. The ZONE table is used as a positioning table.

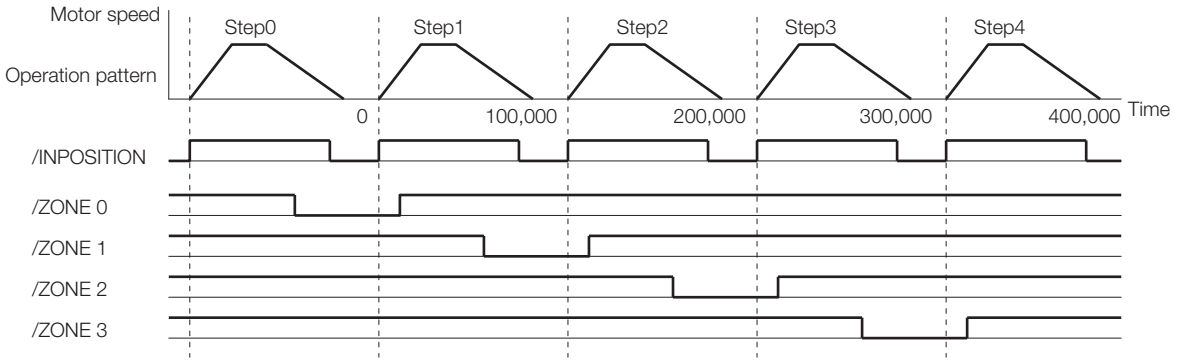
Assume that positioning is performed with the following references.

- Step 0: Position to a target position of 0 references units at a reference speed of 30,000 reference units/s.
- Step 1: Position to a target position of 100,000 references units at a reference speed of 30,000 reference units/s.
- Step 2: Position to a target position of 200,000 references units at a reference speed of 30,000 reference units/s.
- Step 3: Position to a target position of 300,000 references units at a reference speed of 30,000 reference units/s.
- Step 4: Position to a target position of 400,000 references units at a reference speed of 30,000 reference units/s.

The ZONE table is shown below.

ZONE Number (ID)	ZONE N	ZONE P
0	0	0
1	-1,000	+1,000
2	+99,000	+101,000
3	0	0
4	+199,000	+201,000
5	0	0
6	0	0
7	0	0
8	+299,000	+301,000
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0

The relationship between the operation pattern and the ZONE numbers for this example is shown in the following figure.



Tuning

8

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

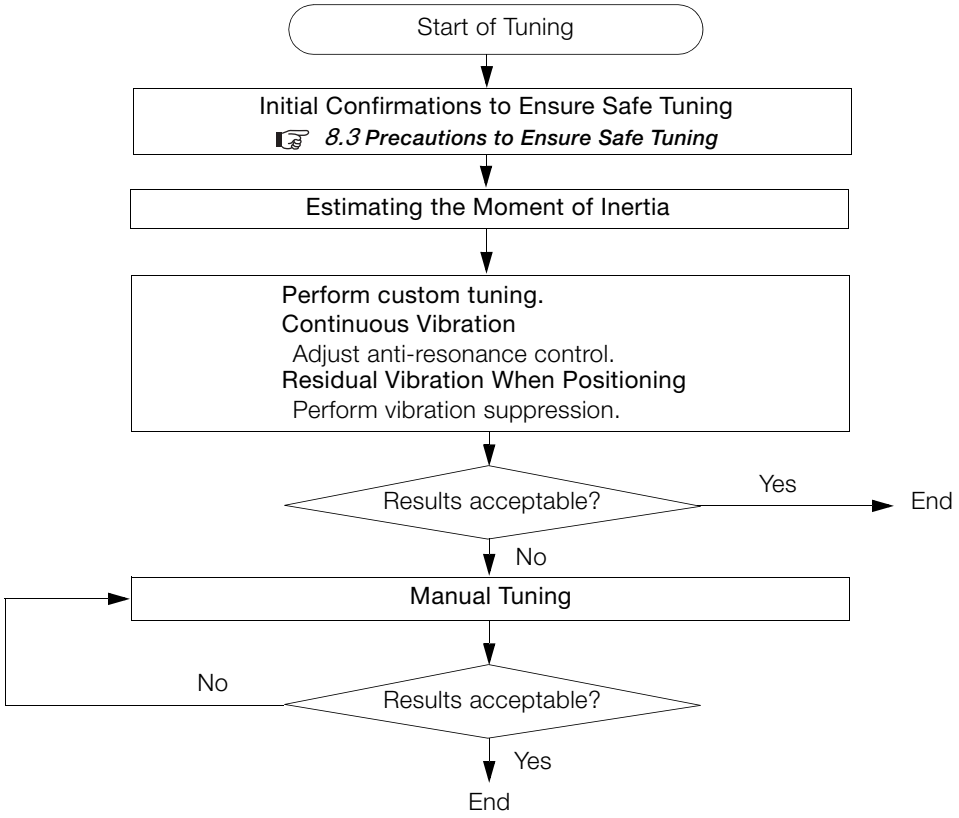
8.1 Overview and Flow of Tuning

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, 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.



8.1.1 Tuning Function

The following table provides an overview of the tuning functions.

Tuning Functions	Description	Reference
Moment of Inertia Estimation	The moment of inertia ratio is calculated by operating the Servomotor a few times. The moment of inertia ratio that is calculated here is used in other tuning functions.	page 8-8
Custom Tuning	The following parameters are adjusted with the 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	page 8-15
Anti-resonance Control Adjustment	This function effectively suppresses continuous vibration.	page 8-24
Vibration Suppression	This function effectively suppresses residual vibration if it occurs when positioning.	page 8-27
Manual Tuning	You can manually adjust the servo gains to adjust the response.	page 8-31

8.2 Monitoring Methods

You can perform monitoring with the data trace function of the SigmaWin+. If you perform custom tuning or manual tuning, always use the above functions to monitor the machine operating status and SERVOPACK signal waveform while you adjust the servo gains.

Check the adjustment results with the following response waveforms.

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

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 during the SERVO ON state.
  - Before starting the Servomotor, make sure that an emergency stop can be performed at any time.
  - Make sure that trial operation has been successfully performed without any problems.
  - Provide an appropriate stopping device on the machine to ensure safety.

Perform the following settings in a way that is suitable for tuning.

8.3.1 Torque Limit Settings

You can limit the torque that is output by the Servomotor based on calculations of the torque required for machine operation. You can use torque limits to reduce the amount of shock applied to the machine when problems occur, such as collisions or interference. If the torque limit is lower than the torque that is required for operation, overshooting or vibration may occur. Refer to the following section for details.

☞ *5.4.3 Torque Limit Selection* on page 5-22

8.3.2 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 Servomotor if the Servomotor operation does not agree with the reference.

The position deviation is the difference between the position reference value and the actual position.

You can calculate the position deviation from the position loop gain (Pn102) and the motor speed with the following formula.

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

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

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

*1. Refer to the following section for details.
☞ *5.4.2 Electronic Gear Settings* on page 5-20

*2. When model following control (Pn140 = n.□□□1) is enabled, use the setting of Pn141 (Model Following Control Gain) instead of the setting of Pn102 (Position Loop Gain).

*3. The underlined coefficient "× (1.2 to 2)" adds a margin to prevent an A.D00 alarm (Position Deviation Overflow) from occurring too frequently.

If you set a value that satisfies the formula, an A.D00 alarm (Position Deviation Overflow) should not occur during normal operation.

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

The following calculation example shows how to calculate the value of Pn520 based on the following values for Pn102, Pn210, and Pn20E. The example uses a Servomotor with a maximum motor speed of 6,000 and an encoder resolution of 1,024 (10 bits).

Pn102 is set to 400. $\frac{Pn210}{Pn20E} = \frac{1}{1}$

Therefore,

$$Pn520 = \frac{6{,}000}{60} \times \frac{1{,}024}{400/10} \times \frac{1}{1} \times 2$$

$$= 2{,}560 \times 2$$

$$= 5{,}120$$

If the acceleration/deceleration rate required for the position reference exceeds the tracking capacity of the Servomotor, the tracking delay will increase and the position deviation will no longer satisfy the above formulas. If this occurs, lower the acceleration/deceleration rate so that the Servomotor can follow the position reference or increase the position deviation overflow alarm level.

Related Parameters

	Position Deviation Overflow Alarm Level				
Pn520	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,823	1 reference unit	25,600	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).

8.3.3 Setting the Position Deviation Overflow Alarm Level at SERVO ON

If there is a large position deviation during the SERVO ON state, the Servomotor will attempt to return to the original position to bring the position deviation to 0, which may create a hazardous situation. To prevent this, you can set a position deviation overflow alarm level at SERVO ON to restrict operation.

The related parameters and alarms are given in the following tables.

Related Parameters

Pn526	Position Deviation Overflow Alarm Level at SERVO ON				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,823	1 reference unit	25,600	Immediately	Setup
Pn528	Position Deviation Overflow Warning Level at SERVO ON				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 100	1%	100	Immediately	Setup
Pn529	Speed Limit Level at SERVO ON				
	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 in the SERVO ON state after the position deviation exceeded the setting of Pn526 (Excessive Position Deviation Alarm Level at SERVO ON) in the SERVO OFF state.
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) will limit the speed in the SERVO ON state. This alarm occurs if reference pulses are input and the setting of Pn520 (Excessive Position Deviation Alarm Level) is exceeded.

Refer to the following section for information on troubleshooting alarms.

☞ *10.1.6 Alarm Reset* on page 10-17

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.

8.4.1 Outline

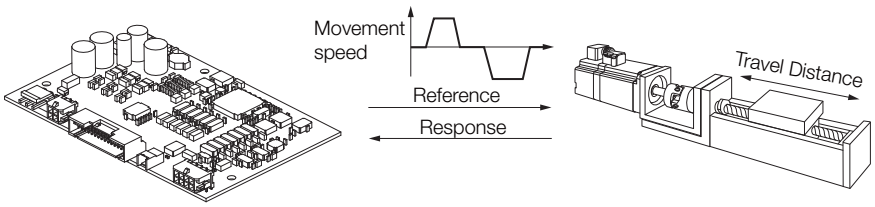
The moment of inertia during operation is automatically calculated by the SERVOPACK for round-trip (forward and reverse) operation.

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

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

The motor is operated with the following specifications.

- Maximum speed: ±1,000 min^{-1} (can be changed)
- Acceleration rate: ±20,000 min^{-1}/s (can be changed)
- Travel distance: ±2.5 rotations max. (can be changed)



Note: Execute moment of inertia estimation after jog operation to a position that ensures a suitable range of motion.

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 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 feedforward is set

Preparations

Check the following settings before you execute moment of inertia estimation.

- The power supply must be ON.
- The system must be in the SERVO OFF state.
- There must be no alarms or warnings.
- The parameters must not be write prohibited.
- Emergency stop status must not exist.
- The motor code of the Servomotor to use must be set in Pn08A (Motor Selection Switch).

8.4.3 Operating Procedure

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

⚠ WARNING

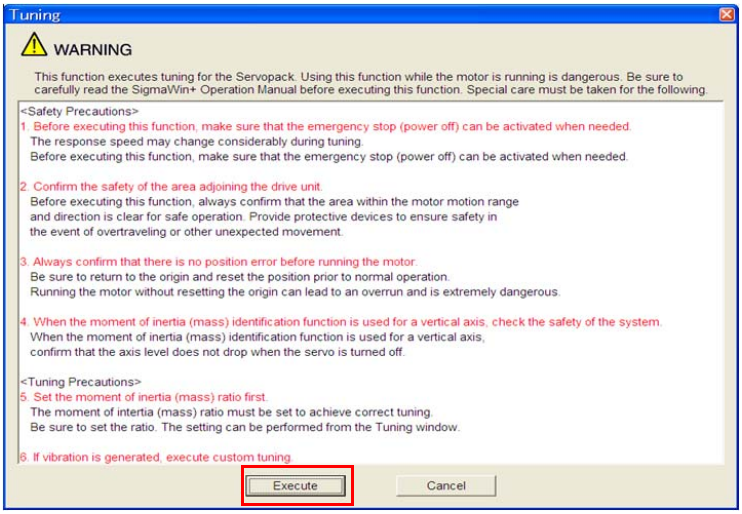
- **Estimating the moment of inertia requires operating the motor and therefore presents hazards. Observe the following precaution.**
  - Confirm safety around moving parts.
    This function involves automatic operation with vibration. Make sure that you can perform an emergency stop (to turn OFF the power supply) at any time. Also, the motor may rotate in both directions within the movement range. Confirm the movement range and direction.

⚠ CAUTION

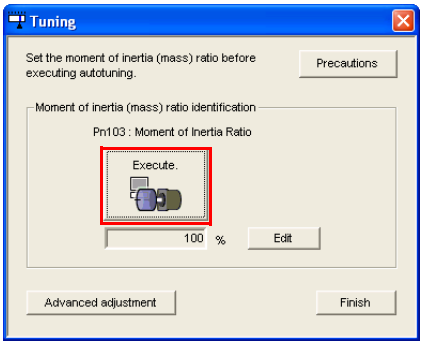
- **If you press the Servo OFF or Cancel Button to cancel moment of inertia estimation while the motor is operating, the motor will coast to a stop.**

1. Select ***Tuning*** - ***Tuning*** from the menu bar of the Main Window of the SigmaWin+.
   The Tuning Dialog Box will be displayed.
   Click the **Cancel** Button to cancel tuning.

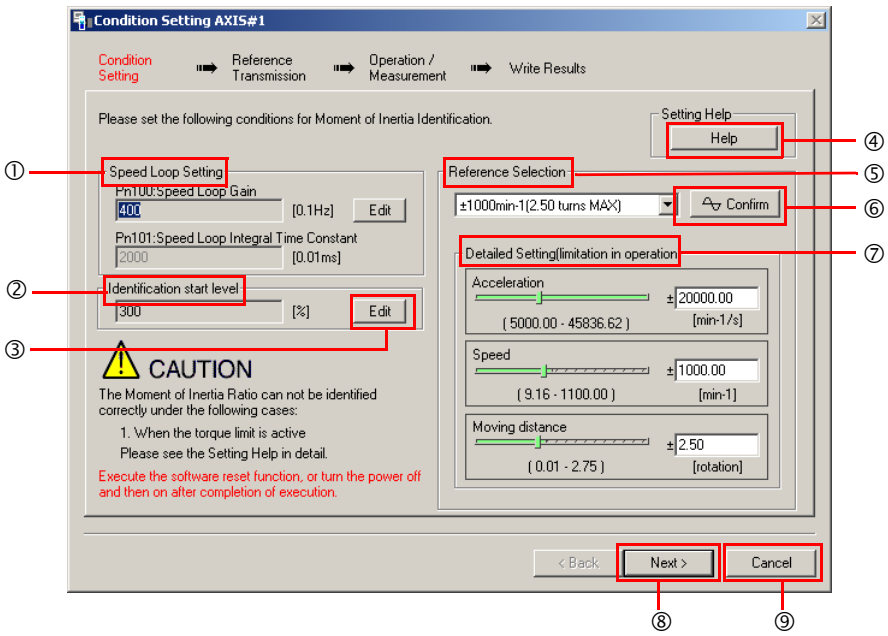
2. Click the **Execute** Button.



3. Click the **Execute** Button.



4. Set the conditions as required.



① **Speed Loop Setting** Area
Make the speed loop settings in this area.
If the speed loop response is too bad, it will not be possible to measure the moment of inertia ratio accurately.
The values for the speed loop response that are required for moment of inertia estimation are set for the default settings. It is normally not necessary to change these settings.
If the default speed loop gain is too high for the machine (i.e., if vibration occurs), lower the setting. It is not necessary to increase the setting any farther.

② **Identification Start Level** Group
This is the setting of the moment of inertia calculation starting level.
If the load is large or the machine has low rigidity, the torque limit may be applied, causing moment of inertia estimation to fail.
If that occurs, estimation may be possible if you double the setting of the start level.

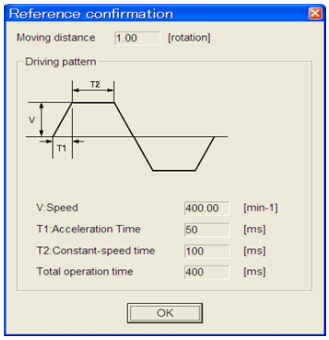
③ **Edit** Buttons
Click the button to display a dialog box to change the settings related to the speed loop or estimation start level.

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

- Operate the 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 acceleration range within the possible range of movement considering the gear ratio, e.g., the pulley diameters or ball screw pitch.

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



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.

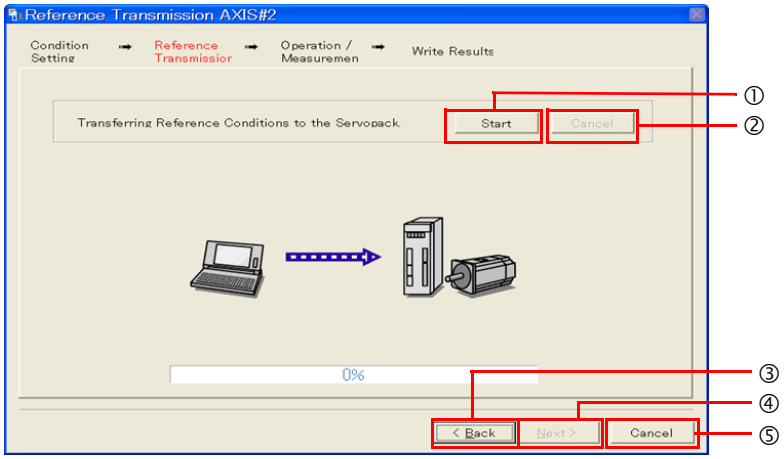
⚠ CAUTION

- 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 and undershooting 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.

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

6. 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.

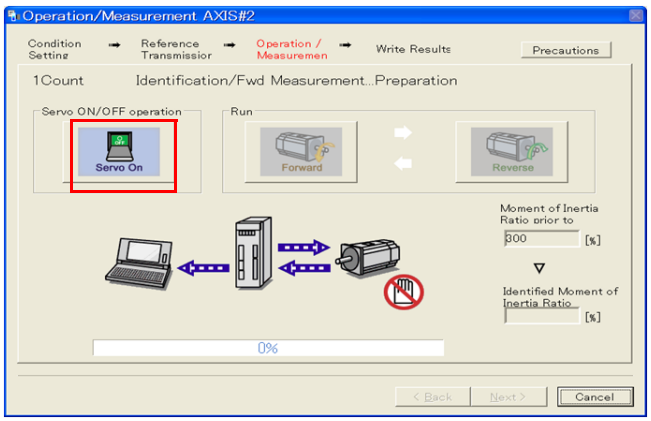
③ **Back** Button
This button returns you to the Condition Setting Dialog Box. It is disabled while data is being transferred.

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.

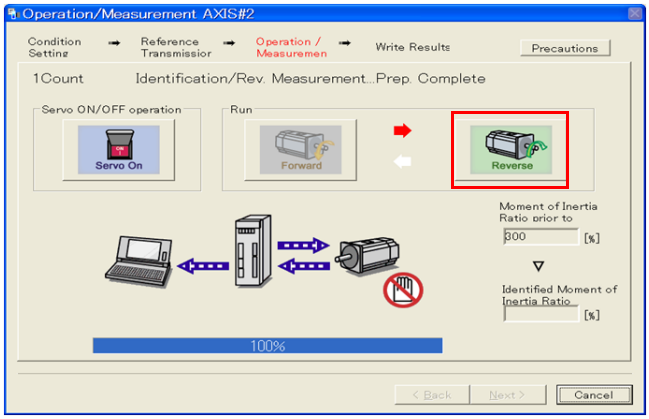
7. Click the **Next** Button.
The Operation/Measurement Dialog Box will be displayed.

8. Click the **Servo On** Button.

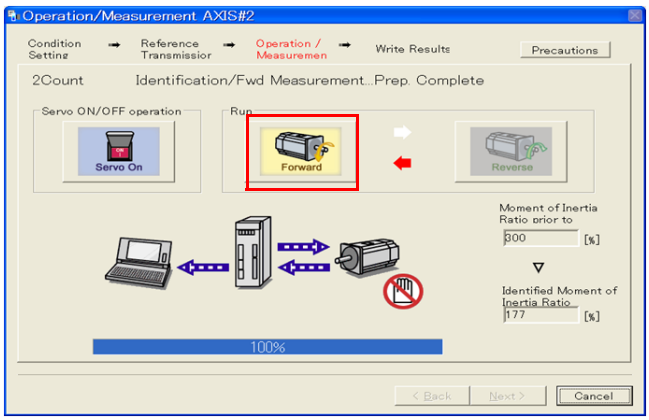


9. Click the **Forward** Button.
The shaft will rotate in the forward direction and the measurement will start. After the measurement and data transfer have been completed, the **Reverse** Button will be displayed in color.

10. Click the **Reverse** Button.



The 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.

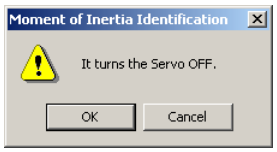


11. Repeat steps 8 to 9 until the **Next** Button is enabled.
Measurements are performed from 2 to 7 times and then verified. The number of measurements is displayed in upper left corner of the dialog box. A progress bar at the bottom of the dialog box will show the progress of the transfer each time.

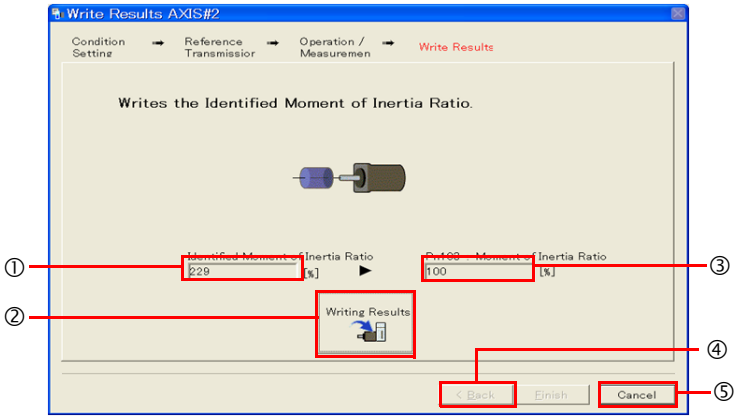
12. When the measurements have been completed, click the **Servo On** Button to change to the SERVO OFF state.

13. Click the **Next** Button.
The Write Results Dialog Box will be displayed.

Information If you click the **Next** Button before you change to the SERVO OFF state, the following Dialog Box will be displayed. Click the **OK** Button to change to the SERVO OFF state.



14. 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.

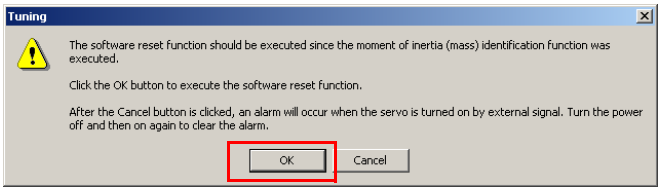
③ **Pn103: Moment of Inertia Ratio** Box
The value that is set for the parameter is displayed here.
After you click the **Writing Results** Button, the value that was found with operation and measurements will be displayed as the new setting.

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

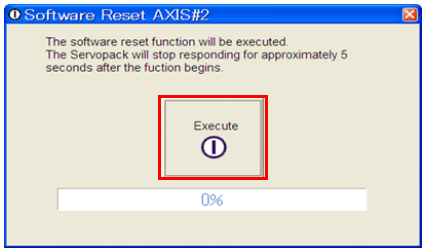
⑤**Cancel** Button
This button will return you to the Tuning Dialog Box.

15. 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.

16. Click the **OK** Button.



17. 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.

8.5 Custom Tuning

This section describes custom tuning.

8.5.1 Outline

You can use custom tuning to manually adjust the servo during operation using a reference pulse signal 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

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

☞ *8.5.6 Related Parameters* on page 8-23

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 and vibration suppression are also possible during custom tuning.

⚠ CAUTION

- Vibration or overshooting may occur during custom tuning. To ensure safety, make sure that you can perform an emergency stop at any time.

8.5.2 Preparations

Check the following settings before you execute custom tuning.

- The parameters must not be write prohibited.

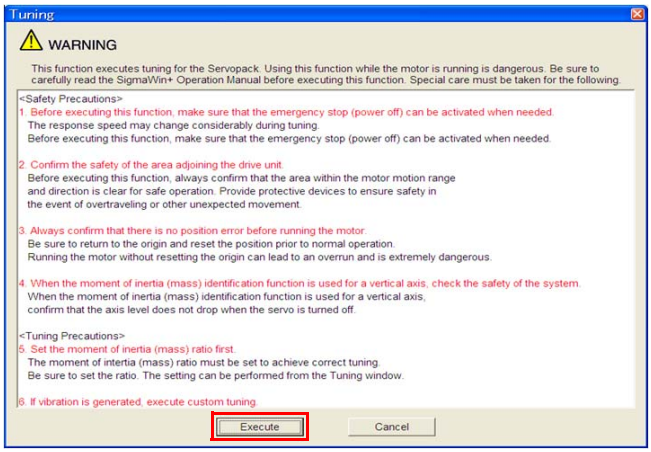
8.5.3 Operating Procedure

Use the following procedure to perform custom tuning.

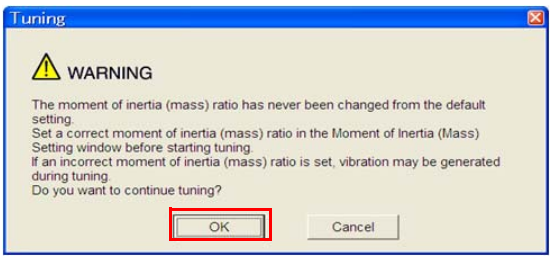
⚠ WARNING

- Before you execute custom tuning, check the information provided in the SigmaWin+ operating manual.
  Observe the following precautions.
  - Make sure that you can perform an emergency stop at any time.
    When custom tuning is started, several parameters will be overwritten with the recommended settings, which may greatly affect the response before and after execution. Make sure that you can perform an emergency stop at any time.
  - Set the moment of inertia correctly before you execute custom tuning.
    If the setting greatly differs from the actual moment of inertia, vibration may occur.
  - If you change the feedforward level, the new setting will not be used immediately. It will be used after positioning is completed.

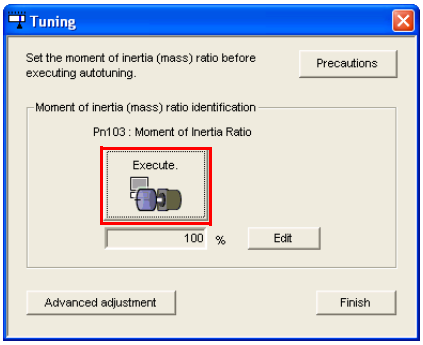
1. Confirm that the moment of inertia ratio (Pn103) is set correctly.
2. Select ***Tuning - Tuning*** from the menu bar of the Main Window of the SigmaWin+.
   Click the **Cancel** Button to cancel tuning.
3. Click the **Execute** Button.



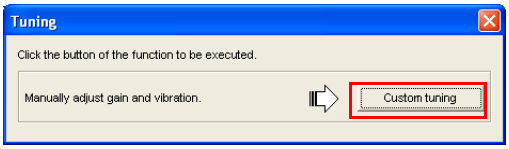
Information When the following dialog box is displayed, click the **OK** Button and then confirm that the correct moment of inertia ratio is set in Pn103 (Moment of Inertia Ratio).



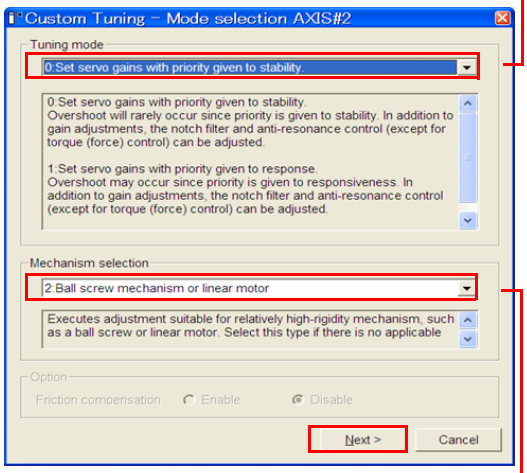
4. Click the **Advanced adjustment** Button.



5. Click the **Custom tuning** Button.



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



Tuning mode Box

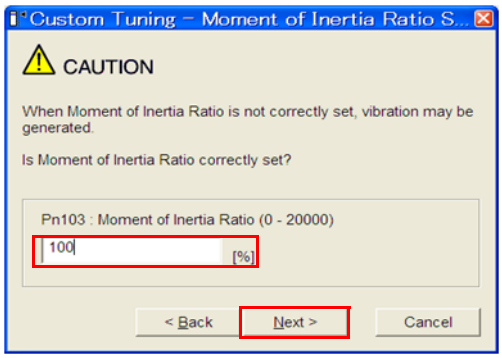
Mode Selection	Description
0: Set servo gains with priority given to stability.	This setting gives priority to stability and preventing overshooting. In addition to gain adjustment, notch filters and anti-resonance control are adjusted.
1: Set servo gains with priority given to response.	Overshooting may occur because priority is given to response. In addition to gain adjustment, notch filters and anti-resonance control are 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.

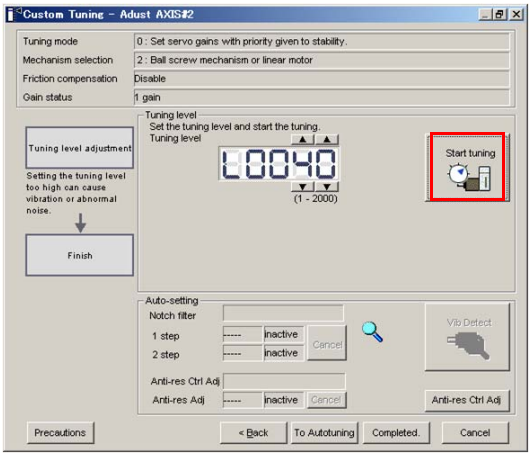
Information The tuning modes that you can select depend on the SERVOPACK setting.

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

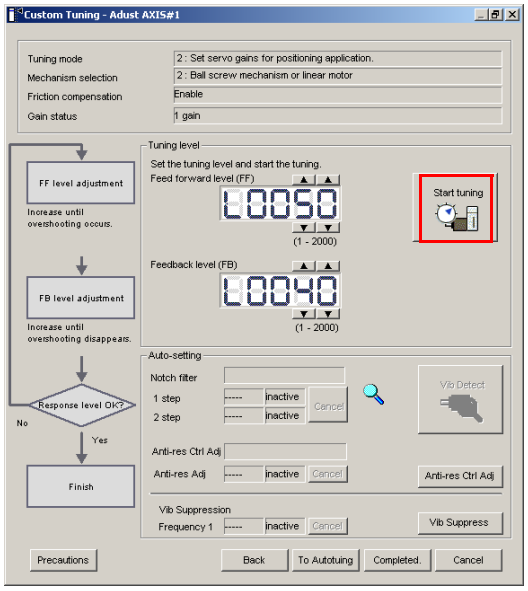


8. Change to the SERVO ON state, enter a reference from the host controller, and then click the **Start tuning** Button.

Tuning Mode 0 or 1



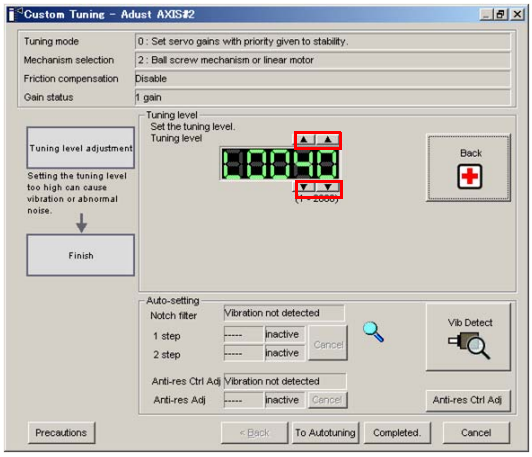
Tuning Mode 2 to 3



9. 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.

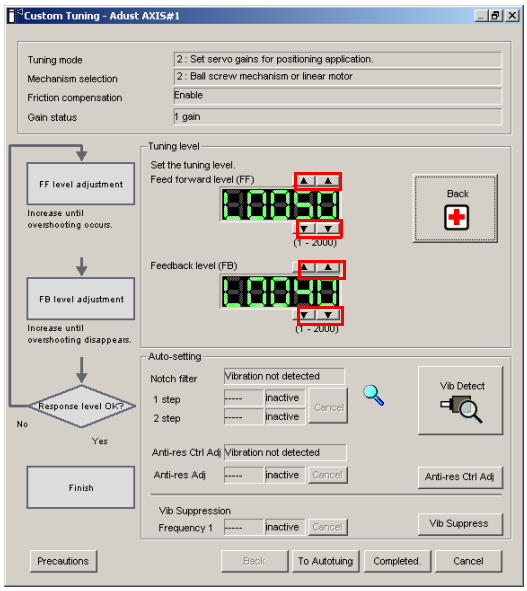
Tuning Mode 0 or 1

Increase the tuning level until overshooting occurs.



Tuning Mode 2 to 3

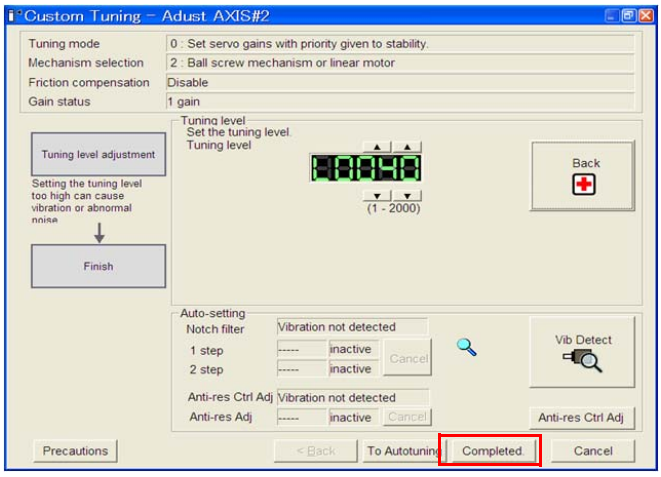
Increase the feedforward level until overshooting occurs and then increase the feedback level until overshooting is eliminated. Repeat these changes to make the adjustment.



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

10. You can set the functions to suppress vibration (notch filters, automatic anti-resonance setting, and vibration suppression) as required.
Refer to the following section for details.
☞ *Vibration Suppression Functions* on page 8-20

11. 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.

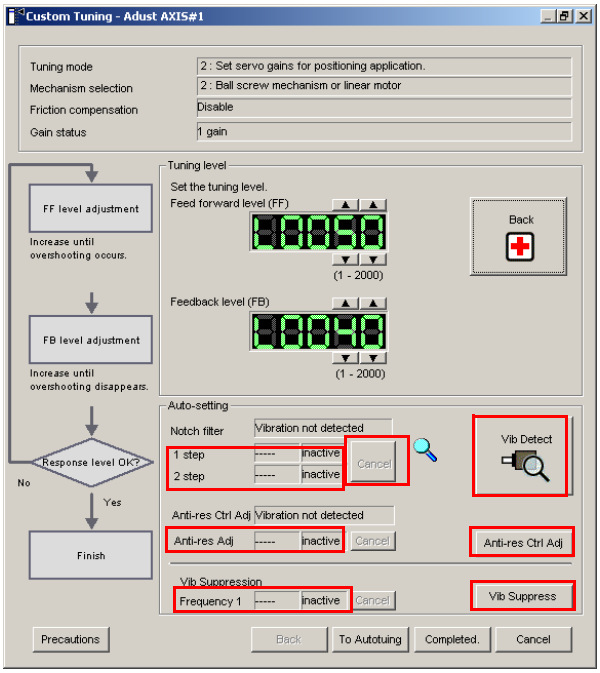
Vibration Suppression Functions

◆ 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.
  ☞ *8.6 Anti-Resonance Control Adjustment* on page 8-24
- **Vib Suppress** Button
  Click the **Vib Suppress** Button to suppress low and transient vibration (oscillation) of approximately 1 Hz to 100 Hz that occurs during positioning. Refer to the following section.
  ☞ *8.7 Vibration Suppression* on page 8-27

8.5.4 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 execution of custom tuning 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 custom tuning.	Immediately	Tuning
	n.□□□1 [default setting]	Adjust the first stage notch filter automatically during execution of custom tuning.		
	n.□0□□	Do not adjust the second stage notch filter automatically during execution of custom tuning.		
	n.□1□□ [default setting]	Adjust the second stage notch filter automatically during execution of custom tuning.		

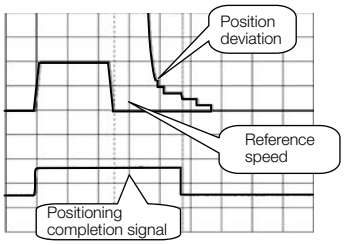
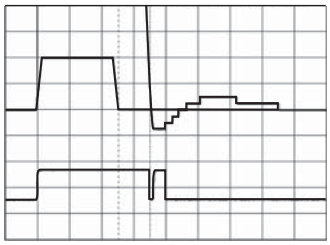
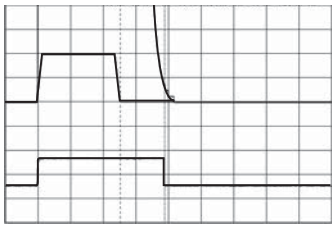
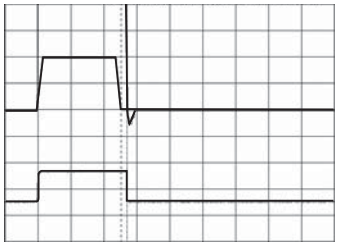
◆ Anti-Resonance Control Adjustment

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 custom tuning and anti-resonance control will be automatically adjusted.

Parameter		Function	When Enabled	Classification
Pn160	n.□□0□	Do not adjust the anti-resonance control automatically during execution of custom tuning.	Immediately	Tuning
	n.□□1□ [default setting]	Adjust the anti-resonance control automatically during execution of custom tuning.		

8.5.5 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.

8.5.6 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
Pn401	First Stage First Torque Reference Filter Time Constant	Yes
Pn408	Torque-Related Function Selections	Yes
Pn409	First Stage Notch Filter Frequency	Yes
Pn40A	First Stage Notch Filter Q Value	Yes
Pn40C	Second Stage Notch Filter Frequency	Yes
Pn40D	Second Stage Notch Filter Q Value	Yes
Pn140	Model Following Control-Related Selections	Yes
Pn141	Model Following Control Gain	Yes
Pn143	Model Following Control Bias in the Forward Direction	Yes
Pn144	Model Following Control Bias in the Reverse Direction	Yes
Pn145	Vibration Suppression 1 Frequency A	No
Pn146	Vibration Suppression 1 Frequency B	No
Pn147	Model Following Control Speed Feedforward Compensation	Yes
Pn160	Anti-Resonance Control-Related Selections	Yes
Pn161	Anti-Resonance Frequency	Yes
Pn163	Anti-Resonance Damping Gain	Yes

Yes: The parameter is automatically set.

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

8.6 Anti-Resonance Control Adjustment

This section describes anti-resonance control.

8.6.1 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. To ensure safety, 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 or use vibration suppression.
- Vibration reduction can be made more effective by increasing the anti-resonance damping gain (Pn163), but the vibration may become larger if the damping gain is too high. Increase the damping gain by approximately 0% to 200% in 10% increments while checking the effect on vibration. If vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain by using a different method, such as custom tuning.

8.6.2 Preparations

Check the following settings before you execute anti-resonance control adjustment.

- The parameters must not be write prohibited.

8.6.3 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

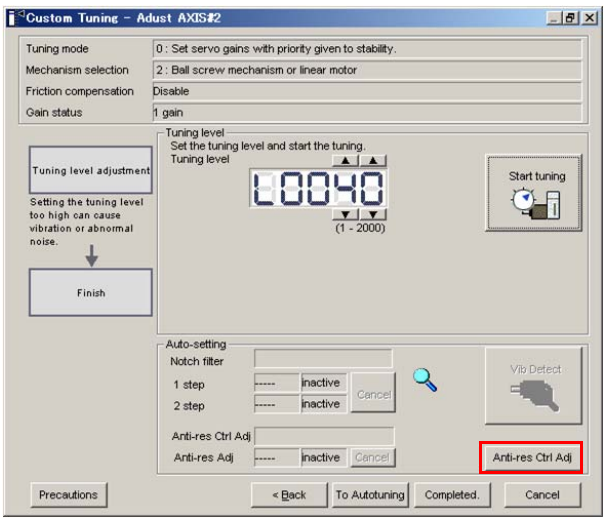
Use the following procedure.

⚠ 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 7 of the procedure for custom tuning. Refer to the following section for details.
   ☞ *8.5.3 Operating Procedure* on page 8-16

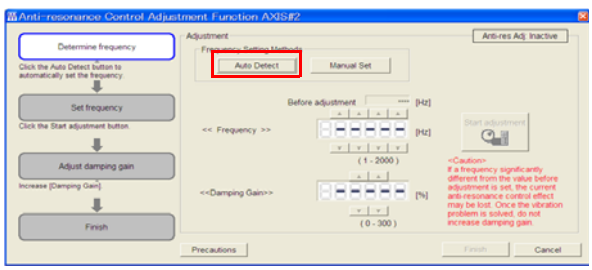
2. Click the **Anti-res Ctrl Adj** Button.
   The rest of the procedure depends on whether you know the vibration frequency.



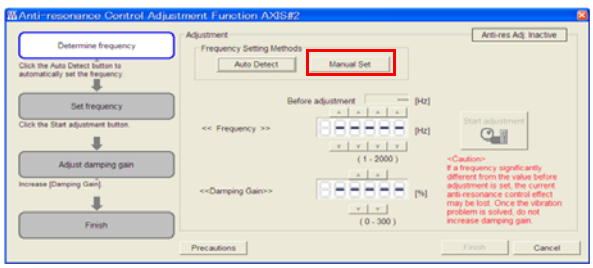
3. If you do not know the vibration frequency, click the **Auto Detect** Button. If you know the vibration frequency, click the **Manual Set** Button.

To Automatically Detect the Vibration Frequency

The frequency will be set.



To Manually Set the Vibration Frequency

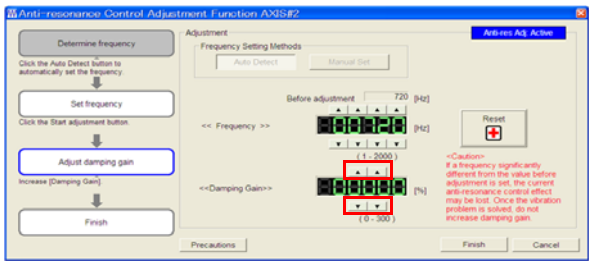


4. Click the **Start adjustment** Button.

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.

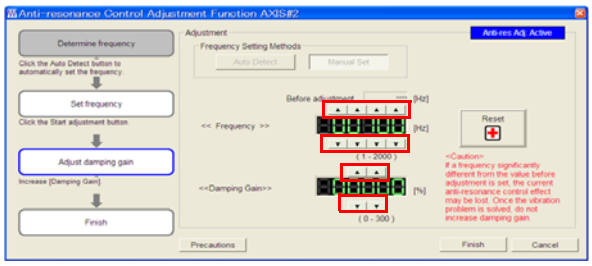
To Automatically Detect the Vibration Frequency

Change the setting of the damping gain.

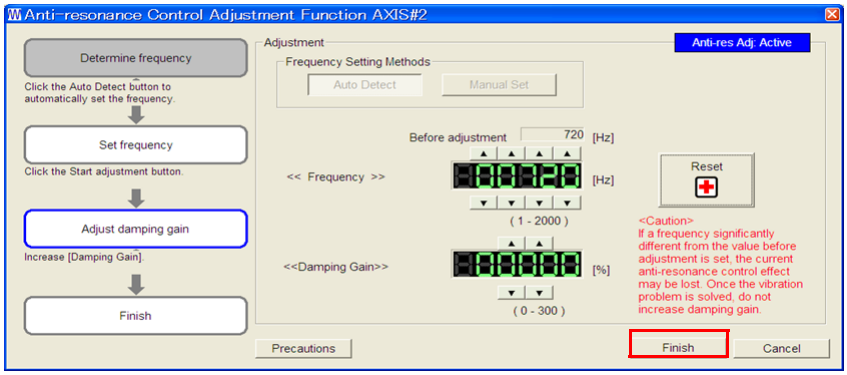


To Manually Set the Vibration Frequency

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.

8.6.4 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
Pn163	Anti-Resonance Damping Gain	Yes

Yes: The parameter is automatically set.

8.7 Vibration Suppression

This section describes vibration suppression.

8.7.1 Outline

You can use vibration suppression to suppress transient vibration at a low frequency from 1 Hz to 100 Hz, which is generated mainly when the machine vibrates during positioning. This is effective for vibration frequencies for which notch filters and anti-resonance control adjustment are not effective.

To execute vibration suppression, input an operation reference and execute the function when there is vibration.

Perform custom tuning if required to increase the response after performing vibration suppression.

⚠ CAUTION

- Related parameters will be set automatically when vibration suppression is executed. This may greatly affect the response before and after execution. To ensure safety, make sure that you can perform an emergency stop at any time.
- Before you execute vibration suppression, set the correct moment of inertia ratio (Pn103). 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

- Vibration suppression detects vibration frequencies between 1 Hz and 100 Hz.
- Frequency detection will not be performed if there is no vibration in the position deviation or if the vibration frequency is outside the range of detectable frequencies. If that is a problem, use a device such as a displacement meter or vibration sensor to measure the vibration frequency.
- If an automatically detected vibration frequency is not suppressed, the actual frequency and the detected frequency may be different. Fine-tune the detected frequency if necessary.

Items That Influence Performance

If continuous vibration occurs while the Servomotor is stopping, vibration suppression cannot be used to suppress the vibration effectively. In this case, use anti-resonance control adjustment or custom tuning.

Detection of Vibration Frequencies

Frequency detection may not be possible if vibration does not appear in the position deviation or the vibration that results from the position deviation is too small. You can adjust the detection sensitivity by changing the setting of the residual vibration detection width (Pn560), which is set as a percentage of the positioning completed width (PnB2D). Perform the detection of vibration frequencies again after adjusting the setting of Pn560.

Pn560	Residual Vibration Detection Width				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 3,000	0.1%	400	Immediately	Setup

Note: As a guideline, change the setting 10% at a time. If the setting of this parameter is lowered, the detection sensitivity will be increased. Vibration may not be detected accurately if the setting is too small.

Information The vibration frequencies that are automatically detected may vary somewhat with each positioning operation. Perform positioning several times and make adjustments while checking the effect of vibration suppression.

8.7.2 Preparations

Check the following settings before you execute vibration suppression.

- The parameters must not be write prohibited.

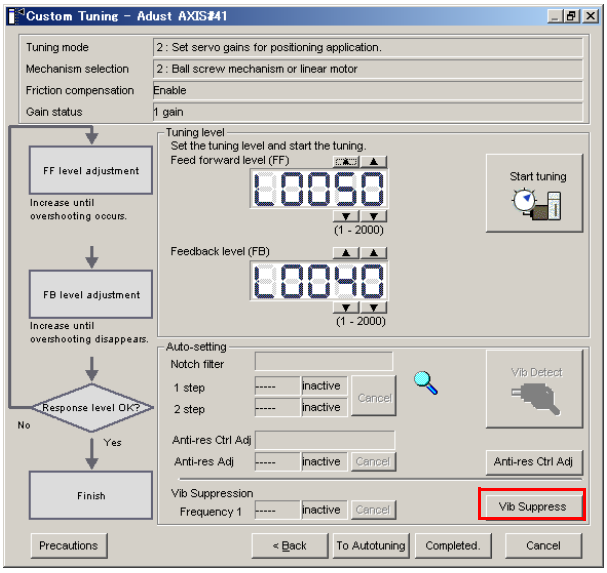
8.7.3 Operating Procedure

Use the following procedure to perform vibration suppression.

1. Perform steps 1 to 7 of the procedure for custom tuning. Refer to the following section for details.

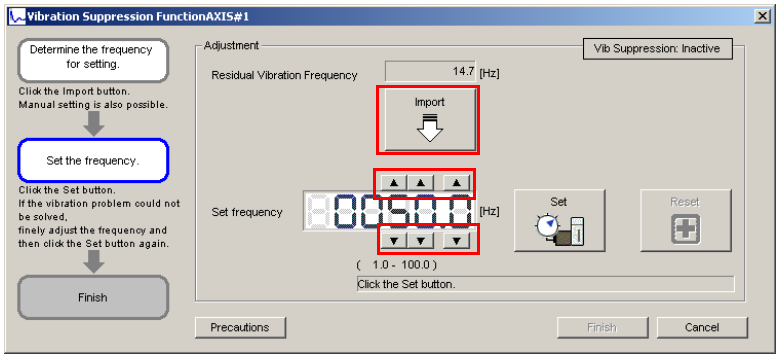
☞ *8.5.3 Operating Procedure* on page 8-16

2. Click the **Vib Suppress** Button.



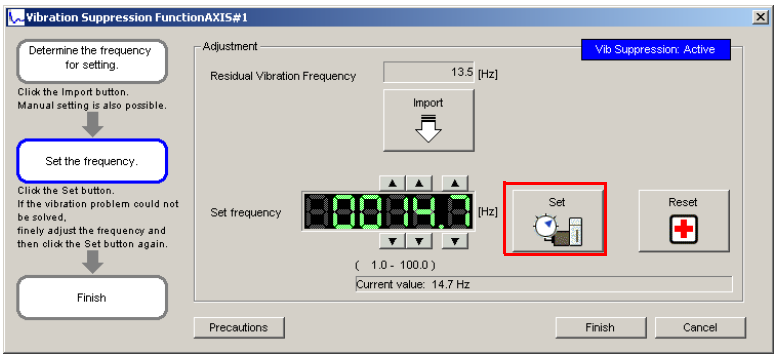
3. Click the **Import** Button or click ▲ and ▼ Button to manually adjust the set frequency.
When you click the **Import** Button, the residual vibration frequency in the motor is read as the set frequency. (The frequency can be read only when the residual vibration frequency is between 1.0 and 100.0.)

> **Important**
> Frequency detection will not be performed if there is no vibration or if the vibration frequency is outside the range of detectable frequencies. If a vibration frequency is not detected, provide a means of measuring the vibration frequency.

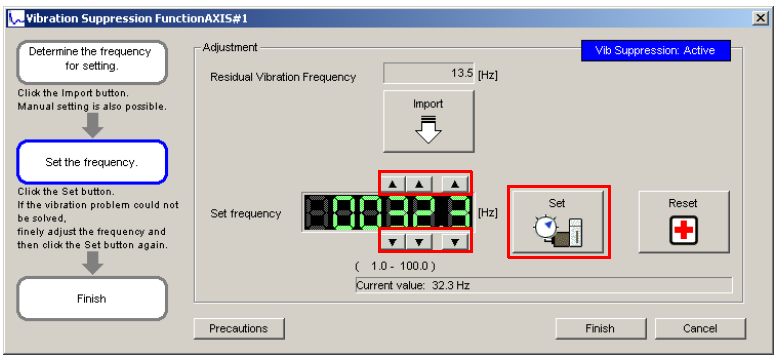


4. Click the **Set** Button.

> Important
> No settings related to vibration suppression are changed during operation.
> If the Servomotor does not stop within approximately 10 seconds after changing the setting, an update timeout will occur. The setting will be automatically returned to the previous value.



If the vibration is not eliminated, use the ▲ and ▼ Buttons for the set frequency to fine-tune the value and click the **Set** Button again.



Click the **Reset** Button during adjustment to restore the setting to its original value. The status from before when adjustment was started will be restored.

5. When the vibration has been eliminated, click the **Finish** Button.
The updated value will be saved in the SERVOPACK.

> Important
> Vibration suppression will be enabled in step 5. The motor response, however, will change when the Servomotor comes to a stop with no reference input.

This concludes the procedure.

8.7.4 Related Parameters

The following parameters are automatically adjusted or used as reference when you execute vibration suppression.

Do not change the settings while vibration suppression is being executed.

Parameter	Name	Automatic Changes
Pn140	Model Following Control-Related Selections	Yes
Pn141	Model Following Control Gain	Yes
Pn143	Model Following Control Bias in the Forward Direction	No
Pn144	Model Following Control Bias in the Reverse Direction	No
Pn145	Vibration Suppression 1 Frequency A	Yes
Pn146	Vibration Suppression 1 Frequency B	Yes
Pn147	Model Following Control Speed Feedforward Compensation	No

Yes: The parameter is automatically set.

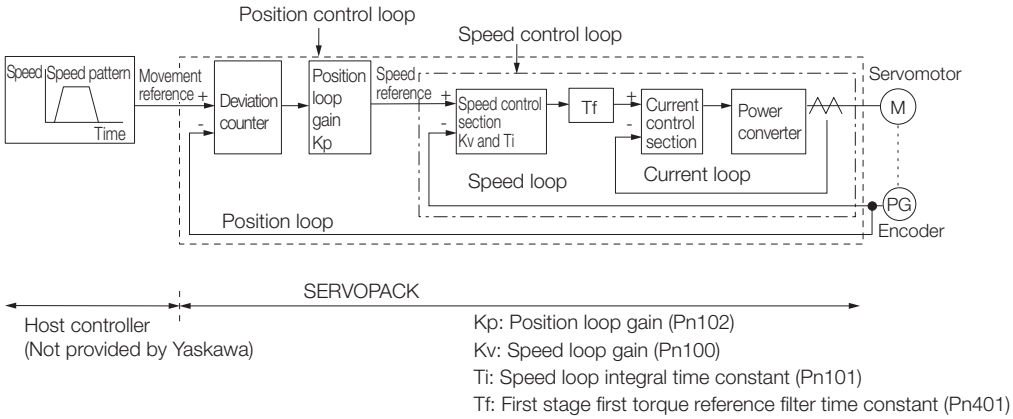
No: The parameter is not automatically set, but the setting is read during execution.

8.8 Manual Tuning

This section describes manual tuning.

8.8.1 Tuning the Servo Gains

Servo Gains



In order to manually tune the servo gains, you must understand the configuration and characteristic of the SERVOPACK and adjust the servo gains individually. In most cases, if you greatly change any one parameter, you must adjust the other parameters again. Monitor the response characteristic with the trace function of the SigmaWin+ while you make the adjustment.

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.

Use manual tuning in the following cases.

- When custom tuning does not work well
- When you want to increase the servo gains higher than the results of custom tuning
- When you want to determine the servo gains and moment of inertia ratio yourself

The operation is started with the default settings for the servo gain parameters.

Applicable Tools

You can perform monitoring with the SigmaWin+.

Precautions

Vibration may occur while you are tuning the servo gains. You must provide an emergency stop device and activate it immediately whenever vibration occurs.

Example Adjustment Procedure

Step	Description
1	Adjust the first stage first torque reference filter time constant (Pn401) so that vibration does not occur.
2	Increase the position loop gain (Pn100) and reduce the speed loop integral time constant (Pn101) as far as possible within the range that does not cause machine vibration.
3	Repeat steps 1 and 2 and return the settings about 10% to 20% from the values that you set.
4	Increase the position loop gain (Pn102) within the range that does not cause vibration.

Information

If you greatly change any one servo gain parameter, you must adjust the other parameters again. Do not increase the setting of just one parameter. As a guideline, adjust the settings of the servo gains by approximately 5% each. As a rule, change the servo parameters in the following order.

• To Increase the Response Speed
1. Reduce the torque reference filter time constant.
2. Increase the speed loop gain.
3. Decrease the speed loop integral time constant.
4. Increase the position loop gain.

• To Reduce Response Speed and to Stop Vibration and Overshooting
1. Reduce the position loop gain.
2. Increase the speed loop integral time constant.
3. Decrease the speed loop gain.
4. Increase the torque filter time constant.

Adjusted Servo Gains

You can set the following gains to adjust the response characteristic of the SERVOPACK.
- Pn100: Speed Loop Gain
- Pn101: Speed Loop Integral Time Constant
- Pn102: Position Loop Gain
- Pn401: First Stage First Torque Reference Filter Time Constant

◆ Position Loop Gain

The position loop gain determines the response characteristic of the position loop in the 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				
	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.

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

If you use a position reference filter, transient deviation will increase due to the filter time constant. When you make the setting, consider deviation accumulation that may result from the filter.

Pn520	Position Deviation Overflow Alarm Level				
	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				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1 Hz	400	Immediately	Tuning

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

The default setting of Pn103 (Moment of Inertia Ratio) is 0. 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				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 20,000	1%	0	Immediately	Tuning

◆ Speed Loop Integral Time Constant

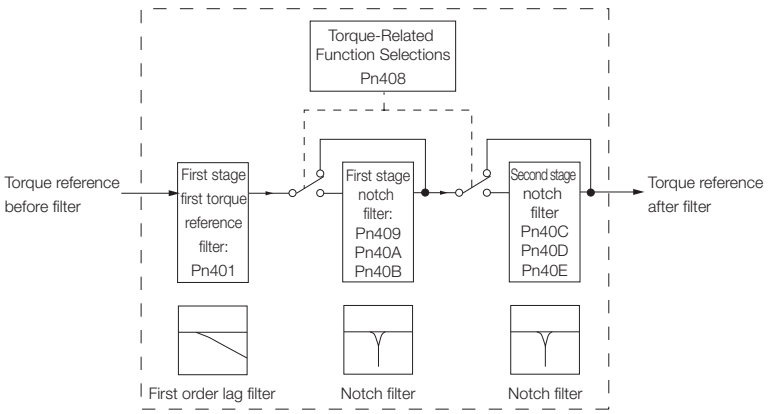
To enable response to even small inputs, the speed loop has an integral element. The integral element becomes a delay factor in the servo system. If the time constant is set too high, overshooting will occur, positioning settling time will increase, and the response characteristic will suffer.

Pn101	Speed Loop Integral Time Constant				
	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 the Pn408 = n.□□□X and Pn408 = n.□X□□.



■ Torque Reference Filter

If you suspect that machine vibration is being caused by the Servo Drive, try adjusting the torque reference filter time constant. This may stop the vibration. The lower the value, the better the control response characteristic will be, but there may be a limit depending on the machine conditions.

	First Stage First Torque Reference Filter Time Constant				
Pn401	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	100	Immediately	Tuning

■ 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.

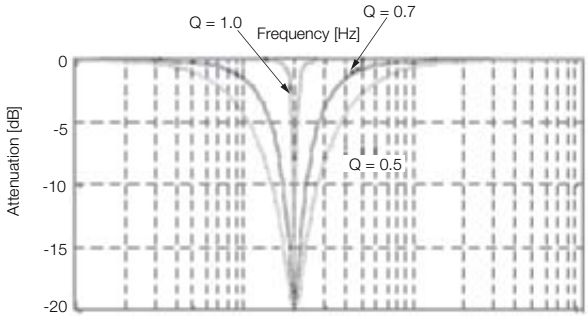
The notch filter puts a notch in the gain curve at the specific vibration frequency (called the notch frequency). The frequency components near the notch frequency can be reduced or removed with a notch filter.

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.



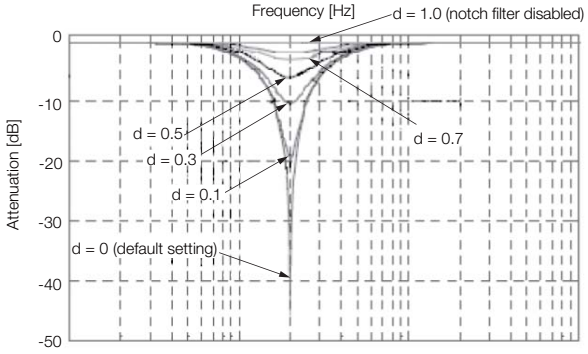
Note: The above notch filter frequency characteristics are based on calculated values and may be different from actual characteristics.

• 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 Pn40B 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.		

Set the machine vibration frequencies in the notch filter parameters.

Pn409	First Stage Notch Filter Frequency				
	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				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 1,000	0.01	70	Immediately	Tuning
Pn40B	First Stage Notch Filter Depth				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,000	0.001	0	Immediately	Tuning
Pn40C	Second Stage Notch Filter Frequency				
	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				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 1,000	0.01	70	Immediately	Tuning
Pn40E	Second Stage Notch Filter Depth				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,000	0.001	0	Immediately	Tuning

Important

- Do not set notch filter frequencies (Pn409 and Pn40C) 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 and Pn40C) only while the Servomotor is stopped. Vibration may occur if a notch filter frequency is changed during operation.

Guidelines for Manually Tuning Servo Gains

When you manually adjust the parameters, make sure that you completely understand the information in the user's 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+ 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 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.

Guidelines are given below for gain settings 1.

- Speed Loop Gain (Pn100 [Hz]) and Position Loop Gain (Pn102 [/s])
  Stable gain: Pn102 [/s] ≤ 2π × Pn100/4 [Hz]
  Critical gain: Pn102 [/s] < 2π × Pn100 [Hz]

- Speed Loop Gain (Pn100 [Hz]) and Speed Loop Integral Time Constant (Pn101 [ms])
  Stable gain: Pn101 [ms] ≥ 4,000/(2π × Pn100 [Hz])
  Critical gain: Pn101 [ms] > 1,000/(2π × Pn100 [Hz])

- Speed Loop Gain (Pn100 [Hz]) and First Stage First Torque Reference Filter Time Constant (Pn401 [ms])
  Stable gain: Pn401 [ms] ≤ 1,000/(2π × Pn100 [Hz] × 4)
  Critical gain: Pn401 [ms] < 1,000/(2π × Pn100 [Hz] × 1)

- Speed Loop Gain (Pn100 [Hz]) and First Stage Notch Filter Frequency (Pn409 [Hz]) (or Second Stage Notch Filter Frequency (Pn40C [Hz]))
  Critical gain: Pn409 [Hz] > 4 × Pn100 [Hz]

◆ Decimal Points in Parameter Settings

Decimal places are given for the settings of parameters 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].

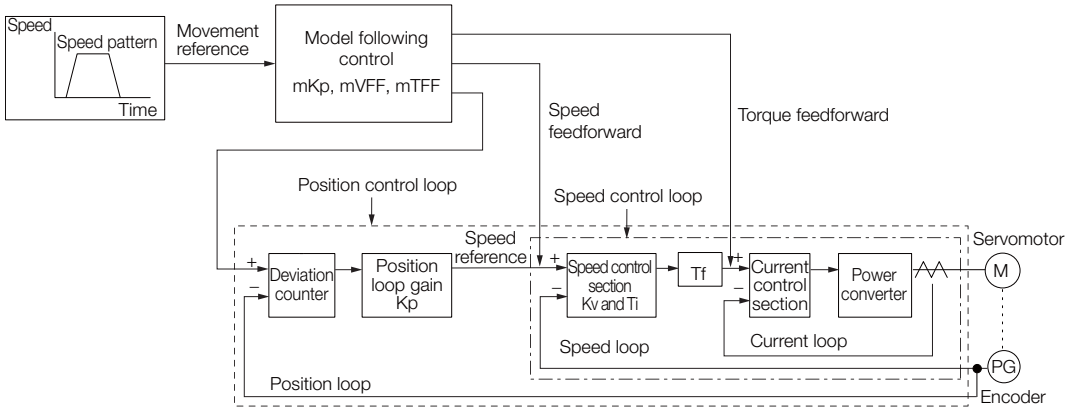
Model Following Control

You can use model following control to improve response characteristic and shorten positioning time.

Normally, the parameters that are used for model following control are automatically set along with the servo gains by executing autotuning or custom tuning. However, you must adjust them manually in the following cases.

- When the tuning results for custom tuning are not acceptable
- When you want to increase the response characteristic higher than that achieved by the tuning results for custom tuning
- When you want to determine the servo gains and model following control parameters yourself

The block diagram for model following control is provided below.



Kp: Position loop gain (Pn102)
Kv: Speed loop gain (Pn100)
Ti: Speed loop integral time constant (Pn101)
Tf: First stage first torque reference filter time constant (Pn401)
mKp: Model following control gain (Pn141)
mTFF: Model following control bias in the forward direction (Pn143)
Model following control bias in the reverse direction (Pn144)
mVFF: Model following control speed feedforward compensation (Pn147)

◆ Manual Tuning Procedure

Use the following tuning procedure for using model following control.

Step	Description
1	Adjust the servo gains. Refer to the following section for an example procedure. ☞ *Example Adjustment Procedure* on page 8-32 Note: 1. Set the moment of inertia ratio (Pn103) as accurately as possible. 2. Refer to the guidelines for manually tuning the servo gains and set a stable gain for the position loop gain (Pn102). ☞ *Example Adjustment Procedure* on page 8-32
2	Increase the model following control gain (Pn141) as much as possible within the range in which overshooting and vibration do not occur.
3	If overshooting occurs or if the response is different for forward and reverse operation, fine-tune model following control with the following settings: model following control bias in the forward direction (Pn143), model following control bias in the reverse direction (Pn144), and model following control speed feedforward compensation (Pn147).

◆ Related Parameters

Next we will describe the following parameters that are used for model following control.

- Pn140 (Model Following Control-Related Selections)
- Pn141 (Model Following Control Gain)
- Pn143 (Model Following Control Bias in the Forward Direction)
- Pn144 (Model Following Control Bias in the Reverse Direction)
- Pn147 (Model Following Control Speed Feedforward Compensation)

■ Model Following Control-Related Selections

Set Pn140 = n.□□□X to specify whether to use model following control.

If you use model following control with vibration suppression, set Pn140 to n.□□1□ or Pn140 to n.□□2□. When you also perform vibration suppression, adjust vibration suppression with custom tuning in advance.

Note: If you use vibration suppression (Pn140 = n.□□1□ or Pn140 = n.□□2□), always set Pn140 to n.□□□1 (Use model following control).

Parameter		Function	When Enabled	Classification
Pn140	n.□□□0 [default setting]	Do not use model following control.	Immediately	Tuning
	n.□□□1	Use model following control.		
	n.□□0□ [default setting]	Do not perform vibration suppression.		
	n.□□1□	Perform vibration suppression for a specific frequency.		
	n.□□2□	Reserved setting (Do not use.)		

■ Model Following Control Gain

The model following control gain determines the response characteristic of the servo system. If you increase the setting of the model following control gain, the response characteristic will improve and the positioning time will be shortened. The response characteristic of the servo system is determined by this parameter, and not by Pn102 (Position Loop Gain).

Pn141	Model Following Control Gain				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1/s	500	Immediately	Tuning

Information

For machines for which a high model following control gain cannot be set, the size of the position deviation in model following control will be determined by the setting of the model following control gain. For a machine with low rigidity, in which a high model following control gain cannot be set, position deviation overflow alarms may occur during high-speed operation. If that is the case, you can increase the setting of the following parameter to increase the level for alarm detection.

Use the following conditional expression for reference in determining the setting.

$$Pn\ 520 \geq \frac{\text{Maximum feed speed [reference units/s]}}{Pn\ 141/10\ [1/s]} \times 2.0$$

Pn520	Position Deviation Overflow Alarm Level				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,823	1 reference unit	25,600	Immediately	Setup

■ Model Following Control Bias in the Forward Direction and Model Following Control Bias in the Reverse Direction

If the response is different for forward and reverse operation, use the following parameters for fine-tuning.

If you decrease the settings, the response characteristic will be lowered but overshooting will be less likely to occur.

Pn143	Model Following Control Bias in the Forward Direction				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	0.1%	1,000	Immediately	Tuning
Pn144	Model Following Control Bias in the Reverse Direction				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	0.1%	1,000	Immediately	Tuning

■ Model Following Control Speed Feedforward Compensation

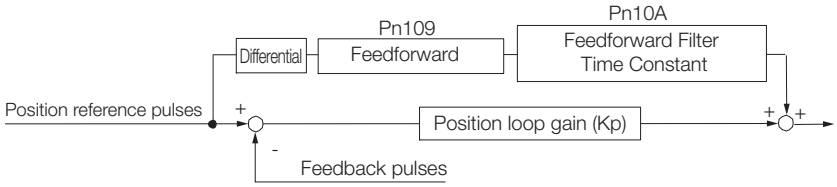
If overshooting occurs even after you adjust the model following control gain, model following control bias in the forward direction, and model following control bias in the reverse direction, you may be able to improve performance by setting the following parameter.

If you decrease the settings, the response characteristic will be lowered but overshooting will be less likely to occur.

	Model Following Control Speed Feedforward Compensation				
Pn147	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	0.1%	1,000	Immediately	Tuning

8.8.2 Feedforward

The feedforward function applies feedforward compensation to shorten the positioning time.

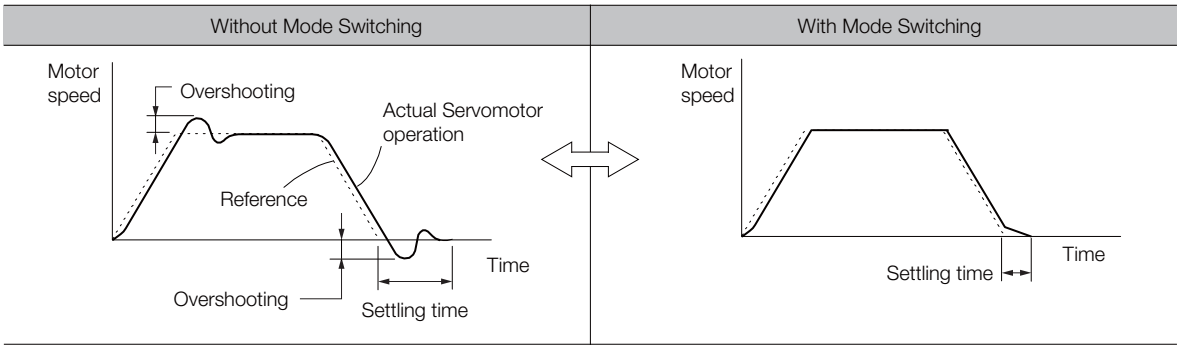


	Feedforward				
Pn109	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	1%	0	Immediately	Tuning
	Feedforward Filter Time Constant				
Pn10A	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 6,400	0.01 ms	0	Immediately	Tuning

Note: If you set the feedforward value too high, the machine may vibrate. As a guideline, use a setting of 80% or less.

8.8.3 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 [default setting]	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	Do not use mode switching.	-		

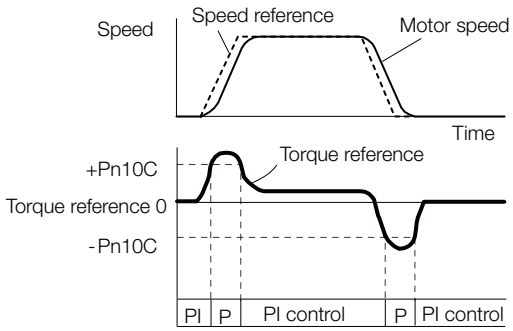
◆ Parameters That Set the Switching Levels

Pn10C	Mode Switching Level for Torque Reference				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%	200	Immediately	Tuning
Pn10D	Mode Switching Level for Speed Reference				
	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				
	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				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 reference unit	0	Immediately	Tuning

Operating Examples for Different Switching Conditions

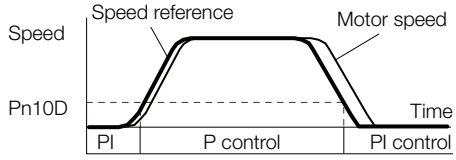
◆ Using the Torque Reference as the Mode Switching Condition (Default Setting)

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%.



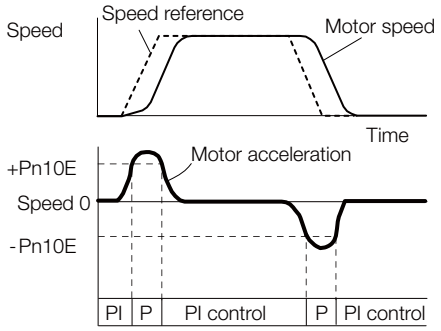
◆ Using the Speed Reference as the Mode Switching Condition

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.



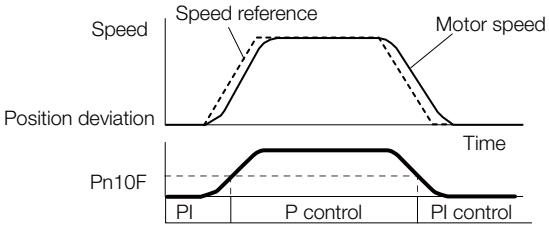
◆ Using the Acceleration as the Mode Switching Condition

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.



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

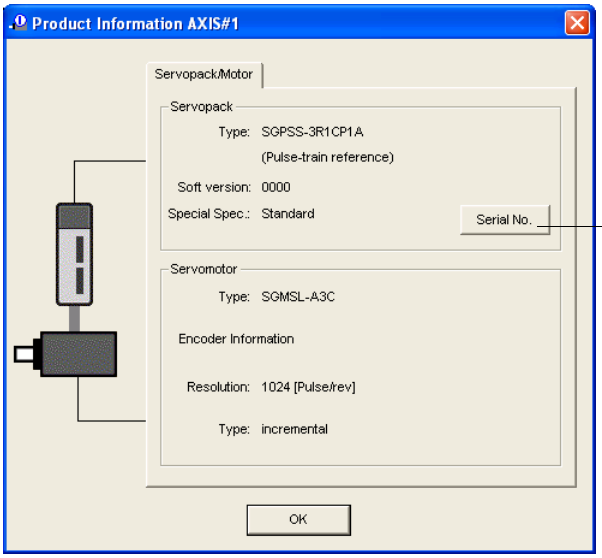
Monitor Items	
Information on SERVOPACKs	• SERVOPACK model • SERVOPACK software version • SERVOPACK special specifications • SERVOPACK serial number • SERVOPACK manufacturing date
Information on Servomotors	• Servomotor model*
Information on Encoders	• Encoder resolution* • Encoder type*

* The Servomotor model for the motor code that is set in Pn08A (Motor Selection Switch) is displayed.

9.1.2 Operating Procedure

Use the following procedure to display the product information monitor dialog box.

- Select ***Monitor - Read Product Information*** from the menu bar of the Main Window of the SigmaWin+.



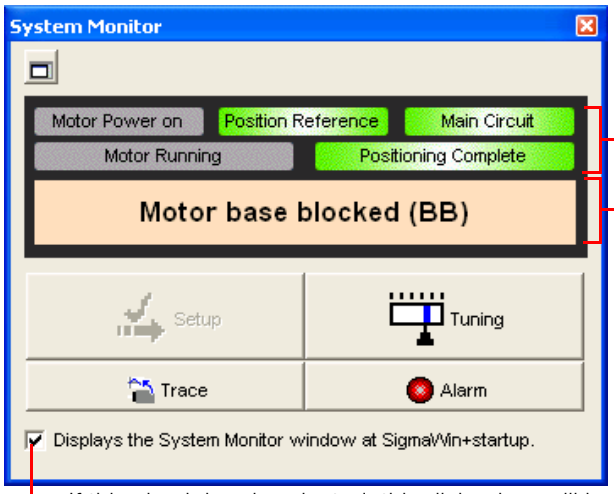
Click the **Serial No.** Button to display the serial number and manufacturing date of the SERVOPACK.

9.2 Monitoring SERVOPACK Status

9.2.1 System Monitor

Use one of the following methods to display the System Monitor Dialog Box.

- Start the SigmaWin+. The System Monitor Dialog Box will be automatically displayed.
- Select ***Monitor - Monitor - System Monitor*** from the menu bar of the Main Window of the SigmaWin+.



The current signal status of the SERVOPACK is displayed.

The current status of the SERVOPACK is displayed.

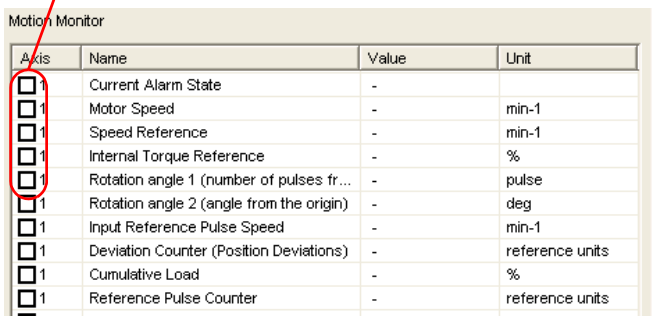
If this check box is selected, this dialog box will be displayed automatically when the SigmaWin+ starts.

9.2.2 Monitoring Status and Operations

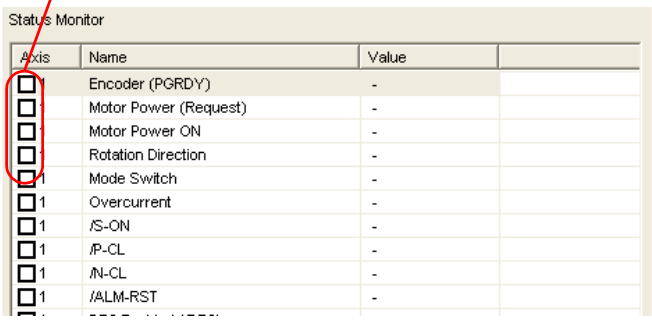
Use the following method to display the SERVOPACK's Status Monitor Window or Motion Monitor Window.

- Select ***Monitor - Monitor - Status Monitor*** or ***Monitor - Monitor - Motion Monitor*** from the menu bar of the Main Window of the SigmaWin+.

If these check boxes are selected, the current values are displayed in the *Value* column.



If these check boxes are selected, the current values are displayed in the *Value* column.



Monitor Items

The items that you can monitor on the Status Monitor Window and Motion Monitor Window are listed below.

- Status Monitor Window

Monitor Items					
Internal Status	• Encoder (PGRDY) • Motor Power (Request) • Motor Power ON • Rotation Direction • Mode Switch • Overcurrent	Input Signal Status	• /S-ON (SERVO ON Input Signal) • /P-CL (Forward External Torque Limit Signal) • /N-CL (Reverse External Torque Limit Signal) • /ALM-RST (Alarm Reset Input Signal) • /DEC (Homing Deceleration Switch Input Signal) • /STOP (Operation Stop Input Signal) • /HOME (Homing Input Signal) • PULS (Position Reference Input Signal) • Position Reference Direction Signal • PULS (Pulse Reference Input Signal) • SIGN (Sign Reference Signal) • /CLR (Position Deviation Clear Input Signal)	Output Signal Status	• ALM (Servo Alarm Output Signal) • /INPOSITION (Positioning Completion Output Signal) • /TGON (Rotation Detection Output Signal) • /S-RDY (Servo Ready Output Signal) • /CLT (Torque Limit Status Output Signal) • /BK (Brake Output Signal) • /WARN (Warning Output Signal) • /NEAR (Near Output Signal) • /POSRDY (Homing Completed Output Signal) • /BUSY (Busy Output Signal) • /S-ONS (SERVO ON Status Output Signal) • E-STPS (Emergency Stop Status Output Signal)

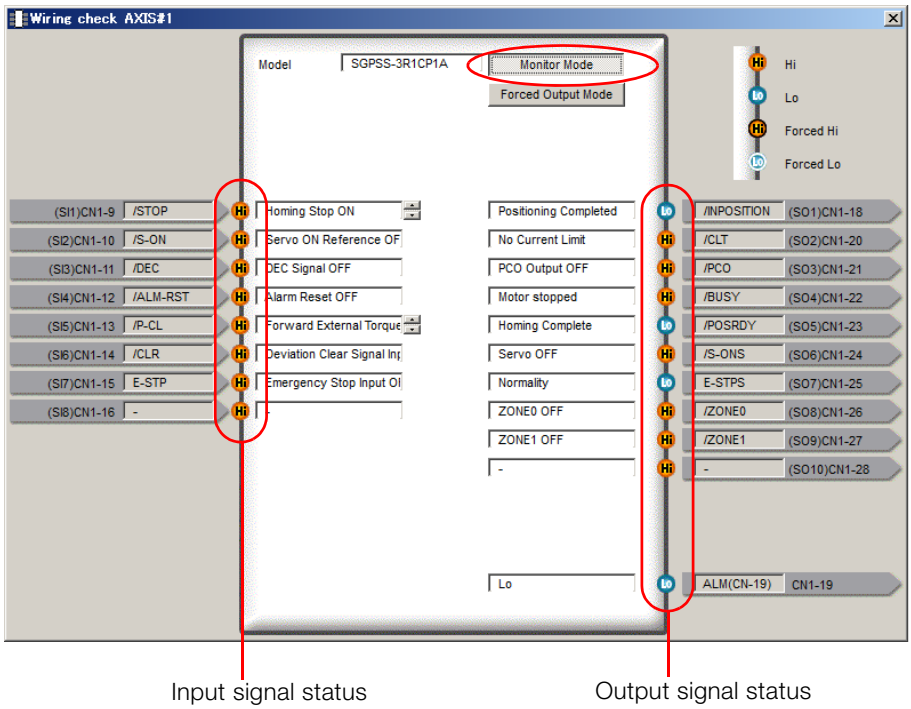
- Motion Monitor Window

Monitor Items	
• Current Alarm State • Motor Speed • Speed Reference • Internal Torque Reference • Rotational Angle 1 (number of encoder pulses from origin within one encoder rotation) • Rotational Angle 2 (angle from origin within one encoder rotation) • Input Reference Pulse Speed • Deviation Counter (Position Deviation) • Cumulative Load • Input Reference Pulse Counter • Feedback Pulse Counter	• Total Operating Time • Alarm Traceback Time Stamps No. 1 to 10 • Position Reference Current Position • Motor Current Position

9.2.3 I/O Signal Monitor

Use the following procedure to check I/O signals.

1. Select *Monitor* - *Check Wiring* from the menu bar of the Main Window of the SigmaWin+.
2. Click the **Monitor Mode** Button.



Information

You can also use the above window to check wiring.

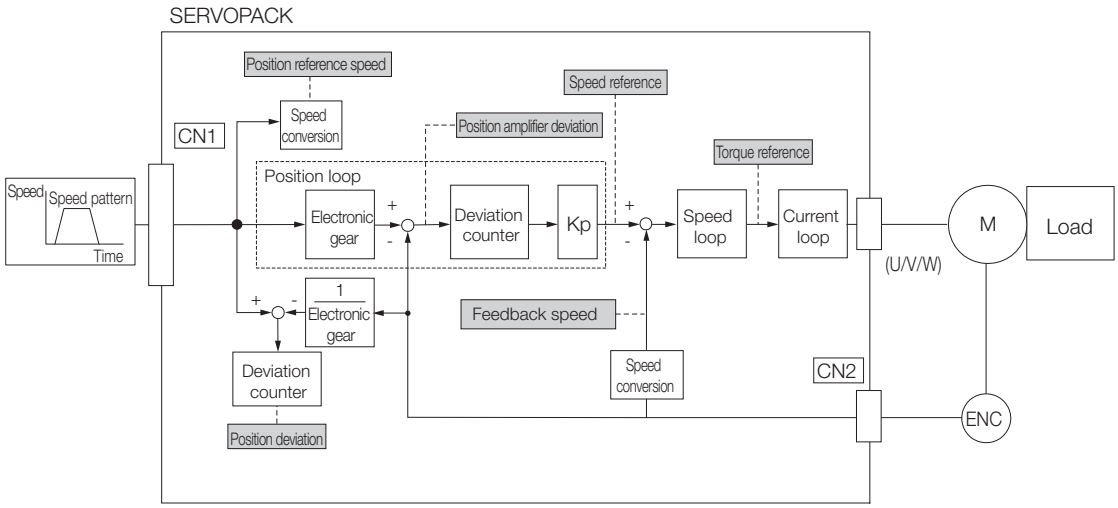
- Checking Input Signal Wiring
  Change the signal status at the host controller. If the input signal status on the window changes accordingly, then the wiring is correct.
- Checking Output Signal Wiring
  Click the **Force Output Mode** Button. This will force the output signal status to change. If the signal status at the host controller changes accordingly, then the wiring is correct.
  You cannot use the **Force Output Mode** Button in the SERVO ON state.

9.3 Monitoring Machine Operation Status and Signal Waveforms

To monitor waveforms, use the SigmaWin+ trace function.

9.3.1 Items That You Can Monitor

You can use the SigmaWin+ to monitor the shaded items in the following block diagram.



9.3.2 Using the SigmaWin+

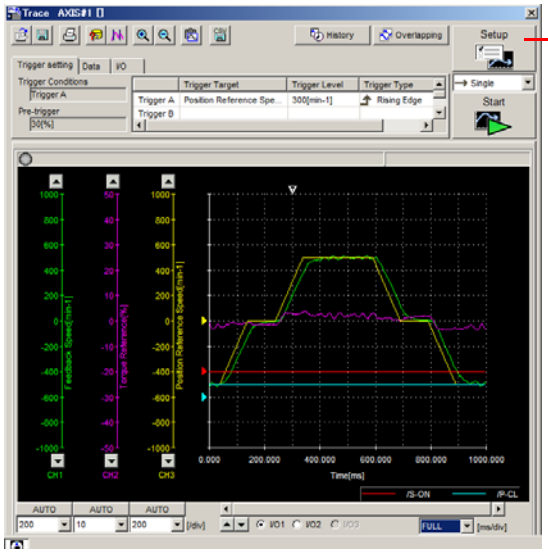
This section describes how to trace data and I/O with the SigmaWin+.

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

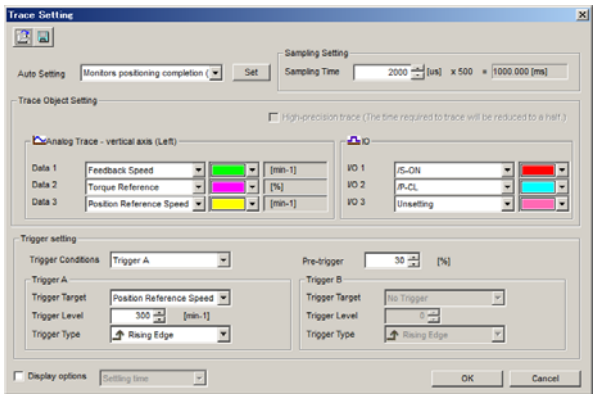
📖 AC Servo Drives Engineering Tool SigmaWin+ Online Manual Σ-S Component (Manual No.: SIEP S800001 06)

Operating Procedures

Select ***Trace - Trace*** from the menu bar of the Main Window of the SigmaWin+.



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	• Position Deviation
• Feedback Speed	• Position Amplifier Deviation
• Reference Speed	• Speed Feedforward
• Position Reference Speed	• CN1 Sequence Output Signals

• I/O Tracing

Trace Objects	
Input Signals	• /HOME (Homing Input Signal) • /S-ON (SERVO ON Input Signal) • /DEC (Homing Deceleration Switch Input Signal) • /ALM-RST (Alarm Reset Input Signal) • /P-CL (Forward External Torque Limit Signal) • /N-CL (Reverse External Torque Limit Signal) • E-STP (Emergency Stop Input Signal)
Output Signals	• ALM (Servo Alarm Output Signal) • /INPOSITION (Positioning Completion Output Signal) • /WARN (Warning Output Signal) • /BK (Brake Output Signal) • /S-RDY (Servo Ready Output Signal) • /CLT (Torque Limit Status Output Signal) • /TGON (Rotation Detection Output Signal) • /NEAR (Near Output Signal) • /PCO (Encoder Origin Signal) • /BUSY (Busy Output Signal) • /POSRDY (Homing Completed Output Signal) • /S-ONS (SERVO ON Status Output Signal) • E-STPS (Emergency Stop Status Output Signal) • /ZONE0 (ZONE Output 0 Signal) • /ZONE1 (ZONE Output 1 Signal) • /ZONE2 (ZONE Output 2 Signal) • /ZONE3 (ZONE Output 3 Signal)

Maintenance

10

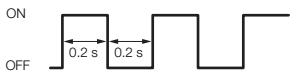
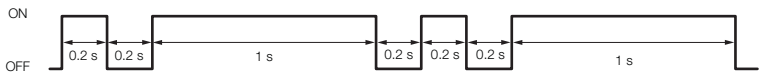
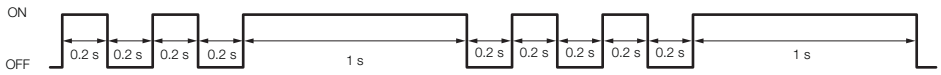
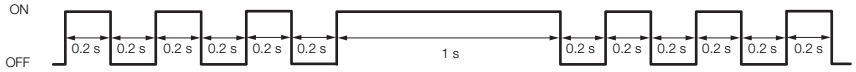
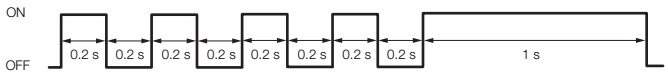
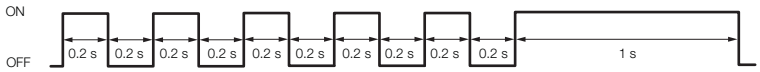
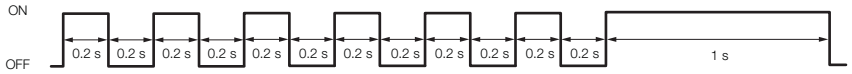
This chapter provides information on the meaning of, causes of, and corrections for alarms and warnings.

10.1 Alarm and Warning Displays

This section describes how to display alarms and warnings, provides a list of the alarms and warnings that may occur, and describes the causes of and corrections for them.

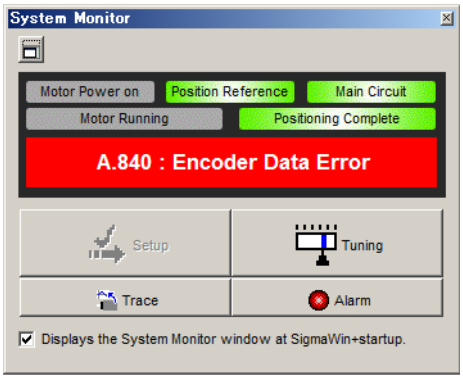
10.1.1 Confirming Alarms and Warnings

The ALM indicator will light when an alarm or warning occurs.

Indicator Lighting/Flashing Pattern	SERVOPACK Status or Alarm Number That Occurred
Not lit.	Normal status
Rapid flashing 	A.9□□ or warning
Alternates between flashing 1 time and lighting for 1 s. 	A.0□□, A.E□□
Alternates between flashing 2 times and lighting for 1 s. 	A.1□□
Alternates between flashing 3 times and lighting for 1 s. 	A.4□□
Alternates between flashing 4 times and lighting for 1 s. 	A.5□□, A.6□□, A.D□□
Alternates between flashing 5 times and lighting for 1 s. 	A.7□□
Alternates between flashing 6 times and lighting for 1 s. 	A.8□□, A.C□□
Lit.	A system error (A.B□□) occurred or initialization is in progress.

You can use the system monitor function of the SigmaWin+ to check for detailed alarm numbers and alarm names.

An example of the System Monitor Dialog Box when an alarm has occurred is shown below.



10.1.2 List of Alarms

The list of alarms gives the alarm name, alarm meaning, and alarm reset possibility,* in order of the alarm numbers.

* 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.

Alarm Number	Alarm Name	Alarm Meaning	Alarm Reset Possible?
A.020	Parameter Checksum Error	There is an error in the parameter data in the SERVOPACK.	No
A.021	Parameter Format Error	There is an error in the parameter data format in the SERVOPACK.	No
A.022	System Checksum Error	There is an error in the parameter data in the SERVOPACK.	No
A.030	Main Circuit Detector Error	There is an error in the voltage detection data.	Yes
A.040	Parameter Setting Error	A parameter setting is outside of the setting range.	No
A.042	Parameter Combination Error	The combination of some parameters exceeds the setting range.	No
A.04A	Parameter Setting Error 2	A PnB□□ parameter setting is outside of the setting range.	No
A.050	Combination Error	A Servomotor with an unsupported capacity is selected in the parameters.	Yes
A.051	Unsupported Device Alarm	An unsupported Servomotor was selected in the parameters.	No
A.0B0	Invalid SERVO ON Command Alarm	The /S-ON (SERVO ON) signal was input from the host controller after a SigmaWin+ function that supplies power to the Servomotor was executed.	Yes
A.100	Overcurrent Detected	An overcurrent flowed through the power transistor.	No
A.400	Overvoltage	The main circuit DC voltage is too high (32 V or higher).	Yes
A.510	Overspeed	The motor exceeded the maximum speed.	Yes
A.6B0	Emergency Stop Operation Failure	The motor did not stop within 10 s of when the emergency stop signal was input.	Yes
A.710	Instantaneous Overload	The Servomotor was operating for several seconds to several tens of seconds under a torque that largely exceeded the rating.	Yes
A.720	Continuous Overload	The Servomotor was operating continuously under a torque that exceeded the rating.	Yes
A.840	Encoder Data Alarm	The amplitude of the encoder signal is too small or an error occurred in the A/D converter.	No

Continued on next page.

Continued from previous page.

Alarm Number	Alarm Name	Alarm Meaning	Alarm Reset Possible?
A.850	Encoder Overspeed	There is an error in the differential data (encoder speed information) for the encoder position.	No
A.B31	Current Detection Error 1	An error occurred in the current detection circuit.	No
A.BF0	System Alarm 0	Internal program error 0 occurred in the SERVOPACK.	No
A.BF1	System Alarm 1	Internal program error 1 occurred in the SERVOPACK.	No
A.BF3	System Alarm 3	Internal program error 3 occurred in the SERVOPACK.	No
A.BF4	System Alarm 4	Internal program error 4 occurred in the SERVOPACK.	No
A.C10	Servomotor Out of Control	The Servomotor ran out of control.	Yes
A.D00	Position Deviation Overflow	The setting of Pn520 (Excessive Position Deviation Alarm Level) was exceeded by the position deviation while the SERVO was ON.	Yes
A.D01	Position Deviation Overflow Alarm at SERVO ON	The SERVO ON state was entered after the position deviation exceeded the setting of Pn526 (Excessive Position Deviation Alarm Level at SERVO ON) in the SERVO OFF state.	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 (Speed Limit Level at SERVO ON) will limit the speed in the SERVO ON state. This alarm occurs if a reference is input and the setting of Pn520 (Excessive Position Deviation Alarm Level) is exceeded before the limit is cleared.	Yes
A.E1C	ZONE Table Checksum Error	The ZONE table was not correctly stored in flash memory.	Yes
A.E1D	ZONE Table Version Mismatch	The combination of firmware and ZONE table versions is wrong.	Yes
A.E1E	ZONE Table Out of Range Alarm	A value in the ZONE table exceeds the setting range.	Yes
A.E24	Homing Failure	Homing failed for pressing homing.	Yes
A.E25	Homing Overspeed	The speed during axis movement for pressing homing was two times the homing creep speed or higher. Note: The lower limit for checking is 50 min^{-1}. If the homing creep speed is low, a check is made for 50 min^{-1}.	Yes

10.1.3 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 for Correction
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 5-6
	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 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 4-4
	Gas, water drops, or cutting oil entered the SERVOPACK and caused failure of SERVOPACK components.	Confirm 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.	–	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 1 (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 during a SigmaWin+ operation.	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 for Correction
A.030: Main Circuit Detector Error	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.040: Parameter Setting Error (A parameter setting is outside of the setting range.)	The SERVOPACK and Servomotor capacities do not match each other.	Check the combination of the SERVOPACK and Servomotor capacities.	Select a proper combination of SERVOPACK and Servomotor capacities.	–
	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: 0.01 < (Pn20E/Pn210) < 100.	Set the electronic gear ratio in the following range: 0.01 < (Pn20E/Pn210) < 100.	page 5-21
	An unsupported Servomotor was selected in the parameters.	Check the setting of Pn08A (Motor Selection Switch).	Set Pn08A (Motor Selection Switch) correctly.	–
A.042: Parameter Combination Error	The speed of program jog operation went below the setting range when the electronic gear ratio (Pn20E/Pn210) or the Servomotor was changed.	Check to see if the detection conditions* are satisfied.	Decrease the setting of the electronic gear ratio (Pn20E/Pn210).	page 5-21
	The speed of program jog operation went below the setting range when Pn533 (Program Jog Speed) was changed.	Check to see if the detection conditions* are satisfied.	Increase the setting of Pn533.	page 6-12
A.04A: Parameter Setting Error 2	The /DEC signal is allocated to a pin other than CN1-9 to CN1-14.	Check the setting of the parameter that allocates the /DEC signal (PnBB2).	Allocate the /DEC signal to CN1-9 to CN1-14.	page 5-11
	The /CLR signal is allocated to a pin other than CN1-9 to CN1-14.	Check the setting of the parameter that allocates the /CLR signal (PnBB7).	Allocate the /CLR signal to CN1-9 to CN1-14.	page 7-14
	The /DEC and /CLR signals are allocated to the same pin with the same polarity.	Check the settings of the parameters that allocate the /DEC and /CLR signals (PnBB2 and PnBB7).	Change the allocations of the /DEC and /CLR signals.	page 5-11, page 7-14
A.050: Combination Error	A Servomotor with an unsupported capacity is selected in the parameters.	Check the setting of Pn08A (Motor Selection Switch).	Set Pn08A (Motor Selection Switch) correctly.	–
A.051: Unsupported Device Alarm	An unsupported Servomotor was selected in the parameters.	Check the setting of Pn08A (Motor Selection Switch).	Set Pn08A (Motor Selection Switch) correctly.	–
A.0B0: Invalid SERVO ON Command Alarm	The /S-ON (SERVO ON) signal was input from the host controller after a SigmaWin+ function that supplies power to the Servomotor was executed.	–	Turn the power supply to the SERVOPACK OFF and ON again. Or, execute a software reset.	page 5-26

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference for Correction
A.100: Overcurrent Detected (An overcurrent flowed through the power transistor.)	The Servomotor Power Cable is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	page 4-11
	There is a short-circuit in the Servomotor Power Cable or a Servomotor power wire (U, V, or W) is in contact with the FG.	Check for short-circuits across Servomotor phases U, V, and W, or between the FG and Servomotor phases U, V, and W.	The cable may be short-circuited. Replace the Servomotor Power Cable.	
	There is a short-circuit inside the Servomotor or contact with the FG.	Check for short-circuits across Servomotor phases U, V, and W, or between the FG and Servomotor phases U, V, or W.	The Servomotor may be faulty. Replace the Servomotor.	
	There is a short-circuit inside the SERVOPACK or contact with the FG.	Check for short-circuits across the Servomotor connection terminals U, V, and W on the SERVOPACK, or between the FG and terminals U, V, or W.	The SERVOPACK may be faulty. Replace the SERVOPACK.	
	A heavy load was applied while the Servomotor was stopped or running at a low speed.	Check to see if the operating conditions exceed Servo Drive specifications.	Reduce the load applied to the Servomotor. Or, increase the operating speed.	–
	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. Or, replace the FG wire with a wire of a size that is suitable for product specifications.	–
	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 for Correction
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 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 DC power supply was too high during acceleration or deceleration.	Check the power supply voltage and the speed and torque during operation.	Set the DC power supply voltage within the specified range.	–
	The moment of inertia ratio exceeded the allowable value.	Check to see if the moment of inertia ratio is within the allowable range.	Increase the deceleration time, or reduce the load.	–
	A failure occurred in the SERVOPACK.	–	If an alarm still occurs even when the power supply voltage is within product specifications, the SERVOPACK may be faulty. Replace the SERVOPACK.	–
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 wiring of the Servomotor.	Make sure that the Servomotor is correctly wired.	–
	The target speed exceeded the overspeed detection level.	Check the target speed.	Reduce the target speed. Or, adjust the gain.	–
	The motor exceeded the maximum speed.	Check the waveform of the motor speed.	Tune the servo gains. Or, reconsider the operating conditions.	–
	A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A.6B0: Emergency Stop Operation Failure	The motor did not stop due to a mechanical problem after the emergency stop signal was input.	Check the waveform of the motor speed on the SigmaWin+.	Correct the mechanical problem.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference for Correction
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 Servomotor and encoder are correctly wired.	page 4-11
	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 Servomotor 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.	–
	An unsupported Servomotor was selected in the parameters.	Check the setting of Pn08A (Motor Selection Switch).	Set Pn08A (Motor Selection Switch) correctly.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference for Correction
A.840: Encoder Data Alarm	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.	–
	There is a cable disconnection or short-circuit in the encoder. Or, the cable length or 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.	–
	A malfunction was caused by noise.	–	Correct the cables around the encoder correctly (e.g., separate the Encoder Cable from the Servomotor Power Cable and ground the encoder).	–
	A failure occurred in the SERVOPACK.	–	Connect the Servomotor to another SERVOPACK, and turn ON the power supply. If no alarm occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–
	A failure occurred in the encoder.	–	Connect the SERVOPACK to another Servomotor, and turn ON the power supply. If no alarm occurs, the encoder may be faulty. Replace the Servomotor.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference for Correction
A.850: Encoder Overspeed	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.	–
	There is a cable disconnection or short-circuit in the encoder. Or, the cable length or 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.	–
	A malfunction was caused by noise.	–	Correct the wiring around the encoder (e.g., separate the Encoder Cable from the Servomotor Power Cable and ground the encoder).	–
	A failure occurred in the SERVOPACK.	–	Connect the Servomotor to another SERVOPACK, and turn ON the power supply. If no alarm occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–
	A failure occurred in the encoder.	–	Connect the SERVOPACK to another Servomotor, and turn ON the power supply. If no alarm occurs, the encoder may be faulty. Replace the Servomotor.	–
A.B31: Current Detection Error 1	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.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.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference for Correction
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.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.	–
A.C10: Servomotor Out of Control (Detected in the SERVO ON state.)	The order of phases U, V, and W in the motor wiring is not correct.	Check the Servomotor wiring.	Make sure that the Servomotor 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 Servomotor may be faulty. Replace the Servomotor.	–
	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 for Correction
A.D00: Position Deviation Overflow (The setting of Pn520 (Excessive Position Error Alarm Level) was exceeded by the position deviation in the SERVO ON state.)	The Servomotor U, V, and W wiring is not correct.	Check the connections of the Servomotor Power Cable.	Make sure that there are no faulty contacts in the wiring for the Servomotor and encoder.	–
	The target speed is too high.	Reduce the target speed and try operating the Servomotor.	Reduce the target speed or reconsider the electronic gear ratio.	page 5-21
	The acceleration rate is too high.	Reduce the reference acceleration and try operating the SERVOPACK.	Lower the acceleration rate or use Pn217 (Average Position Reference Movement Time) to filter the position reference.	page 5-29
	The setting of Pn520 (Excessive Position Deviation Alarm Level) is too low for the operating conditions.	Check Pn520 (Excessive Position Deviation Alarm Level) to see if it is set to an appropriate value.	Optimize the setting of Pn520.	page 8-5
	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.D01: Position Deviation Overflow Alarm at SERVO ON	The system changes to the SERVO ON state after the position deviation exceeded the setting of Pn526 (Excessive Position Deviation Alarm Level at SERVO ON) in the SERVO OFF state.	Check the position deviation in the SERVO OFF state.	Optimize the setting of Pn526 (Excessive Position Error Alarm Level at SERVO ON).	page 8-5
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) will limit the speed in the SERVO ON state. This alarm occurs if a reference is input and the setting of Pn520 (Excessive Position Deviation Alarm Level) is exceeded.	–	Optimize the setting of Pn520 (Excessive Position Deviation Alarm Level). Or, adjust the setting of Pn529 (Speed Limit Level at SERVO ON).	
A.E1C: ZONE Table Checksum Error	The ZONE table was not correctly stored in flash memory. (This alarm may occur if the power supply was turned OFF while saving or initializing the ZONE table.)	–	Initialize the ZONE table. If that does not reset the alarm, correct the ZONE table.	–
A.E1D: ZONE Table Version Mismatch	The combination of firmware and ZONE table versions is wrong.	–	Change the version of the ZONE table to a version that is compatible with the firmware.	–

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference for Correction
A.E1E: ZONE Table Out of Range Alarm	A value in the ZONE table exceeds the setting range.	Check the settings in the ZONE table with the SigmaWin+.	Change the version of the ZONE table to a version that is compatible with the firmware.	–
A.E24: Homing Failure	The torque limit was released during pressing homing after reaching the torque limit and before completion of homing.	Check the waveform of the torque on the SigmaWin+.	Change the setting of PnBE3 (Pressing Time for Pressing Homing).	page 7-6
A.E25: Homing Overspeed	An excessive position deviation occurred due to a mechanical problem during homing.	Check the waveform of the motor speed and position deviation on the SigmaWin+.	Fix the mechanical problem so that an excessive position deviation does not accumulate.	–

* Detection Conditions
If either of the following conditions is detected, an alarm will occur.

- $\text{Pn533 [min}^{-1}\text{]} \times \dfrac{\text{Encoder Resolution}}{6\times10^{5}} \leq \dfrac{\text{Pn20E}}{\text{Pn210}}$

- $\text{Maximum Motor Speed} \times \dfrac{\text{Encoder Resolution}}{\text{Approx. } 3.66\times10^{12}} \geq \dfrac{\text{Pn20E}}{\text{Pn210}}$

10.1.4 List of Warnings

The list of warnings gives the warning name and warning meaning in order of the warning numbers.


Note

Warnings are displayed to warn you before an alarm occurs. Warnings are reset automatically.

Warning Number	Warning Name	Meaning
A.900	Position Deviation Overflow	The position deviation exceeded the following value: $\left(\frac{\text{Pn520} \times \text{Pn51E}}{100}\right)$
A.901	Position Deviation Overflow Alarm at SERVO ON	The position deviation exceeded the following value in the SERVO ON state: $\left(\frac{\text{Pn526} \times \text{Pn528}}{100}\right)$
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.
A.941	Change of Parameters Requires Restart	Parameters have been changed that require the power supply to be turned OFF and ON again.
A.A9F	Motion Error Warning	Starting homing was requested even though homing is disabled.

Note: If you set Pn008 to n.□1□□ (Do not detect warnings), no warnings will be detected.

10.1.5 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 for Correction
A.900: Position Deviation Overflow	The Servomotor U, V, and W wiring is not correct.	Check the connections of the Servomotor Power Cable.	Make sure that there are no faulty contacts in the wiring for the Servomotor and encoder.	–
	A SERVOPACK gain is too low.	Check the SERVOPACK gains.	Increase the servo gains with custom tuning.	page 8-15
	The target speed is too high.	Reduce the target speed and try operating the Servomotor.	Reduce the target speed or the reference acceleration rate, or reconsider the electronic gear ratio.	page 5-21
	The acceleration rate is too high.	Reduce the reference acceleration and try operating the SERVOPACK.	Lower the acceleration rate or use Pn217 (Average Position Reference Movement Time) to filter the position reference.	page 5-29
	The setting of Pn520 (Excessive Position Deviation Alarm Level) is too low for the operating conditions.	Check Pn520 (Excessive Position Deviation Alarm Level) to see if it is set to an appropriate value.	Optimize the setting of Pn520.	page 8-5
	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 exceeded the following value in the SERVO ON state: $\left(\frac{Pn526 \times Pn528}{100}\right)$	–	Optimize the setting of Pn528 (Excessive Position Error Warning Level at SERVO ON).	page 8-7
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 Servomotor 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 Servomotor was not driven because of 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.	–
A.941: Change of Parameters Requires Restart	Parameters have been changed that require the power supply to be turned OFF and ON again.	–	Turn the power supply to the SERVOPACK OFF and ON again.	–

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Warning Number: Warning Name	Possible Cause	Confirmation	Correction	Reference for Correction
A.A9F: Motion Error Warning	The specified target position exceeds PnB21 (Forward Software Limit) or PnB23 (Reverse Software Limit).	Check the settings of PnB21 and PnB23 (the software limit parameters).	Set the software limit parameters to suitable values.	page 5-24

10.1.6 Alarm Reset

If there is an ALM (Servo Alarm) signal, use one of the following methods to reset the alarm after eliminating the cause of the alarm.

Be sure to eliminate the cause of an alarm before you reset the alarm.
If you reset the alarm and continue operation without eliminating the cause of the alarm, it may result in damage to the equipment or fire.

Resetting Alarms with the /ALM-RST (Alarm Reset Input) Signal

Type	Signal	Connector Pin No.	Name
Input	/ALM-RST	CN1-12	Alarm Reset

Note: Use PnBB4 = n.□□X□ (/ALM-RST (Alarm Reset) Signal Allocation) to allocate the /ALM-RST signal to another connector pin. Refer to the following section for details.
☞ *5.3.3 Allocating Input Signals to Pins and Parameter Settings* on page 5-17

10.1.7 Displaying the Alarm History

The alarm history displays up to the last ten alarms that have occurred in the SERVOPACK.

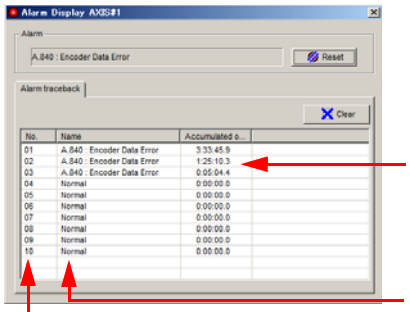
Preparations

No preparations are required.

Operating Procedure

Use the following display procedure.

1. Select *Alarm* - *Display Alarm* from the menu bar of the Main Window of the SigmaWin+.
   The Alarm Display Dialog Box will be displayed.
2. 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 values.)

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 you reset alarms or turn OFF the power supply to the SERVOPACK.
3. Warnings are not recorded in the alarm history.

10.1.8 Alarm History Clear

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 power supply is turned OFF. You must perform the following procedure.

Preparations

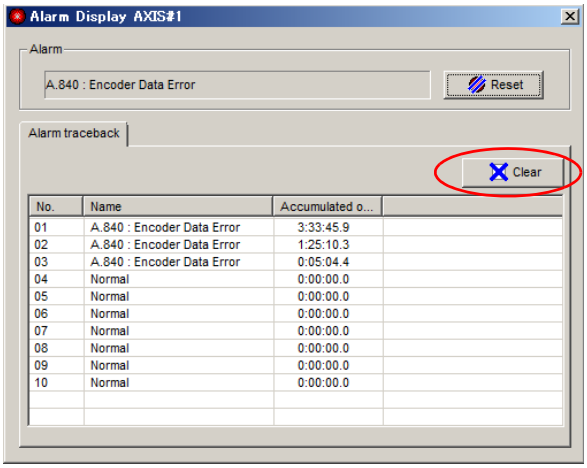
Check the following setting before you clear the alarm history.

- The parameters must not be write prohibited.

Operating Procedure

Use the following procedure.

1. Select *Alarm* - *Display Alarm* from the menu bar of the Main Window of the SigmaWin+.
   The Alarm Display Dialog Box will be displayed.
2. Click the **Alarm History** Tab.
3. Click the **Clear** Button.
   The alarm history will be cleared.



10.2 Troubleshooting Based on the Operation and Conditions of the Servo Drive

This section provides troubleshooting based on the operation and conditions of the Servo Drive, including causes and corrections.

Turn OFF the Servo System before troubleshooting the items shown in bold lines in the table.

Problem	Possible Cause	Confirmation	Correction	Reference
Servomotor Does Not Start	The power supply is not turned ON.	Measure the voltage between the power supply input terminals.	Correct the wiring so that the power supply is turned ON.	–
	The I/O signal connector (CN1) pins are not wired correctly or are disconnected.	Check the wiring condition of the I/O signal connector (CN1) pins.	Correct the wiring of the I/O signal connector (CN1) pins.	page 4-14
	The wiring for the Servomotor Power Cables or Encoder Cable is disconnected.	Check the wiring conditions.	Wire the Serial Converter Unit correctly.	–
	There is an overload on the Servomotor.	Operate the Servomotor with no load and check the load status.	Reduce the load or replace the Servomotor with a Servomotor with a larger capacity.	–
	The model of Servomotor that is being used does not agree with the setting of Pn08A (Motor Selection Switch).	Check the model of Servomotor that is being used and the setting of Pn08A (Motor Selection Switch).	Make sure that the model of Servomotor that is being used agrees with the setting of Pn08A (Motor Selection Switch).	page 5-9
	There is a mistake in the input signal allocations (PnBA2 to PnBB9).	Check the input signal allocations (PnBA2 to PnBB9).	Correctly allocate the input signals (PnBA2 to PnBB9).	page 5-10
	The /S-ON (SERVO ON) signal is OFF.	Check the settingof PnBAF = n.□□XX (allocation of /S-ON signal).	Set PnBAF = n.□□XX correctly and turn ON the /S-ON signal.	page 5-10
	The /CLR (Position Deviation Clear) input signal has not been turned OFF.	Check the /CLR signal (CN1-14).	Turn OFF the /CLR signal.	–
	The E-STP (Emergency Stop Input) signal is still OFF.	• Check the E-STP signal. • Check the E-STPS signal.	• Turn ON the E-STP signal. • If you will not use emergency stops, set PnBB8 to n.□□□3 (Always disable emergency stops).	–
	The current position of the Servomotor is beyond one of the software limits.	• Check the current position of the Servomotor and the settings of the software limit parameters (PnB21 and PnB23). • Check the ALM indicator in the operating status indicators. • Check the error number on the Motion Monitor Window of the SigmaWin+.	Move the Servomotor to within the software limits.	–
	The Servomotor has failed.	–	Replace the Servomotor.	–

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Problem	Possible Cause	Confirmation	Correction	Reference
Servomotor Moves Instantaneously and Then Stops, or Operation Is Not Stable	There is a mistake in the Servomotor wiring.	Check the wiring.	Wire the Servomotor correctly.	–
	There is a mistake in the encoder wiring.	Check the wiring.	Wire the encoder correctly.	–
	The model of Servomotor that is being used does not agree with the setting of Pn08A (Motor Selection Switch).	The model of Servomotor that is being used and the setting of Pn08A (Motor Selection Switch).	Make sure that the model of Servomotor that is being used agrees with the setting of Pn08A (Motor Selection Switch).	page 5-9
	There is a faulty connection in the Servomotor wiring.	The connector connections for the power wires (U, V, and W phases) and the encoder may be unstable. Check the wiring.	• Insert connectors firmly until the lock mechanisms lock into place. • Tighten any loose connectors and correct the wiring.	–
Servomotor Moves without a Reference Input	A failure occurred in the SERVOPACK.	–	Replace the SERVOPACK.	–
Abnormal Noise from Servomotor	The machine mounting is not secure.	Check to see if there are any loose mounting screws.	Tighten the mounting screws.	–
	The machine mounting is not secure.	Check to see if there is misalignment in the coupling.	Align the coupling.	–
		Check to see if the coupling is balanced.	Balance the coupling.	–
	The bearings are defective.	Check for noise and vibration around the bearings.	Replace the Servomotor.	–
	There is a vibration source at the driven machine.	Check for any foreign matter, damage, or deformation in the machine's moving parts.	Consult with the machine manufacturer.	–
	The Encoder Cable does not satisfy specifications.	Check the Encoder Cable to see if is satisfies specifications.	Use cables that satisfy the specifications.	–
	There is excessive external noise interference on the Encoder Cable.	Check to see if the Encoder Cable is bundled with a high-current line or installed near a high-current line. Check to see if there is noise interference on the signal line from the encoder.	Correct the cable layout so that no surge is applied by high-current lines. Take measures to prevent noise interference from the signal lines on the encoder cable.	–
	There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder.	Check to see if the machines are correctly grounded.	Properly ground the machines to separate them from the FG of the encoder.	–
	The encoder was subjected to excessive vibration or shock.	Check to see if vibration from the machine occurred. Check the Servomotor installation (mounting surface precision, securing state, and alignment).	Reduce machine vibration. Improve the mounting conditions of the Servomotor.	–
	A failure occurred in the encoder.	–	Replace the Servomotor.	–

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Problem	Possible Cause	Confirmation	Correction	Reference
Motor Vibration	The servo gains are not balanced.	Check to see if the servo gains have been correctly tuned.	Execute custom tuning.	page 8-15
	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 Pn102 (Position Loop Gain) is too high.	Check the setting of Pn102. The default setting is Kp = 40.0/s.	Set Pn102 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) is not appropriate.	Check Pn103 (Moment of Inertia Ratio).	Set Pn103 (Moment of Inertia Ratio) to an appropriate value.	–
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.	Execute custom tuning.	page 8-15
	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 Pn102 (Position Loop Gain) is too high.	Check the setting of Pn102. The default setting is Kp = 40.0/s.	Set Pn102 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) is not appropriate.	Check Pn103 (Moment of Inertia Ratio).	Set Pn103 (Moment of Inertia Ratio) to an appropriate value.	–
Position Deviation (without Alarm)	The Encoder Cable does not satisfy specifications.	Check the Encoder Cable to see if is satisfies specifications.	Use cables that satisfy the specifications.	–
	There is excessive external noise interference on the Encoder Cable.	Check to see if the Encoder Cable is bundled with a high-current line or installed near a high-current line. Check to see if there is noise interference on the signal line from the encoder.	Correct the cable layout so that no surge is applied by high-current lines. Take measures to prevent noise interference from the signal lines on the encoder cable.	–
	There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder.	Check to see if the machines are correctly grounded.	Properly ground the machines to separate them from the FG of the encoder.	–
	The encoder was subjected to excessive vibration or shock.	Check to see if vibration from the machine occurred. Check the Servomotor installation (mounting surface precision, securing state, and alignment).	Reduce machine vibration. Or, improve the mounting conditions of the Servomotor.	–
	The coupling between the machine and Servomotor is not suitable.	Check to see if position offset occurs at the coupling between machine and Servomotor.	Correctly secure the coupling between the machine and Servomotor.	–

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Problem	Possible Cause	Confirmation	Correction	Reference
Position Deviation (without Alarm)	A failure occurred in the encoder.	–	Replace the Servomotor.	–
	A failure occurred in the SERVOPACK.	–	Replace the SERVOPACK.	–
Servomotor Overheated	The surrounding air temperature is too high.	Measure the surrounding temperature around the Servomotor.	Reduce the surrounding air temperature to 40°C or less.	–
	The surface of the Servomotor is dirty.	Visually check the surface for dirt.	Clean dirt, dust, and oil from the surface.	–
	There is an overload on the Servomotor.	Check the load status with the SigmaWin+.	If the load is excessive, reduce the load or replace the Servomotor with a Servomotor with a larger capacity.	–
The SERVOPACK was not found by an axis search from the SigmaWin+.	The SigmaWin+ address setting and SERVOPACK address setting do not match.	–	Make sure that the SigmaWin+ address setting and SERVOPACK address setting match. (The default axis address for the SERVOPACK is 1h.)	–

10.3 Inspections and Guideline for Product Replacement Period

This section describes inspections and the product replacement period for the SERVOPACK.

10.3.1 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
External Appearance	At least once a year	Check for dust, dirt, and oil on the surfaces.	To clean the SERVOPACK, use compressed air or another means that will not create static electricity.

10.3.2 Guideline for Product Replacement Period

The electric and electronic parts in the SERVOPACK are subject to deterioration over time. Replace the SERVOPACK using the following part service life as a guideline.

Part	Guidelines for Part Service Lives	Remarks
Electrolytic Capacitor	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 ratio: 80% max. • Operation rate: 20 hours/day max.

Parameter List

11

This chapter provides information on the parameters.

11.1 List of Parameters

11.1.1 Interpreting the Parameter Lists

This is when any change made to the parameter will become effective.
If you change any parameters that are enabled after restarting, either turn the power supply OFF and ON again or perform a software reset.

There are the following two classifications.
- Setup
- Tuning

Refer to the following section for details.
☞ *5.1.1 Parameter Classification* on page 5-3

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classi-fication	Reference
Pn000	2	Basic Function Selections 0	0000h to 00B3h	–	0000h	After restart	Setup	–

n.□□□X	Rotation Direction Selection		Reference
	0	Use CCW as the forward direction.	page 5-20
	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.)		

11.1.2 List of Parameters

The following table lists the parameters.

Note: Do not change the following parameters from their default settings.
- Reserved parameters
- Parameters not given in this manual

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classi-fication	Reference
Pn000	2	Basic Function Selections 0	0000h to 00B3h	–	0000h	After restart	Setup	–

n.□□□X	Rotation Direction Selection		Reference
	0	Use CCW as the forward direction.	page 5-20
	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.)		

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn008	2	Application Function Selections 8	0000h to 7121h	–	0000h	After restart	Setup	–

n.□□□X	Reserved parameter (Do not change.)	
n.□□X□	Reserved parameter (Do not change.)	
n.□X□□	Warning Detection Selection	Reference
	0 Detect warnings.	page 10-15
	1 Do not detect warnings.	
n.X□□□	Reserved parameter (Do not change.)	

Pn010	2	Axis Address Selection for SigmaWin+ Communications	0000h to 007Fh	–	0001h	After restart	Setup	–
Pn08A	2	Motor Selection Switch	0000h to FFFFh	–	7001h	After restart	Setup	page 5-9

Setting	Description
7001h	SGMSL-A3CK
7002h	SGMSL-A5CK

Pn100	2	Speed Loop Gain	10 to 20,000	0.1 Hz	400	Immediately	Tuning	page 8-31
Pn101	2	Speed Loop Integral Time Constant	15 to 51,200	0.01 ms	2000	Immediately	Tuning	page 8-31
Pn102	2	Position Loop Gain	10 to 20,000	0.1/s	400	Immediately	Tuning	page 8-31
Pn103	2	Moment of Inertia Ratio	0 to 20,000	1%	0	Immediately	Tuning	page 8-31
Pn109	2	Feedforward	0 to 100	1%	0	Immediately	Tuning	page 8-40
Pn10A	2	Feedforward Filter Time Constant	0 to 6,400	0.01 ms	0	Immediately	Tuning	page 8-40

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn10B	2	Gain Application Selections	0000h to 5334h	–	0004h	–	Setup	–

n.□□□X	Mode Switching Selection	When Enabled	Reference
	0: Use the internal torque reference as the condition (level setting: Pn10C).	Immediately	page 8-41
	1: Use the speed reference as the condition (level setting: Pn10D).		
	2: Use the acceleration reference as the condition (level setting: Pn10E).		
	3: Use the position deviation as the condition (level setting: Pn10F).		
	4: Do not use mode switching.		

n.□□X□	Reserved parameter (Do not change.)
n.□X□□	Reserved parameter (Do not change.)
n.X□□□	Reserved parameter (Do not change.)

Pn10C	2	Mode Switching Level for Torque Reference	0 to 800	1%	200	Immediately	Tuning	page 8-41
Pn10D	2	Mode Switching Level for Speed Reference	0 to 10,000	1 min^{-1}	0	Immediately	Tuning	page 8-41
Pn10E	2	Mode Switching Level for Acceleration	0 to 30,000	1 min^{-1}/ s	0	Immediately	Tuning	page 8-41
Pn10F	2	Mode Switching Level for Position Deviation	0 to 10,000	1 reference unit	0	Immediately	Tuning	page 8-41
Pn121	2	Reserved parameter (Do not change.)	10 to 1,000	1%	100	Immediately	Tuning	–
Pn123	2	Reserved parameter (Do not change.)	0 to 100	1%	0	Immediately	Tuning	–
Pn140	2	Model Following Control-Related Selections	0000h to 1121h	–	0100h	Immediately	Tuning	–

n.□□□X	Model Following Control Selection
	0: Do not use model following control.
	1: Use model following control.

n.□□X□	Vibration Suppression Selection
	0: Do not perform vibration suppression.
	1: Perform vibration suppression for a specific frequency.
	2: Reserved setting (Do not use.)

n.□X□□	Reserved parameter (Do not change.)
n.X□□□	Reserved parameter (Do not change.)

Pn141	2	Model Following Control Gain	10 to 20,000	0.1/s	500	Immediately	Tuning	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn143	2	Model Following Control Bias in the Forward Direction	0 to 10,000	0.1%	1000	Immediately	Tuning	–
Pn144	2	Model Following Control Bias in the Reverse Direction	0 to 10,000	0.1%	1000	Immediately	Tuning	–
Pn145	2	Vibration Suppression 1 Frequency A	10 to 2,500	0.1 Hz	500	Immediately	Tuning	–
Pn146	2	Vibration Suppression 1 Frequency B	10 to 2,500	0.1 Hz	700	Immediately	Tuning	–
Pn147	2	Model Following Control Speed Feedforward Compensation	0 to 10,000	0.1%	1000	Immediately	Tuning	–
Pn160	2	Anti-Resonance Control-Related Selections	0000h to 0011h	–	0010h	Immediately	Tuning	–

n.□□□X	Anti-Resonance Control Selection
0	Do not use anti-resonance control.
1	Use anti-resonance control.

n.□□X□	Anti-Resonance Control Adjustment Selection	Reference
0	Do not adjust the anti-resonance control automatically during execution of custom tuning.	page 8-21
1	Adjust the anti-resonance control automatically during execution of custom tuning.	

n.□X□□	Reserved parameter (Do not change.)

Pn161	2	Anti-Resonance Frequency	10 to 20,000	0.1 Hz	1000	Immediately	Tuning	–
Pn163	2	Anti-Resonance Damping Gain	0 to 300	1%	0	Immediately	Tuning	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn200	2	Position Control Reference For Selections	0000h to 2236h	–	0000h	After restart	Setup	–

n.□□□X	Reference Pulse Form		Reference
	0	Sign and pulse train, positive logic.	page 7-13
	1	CW and CCW pulse trains, positive logic	
	2	Two-phase pulse trains with 90° phase differential (phase A and phase B) ×1, positive logic	
	3	Two-phase pulse trains with 90° phase differential (phase A and phase B) ×2, positive logic	
	4	Two-phase pulse trains with 90° phase differential (phase A and phase B) ×4, positive logic	
	5	Sign and pulse train, negative logic.	
	6	CW and CCW pulse trains, negative logic	

n.□□X□	Clear Signal Form		Reference
	0	Clear position deviation while the signal is ON.	page 7-15
	1	Clear position deviation when the signal changes from OFF to ON.	
	2	Clear position deviation while the signal is OFF.	
	3	Clear position deviation when the signal changes from ON to OFF.	

n.□X□□	Clear Operation		Reference
	0	Clear position deviation at a base block (at SERVO OFF or when alarm occurs).	page 7-15
	1	Do not clear position error (cleared only with CLR (Clear Position Deviation) signal).	
	2	Clear position deviation when an alarm occurs.	

n.X□□□	Reserved parameter (Do not change.)

Pn207	2	Position Control Function Selections	0000h to 2210h	–	0010h	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□□□	/INPOSITION Output Timing	
	0	Output the /INPOSITION signal when the absolute value of the position deviation is the same or less than the setting of PnB2D (Positioning Completed Width).
	1	Reserved setting (Do not use.)
	2	Output the /INPOSITION signal when the absolute value of the position deviation is the same or less than the setting of PnB2D (Positioning Completed Width) and the reference input is 0.

Pn20E	4	Electronic Gear Ratio (Numerator)	1 to 65,535	1	1	After restart	Setup	page 5-20
Pn210	4	Electronic Gear Ratio (Denominator)	1 to 65,535	1	1	After restart	Setup	page 5-20
Pn217	2	Average Position Reference Movement Time	0 to 10,000	0.1 ms	0	Immediately after the motor stops	Setup	page 5-29

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn304	2	Jog Speed	0 to 10,000	1 min^{-1}	500	Immediately	Setup	page 6-4
Pn305	2	Soft Start Acceleration Time	0 to 10,000	1 ms	100	Immediately	Setup	–
Pn306	2	Soft Start Deceleration Time	0 to 10,000	1 ms	100	Immediately	Setup	–
Pn401	2	First Stage First Torque Reference Filter Time Constant	0 to 65,535	0.01 ms	100	Immediately	Tuning	page 8-33
Pn402	2	Forward Torque Limit	0 to 800	1%*1	800	Immediately	Setup	page 5-22
Pn403	2	Reverse Torque Limit	0 to 800	1%*1	800	Immediately	Setup	page 5-22
Pn404	2	Forward External Torque Limit	0 to 800	1%*1	100	Immediately	Setup	page 5-22
Pn405	2	Reverse External Torque Limit	0 to 800	1%*1	100	Immediately	Setup	page 5-22
Pn406	2	Emergency Stop Torque	0 to 800	1%*1	800	Immediately	Setup	–
Pn408	2	Torque-Related Function Selections	0000h to 1111h	–	0000h	–	Setup	–

n.□□□X	Notch Filter Selection 1		When Enabled	Reference
	0	Disable first stage notch filter.	Immediately	page 8-33
	1	Enable first stage notch filter.		

n.□□X□	Reserved parameter (Do not change.)

n.□X□□	Notch Filter Selection 2		When Enabled	Reference
	0	Disable second stage notch filter.	Immediately	page 8-33
	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 2,000	1 Hz	2000	Immediately	Tuning	page 8-33
Pn40A	2	First Stage Notch Filter Q Value	50 to 1,000	0.01	70	Immediately	Tuning	page 8-33
Pn40B	2	First Stage Notch Filter Depth	0 to 1,000	0.001	0	Immediately	Tuning	page 8-33
Pn40C	2	Second Stage Notch Filter Frequency	50 to 2,000	1 Hz	2000	Immediately	Tuning	page 8-33
Pn40D	2	Second Stage Notch Filter Q Value	50 to 1,000	0.01	70	Immediately	Tuning	page 8-33
Pn40E	2	Second Stage Notch Filter Depth	0 to 1,000	0.001	0	Immediately	Tuning	page 8-33

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*1. Set a percentage of the rated motor torque.

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn460	2	Notch Filter Adjustment Selections	0000h to 0101h	–	0101h	Immediately	Tuning	page 8-15
		n.□□□X	Notch Filter Adjustment Selection 1					
			0	Do not adjust the first stage notch filter automatically during execution of custom tuning.				
			1	Adjust the first stage notch filter automatically during execution of 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 custom tuning.				
			1	Adjust the second stage notch filter automatically during execution of custom tuning.				
		n.X□□□	Reserved parameter (Do not change.)					
Pn502	2	Rotation Detection Level	1 to 10,000	1 min^{-1}	30	Immediately	Setup	page 5-14
Pn503	2	Speed Coincidence Detection Signal Output Width	0 to 100	1 min^{-1}	30	Immediately	Setup	–
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 Reference Waiting Time	10 to 100	10 ms	50	Immediately	Setup	–
Pn51E	2	Position Deviation Overflow Warning Level	10 to 100	1%	100	Immediately	Setup	page 10-15
Pn520	4	Position Deviation Overflow Alarm Level	1 to 1,073,741,823	1 reference unit	25600	Immediately	Setup	page 8-5, page 10-3
Pn526	4	Position Deviation Overflow Alarm Level at SERVO ON	1 to 1,073,741,823	1 reference unit	25600	Immediately	Setup	page 8-5
Pn528	2	Position Deviation Overflow Warning Level at SERVO ON	10 to 100	1%	100	Immediately	Setup	page 8-5
Pn529	2	Speed Limit Level at SERVO ON	0 to 10,000	1 min^{-1}	10000	Immediately	Setup	page 8-5
Pn52B	2	Overload Warning Level	1 to 100	1%	20	Immediately	Setup	page 5-25
Pn52C	2	Base Current Derating at Motor Overload Detection	10 to 100	1%	100	After restart	Setup	page 5-25

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
Pn530	2	Program Jog Operation-Related Selections	0000h to 0005h	–	0000h	Immediately	Setup	page 6-12

n.□□□X	Program Jog 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
	3	(Waiting time in Pn535 → Reverse 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 → Reserve 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.)	

Pn531	4	Program Jog Travel Distance	1 to 134,217,728	1 reference unit	1024	Immediately	Setup	page 6-12
Pn533	2	Program Jog Movement Speed	1 to 10,000	1 min^{-1}	500	Immediately	Setup	page 6-12
Pn534	2	Program Jog Acceleration/ Deceleration Time	2 to 10,000	1 ms	100	Immediately	Setup	page 6-12
Pn535	2	Program Jog Waiting Time	0 to 10,000	1 ms	100	Immediately	Setup	page 6-12
Pn536	2	Program Jog Number of Movements	0 to 1,000	Times	1	Immediately	Setup	page 6-12
Pn560	2	Residual Vibration Detection Width	1 to 3,000	0.1%	400	Immediately	Setup	page 8-27
PnB20	2	Reserved parameter (Do not change.)	0 to 3	–	0	After restart	–	–
PnB21	4	Forward Software Limit (P-LS)	-9,999,999 to +99,999,999	Reference Unit	0	After restart	Setup	page 5-24
PnB23	4	Reverse Software Limit (N-LS)	-99,999,999 to +99,999,999	Reference Unit	0	After restart	Setup	page 5-24
PnB25	4	Home Position	-99,999,999 to +99,999,999	Reference Unit	0	After restart	Setup	page 5-24
PnB27	4	Reserved parameter (Do not change.)	1 to 99,999,999	Reference units/s	2000	After restart	Setup	–
PnB29	4	Acceleration Rate	1 to 99,999,999	Reference units/s^2	500000	Immediately	Setup	page 7-4
PnB2B	4	Deceleration Rate	1 to 99,999,999	Reference units/s^2	500000	Immediately	Setup	page 7-4

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
PnB2D	4	Positioning Completed Width (/INPOSITION Width)	1 to 99,999	Reference Unit	10	Immediately	Setup	page 5-12
PnB2F	4	Near Signal Width (/NEAR Width)	1 to 99,999	Reference Unit	10	Immediately	Setup	page 5-14
PnB31	2	Homing Method	0000 to 0005	–	0	After restart	–	page 7-3
	n.□□□X	0	Do not perform homing.					
		1	Use the /DEC signal and phase C for homing.					
		2	Use the /DEC signal for homing.					
		3	Use the phase C for homing.					
		4	Perform pressing homing.					
		5	For homing, detect the /DEC input, reverse direction, and then use phase C detection.					
	n.□□X□	Reserved parameter (Do not change.)						
	n.□X□□	Reserved parameter (Do not change.)						
	n.X□□□	Reserved parameter (Do not change.)						
PnB32	2	Homing Direction	0 to 1	–	0	Immediately	–	page 7-3
	n.□□□X	0	When the /HOME signal turns ON, perform homing in the forward direction.					
		1	When the /HOME signal turns ON, perform homing in the reverse direction.					
	n.□□X□	Reserved parameter (Do not change.)						
	n.□X□□	Reserved parameter (Do not change.)						
	n.X□□□	Reserved parameter (Do not change.)						
PnB33	4	Homing Movement Speed	1 to 99,999,999	Reference units/s	2000	Immediately	Setup	page 7-4
PnB35	4	Homing Approach Speed	1 to 99,999,999	Reference units/s	2000	Immediately	Setup	page 7-5
PnB37	4	Homing Creep Speed	1 to 99,999,999	Reference units/s	2000	Immediately	Setup	page 7-5
PnB39	4	Final Travel Distance for Homing	-99,999,999 to +99,999,999	Reference Unit	0	Immediately	Setup	page 7-5
PnB4F	2	Reserved parameter (Do not change.)	0 to 1	–	0	After restart	–	–
PnB50	2	Reserved parameter (Do not change.)	-1,000 to 1,000	Reference Unit	0	Immediately	Setup	–
PnB90	2	Reserved parameter (Do not change.)	0000h to 0002h	–	0000h	After restart	Setup	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
PnB91	2	/INPOSITION Control Switch	0000h to 0011h	–	0000h	After restart	Setup	page 7-4
		n.□□□X	0	Enable /INPOSITION (Positioning Completion) signal before homing is performed.				
			1	Do not enable /INPOSITION (Positioning Completion) signal before homing is performed.				
		n.□□X□	Reserved parameter (Do not change.)					
		n.□X□□	Reserved parameter (Do not change.)					
		n.X□□□	Reserved parameter (Do not change.)					
PnB92	2	Reserved parameter (Do not change.)	0000h to 0002h	–	0001h	After restart	Setup	–
PnBA0	2	Reserved parameter (Do not change.)	0000h to 00C3h	–	0003h	After restart	Setup	–
PnBA1	2	Reserved parameter (Do not change.)	0000h to 00C3h	–	0003h	After restart	Setup	–
PnBA2	2	/STOP (Operation Stop Input) Signal Allocation	0000h to 00C3h	–	0001h	After restart	Setup	page 5-10
		n.□□□X	Signal Usage Method					
			0	Stop program table operation when the /STOP signal turns ON (closes).				
			1	Stop program table operation when the /STOP signal turns OFF (opens).				
			2, 3	Program table operation is not stopped.				
		n.□□X□	Signal Terminal Number					
			0	Input signal from CN1-9.				
			1	Input signal from CN1-10.				
			2	Input signal from CN1-11.				
			3	Input signal from CN1-12.				
			4	Input signal from CN1-13.				
			5	Input signal from CN1-14.				
			6	Input signal from CN1-15.				
			7	Input signal from CN1-16.				
		n.□X□□	Reserved parameter (Do not change.)					
		n.X□□□	Reserved parameter (Do not change.)					
PnBA3	2	Reserved parameter (Do not change.)	0000h to 00C3h	–	0003h	After restart	Setup	–
PnBA4	2	Reserved parameter (Do not change.)	0000h to 00C3h	–	0003h	After restart	Setup	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
PnBA5	2	/HOME (Homing Input) Signal Allocation	0000h to 00C3h	–	0000h	After restart	Setup	page 5-10

n.□□□X	Signal Usage Method	
	0	Start homing when the input signal turns ON (closes).
	1	Start homing when the input signal turns OFF (opens).
	2	Reserved setting (Do not use.)
	3	Homing is not started.
n.□□X□	Signal Terminal Number	
	Same as PnBA2 = n.□□X□.	
n.□X□□	Reserved parameter (Do not change.)	
n.X□□□	Reserved parameter (Do not change.)	

PnBA6	2	Reserved parameter (Do not change.)	0000h to 00C3h	–	0003h	After restart	Setup	–
PnBA7	2	Reserved parameter (Do not change.)	0000h to 00C3h	–	0003h	After restart	Setup	–
PnBA8	2	Reserved parameter (Do not change.)	0000h to 00C3h	–	0003h	After restart	Setup	–
PnBA9	2	Reserved parameter (Do not change.)	0000h to 00C3h	–	0003h	After restart	Setup	–
PnBAA	2	Reserved parameter (Do not change.)	0000h to 00C3h	–	0003h	After restart	Setup	–
PnBAB	2	Reserved parameter (Do not change.)	0000h to 00C3h	–	0003h	After restart	Setup	–
PnBAC	2	Reserved parameter (Do not change.)	0000h to 00C3h	–	0003h	After restart	Setup	–
PnBAF	2	/S-ON (SERVO ON) Signal Allocation	0000h to 00C3h	–	0010h	After restart	Setup	page 5-10

n.□□□X	Signal Usage Method	
	0	The system changes to the SERVO ON state (power is supplied) and operation is enabled when the input signal turns ON (closes).
	1	The system changes to the SERVO ON state (power is supplied) and operation is enabled when the input signal turns OFF (opens).
	2	The system is always in the SERVO ON state.
	3	The system is always in the SERVO OFF state.
n.□□X□	Signal Terminal Number	
	Same as PnBA2 = n.□□X□.	
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	Classi-fication	Reference
PnBB2	2	/DEC (Homing Deceleration Switch Input) Signal Allocation	0000h to 00C3h	–	0020h	After restart	Setup	page 5-11

n.□□□X	Signal Usage Method
0	Start deceleration during homing when the input signal turns ON (closes).
1	Start deceleration during homing when the input signal turns OFF (opens).
2	Homing deceleration switch is always ON.
3	Homing deceleration switch is always OFF.

n.□□X□	Signal Terminal Number
	Same as PnBA2 = 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	Classi-fication	Reference
PnBB4	2	/ALM-RST (Alarm Reset) Signal Allocation	0000h to 00C3h	–	0030h	After restart	Setup	page 5-11

n.□□□X	Signal Usage Method
0	Reset alarms when the input signal turns ON (closes).
1	Reset alarms when the input signal turns OFF (opens).
2, 3	Do not resets alarms. (The signal is disabled.)

n.□□X□	Signal Terminal Number
	Same as PnBA2 = 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	Classi-fication	Reference
PnBB5	2	/P-CL (Forward External Torque Limit Input) Signal Allocation	0000h to 00C3h	–	0040h	After restart	Setup	page 5-11

n.□□□X	Signal Usage Method
0	Enable the forward external torque limit when the input signal turns ON (closes).
1	Enable the forward external torque limit when the input signal turns OFF (opens).
2	Always enable the forward external torque limit.
3	Always disable the forward external torque limit.

n.□□X□	Signal Terminal Number
	Same as PnBA2 = n.□□X□.

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	Classi-fication	Reference
PnBB6	2	/N-CL (Reverse External Torque Limit Input) Signal Allocation	0000h to 00C3h	–	0040h	After restart	Setup	page 5-11

n.□□□X	Signal Usage Method	
	0	Enable the reverse external torque limit when the input signal turns ON (closes).
	1	Enable the reverse external torque limit when the input signal turns OFF (opens).
	2	Always enable the reverse external torque limit.
	3	Always disable the reverse external torque limit.
n.□□X□	Signal Terminal Number	
	Same as PnBA2 = 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	Classi-fication	Reference
PnBB7	2	/CLR (Position Deviation Clear) Signal Allocation	0000h to 00C3h	–	0050h	After restart	Setup	page 5-11

n.□□□X	Signal Usage Method	
	0	Enable input signal. Note: Set the reference pulse form and clear signal form with Pn200.
	1	Disable input signal.
	2	Reserved setting (Do not use.)
	3	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	Classi-fication	Reference
PnBB8	2	E-STP (Emergency Stop Input) Signal Allocation	0000h to 00C3h	–	0060h	After restart	Setup	page 5-11

n.□□□X	Signal Usage Method	
	0	Enable an emergency stop when the input signal turns OFF (opens).
	1	Enable an emergency stop when the input signal turns ON (closes).
	2	Always enable the emergency stop.
	3	Always disable the emergency stop.
n.□□X□	Signal Terminal Number	
	Same as PnBA2 = 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	Classi-fication	Reference
PnBB9	2	Reserved parameter (Do not change.)	0000h to 00C3h	–	0003h	After restart	Setup	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
PnBC0	2	/INPOSITION (Positioning Completion Output) Signal Allocation	0000h to 00C2h	–	0000h	After restart	Setup	page 5-12

n.□□□X	Signal Usage Method
0	Turn ON (close) the output when positioning is completed.
1	Turn OFF (open) the output when positioning is completed.
2	Do not use this signal.

n.□□X□	Signal Terminal Number
0	Output signal from CN1-18.
1	Output signal from CN1-20.
2	Output signal from CN1-21.
3	Output signal from CN1-22.
4	Output signal from CN1-23.
5	Output signal from CN1-24.
6	Output signal from CN1-25.
7	Output signal from CN1-26.
8	Output signal from CN1-27.
9	Output signal from CN1-28.

n.□X□□	Reserved parameter (Do not change.)
n.X□□□	Reserved parameter (Do not change.)

PnBC1	2	Reserved parameter (Do not change.)	0000h to 00C2h	–	0002h	After restart	Setup	–
PnBC2	2	Reserved parameter (Do not change.)	0000h to 00C2h	–	0002h	After restart	Setup	–
PnBC3	2	Reserved parameter (Do not change.)	0000h to 00C2h	–	0002h	After restart	Setup	–
PnBC4	2	Reserved parameter (Do not change.)	0000h to 00C2h	–	0002h	After restart	Setup	–
PnBC5	2	Reserved parameter (Do not change.)	0000h to 00C2h	–	0002h	After restart	Setup	–
PnBC6	2	Reserved parameter (Do not change.)	0000h to 00C2h	–	0002h	After restart	Setup	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classi-fication	Reference
PnBC9	2	/WARN (Warning Output) Signal Allocation	0000h to 00C2h	–	0002h	After restart	Setup	page 5-13
	n.□□□X	Signal Usage Method						
		0	Turn ON (close) the output when an error or warning occurs (error/warning status).					
		1	Turn OFF (open) the output when an error or warning occurs (error/warning status).					
		2	Do not use this signal.					
	n.□□X□	Signal Terminal Number						
		Same as PnBC0 = n.□□X□.						
	n.□X□□	Reserved parameter (Do not change.)						
	n.X□□□	Reserved parameter (Do not change.)						
PnBCA	2	/BK (Brake Output) Signal Allocation	0000h to 00C2h	–	0002h	After restart	Setup	page 5-13
	n.□□□X	Signal Usage Method						
		0	Release the brake when the brake signal turns ON (closes).					
		1	Release the brake when the brake signal turns OFF (opens).					
		2	Do not use this signal.					
	n.□□X□	Signal Terminal Number						
		Same as PnBC0 = n.□□X□.						
	n.□X□□	Reserved parameter (Do not change.)						
	n.X□□□	Reserved parameter (Do not change.)						
PnBCB	2	/S-RDY (Servo Ready) Signal Allocation	0000h to 00C2h	–	0002h	After restart	Setup	page 5-13
	n.□□□X	Signal Usage Method						
		0	Turn ON (close) the output when the servo is ready.					
		1	Turn OFF (open) the output when the servo is ready.					
		2	Do not use this signal.					
	n.□□X□	Signal Terminal Number						
		Same as PnBC0 = n.□□X□.						
	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
PnBCC	2	/CLT (Torque Limit Status Output) Signal Allocation	0000h to 00C2h	–	0010h	After restart	Setup	page 5-13

n.□□□X	Signal Usage Method	
	0	Turn ON (close) the output while torque is being limited.
	1	Turn OFF (open) the output while torque is being limited.
	2	Do not use this signal.
n.□□X□	Signal Terminal Number	
	Same as PnBC0 = 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
PnBCD	2	/TGON (Rotation Detection Output) Signal Allocation	0000h to 00C2h	–	0002h	After restart	Setup	page 5-14

n.□□□X	Signal Usage Method	
	0	Turn ON (close) the output while the Servomotor is rotating.
	1	Turn OFF (open) the output while the Servomotor is rotating.
	2	Do not use this signal.
n.□□X□	Signal Terminal Number	
	Same as PnBC0 = 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
PnBCE	2	/NEAR (Near Output) Signal Allocation	0000h to 00C2h	–	0002h	After restart	Setup	page 5-14

n.□□□X	Signal Usage Method	
	0	Turn ON (close) the output when the position deviation is equal to or greater than the setting of PnB2F (Near Signal Width).
	1	Turn OFF (open) the output when the position deviation is equal to or greater than the setting of PnB2F (Near Signal Width).
	2	Do not use this signal.
n.□□X□	Signal Terminal Number	
	Same as PnBC0 = 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
PnBCF	2	Reserved parameter (Do not change.)	0000h to 00C2h	–	0002h	After restart	Setup	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
PnBD0	2	/PCO (Encoder Origin) Signal Allocation	0000h to 00C2h	–	0020h	After restart	Setup	page 5-16
	n.□□□X	Signal Usage Method						
		0	Turn ON (close) the output while the encoder origin is being detected.					
		1	Turn OFF (open) the output while the encoder origin is being detected.					
		2	Do not use this signal.					
	n.□□X□	Signal Terminal Number						
		Same as PnBC0 = n.□□X□.						
	n.□X□□	Reserved parameter (Do not change.)						
	n.X□□□	Reserved parameter (Do not change.)						
PnBD1	2	/BUSY (Busy Output) Signal Allocation	0000h to 00C2h	–	0030h	After restart	Setup	page 5-15
	n.□□□X	Signal Usage Method						
		0	Turn ON (close) the output while the Servomotor is operating.					
		1	Turn OFF (open) the output while the Servomotor is operating.					
		2	Do not use this signal.					
	n.□□X□	Signal Terminal Number						
		Same as PnBC0 = n.□□X□.						
	n.□X□□	Reserved parameter (Do not change.)						
	n.X□□□	Reserved parameter (Do not change.)						
PnBD2	2	/POSRDY (Homing Completed Output) Signal Allocation	0000h to 00C2h	–	0040h	After restart	Setup	page 5-15
	n.□□□X	Signal Usage Method						
		0	Turn ON (close) the output when homing is completed.					
		1	Turn OFF (open) the output when homing is completed.					
		2	Do not use this signal.					
	n.□□X□	Signal Terminal Number						
		Same as PnBC0 = n.□□X□.						
	n.□X□□	Reserved parameter (Do not change.)						
	n.X□□□	Reserved parameter (Do not change.)						
PnBD3	2	Reserved parameter (Do not change.)	0000h to 00C2h	–	0002h	After restart	Setup	–

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
PnBD4	2	/S-ONS (SERVO ON Status Output) Signal Allocation	0000h to 00C2h	–	0050h	After restart	Setup	page 5-15

n.□□□X	Signal Usage Method
0	Turn ON (close) the output in the SERVO ON state.
1	Turn OFF (open) the output in the SERVO ON state.
2	Do not use this signal.

n.□□X□	Signal Terminal Number
	Same as PnBC0 = 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
PnBD5	2	E-STPS (Emergency Stop Status Output) Signal Allocation	0000h to 00C2h	–	0061h	After restart	Setup	page 5-15

n.□□□X	Signal Usage Method
0	Turn ON (close) the output during emergency stop status.
1	Turn OFF (open) the output during emergency stop status.
2	Do not use this signal.

n.□□X□	Signal Terminal Number
	Same as PnBC0 = 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
PnBD6	2	/ZONE0 (ZONE Output 0) Signal Allocation	0000h to 00C2h	–	0070h	After restart	Setup	page 5-16

n.□□□X	Signal Usage Method
0	Turn ON (close) the output when ZONE output 0 is 1.
1	Turn OFF (open) the output when ZONE output 0 is 1.
2	Do not use this signal.

n.□□X□	Signal Terminal Number
	Same as PnBC0 = n.□□X□.

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
PnBD7	2	/ZONE1 (ZONE Output 1) Signal Allocation	0000h to 00C2h	–	0080h	After restart	Setup	page 5-16
	n.□□□X	Signal Usage Method						
		0	Turn ON (close) the output when ZONE output 1 is 1.					
		1	Turn OFF (open) the output when ZONE output 1 is 1.					
		2	Do not use this signal.					
	n.□□X□	Signal Terminal Number						
		Same as PnBC0 = n.□□X□.						
	n.□X□□	Reserved parameter (Do not change.)						
	n.X□□□	Reserved parameter (Do not change.)						
PnBD8	2	/ZONE2 (ZONE Output 2) Signal Allocation	0000h to 00C2h	–	0002h	After restart	Setup	page 5-16
	n.□□□X	Signal Usage Method						
		0	Turn ON (close) the output when ZONE output 2 is 1.					
		1	Turn OFF (open) the output when ZONE output 2 is 1.					
		2	Do not use this signal.					
	n.□□X□	Signal Terminal Number						
		Same as PnBC0 = n.□□X□.						
	n.□X□□	Reserved parameter (Do not change.)						
	n.X□□□	Reserved parameter (Do not change.)						
PnBD9	2	/ZONE3 (ZONE Output 3) Signal Allocation	0000h to 00C2h	–	0002h	After restart	Setup	page 5-16
	n.□□□X	Signal Usage Method						
		0	Turn ON (close) the output when ZONE output 3 is 1.					
		1	Turn OFF (open) the output when ZONE output 3 is 1.					
		2	Do not use this signal.					
	n.□□X□	Signal Terminal Number						
		Same as PnBC0 = n.□□X□.						
	n.□X□□	Reserved parameter (Do not change.)						
	n.X□□□	Reserved parameter (Do not change.)						
PnBDB	Reserved parameter (Do not change.)		0000h to 00C2h	–	0002h	After restart	Setup	–
PnBE1	2	Pressing Torque for Pressing Homing	0 to 100	1%	25	Immediately	Setup	page 7-5
PnBE2	2	Pressing Detection Time for Pressing Homing	0 to 10,000	1 ms	250	Immediately	Setup	page 7-6

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	Reference
PnBE3	2	Pressing Time for Pressing Homing	0 to 10,000	1 ms	250	Immediately	Setup	page 7-6
PnBE4	2	Reserved parameter (Do not change.)	0 to 10,000	1 ms	250	Immediately	Setup	–

11.2 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
Pn008	0000h						Application Function Selections 8	After restart
Pn010	0001h						Axis Address Selection for SigmaWin+ Communications	After restart
Pn08A	7001h						Motor Selection Switch	After restart
Pn100	400						Speed Loop Gain	Immediately
Pn101	2000						Speed Loop Integral Time Constant	Immediately
Pn102	400						Position Loop Gain	Immediately
Pn103	0						Moment of Inertia Ratio	Immediately
Pn109	0						Feedforward	Immediately
Pn10A	0						Feedforward Filter Time Constant	Immediately
Pn10B	0004h						Gain Application Selections	*
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
Pn10F	0						Mode Switching Level for Position Deviation	Immediately
Pn121	100						Reserved parameter (Do not change.)	Immediately
Pn123	0						Reserved parameter (Do not change.)	Immediately
Pn140	0100h						Model Following Control-Related Selections	Immediately
Pn141	500						Model Following Control Gain	Immediately
Pn143	1000						Model Following Control Bias in the Forward Direction	Immediately
Pn144	1000						Model Following Control Bias in the Reverse Direction	Immediately
Pn145	500						Vibration Suppression 1 Frequency A	Immediately
Pn146	700						Vibration Suppression 1 Frequency B	Immediately
Pn147	1000						Model Following Control Speed Feedforward Compensation	Immediately
Pn160	0010h						Anti-Resonance Control-Related Selections	Immediately
Pn161	1000						Anti-Resonance Frequency	Immediately
Pn163	0						Anti-Resonance Damping Gain	Immediately

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Parameter No.	Default Setting						Name	When Enabled
Pn200	0000h						Position Control Reference for Selections	After restart
Pn207	0010h						Position Control Function Selections	After restart
Pn20E	1						Electronic Gear Ratio (Numerator)	After restart
Pn210	1						Electronic Gear Ratio (Denominator)	After restart
Pn217	0						Average Position Reference Movement Time	Immediately after the motor stops
Pn304	500						Jog Speed	Immediately
Pn305	100						Soft Start Acceleration Time	Immediately
Pn306	100						Soft Start Deceleration Time	Immediately
Pn401	100						First Stage First Torque Reference Filter Time Constant	Immediately
Pn402	800						Forward Torque Limit	Immediately
Pn403	800						Reverse Torque Limit	Immediately
Pn404	100						Forward External Torque Limit	Immediately
Pn405	100						Reverse External Torque Limit	Immediately
Pn406	800						Emergency Stop Torque	Immediately
Pn408	0000h						Torque-Related Function Selections	*
Pn409	2000						First Stage Notch Filter Frequency	Immediately
Pn40A	70						First Stage Notch Filter Q Value	Immediately
Pn40B	0						First Stage Notch Filter Depth	Immediately
Pn40C	2000						Second Stage Notch Filter Frequency	Immediately
Pn40D	70						Second Stage Notch Filter Q Value	Immediately
Pn40E	0						Second Stage Notch Filter Depth	Immediately
Pn460	0101h						Notch Filter Adjustment Selections	Immediately
Pn502	30						Rotation Detection Level	Immediately
Pn503	30						Speed Coincidence Detection Signal Output Width	Immediately
Pn506	0						Brake Reference-SERVO OFF Delay Time	Immediately
Pn507	100						Brake Reference Output Speed Level	Immediately
Pn508	50						SERVO OFF-Brake Reference Waiting Time	Immediately
Pn51E	100						Position Deviation Overflow Warning Level	Immediately
Pn520	25600						Position Deviation Overflow Alarm Level	Immediately

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Parameter No.	Default Setting						Name	When Enabled
Pn526	25600						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
Pn52B	20						Overload Warning Level	Immediately
Pn52C	100						Base Current Derating at Motor Overload Detection	After restart
Pn530	0000h						Program Jog Operation-Related Selections	Immediately
Pn531	1024						Program Jog Travel Distance	Immediately
Pn533	500						Program Jog Movement Speed	Immediately
Pn534	100						Program Jog Acceleration/Deceleration Time	Immediately
Pn535	100						Program Jog Waiting Time	Immediately
Pn536	1						Program Jog Number of Movements	Immediately
Pn560	400						Residual Vibration Detection Width	Immediately
PnB20	0						Reserved parameter (Do not change.)	After restart
PnB21	0						Forward Software Limit (P-LS)	After restart
PnB23	0						Reverse Software Limit (N-LS)	After restart
PnB25	0						Home Position	After restart
PnB27	2000						Reserved parameter (Do not change.)	After restart
PnB29	500000						Acceleration Rate	Immediately
PnB2B	500000						Deceleration Rate	Immediately
PnB2D	10						Positioning Completed Width (/INPOSITION Width)	Immediately
PnB2F	10						Near Signal Width (/NEAR Width)	Immediately
PnB31	0						Homing Method	After restart
PnB32	0						Homing Direction	Immediately
PnB33	2000						Homing Movement Speed	Immediately
PnB35	2000						Homing Approach Speed	Immediately
PnB37	2000						Homing Creep Speed	Immediately
PnB39	0						Final Travel Distance for Homing	Immediately
PnB4F	0						Reserved parameter (Do not change.)	After restart
PnB50	0						Reserved parameter (Do not change.)	Immediately
PnB90	0000h						Reserved parameter (Do not change.)	After restart
PnB91	0000h						INPOSITION Control Switch	After restart

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Parameter No.	Default Setting						Name	When Enabled
PnB92	0001h						Reserved parameter (Do not change.)	After restart
PnBA0	0003h						Reserved parameter (Do not change.)	After restart
PnBA1	0003h						Reserved parameter (Do not change.)	After restart
PnBA2	0001h						/STOP (Operation Stop Input) Signal Allocation	After restart
PnBA3	0003h						Reserved parameter (Do not change.)	After restart
PnBA4	0003h						Reserved parameter (Do not change.)	After restart
PnBA5	0000h						/HOME (Homing Input) Signal Allocation	After restart
PnBA6	0003h						Reserved parameter (Do not change.)	After restart
PnBA7	0003h						Reserved parameter (Do not change.)	After restart
PnBA8	0003h						Reserved parameter (Do not change.)	After restart
PnBA9	0003h						Reserved parameter (Do not change.)	After restart
PnBAA	0003h						Reserved parameter (Do not change.)	After restart
PnBAB	0003h						Reserved parameter (Do not change.)	After restart
PnBAC	0003h						Reserved parameter (Do not change.)	After restart
PnBAF	0010h						/S-ON (SERVO ON) Signal Allocation	After restart
PnBB2	0020h						/DEC (Homing Deceleration Switch Input) Signal Allocation	After restart
PnBB4	0030h						/ALM-RST (Alarm Reset) Signal Allocation	After restart
PnBB5	0040h						/P-CL (Forward External Torque Limit Input) Signal Allocation	After restart
PnBB6	0040h						/N-CL (Reverse External Torque Limit Input) Signal Allocation	After restart
PnBB7	0050h						/CLR (Position Deviation Clear) Signal Allocation	After restart
PnBB8	0060h						E-STP (Emergency Stop Input) Signal Allocation	After restart
PnBB9	0003h						Reserved parameter (Do not change.)	After restart
PnBC0	0000h						/INPOSITION (Positioning Completion Output) Signal Allocation	After restart
PnBC1	0002h						Reserved parameter (Do not change.)	After restart
PnBC2	0002h						Reserved parameter (Do not change.)	After restart
PnBC3	0002h						Reserved parameter (Do not change.)	After restart

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Parameter No.	Default Setting						Name	When Enabled
PnBC4	0002h						Reserved parameter (Do not change.)	After restart
PnBC5	0002h						Reserved parameter (Do not change.)	After restart
PnBC6	0002h						Reserved parameter (Do not change.)	After restart
PnBC9	0002h						/WARN (Warning Output) Signal Allocation	After restart
PnBCA	0002h						Allocation /BK (Brake) Signal	After restart
PnBCB	0002h						/S-RDY (Servo Ready) Signal Allocation	After restart
PnBCC	0010h						/CLT (Torque Limit Status Output) Signal Allocation	After restart
PnBCD	0002h						/TGON (Rotation Detection Output) Signal Allocation	After restart
PnBCE	0002h						/NEAR (Near Output) Signal Allocation	After restart
PnBCF	0002h						Reserved parameter (Do not change.)	After restart
PnBD0	0020h						/PCO (Encoder Origin) Signal Allocation	After restart
PnBD1	0030h						/BUSY (Busy Output) Signal Allocation	After restart
PnBD2	0040h						/POSRDY (Homing Completed Output) Signal Allocation	After restart
PnBD3	0002h						Reserved parameter (Do not change.)	After restart
PnBD4	0050h						/S-ONS (SERVO ON Status Output) Signal Allocation	After restart
PnBD5	0061h						E-STPS (Emergency Stop Status Output) Signal Allocation	After restart
PnBD6	0070h						/ZONE0 (ZONE Output 0) Signal Allocation	After restart
PnBD7	0080h						/ZONE1 (ZONE Output 1) Signal Allocation	After restart
PnBD8	0002h						/ZONE2 (ZONE Output 2) Signal Allocation	After restart
PnBD9	0002h						/ZONE3 (ZONE Output 3) Signal Allocation	After restart
PnBDB	0002h						Reserved parameter (Do not change.)	After restart
PnBE1	25						Pressing Torque for Pressing Homing	Immediately
PnBE2	250						Pressing Detection Time for Pressing Homing	Immediately
PnBE3	250						Pressing Time for Pressing Homing	Immediately
PnBE4	250						Reserved parameter (Do not change.)	Immediately

* The enable timing depends on the digit that is changed. Refer to the following section for details.

☞ *11.1 List of Parameters* on page 11-2

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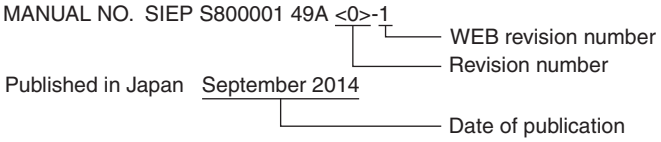
Revision History

The revision dates and numbers of the revised manuals are given on the bottom of the back cover.



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AC Servo Drives

Σ-S Series

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