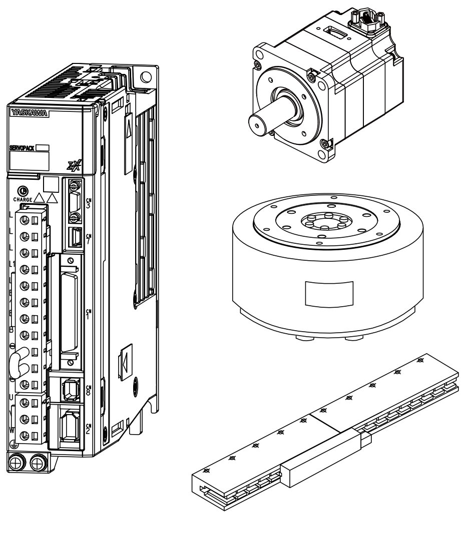
YASKAWA

Σ-X-Series AC Servo Drive

Σ-XS SERVOPACK with Analog Voltage/Pulse Train References

Product Manual

Model: SGDXS-□□□□00



MANUAL NO. SIEP C710812 03F

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Preface and General Precautions

i.1 About this Manual

This manual provides information required to select Σ-XS SERVOPACKs with analog voltage/pulse train references for Σ-X-series AC servo drives, and to design, perform trial operation of, tune, operate, and maintain the servo drives.

Read and understand this manual to ensure correct usage of the Σ-X-series AC servo drives. Keep this manual in a safe place so that it can be referred to whenever necessary.

i.2 Target Readers

This manual is intended for the following readers who are assumed to possess knowledge about the fundamentals of servo drives and electric/electronic circuits.

- Readers who wish to deepen their knowledge of SERVOPACK products
- Personnel in charge of selecting products for equipment
- Designers of applications for SERVOPACKs and servomotors in various types of equipment
- Personnel who maintain equipment
- Designers of FA systems

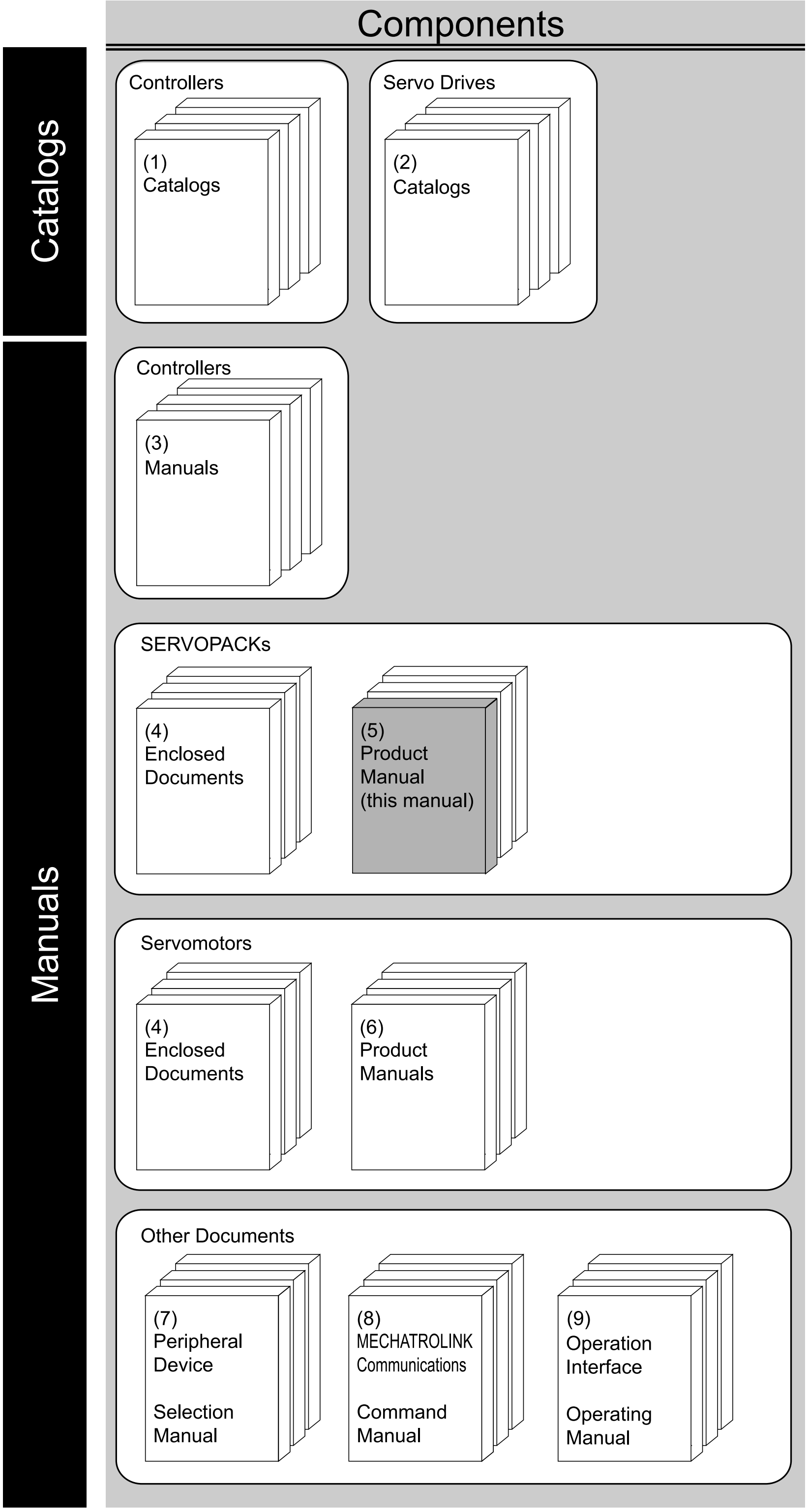
i.3 Outline of Manual

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

Chapter	Chapter Title	Contents
1	Basic Information on SERVOPACKs	Provides information required to select SERVOPACKs, such as SERVOPACK models and combinations with servomotors.
2	Selecting a SERVOPACK	Provides information required to select SERVOPACKs, such as specifications, block diagrams, dimensional drawings, and connection examples.
3	SERVOPACK Installation	Provides information on installing SERVOPACKs in the required locations.
4	Wiring and Connecting SERVOPACKs	Provides information on wiring and connecting SERVOPACKs to power supplies and peripheral devices.
5	Basic Functions That Require Setting before Operation	Describes the basic functions that must be set before you start servo system operation. It also describes the setting methods.
6	Application Functions	Describes the application functions that you can set before you start servo system operation. It also describes the setting methods.
7	Trial Operation and Actual Operation	Provides information on the flow and procedures for trial operation and convenient functions to use during trial operation.
8	Tuning	Provides information on the flow of tuning, details on tuning functions, and related operating procedures.
9	Monitoring	Provides information on monitoring SERVOPACK product information and SERVOPACK status.
10	Fully-Closed Loop Control	Provides detailed information on performing fully-closed loop control with the SERVOPACK.
11	Σ-LINK II Function	Provides detailed information on the Σ-LINK II functions of the SERVOPACK.
12	Safety Functions	Provides detailed information on the safety functions of the SERVOPACK.
13	Maintenance	Provides information on the meaning of, causes of, and corrections for alarms and warnings.
14	Panel Displays and Panel Operator Procedures	Describes how to interpret panel displays and the operation of the panel operator.
15	Parameter Lists	Provides information on the parameters.
16	Appendices	Provides host controller connection examples and tables of corresponding SERVOPACK and SigmaWin+ function names.

i.4 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.



i.4.1 Related Documents

(1) Machine Controllers Catalogs

You can check for products related to YASKAWA machine controllers. Refer to these documents as required.

(2) Servo Drives Catalogs

Document Name	Document No.	Description
AC Servo Drives Sigma-X Series	KAEP C710812 03	Provides detailed information on Σ-X-series AC servo drives, including features and specifications.

(3) Machine Controllers Manuals

The machine controller to use depends on the SERVOPACK that is used. Refer to the manual for the machine controller as required.

(4) Enclosed Documents

Document Name	Document No.	Description
Σ-X-Series AC Servo Drive Σ-XS/Σ-XW SERVOPACK Safety Precautions	TOMP C710812 00	Provides detailed information for the safe usage of Σ-X-series SERVOPACKs.
Σ-X-Series AC Servo Drive Σ-XT SERVOPACK Safety Precautions	TOMP C710812 16	
Σ-X-Series AC Servo Drive Σ-LINK II Sensor Hub Instructions	TOMP C710812 06	Provides detailed information for the safe usage of the Σ-LINK II sensor hub, as well as specifications, installation, and connection information.
Σ-X-Series AC Servo Drive Σ-LINK II Booster Unit Instructions	TOMP C710812 08	Provides detailed information for the safe usage of the Σ-LINK II booster unit, as well as specifications, installation, and connection information.
Σ-V-Series/Σ-V-Series for Large-Capacity Models/Σ-7-Series/Σ-X-Series Installation Guide Fully-closed Module	TOBP C720829 03	Provides detailed procedures for installing the fully-closed module in a SERVOPACK.
AC Servo Drive Rotary Servomotor Safety Precautions	TOBP C230260 00	Provides detailed information for the safe usage of rotary servomotors and direct drive servomotors.

(5) SERVOPACK Product Manuals

Document Name	Document No.	Description
Σ-X-Series AC Servo Drive Σ-XS SERVOPACK with MECHATROLINK-4/III Communications References Product Manual	SIEP C710812 01	Provide detailed information on selecting Σ-X-series Σ-XS or Σ-XW SERVOPACKs; installing, connecting, setting, testing in trial operation, tuning, monitoring, and maintaining servo drives; and other information.
Σ-X-Series AC Servo Drive Σ-XS SERVOPACK with EtherCAT Communications References Product Manual	SIEP C710812 02	
Σ-X-Series AC Servo Drive Σ-XS SERVOPACK with Analog Voltage/Pulse Train References Product Manual	SIEP C710812 03	
Σ-X-Series AC Servo Drive Σ-XW SERVOPACK with MECHATROLINK-4/III Communications References Product Manual	SIEP C710812 04	
Σ-X-Series AC Servo Drive Σ-XW SERVOPACK with EtherCAT Communications References Product Manual	SIEP C710812 05	
Σ-X-Series AC Servo Drive Σ-XT SERVOPACK with MECHATROLINK-4/III Communications References Product Manual	SIEP C710812 16	Provide detailed information on selecting Σ-X-series Σ-XT SERVOPACKs; installing, connecting, setting, testing in trial operation, tuning, monitoring, and maintaining servo drives; and other information.
Σ-X-Series AC Servo Drive Σ-XT SERVOPACK with EtherCAT Communications References Product Manual	SIEP C710812 17	
Σ-X-Series AC Servo Drive Σ-XW/Σ-XT SERVOPACK Hardware Option Specifications HWBB Function Product Manual	SIEP C710812 13	Provides information on servo drives equipped with the HWBB safety function (SGDXW-□□□□40□1000, SGDXW-□□□□A0□1000, SGDXT-□□□□40□1000, and SGDXT-□□□□A0□1000)). The differences in specifications from SERVOPACKs not equipped with the HWBB are given in this manual.
Σ-X-Series AC Servo Drive Σ-XS/Σ-XW/Σ-XT SERVOPACK Hardware Option Specifications Dynamic Brake Product Manual	SIEP C710812 14	Provides information on Σ-X-series AC servo drives (SGDX□-□□□□□□□0020) with the dynamic brake option. The differences in specifications from SERVOPACKs without the dynamic brake option are given in this manual.

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Document Name	Document No.	Description
Σ-X-Series AC Servo Drive Σ-XS/Σ-XW SERVOPACK with MECHATROLINK-4/III Communications References FT Specification for Gantry Applications Product Manual	SIEP C710812 19	Provide information on the gantry application function and torque/force assistance in the Σ-X-series Σ-XS/Σ-XW SERVOPACK.
Σ-X-Series AC Servo Drive Σ-XS/Σ-XW SERVOPACK with EtherCAT Communications References FT Specification for Gantry Applications Product Manual	SIEP C710812 20	
Σ-X-Series AC Servo Drive Σ-XS SERVOPACK with MECHATROLINK-4/III Communications References FT Specification for Press and Injection Molding Applications Product Manual	SIEP C710812 22	Provide information on the press and injection molding function in the Σ-X-series Σ-XS SERVOPACK.
Σ-X-Series AC Servo Drive Σ-XS SERVOPACK with EtherCAT Communications References FT Specification for Press and Injection Molding Applications Product Manual	SIEP C710812 23	
Σ-X-Series AC Servo Drive Σ-XS SERVOPACK with FT Specification Customized Sensing Data Function Option Product Manual	SIEP C710812 18	Provides information on the customized sensing data function in the Σ-X-series Σ-XS SERVOPACK.
Σ-X-Series AC Servo Drive Σ-XS SERVOPACK with FT Specification Customized Sensing Data Function Option (with Custom Motion Function) Product Manual	SIEP C710812 21	Provides information on the customized sensing data function (with custom motion function) in the Σ-X-series Σ-XS SERVOPACK.

(6) Servomotor Product Manuals

Document Name	Document No.	Description
Σ-X-Series AC Servo Drive Rotary Servomotor Product Manual	SIEP C230210 00	Provides detailed information on selecting, installing, and connecting the Σ-X-series servomotors.

(7) Peripheral Device Selection Manual

Document Name	Document No.	Description
Σ-X-Series AC Servo Drive Peripheral Device Selection Manual	SIEP C710812 12	Provides the following information in detail for Σ-X-series servo systems. • Cables: Models, dimensions, wiring materials, connector models, and connection specifications • Peripheral devices: Models, specifications, diagrams, and selection (calculation) methods

(8) MECHATROLINK Communications Command Manuals

Document Name	Document No.	Description
Σ-7/Σ-X-Series AC Servo Drive MECHATROLINK-III Communications Standard Servo Profile Command Manual	SIEP S800001 31	Provides detailed information on the MECHATROLINK-III communications standard servo profile commands that are used for a Σ-7/Σ-X-series servo system.
Σ-7/Σ-X-Series AC Servo Drive MECHATROLINK-4 Communications Standard Servo Profile Command Manual	SIEP S800002 32	Provides detailed information on the MECHATROLINK-4 communications standard servo profile commands that are used for a Σ-7/Σ-X-series servo system.

(9) Operation Interface Operating Manuals

Document Name	Document No.	Description
System Integrated Engineering Tool MPE720 Ver.7 User's Manual	SIEP C880761 03	Describes in detail how to operate MPE720 version 7.
Σ-7/Σ-X-Series AC Servo Drive Digital Operator Operating Manual	SIEP S800001 33	Describes the operating procedures for a digital operator for a Σ-7/Σ-X-series servo system.
AC Servo Drive Engineering Tool SigmaWin+ Operation Manual	SIET S800001 34	Provides detailed operating procedures for the SigmaWin + engineering tool for a Σ-7/Σ-X series servo system.

i.5 Using This Manual

i.5.1 Technical Terms Used in This Manual

The following terms are used in this manual.

Term	Meaning
servomotor	A generic term for a rotary servomotor or linear servomotor that can be driven by this SERVOPACK.
rotary servomotor	A generic term used for a Σ-X-series or Σ-7-series rotary servomotor (SGMXJ, SGMXA, SGMXP, SGMXG, SGM7M) or a Σ-7-series direct drive servomotor (SGM7D, SGM7E, SGM7F). The descriptions will specify when direct drive servomotors are excluded.
linear servomotor	A generic term used for a Σ-7-series linear servomotor (SGLG, SGLF, SGLT).
SERVOPACK	A Σ-X-series Σ-XS servo amplifier with analog voltage/pulse train references.
servo drive	The combination of a servomotor and SERVOPACK.
servo system	A servo control system that includes the combination of a servo drive with a host controller and peripheral devices.
servo ON	Supplying power to the motor.
servo OFF	Not supplying power to the motor.
base block (BB)	Shutting OFF the power supply to the motor by shutting OFF the base current to the power transistor in the SERVOPACK.
servo lock	A state in which the motor is stopped and is in a position loop with a position reference of 0.
main circuit cable	One of the cables that connect to the main circuit terminals, including the main circuit power supply cable, control power supply cable, and servomotor main circuit cable.
SigmaWin+	The engineering tool for setting up and tuning servo drives or a computer in which the engineering tool is installed.

i.5.2 Differences in Terms for Rotary Servomotors and Linear Servomotors

There are differences in the terms that are used for rotary servomotors and linear servomotors. This manual primarily describes rotary servomotors. If you are using a linear servomotor, you need to interpret the terms as given in the following table.

Rotary Servomotor	Linear Servomotor
torque	force
moment of inertia	mass
rotation	movement
forward rotation and reverse rotation	forward movement and reverse movement
CW + CCW pulse trains	forward and reverse pulse trains
rotary encoder	linear encoder
absolute rotary encoder	absolute linear encoder
incremental rotary encoder	incremental linear encoder
unit: min^{-1}	unit: mm/s
unit: N·m	unit: N

i.5.3 Notation Used in this Manual

(1) 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.

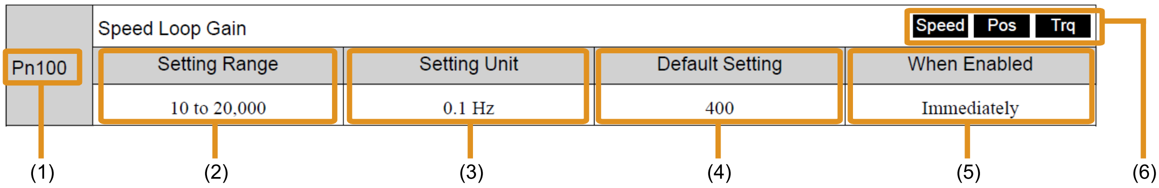
Notation Example

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

(2) 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).

(a) Parameters for Numeric Settings

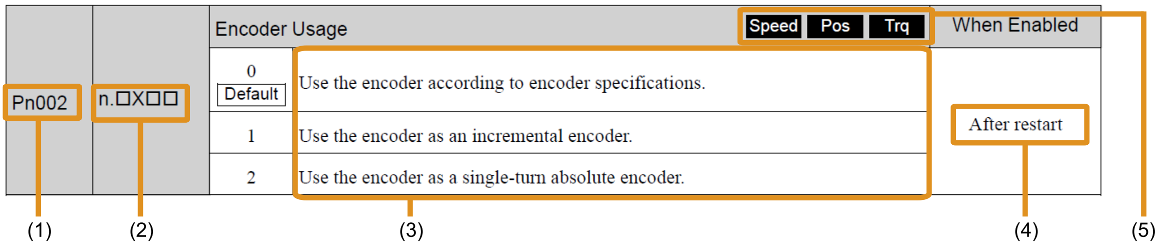


Pn100 Speed Loop Gain Speed Pos Trq

Setting Range	Setting Unit	Default Setting	When Enabled
10 to 20,000	0.1 Hz	400	Immediately

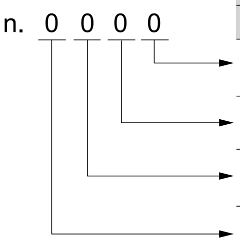
No.	Description
(1)	Parameter number
(2)	This is the setting range for the parameter.
(3)	This is the setting unit (setting increment) that you can set for the parameter.
(4)	This is the parameter setting before shipment.
(5)	This is when any change made to the parameter will become effective.
(6)	The control methods for which the parameters apply are given. Speed: A parameter that can be used in speed control. Pos: A parameter that can be used in position control. Trq: A parameter that can be used in torque control. "Torque" is used even for linear servomotor parameters. Grayed-out icons (Speed, Pos, Trq) indicate parameters that cannot be used in the corresponding control method.

(b) Parameters for Selecting Functions



Pn002 n.□X□□ Encoder Usage Speed Pos Trq

		When Enabled
0 Default	Use the encoder according to encoder specifications.	After restart
1	Use the encoder as an incremental encoder.	
2	Use the encoder as a single-turn absolute encoder.	

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td>(1)</td><td>Parameter number</td></tr>
<tr><td>(2)</td><td>The notation “n.□□□□” indicates a parameter for selecting functions. The digit shown as "X" is the content being explained in this parameter.
Notation Example
Notation Examples for Pn002

<table>
<tr><th colspan="2">Digit Notation</th><th colspan="2">Numeric Value Notation</th></tr>
<tr><th>Notation</th><th>Meaning</th><th>Notation</th><th>Meaning</th></tr>
<tr><td>Pn002 = n.□□□X</td><td>Indicates the first digit from the right in Pn002.</td><td>Pn002 = n.□□□1</td><td>Indicates that the first digit from the right in Pn002 is set to 1.</td></tr>
<tr><td>Pn002 = n.□□X□</td><td>Indicates the second digit from the right in Pn002.</td><td>Pn002 = n.□□1□</td><td>Indicates that the second digit from the right in Pn002 is set to 1.</td></tr>
<tr><td>Pn002 = n.□X□□</td><td>Indicates the third digit from the right in Pn002.</td><td>Pn002 = n.□1□□</td><td>Indicates that the third digit from the right in Pn002 is set to 1.</td></tr>
<tr><td>Pn002 = n.X□□□</td><td>Indicates the fourth digit from the right in Pn002.</td><td>Pn002 = n.1□□□</td><td>Indicates that the fourth digit from the right in Pn002 is set to 1.</td></tr>
</table></td></tr>
<tr><td>(3)</td><td>This column explains the selections for the function.
In the above example, the first line gives an explanation of when Pn002 = n.□0□□ is set.</td></tr>
<tr><td>(4)</td><td>This is when any change made to the parameter will become effective.</td></tr>
<tr><td>(5)</td><td>The control methods for which the parameters apply are given.
Speed: A parameter that can be used in speed control.
Pos: A parameter that can be used in position control.
Trq: A parameter that can be used in torque control. "Torque" is used even for linear servomotor parameters.
Grayed-out icons (Speed, Pos, Trq) indicate parameters that cannot be used in the corresponding control method.</td></tr>
</table>

i.5.4 Engineering Tools Used in This Manual

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

The interfaces and procedures contained in this manual are currently in development and may differ from the actual specifications.

i.5.5 Trademarks

- Σ-LINK is a trademark of the MECHATROLINK Members Association.
- QR code is a trademark of Denso Wave Inc.
- Other product names and company names are the trademarks or registered trademarks of their respective companies. “TM” and the ® mark do not appear with product or company names in this manual.

i.5.6 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.

Information Indicates supplemental information to deepen understanding or useful information.

i.6 Safety Precautions

i.6.1 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.

i.6.2 Safety Precautions That Must Always Be Observed

(1) General Precautions

⚠ DANGER

Read and understand this manual to ensure the safe usage of the product.

Keep this manual in a safe, convenient place so that it can be referred to whenever necessary. Make sure that it is delivered to the final user of the product.

Do not remove covers, cables, connectors, or optional devices while power is being supplied to the SERVOPACK.

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

⚠ WARNING

Use a power supply with specifications (number of phases, voltage, frequency, and AC/DC type) that are appropriate for the product.

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

Connect the ground terminals on the SERVOPACK and servomotor to ground poles according to local electrical codes (100 Ω max).

There is a risk of electric shock or fire.

Do not attempt to disassemble, repair, or modify the product.

There is a risk of fire or failure. The warranty is void for the product if you disassemble, repair, or modify it.

⚠ CAUTION

The SERVOPACK heat sinks, regenerative resistors, external dynamic brake resistors, servomotors, and other components can be very hot while power is ON or soon after the power is turned OFF. Implement safety measures, such as installing covers, so that hands and parts such as cables do not come into contact with hot components.

There is a risk of burning.

For a 24-VDC power supply, use a power supply device with double insulation or reinforced insulation.

There is a risk of electric shock.

Do not damage, pull on, apply excessive force to, place heavy objects on, or pinch cables.

There is a risk of failure, damage, or electric shock.

The person who designs the system that uses the safety function must have a complete knowledge of the related safety standards and a complete understanding of the instructions in this document.

There is a risk of injury, product damage, or machine damage.

Do not place the product in locations where it is subject to water, corrosive gases, flammable gases, potentially explosive atmospheres, 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 and stops operation immediately when an error occurs.

In locations with poor power supply conditions, install the necessary protective devices (such as AC reactors) to ensure that the input power is supplied within the specified voltage range.

There is a risk of damage to the SERVOPACK.

Use a noise filter to minimize the effects of electromagnetic interference.

Electronic devices used near the SERVOPACK may be affected by electromagnetic interference.

Always use a servomotor and SERVOPACK in one of the specified combinations.

Do not touch a SERVOPACK or servomotor with wet hands.

There is a risk of product failure.

(2) Storage Precautions

⚠ CAUTION

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

There is a risk of injury or damage.

NOTICE

Do not install or store the product in any of the following locations.

- **Locations that are subject to direct sunlight**
- **Locations that are subject to surrounding temperatures that exceed product specifications**
- **Locations that are subject to relative humidities that exceed product specifications**
- **Locations that are subject to condensation as the result of extreme changes in temperature**
- **Locations that are subject to corrosive or flammable gases**
- **Locations that are near flammable materials**
- **Locations that are subject to dust, salts, or iron powder**
- **Locations that are subject to water, oil, or chemicals**
- **Locations that are subject to vibration or shock that exceeds product specifications**
- **Locations that are subject to radiation**

If you store or install the product in any of the above locations, the product may fail or be damaged.

(3) Transportation Precautions

⚠ CAUTION

Transport the product in a way that is suitable to the mass of the product.

Do not use the eyebolts on a SERVOPACK or servomotor to move the machine.

There is a risk of damage or injury.

When you handle a SERVOPACK or servomotor, be careful of sharp parts, such as the corners.

There is a risk of injury.

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

There is a risk of injury or damage.

NOTICE

Do not hold onto the front cover or connectors when you move a SERVOPACK.

There is a risk of the SERVOPACK falling.

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.

NOTICE

If disinfectants or insecticides must be used to treat packing materials such as wooden frames, plywood, or pallets, use a method other than fumigation. For example, use heat sterilization (core temperature of 56°C or higher for 30 minutes or longer). Treat the packing materials before the product is packaged instead of using a method that treats the entire packaged product.

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

Do not overtighten the eyebolts on a SERVOPACK or servomotor.

If you use a tool to overtighten the eyebolts, the tapped holes may be damaged.

(4) Installation Precautions

⚠ CAUTION

Install the servomotor or SERVOPACK in a way that will support the mass given in technical documents.

Install SERVOPACKs, servomotors, regenerative resistors, and external dynamic brake resistors on nonflammable materials.

Installation directly onto or near flammable materials may result in fire.

Provide the specified clearances between the SERVOPACK and the control panel as well as with other devices.

There is a risk of fire or failure.

Install the SERVOPACK in the specified orientation.

There is a risk of fire or failure.

Do not step on or place a heavy object on the product.

There is a risk of failure, damage, or injury.

Do not allow any foreign matter to enter the SERVOPACK or servomotor.

There is a risk of failure or fire.

NOTICE

Do not install or store the product in any of the following locations.

- **Locations that are subject to direct sunlight**
- **Locations that are subject to surrounding temperatures that exceed product specifications**
- **Locations that are subject to relative humidities that exceed product specifications**
- **Locations that are subject to condensation as the result of extreme changes in temperature**
- **Locations that are subject to corrosive or flammable gases**
- **Locations that are near flammable materials**
- **Locations that are subject to dust, salts, or iron powder**
- **Locations that are subject to water, oil, or chemicals**
- **Locations that are subject to vibration or shock that exceeds product specifications**
- **Locations that are subject to radiation**

If you store or install the product in any of the above locations, the product may fail or be damaged.

Use the product in an environment that is appropriate for the product specifications.

If you use the product in an environment that exceeds product specifications, the product may fail or be damaged.

NOTICE

SERVOPACK or servomotor is a precision device. Do not drop it or subject it to strong shock.

There is a risk of failure or damage.

Always install a SERVOPACK in a control panel.

Do not allow any foreign matter to enter a SERVOPACK or a servomotor with a cooling fan and do not cover the outlet from the servomotor's cooling fan.

There is a risk of failure.

(5) Wiring Precautions

⚠ DANGER

Do not change any wiring while power is being supplied.

There is a risk of electric shock or injury.

⚠ WARNING

Wiring and inspections must be performed only by qualified engineers.

There is a risk of electric shock or product failure.

Check all wiring and power supplies carefully.

Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures. If a short-circuit failure occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident that may result in death or injury. There is also a risk that some parts damaged by the short-circuit failure may fall from the SERVOPACK.

Always use the specified terminals to connect the SERVOPACK and peripheral devices. For the power supply wiring in particular, confirm that the connections are made with the terminals shown below.

- **Connect an AC power supply to the L1, L2, and L3 terminals and the L1C and L2C terminals on the SERVOPACK.**
- **Connect a DC power supply to the B1/⊕ and ⊖2 terminals and the L1C and L2C terminals on the SERVOPACK.**

There is a risk of failure or fire.

If you use a SERVOPACK with the dynamic brake hardware option, connect an external dynamic brake resistor that is suitable for the machine and equipment specifications to the specified terminals.

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

⚠ CAUTION

Wait for at least 20 minutes (or 100 minutes when using DC power supply input) after turning OFF the power and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the main circuit terminals while the CHARGE indicator is lit because high voltage may still remain in the SERVOPACK even after turning OFF the power.

There is a risk of electric shock.

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

Failures caused by incorrect wiring or incorrect voltage application in the brake circuit may cause the SERVOPACK to fail, damage the equipment, or cause an accident resulting in death or injury.

⚠ CAUTION

Check the wiring to be sure it has been performed correctly. Connectors and pin layouts are sometimes different for different models. Always confirm the pin layouts in technical documents for your model before operation.

There is a risk of failure or malfunction.

Connect wires to main circuit terminals and motor connection terminals securely with the specified methods and tightening torque.

Insufficient tightening may cause wires and terminal blocks to generate heat due to faulty contact, possibly resulting in fire.

Use shielded twisted-pair cables or screened unshielded multi-twisted-pair cables for I/O signal cables and encoder cables.

The maximum wiring length is 3 m for I/O signal cables and 50 m for servomotor main circuit cables and encoder cables.

Observe the following precautions when wiring the SERVOPACK's main circuit terminals.

- **Turn ON the power to the SERVOPACK only after all wiring, including the main circuit terminals, has been completed.**
- **If a connector is used for the main circuit terminals, remove the main circuit connector from the SERVOPACK before you wire it.**
- **Insert only one wire per insertion hole in the main circuit terminals.**
- **When you insert a wire, make sure that the conductor wire (e.g., whiskers) does not come into contact with adjacent wires and cause a short-circuit.**

Install molded-case circuit breakers and other safety measures to provide protection against short circuits in external wiring.

There is a risk of fire or failure.

NOTICE

Whenever possible, use the cables specified by Yaskawa. If you use any other cables, confirm the rated current and application environment of your model and use the wiring materials specified by Yaskawa or equivalent materials.

Securely tighten connector screws and lock mechanisms.

Insufficient tightening may result in connectors falling off during operation.

Do not bundle power lines (e.g., the main circuit cable) and low-current lines (e.g., the I/O signal cables or encoder cables) together or run them through the same duct. If you do not place power lines and low-current lines in separate ducts, separate them by at least 30 cm.

If the cables are too close to each other, malfunctions may occur due to noise affecting the low-current lines.

Install a battery at either the host controller or on the encoder cable.

If you install batteries both at the host controller and on the encoder cable at the same time, you will create a loop circuit between the batteries, resulting in a risk of damage or burning.

When connecting a battery, connect the polarity correctly.

There is a risk of battery rupture or encoder failure.

(6) Operation Precautions

⚠ WARNING

Before starting operation with a machine connected, change the settings of the switches and parameters to match the machine.

Unexpected machine operation, failure, or personal injury may occur if operation is started before appropriate settings are made.

Do not radically change the settings of the parameters.

There is a risk of unstable operation, machine damage, or injury.

Install limit switches or stoppers at the ends of the moving parts of the machine to prevent unexpected accidents.

There is a risk of machine damage or injury.

For trial operation, securely mount the servomotor and disconnect it from the machine.

There is a risk of injury.

Forcing the motor to stop for overtravel is disabled when the Jog, Origin Search, or Easy FFT utility function is executed. Take necessary precautions.

There is a risk of machine damage or injury.

When an alarm occurs, the servomotor will coast to a stop or stop with the dynamic brake according to the SERVOPACK option and settings. The coasting distance will change with the moment of inertia of the load and the external dynamic brake resistance. 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.

Perform the correct operation with the servomotor connected to the machine.

There is a risk of machine damage or personal injury.

⚠ CAUTION

Design the system to ensure safety even when problems, such as broken signal lines, occur. For example, the P-OT and N-OT signals are set in the default settings to operate on the safe side if a signal line breaks. Do not change the polarity of this type of signal.

When overtravel occurs, the power to the motor is turned OFF and the brake is released. If you use the servomotor to drive a vertical load, set the servomotor to enter a zero-clamped state after the servomotor stops. Also, install safety devices (such as an external brake or counterweight) to prevent the moving parts of the machine from falling.

⚠ CAUTION

Always turn OFF the servo before you turn OFF the power. If you turn OFF the main circuit power or control power during operation before you turn OFF the servo, the servomotor will stop as follows:

- **If you turn OFF the main circuit power during operation without turning OFF the servo, the servomotor will stop abruptly with the dynamic brake.**
- **If you turn OFF the control power without turning OFF the servo, the stopping method that is used by the servomotor depends on the model of the SERVOPACK. For details, refer to the manual for the SERVOPACK.**
- **If you use a SERVOPACK with the dynamic brake hardware option, the servomotor stopping methods will be different from the stopping methods used without the option or with other hardware options.**

Do not use the dynamic brake for any application other than an emergency stop.

There is a risk of failure due to rapid deterioration of elements in the SERVOPACK and the risk of unexpected operation, machine damage, burning, or injury.

NOTICE

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

If a high gain causes vibration, the servomotor will be damaged quickly.

Do not frequently turn the power ON and OFF. After you have started actual operation, allow at least one hour between turning the power ON and OFF (as a guideline). Do not use the product in applications that require the power to be turned ON and OFF frequently.

The elements in the SERVOPACK will deteriorate quickly.

An alarm or warning may occur if communications are performed with the host controller while the SigmaWin+ or digital operator is operating.

If an alarm or warning occurs, it may interrupt the current process and stop the system.

After you complete trial operation of the machine and facilities, use the SigmaWin+ to back up the settings of the SERVOPACK parameters. You can use them to reset the parameters after SERVOPACK replacement.

If you do not copy backed up parameter settings, normal operation may not be possible after a faulty SERVOPACK is replaced, possibly resulting in machine or equipment damage.

(7) Maintenance and Inspection Precautions

⚠ DANGER

Do not change any wiring while power is being supplied.

There is a risk of electric shock or injury.

⚠ WARNING

Wiring and inspections must be performed only by qualified engineers.

There is a risk of electric shock or product failure.

⚠ CAUTION

Wait for at least 20 minutes (or 100 minutes when using DC power supply input) after turning OFF the power and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the main circuit terminals while the CHARGE indicator is lit because high voltage may still remain in the SERVOPACK even after turning OFF the power.

There is a risk of electric shock.

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

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

NOTICE

Discharge all static electricity from your body before you operate any of the buttons or switches inside the front cover of the SERVOPACK.

There is a risk of equipment damage.

(8) Troubleshooting Precautions

⚠ DANGER

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

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

⚠ WARNING

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

There is a risk of injury.

⚠ CAUTION

When an alarm occurs, remove the cause of the alarm and ensure safety. Then reset the alarm or turn the power OFF and ON again to restart operation.

There is a risk of injury or machine damage.

If the Servo ON signal is input to the SERVOPACK and an alarm is reset, the servomotor may suddenly restart operation. Confirm that the servo is OFF and ensure safety before you reset an alarm.

There is a risk of injury or machine damage.

Always insert a magnetic contactor in the line between the main circuit power supply and the main circuit terminals on the SERVOPACK so that the power can be shut OFF at the main circuit power supply.

If a magnetic contactor is not connected when the SERVOPACK fails, a large current may flow continuously, possibly resulting in fire.

⚠ CAUTION

If an alarm occurs, shut OFF the main circuit power supply.

There is a risk of fire due to a regenerative resistor overheating as the result of regenerative transistor failure.

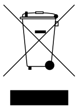
Install a ground fault detector against overloads and short-circuiting or install a molded-case circuit breaker combined with a ground fault detector.

There is a risk of SERVOPACK failure or fire if a ground fault occurs.

The holding brake on a servomotor will not ensure safety if there is the possibility that an external force (including gravity) may move the current position and create a hazardous situation when power is interrupted or an error occurs. If an external force may cause movement, install an external braking mechanism that ensures safety.

(9) Disposal Precautions

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



(10) General Precautions

- Figures provided in this manual are typical examples or conceptual representations. There may be differences between them and actual wiring, circuits, and products.
- The products shown in illustrations in this manual are sometimes shown with their covers or protective guards removed to illustrate detail. Always replace all covers and protective guards before you use the product.
- If you need a new copy of this manual because it has been lost or damaged, contact your nearest Yaskawa representative or one of the offices listed on the back of this manual.
- This manual is subject to change without notice for product improvements, specifications changes, and improvements to the manual itself. We will update the manual number of the manual 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.

i.7 Warranty

i.7.1 Details of Warranty

(1) 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.

(2) Warranty Scope

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

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

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

i.7.2 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.

i.7.3 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.

i.7.4 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.

i.8 Compliance with UL Standards, EU Directives, and Other Safety Standards

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

Refer to the servomotor manual for compliant standards of servomotors.

i.8.1 North American Safety Standards (UL)

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

i.8.2 EU Directives

Product	Model	EU Directives	Harmonized Standards
SERVOPACK	SGDXS	Machinery Directive 2006/42/EC	EN 62061 EN 61800-5-2
		EMC Directive 2014/30/EU	EN 55011 group 1, class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Low Voltage Directive 2014/35/EU	EN 61800-5-1
		RoHS Directive 2011/65/EU (EU)2015/863	EN IEC 63000
		WEEE Directive 2012/19/EU	–

Note:

- We declared the CE Marking based on the harmonized standards in the above table. These products complied with the corresponding IEC standards. Refer to the declaration of conformity for details.
- These products are for industrial use. In home environments, these products may cause electromagnetic interference and additional noise reduction measures may be necessary.

i.8.3 UK Conformity Assessed (UKCA)

Product	Model	UK Regulations	Designated Standards
SERVOPACKs	SGDXS	Supply of Machinery (Safety) Regulations S.I. 2008/1597	EN ISO 13849-1: 2015 EN 62061 EN 61800-5-2
		Electromagnetic Compatibility Regulations S.I. 2016/1091	EN 55011 group 1, class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Electrical Equipment (Safety) Regulations S.I. 2016/1101	EN 61800-5-1
		RoHS Directive S.I. 2012/3032	EN IEC 63000

Note:

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

i.8.4 Safety Standards

Product	Model	Standards
SERVOPACK	SGDXS	EN ISO 13849-1:2015 EN 62061 EN 61800-5-2 EN 61000-6-7 EN 61326-3-1 EN 61508 series

Note:

These products complied with the corresponding IEC standards. Refer to the declaration of conformity for details.

- Safety Parameters

Item	Standards	Performance Level
Safety Integrity Level	IEC 61508	SIL3
	IEC 62061	SILCL3/maximum SIL3
Mission Time	EN ISO 13849-1	20 years
Probability of Dangerous Failure per Hour	IEC 61508 IEC 62061	PFH = 8.57 × 10^{-9} [1/h] (8.57% of SIL3)
Performance Level	EN ISO 13849-1	PL e (Category 3)
Mean Time to Dangerous Failure of Each Channel	EN ISO 13849-1	MTTFd: High
Average Diagnostic Coverage	EN ISO 13849-1	DCavg: Medium
Stop Category	IEC 60204-1	Stop category 0
Safety Function	IEC 61800-5-2	STO
Hardware Fault Tolerance	IEC 61508	HFT = 1
Subsystem	IEC 61508	B

Note:

Mission time is a parameter used in the statistic calculation required by functional safety standards. Mission time is not related to the warranty period.

1

Basic Information on SERVOPACKs

This chapter provides information required to select SERVOPACKs, such as SERVOPACK model numbers and combinations with servomotors.

1.1 The Σ-X Series

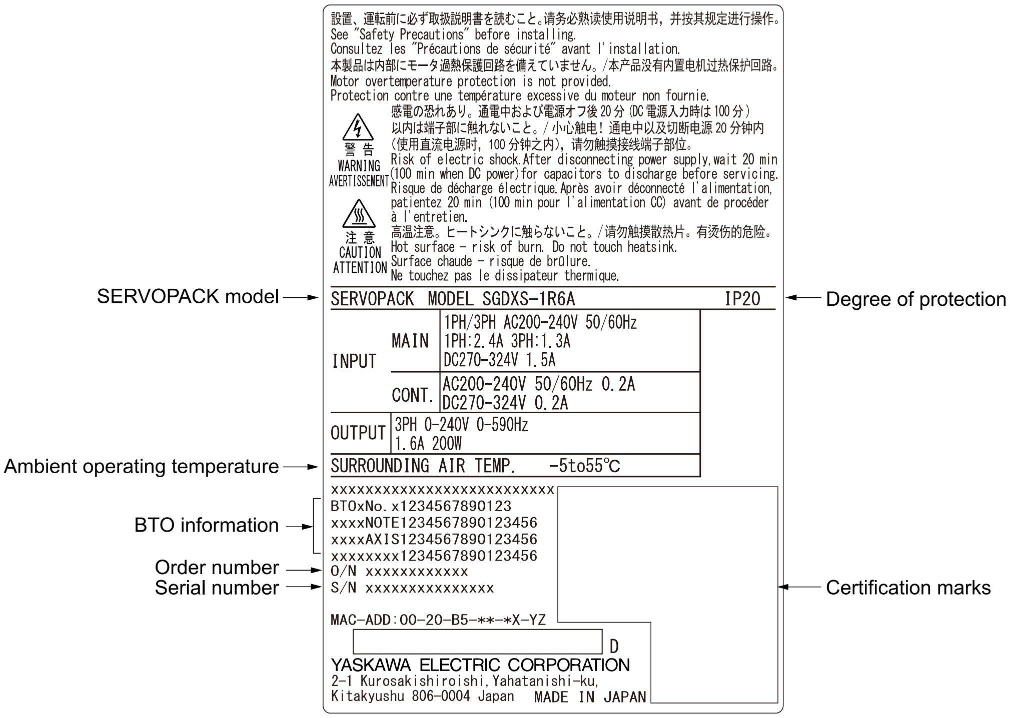
The Σ-X-series SERVOPACKs are designed for applications that require frequent high-speed and high-precision positioning. The SERVOPACK will make the most of machine performance in the shortest time possible, thus contributing to improving productivity.

Σ-X-series SERVOPACKs are available in the three models shown below.

Model Name	Description
Σ-XS	Single-axis SERVOPACKs
Σ-XW	Two-axis SERVOPACKs
Σ-XT	Three-axis SERVOPACKs

1.2 Interpreting the Nameplate

The following basic information is provided on the nameplate.



設置、運転前に必ず取扱説明書を読むこと。请务必熟读使用说明书，并按其规定进行操作。
See "Safety Precautions" before installing.
Consultez les "Précautions de sécurité" avant l'installation.
本製品は内部にモータ過熱保護回路を備えていません。/本产品没有内置电机过热保护回路。
Motor overtemperature protection is not provided.
Protection contre une température excessive du moteur non fournie.
感電の恐れあり。通電中および電源オフ後 20 分 (DC 電源入力時は 100 分)
以内は端子部に触れないこと。/ 小心触电！通电中以及切断电源 20 分钟内
(使用直流电源时，100 分钟之内)，请勿触摸接线端子部位。
Risk of electric shock. After disconnecting power supply, wait 20 min
(100 min when DC power) for capacitors to discharge before servicing.
Risque de décharge électrique. Après avoir déconnecté l'alimentation,
patientez 20 min (100 min pour l'alimentation CC) avant de procéder
à l'entretien.
高温注意。ヒートシンクに触らないこと。/请勿触摸散热片。有烫伤的危险。
Hot surface - risk of burn. Do not touch heatsink.
Surface chaude - risque de brûlure.
Ne touchez pas le dissipateur thermique.

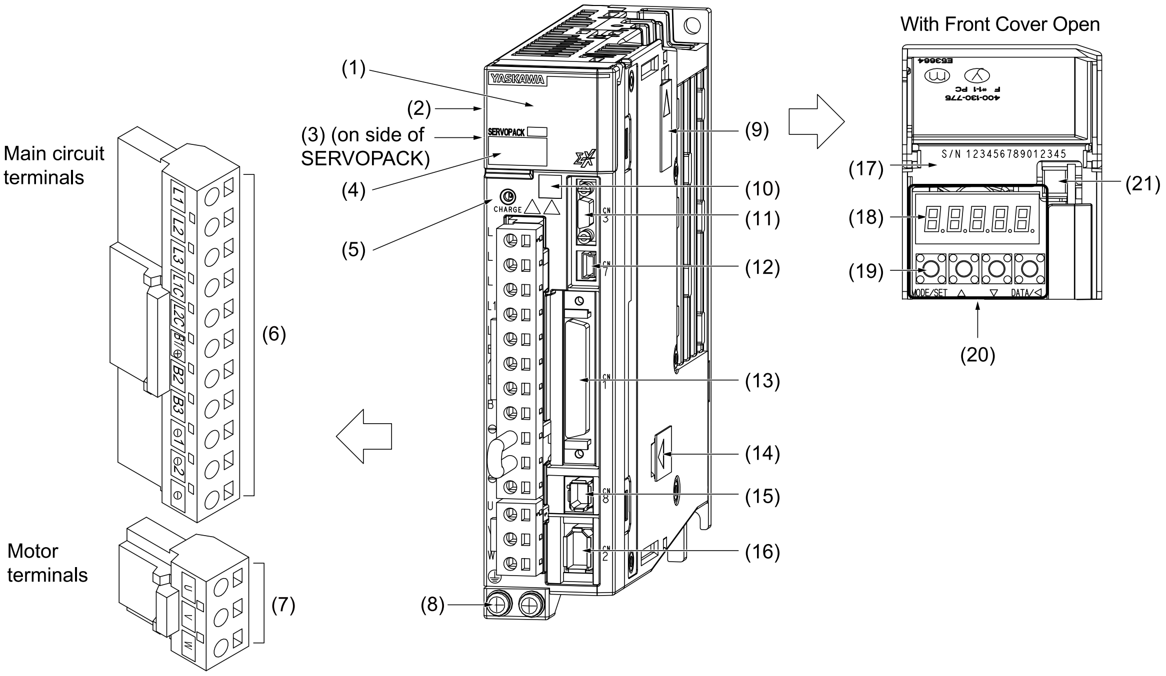
SERVOPACK MODEL SGDXS-1R6A IP20

INPUT	MAIN	1PH/3PH AC200-240V 50/60Hz 1PH:2.4A 3PH:1.3A DC270-324V 1.5A
	CONT.	AC200-240V 50/60Hz 0.2A DC270-324V 0.2A
OUTPUT		3PH 0-240V 0-590Hz 1.6A 200W
SURROUNDING AIR TEMP.		-5to55℃

xxxxxxxxxxxxxxxxxxxxxxxxxxx
BTOxNo. x1234567890123
xxxxNOTE1234567890123456
xxxxAXIS1234567890123456
xxxxxxxx1234567890123456
O/N xxxxxxxxxxxx
S/N xxxxxxxxxxxxxxx

MAC-ADD:00-20-B5-**-*X-YZ
D
YASKAWA ELECTRIC CORPORATION
2-1 Kurosakishiroishi, Yahatanishi-ku,
Kitakyushu 806-0004 Japan MADE IN JAPAN

1.3 Part Names



Code	Name	Description	Reference
(1)	Front Cover	–	–
(2)	Nameplate	Indicates the SERVOPACK model and ratings.	49
(3)	Input Voltage	–	–
(4)	Model	The model of the SERVOPACK.	52
(5)	CHARGE	Lits while the main circuit power is being supplied. **Note:** Even if you turn OFF the main circuit power supply, this indicator will be lit as long as the internal capacitor remains charged. Do not touch the main circuit or motor terminals while this indicator is lit. There is a risk of electric shock.	–
(6)	Main Circuit Terminals	The terminals depend on the main circuit power supply input specifications of the SERVOPACK.	113
(7)	Servomotor Terminals (U, V, and W)	The connection terminals for the servomotor main circuit cable (power line).	125
(8)	Ground Terminal (⏚)	The ground terminals to prevent electric shock. Always connect this terminal.	–
(9)	Safety Option Module Connector (CN11)	Connects to a safety option module (currently in development).	–
(10)	QR Code	The QR code that is used by the MechatroCloud service.	–
(11)	Serial Communications Connector (CN3)	Connects to the digital operator (a peripheral device) or a computer (RS-422).	151 , 152
(12)	Personal Computer Connector (CN7)	A USB connector to connect a personal computer. The digital operator can also be connected.	150 , 151
(13)	I/O Signal Connector (CN1)	Connects to reference input signals and sequence I/O signals.	135
(14)	Feedback Option Module Connector (CN12)	Connects to a feedback option module.	–
(15)	Safety Connector (CN8)	Connects to a safety function device.	148

Continued on next page.

Continued from previous page.

Code	Name	Description	Reference
(16)	Encoder Cable Connector (CN2)	This connector is used for the following purposes. • Rotary servomotor: Connects to the encoder in the servomotor. • Linear servomotor: Connects to the serial converter unit or linear encoder. • Connects to Σ-LINK II-compatible sensors and the Σ-LINK II sensor hub.	125
(17)	Serial Number	–	–
(18)	Panel Display	Used to display SERVOPACK status, alarm numbers, and parameters.	635
(19)	Panel Operator Keys	Used to set parameters.	
(20)	Panel Operator	–	
(21)	Analog Monitor Connector (CN5)	You can use a special cable (peripheral device) to monitor the motor speed, torque reference, or other values.	153

1.4 Interpreting Model Numbers

1.4.1 Interpreting SERVOPACK Model Numbers

SGDXS	-	R70	A	00	A	0001	00	B
Σ-X-Series Σ-XS model		1st+2nd+3rd digits	4th digit	5th+6th digits	7th digit	8th+9th+10th+11th digits	12th+13th digits	14th digit

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

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

4th digit Voltage

Code	Specification
A	200 VAC

5th+6th digits Interface*3

Code	Specification
00	Analog voltage/pulse train reference

7th digit Design Revision Order

A

8th+9th+10th+11th digits Hardware Options Specification

Code	Specification	Applicable Models
None 0000	Without options	All models
0001	Rack-mounted	SGDXS-R70A to -330A
	Duct-ventilated	SGDXS-470A to -780A
0002	Varnished	All models
0008	Single-phase, 200-VAC power supply input	SGDXS-120A
0020*4	No dynamic brake	SGDXS-R70A to -2R8A
	External dynamic brake resistor	SGDXS-3R8A to -780A

12th+13th digits FT Specification

Code	Specification
None 00	None

14th digit BTO Specification (under development)

Code	Specification
None	None
B	BTO specification

[*1] You can use these models with either a single-phase or three-phase input.

[*2] A model with a single-phase, 200-VAC power supply input is available as a hardware option specification. (Model: SGDXS-120A00A0008)

[*3] The same SERVOPACKs are used for both rotary servomotors and linear servomotors.

[*4] Refer to the following manual for details.

📖 Σ-X-Series Σ-XS/Σ-XW/Σ-XT SERVOPACK with Dynamic Brake Hardware Option Specifications Product Manual (Manual No.: SIEP C710812 14)

1.4.2 Interpreting Servomotor Model Numbers

This section outlines the model numbers of servomotors that can be combined with a Σ-X-series SERVOPACK. Refer to the relevant manual in the following list for details.

📖 Σ-X-series Rotary Servomotor Product Manual (Manual No.: SIEP C230210 00)

📖 Σ-7-series Rotary Servomotor Product Manual (Manual No.: SIEP S800001 36)

📖 Σ-7-series Linear Servomotor Product Manual (Manual No.: SIEP S800001 37)

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

(1) Rotary Servomotors

SGM□□	-	01	A	U	A	2	1	A	1
Series		1st+2nd digits	3rd digit	4th digit	5th digit	6th digit	7th digit	8th digit	9th digit

Series

Σ-X Series Servomotors

Code	Specification
SGMXJ	Medium inertia, high speed
SGMXA	Low inertia, high speed
SGMXP	Medium inertia, flat
SGMXG	Medium inertia, low speed, high torque

Σ-7 Series Servomotors

Code	Specification
SGM7M	Low inertia, ultra-small capacity

1st+2nd digits Rated Output

3rd digit Power Supply Voltage

- 200 VAC
- 24 VDC/48 VDC

4th digit Serial Encoder Specification

- 20-bit absolute encoder
- 26-bit batteryless absolute encoder
- 26-bit absolute encoder

5th digit Design Revision Order

6th digit Shaft End Specification

- Straight without key
- Straight with tap
- Straight with key and tap
- Straight with flat seat
- With two flat seats

7th digit Option Specification

- With 24-V holding brake
- With oil seal

8th digit Destination

A

9th digit Ancillary Specification

Code	Specification
1	Standard
2	Σ-7 compatible

(2) Direct Drive Servomotors

SGM□□	-	02	B	3	C	1	1
Series		1st+2nd digits	3rd digit	4th digit	5th digit	6th digit	7th digit

Series Σ-7 Series Servomotors

Code	Specification
SGM7D	With core outer rotor
SGM7E	Small capacity, coreless inner rotor
SGM7F	Small capacity,with core inner rotor
	Medium capacity, with core inner rotor

1st+2nd digits Rated Torque

3rd digit Servomotor Outer Diameter

4th digit Serial Encoder Specification

5th digit Design Revision Order

6th digit Flange Specification

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

7th digit Option Specification

- High mechanical precision

(3) Linear Servomotors

SGL □ □ - 30 A 050 C P □

Series | 1st digit | 2nd digit | 3rd digit on

Series Σ-7 Series Servomotors

1st digit Servomotor Type

Code	Specification
G	Coreless models
F	Models with F-type iron core
T	Models with T-type iron core

2nd digit Moving Coil/Magnetic Way

Code	Specification
W	Moving coil
W2	
M	Magnetic way
M2	

3rd digit on

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

1.5 Combinations of SERVOPACKs and Servomotors

1.5.1 Combinations of Rotary Servomotors and SERVOPACKs

Rotary Servomotor Model		Capacity	SERVOPACK Model
			SGDXS-
SGMXJ (Medium Inertia, Small Capacity) 3000 min^{-1}	SGMXJ-A5A	50 W	R70A
	SGMXJ-01A	100 W	R90A
	SGMXJ-C2A	150 W	1R6A
	SGMXJ-02A	200 W	
	SGMXJ-04A	400 W	2R8A
	SGMXJ-06A	600 W	5R5A
	SGMXJ-08A	750 W	
SGMXA (Low Inertia, Small Capacity) 3000 min^{-1}	SGMXA-A5A	50 W	R70A
	SGMXA-01A	100 W	R90A
	SGMXA-C2A	150 W	1R6A
	SGMXA-02A	200 W	
	SGMXA-04A	400 W	2R8A
	SGMXA-06A	600 W	5R5A
	SGMXA-08A	750 W	
	SGMXA-10A	1.0 kW	120A
	SGMXA-15A	1.5 kW	
	SGMXA-20A	2.0 kW	180A
	SGMXA-25A	2.5 kW	200A
	SGMXA-30A	3.0 kW	
	SGMXA-40A	4.0 kW	330A
	SGMXA-50A	5.0 kW	
	SGMXA-70A	7.0 kW	550A
SGMXP (Medium Inertia, Flat) 3000 min^{-1}	SGMXP-01A	100 W	R90A
	SGMXP-02A	200 W	2R8A
	SGMXP-04A	400 W	
	SGMXP-08A	750 W	5R5A
	SGMXP-15A	1.5 kW	120A

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Rotary Servomotor Model		**Capacity**	**SERVOPACK Model**
			SGDXS-
SGMXG (Medium Inertia, Medium Capacity) 1500 min^{-1}	SGMXG-03A	300 W	3R8A
	SGMXG-05A	450 W	
	SGMXG-09A	850 W	7R6A (120A) *1
	SGMXG-13A	1.3 kW	120A (180A) *1
	SGMXG-20A	1.8 kW	180A (200A) *1
	SGMXG-30A	2.9 kW *2	330A (470A) *1
	SGMXG-44A	4.4 kW	330A (550A) *1
	SGMXG-55A	5.5 kW	470A (780A) *1
	SGMXG-75A	7.5 kW	550A
	SGMXG-1AA	11 kW	590A
	SGMXG-1EA	15 kW	780A
SGM7M (Low Inertia, Ultra-small Capacity) 3000 min^{-1}	SGM7M-A1A	11 W	R90A
	SGM7M-A2A	22 W	
	SGM7M-A3A	33 W	1R6A

*1 To increase the instantaneous maximum torque, use the SERVOPACK with the model number given inside the parentheses. Refer to the following manual for the instantaneous maximum torque of each SERVOPACK.

Σ-X-Series Rotary Servomotor Product Manual (Manual No.: SIEP C230210 00)

*2 2.4 kW when using the servomotor with a SGDXS-200A SERVOPACK.

1.5.2 Combinations of Direct Drive Servomotors and SERVOPACKs

Direct Drive Servomotor Model		Rated Torque N·m	Instantaneous Maximum Torque N·m	SERVOPACK Model
				SGDXS-
SGM7D (With Core, Outer Rotor)	SGM7D-30F	30.0	50.0	120A
	SGM7D-58F	58.0	100	
	SGM7D-90F	90.0	150	
	SGM7D-1AF	110	200	
	SGM7D-01G	1.30	4.00	2R8A
	SGM7D-05G	5.00	6.00	
	SGM7D-08G	8.00	15.0	120A
	SGM7D-18G	18.0	30.0	
	SGM7D-24G	24.0	45.0	
	SGM7D-34G	34.0	60.0	
	SGM7D-45G	45.0	75.0	
	SGM7D-03H	3.00	4.00	2R8A
SGM7D (With Core, Outer Rotor)	SGM7D-28I	28.0	50.0	120A
	SGM7D-70I	70.0	100	
	SGM7D-1ZI	100	150	
	SGM7D-1CI	130	200	
	SGM7D-2BI	220	300	
	SGM7D-2DI	240	400	
	SGM7D-06J	6.00	8.00	
	SGM7D-09J	9.00	15.0	
	SGM7D-18J	18.0	30.0	
	SGM7D-20J	20.0	45.0	
	SGM7D-38J	38.0	60.0	
	SGM7D-02K	2.06	5.00	2R8A
	SGM7D-06K	6.00	10.0	
	SGM7D-08K	8.00	15.0	
	SGM7D-06L	6.00	10.0	
	SGM7D-12L	12.0	20.0	
	SGM7D-30L	30.0	40.0	120A

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

*1 For this combination, use the following derated values for the rated output and rated rotation speed.

- Rated output: 1000 W
- Rated rotation speed: 270 min^{-1}

1.5.3 Combinations of Linear Servomotors and SERVOPACKs

Linear Servomotor Model		Rated Force N	Instantaneous Maximum Force N	SERVOPACK Model
				SGDXS-
SGLG (Coreless) Used with Standard-Force Magnetic Way	SGLGW-30A050C	12.5	40	R70A
	SGLGW-30A080C	25	80	R90A
	SGLGW-40A140C	47	140	
	SGLGW-40A253C	93	280	1R6A
	SGLGW-40A365C	140	420	2R8A
	SGLGW-60A140C	70	220	1R6A
	SGLGW-60A253C	140	440	2R8A
	SGLGW-60A365C	210	660	5R5A
	SGLGW-90A200C	325	1300	120A
	SGLGW-90A370C	550	2200	180A
	SGLGW-90A535C	750	3000	200A
SGLG (Coreless) Used with High-Force Magnetic Way	SGLGW-40A140C	57	230	1R6A
	SGLGW-40A253C	114	460	2R8A
	SGLGW-40A365C	171	690	3R8A
	SGLGW-60A140C	85	360	1R6A
	SGLGW-60A253C	170	720	3R8A
	SGLGW-60A365C	255	1080	7R6A
SGLF (With F-type Iron Cores)	SGLFW2-30A070A	45	135	1R6A
	SGLFW2-30A120A	90	270	
	SGLFW2-30A230A *1	180	540	3R8A
		170	500	2R8A
	SGLFW2-45A200A	280	840	5R5A
	SGLFW2-45A380A *1	560	1680	180A
			1500	120A
	SGLFW2-90A200A□1	560	1680	
	SGLFW2-90A200A□L	896	1680	
	SGLFW2-90A380A	1120	3360	200A
	SGLFW2-90A560A	1680	5040	330A
	SGLFW2-1DA380A	1680	5040	200A
	SGLFW2-1DA560A	2520	7560	330A

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

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

1.6 Functions

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

- Functions Related to the Machine

Function	Reference
Setting the Power Supply Type for the Main Circuit and Control Circuit	167
Automatic Detection of Connected Motor	169
Setting the Motor Direction	172
Setting the Linear Encoder Pitch	174
Writing the Linear Servomotor Parameters	175
Selecting the Phase Sequence for a Linear Servomotor	179
Setting the Polarity Sensor	181
Polarity Detection	182
Overtravel Function and Settings	186
Holding Brake	191
Motor Stopping Methods for Servo OFF and Alarms	195
Resetting the Absolute Encoder	206
Setting the Origin of the Absolute Encoder	209
Setting the Regenerative Resistor Capacity	212
Operation for Momentary Power Interruptions	229
SEMI F47 Function	230
Setting the Maximum Motor Speed	232
Setting the Multiturn Limit	300
Adjusting the Motor Current Detection Signal Offset	317
Forcing the Motor to Stop	322
Overheat Protection	324
Speed Ripple Compensation	443
Selecting the Current Control Mode	475
Setting the Current Gain Level	475
Selecting the Speed Detection Method	475
Fully-Closed Loop Control	529
Σ-LINK II Function	541
Safety Function	563

- Functions Related to the Host Controller

Function	Reference
Setting the Electronic Gear	200
Allocating the I/O Signal	218
ALM (Servo Alarm Output) Signal	225
ALO1 to ALO3 (Alarm Code Output) Signal	226
/WARN (Warning Output) Signal	226
/TGON (Rotation Detection Output) Signal	227
/S-RDY (Servo Ready Output) Signal	228
Speed Control	233
Basic Settings for Speed Control	233
Speed Reference Filter	240
Zero Clamping	240
/V-CMP (Speed Coincidence Detection Output) Signal	242
Position Control	246
Reference Pulse Form	247
CLR (Position Deviation Clear Input) Signal Function and Settings	249
Reference Pulse Input Multiplication Switching	250
/COIN (Positioning Completion Output) Signal	252
/NEAR (Near Output) Signal	253
Reference Pulse Inhibition and Settings	254
Torque Control	256
Basic Settings for Torque Control	256
Setting the Torque Reference Input Filter	261
Speed Limit during Torque Control	261
/VLT (Speed Limit Detection Output) Signal	262
Encoder Divided Pulse Output	264
Selecting Torque Limits	281
Initializing the Vibration Detection Level	314
Alarm Reset	610
Replacing the Battery	577
Setting the Position Deviation Overflow Alarm Level	364

- Functions to Achieve Optimum Motions

Function	Reference
Speed Control	233
Soft Start Settings	239
Position Control	246
Smoothing Settings	251
Torque Control	256
Tuning-less Function	368
Autotuning without a Host Reference	394
Autotuning with a Host Reference	407
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Load Fluctuation Compensation Control	465
Gain Switching	468
Friction Compensation	472
Gravity Compensation	473
Output Torque Compensation	474
Model Following Control	485
Compatible Adjustment Functions	488
Mechanical Analysis	494
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- Functions for Trial Operation during Setup

Function	Reference
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Trial Operation for the Servomotor without a Load	333
Program JOG Operation	344
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Monitoring Machine Operation Status and Signal Waveforms	511

- Functions for Inspection and Maintenance

Function	Reference
Write Prohibition Setting for Parameters	161
Initializing Parameter Settings	164
Automatic Detection of Connected Motor	169
Monitoring Product Information	502
Monitoring Product Life	518
Error Detection Setting	522
Displaying the Alarm History	612
Alarm Tracing	521

2

Selecting a SERVOPACK

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

2.1 Ratings and Specifications

This section gives the ratings and specifications of SERVOPACKs.

2.1.1 Ratings

(1) Three-Phase, 200 VAC

Model SGDXS-			R70A	R90A	1R6A	2R8A	3R8A	5R5A	7R6A	120A	180A	200A	330A
Maximum Applicable Motor Capacity [kW]			0.05	0.1	0.2	0.4	0.5	0.75	1.0	1.5	2.0	3.0	5.0
Continuous Output Current [Arms]			0.66	0.91	1.6	2.8	3.8	5.5	7.6	11.6	18.5	19.6	32.9
Instantaneous Maximum Output Current [Arms]			2.1	3.2	5.9	9.3	11	16.9	17	28	42	56	84
Main Circuit	Power Supply		200 VAC to 240 VAC, 50 Hz/60 Hz										
	Allowable Voltage Fluctuation		-15% to +10%										
	Input Current [Arms] *1		0.4	0.8	1.3	2.5	3.0	4.1	5.7	7.3	10	15	25
Control	Power Supply		200 VAC to 240 VAC, 50 Hz/60 Hz										
	Allowable Voltage Fluctuation		-15% to +10%										
	Input Current [Arms] *1		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.25	0.25	0.3
Power Supply Capacity [kVA] *1			0.2	0.3	0.5	1.0	1.3	1.6	2.3	3.2	4.0	5.9	7.5
Power Loss *1	Main Circuit Power Loss [W]		5.0	7.0	11.9	22.5	28.5	38.9	49.2	72.6	104.2	114.2	226.6
	Control Circuit Power Loss [W]		12	12	12	12	14	14	14	15	16	16	19
	Total Power Loss [W]		17.0	19.0	23.9	34.5	42.5	52.9	63.2	87.6	120.2	130.2	245.6
Regenerative Resistor	Built-In Regenerative Resistor	Resistance [Ω]	–	–	–	–	35	35	35	20	12	10	6
		Capacity [W]	–	–	–	–	60	60	60	60	60	60	180
		Allowable Power Consumption [W]	–	–	–	–	15	15	15	30	30	30	36
	Minimum Allowable External Resistance [Ω]		40	40	40	40	35	35	35	20	12	10	6
Overvoltage Category			III										

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

Model SGDXS-		470A	550A	590A	780A
Maximum Applicable Motor Capacity [kW]		6.0	7.5	11	15
Continuous Output Current [Arms]		46.9	54.7	58.6	78.0
Instantaneous Maximum Output Current [Arms]		110	130	140	170
Main Circuit	Power Supply	200 VAC to 240 VAC, 50 Hz/60 Hz			
	Allowable Voltage Fluctuation	-15% to +10%			
	Input Current [Arms] *1	29	37	54	73
Control	Power Supply	200 VAC to 240 VAC, 50 Hz/60 Hz			
	Allowable Voltage Fluctuation	-15% to +10%			
	Input Current [Arms] *1	0.3	0.3	0.4	0.4
Power Supply Capacity [kVA] *1		10.7	14.6	21.7	29.6
Power Loss *1	Main Circuit Power Loss [W]	271.7	326.9	365.3	501.4
	Control Circuit Power Loss [W]	21	21	28	28
	Total Power Loss [W]	292.7	347.9	393.3	529.4
External Regenerative Resistor Unit	Resistance [Ω]	5 *2	3.13 *3	3.13 *3	3.13 *3
	Capacity [W]	880 *2	1760 *3	1760 *3	1760 *3
	Allowable Power Consumption [W]	180 *2	350 *3	350 *3	350 *3
	Minimum Allowable External Resistance [Ω]	5	2.9	2.9	2.9
Overvoltage Category		III			

*1 This is the net value at the rated load.
*2 This value is for the optional JUSP-RA29-E regenerative resistor unit.
*3 This value is for the optional JUSP-RA05-E regenerative resistor unit.

(2) Single-Phase, 200 VAC

Model SGDXS-		R70A	R90A	1R6A	2R8A	5R5A	120A
Maximum Applicable Motor Capacity [kW]		0.05	0.1	0.2	0.4	0.75	1.5
Continuous Output Current [Arms]		0.66	0.91	1.6	2.8	5.5	11.6
Instantaneous Maximum Output Current [Arms]		2.1	3.2	5.9	9.3	16.9	28
Main Circuit	Power Supply	200 VAC to 240 VAC, 50 Hz/60 Hz					
	Allowable Voltage Fluctuation	-15% to +10%					
	Input Current [Arms] *1	0.8	1.6	2.4	5.0	8.7	16 *2
Control	Power Supply	200 VAC to 240 VAC, 50 Hz/60 Hz					
	Allowable Voltage Fluctuation	-15% to +10%					
	Input Current [Arms] *1	0.2	0.2	0.2	0.2	0.2	0.2
Power Supply Capacity [kVA] *1		0.2	0.3	0.6	1.2	1.9	4.0

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Model SGDXS-			**R70A**	**R90A**	**1R6A**	**2R8A**	**5R5A**	**120A**
Power Loss *1	Main Circuit Power Loss [W]		5.0	7.1	12.1	23.7	39.2	72.6
	Control Circuit Power Loss [W]		12	12	12	12	14	15
	Total Power Loss [W]		17.0	19.1	24.1	35.7	53.2	87.6
Regenerative Resistor	Built-In Regenerative Resistor	Resistance [Ω]	–	–	–	–	35	20
		Capacity [W]	–	–	–	–	60	60
		Allowable Power Consumption [W]	–	–	–	–	15	30
	Minimum Allowable External Resistance [Ω]		40	40	40	40	35	20
Overvoltage Category			III					

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

*2 Derate to 12 Arms for UL certification.

(3) 270 VDC

Model SGDXS-		**R70A**	**R90A**	**1R6A**	**2R8A**	**3R8A**	**5R5A**	**7R6A**	**120A**
Maximum Applicable Motor Capacity [kW]		0.05	0.1	0.2	0.4	0.5	0.75	1.0	1.5
Continuous Output Current [Arms]		0.66	0.91	1.6	2.8	3.8	5.5	7.6	11.6
Instantaneous Maximum Output Current [Arms]		2.1	3.2	5.9	9.3	11.0	16.9	17.0	28.0
Main Circuit	Power Supply	270 VDC to 324 VDC							
	Allowable Voltage Fluctuation	-15% to +10%							
	Input Current [Arms] *1	0.5	1.0	1.5	3.0	3.8	4.9	6.9	11
Control	Power Supply	270 VDC to 324 VDC							
	Allowable Voltage Fluctuation	-15% to +10%							
	Input Current [Arms] *1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Power Supply Capacity [kVA] *1		0.2	0.3	0.6	1	1.4	1.6	2.3	3.2
Power Loss *1	Main Circuit Power Loss [W]	4.4	5.9	9.8	17.5	23.0	30.7	38.7	55.8
	Control Circuit Power Loss [W]	12	12	12	12	14	14	14	15
	Total Power Loss [W]	16.4	17.9	21.8	29.5	37.0	44.7	52.7	70.8
Overvoltage Category		III							

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

Model SGDXS-	**180A**	**200A**	**330A**	**470A**	**550A**	**590A**	**780A**
Maximum Applicable Motor Capacity [kW]	2.0	3.0	5.0	6.0	7.5	11.0	15.0
Continuous Output Current [Arms]	18.5	19.6	32.9	46.9	54.7	58.6	78.0
Instantaneous Maximum Output Current [Arms]	42.0	56.0	84.0	110	130	140	170

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Model SGDXS-		180A	200A	330A	470A	550A	590A	780A
Main Circuit	Power Supply	270 VDC to 324 VDC						
	Allowable Voltage Fluctuation	-15% to +10%						
	Input Current [Arms] *1	14	20	34	36	48	68	92
Control	Power Supply	270 VDC to 324 VDC						
	Allowable Voltage Fluctuation	-15% to +10%						
	Input Current [Arms] *1	0.25	0.25	0.3	0.3	0.3	0.4	0.4
Power Supply Capacity [kVA] *1		4.0	5.9	7.5	10.7	14.6	21.7	29.6
Power Loss *1	Main Circuit Power Loss [W]	82.7	83.5	146.2	211.6	255.3	243.6	343.4
	Control Circuit Power Loss [W]	16	16	19	21	21	28	28
	Total Power Loss [W]	98.7	99.5	165.2	232.6	276.3	271.6	371.4
Overvoltage Category		III						

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

2.1.2 SERVOPACK Overload Protection Characteristics

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

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

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

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

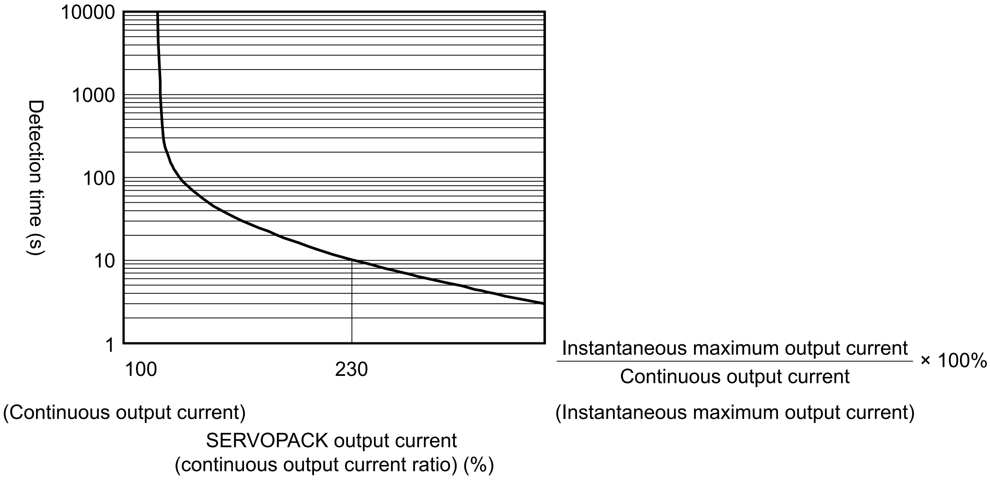


Figure 2.1 SGDXS-R70A, -R90A, -1R6A, -2R8A

Note:

- The above overload protection characteristics do not mean that you can perform continuous duty operation with an output of 100% or higher.
  For a Yaskawa-specified combination of SERVOPACK and servomotor, maintain the effective torque within the continuous duty zone of the torque-motor speed characteristic of the servomotor.
- This overload protection function is not a protection function related to speed. This product does not have a built-in thermal memory hold function.

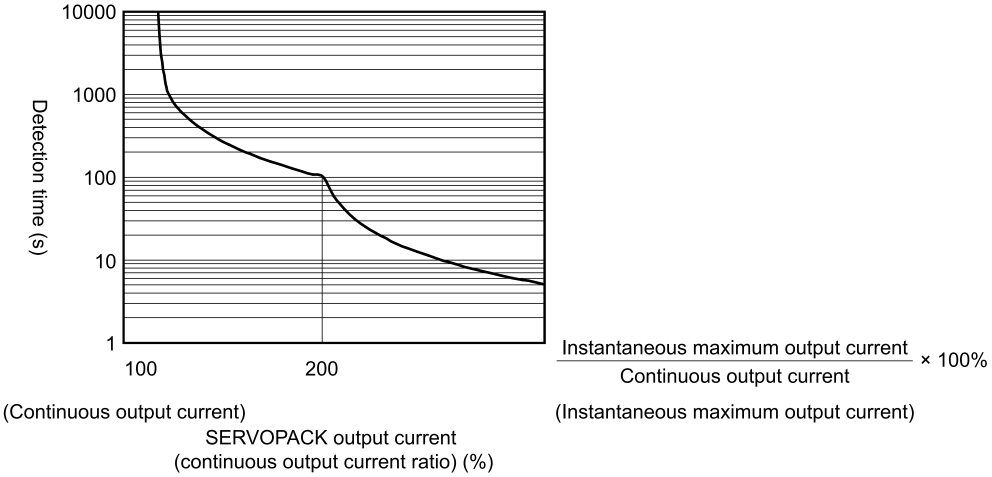


Figure 2.2 SGDXS-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, -330A, -470A, -550A, -590A, -780A

Note:

- The above overload protection characteristics do not mean that you can perform continuous duty operation with an output of 100% or higher.
  For a Yaskawa-specified combination of SERVOPACK and servomotor, maintain the effective torque within the continuous duty zone of the torque-motor speed characteristic of the servomotor.
- This overload protection function is not a protection function related to speed. This product does not have a built-in thermal memory hold function.

2.1.3 Specification

(1) Environmental Conditions

Item	Specification
Surrounding Air Temperature	-5°C to 55°C (With derating, usage is possible between 55°C and 60°C.) Refer to the following section for derating specifications. ☞ *3.6 Derating Specifications on page 99*
Storage Temperature **1*	-20°C to 85°C
Surrounding Air Humidity	95% relative humidity max. (with no freezing or condensation)
Storage Humidity	95% relative humidity max. (with no freezing or condensation)
Vibration Resistance	When there is continuous vibration: 10 Hz to 55 Hz, acceleration amplitude 5.9 m/s^2 (0.6G)
Impact Resistance	19.6 m/s^2
Degree of Protection	IP20: Models SGDXS-R70A, -R90A, -1R6A, -2R8A, -3R8A, -5R5A, -7R6A, -120A IP10: Models SGDXS-180A, -200A, -330A, -470A, -550A, -590A, -780A
Pollution Degree	2 • Must be no corrosive or flammable gases. • Must be no exposure to water, oil, or chemicals. • Must be no dust, salts, or iron dust.
Altitude **1*	1000 m max. (With derating, usage is possible between 1000 m and 2000 m.) Refer to the following section for derating specifications. ☞ *3.6 Derating Specifications on page 99*
Others	Do not use the SERVOPACK in the following locations: Locations subject to static electricity noise, strong electro-magnetic/magnetic fields, or radioactivity

[1] If you combine a Σ-X-series SERVOPACK with a Σ-V-series option module, the following Σ-V-series SERVOPACKs specifications must be used: a surrounding air temperature of 0°C to 55°C and an altitude of 1000 m max. Also, the applicable surrounding range cannot be increased by derating.

(2) I/O Signals

Item		Specification
Encoder Divided Pulse Output		Phase A, phase B, phase C: Line-driver output Number of divided output pulses: Any setting is allowed.
Overheat Protection Input		Number of input points: 1 Input voltage range: 0 V to +5 V
Sequence Input Signals	Fixed Input	Allowable voltage range: 5 VDC ±5% Number of input points: 1 (input method: sink inputs or source inputs)
		Input signal: SEN (Absolute Data Request Input) signal
	Input Signals That Can Be Allocated	Allowable voltage range: 24 VDC ±20% Number of input points: 7 (input method: sink inputs or source inputs)
		Input signals: • /S-ON (Servo ON Input) signal • /P-CON (Proportional Control Input) signal • P-OT (Forward Drive Prohibit Input) and N-OT (Reverse Drive Prohibit Input) signals • /ALM-RST (Alarm Reset Input) signal • /P-CL (Forward External Torque Limit Input) and /N-CL (Reverse External Torque Limit Input) signals • /SPD-D (Motor Direction Input) signal • /SPD-A and /SPD-B (Internal Set Speed Selection Input) signals • /C-SEL (Control Selection Input) signal • /ZCLAMP (Zero Clamping Input) signal • /INHIBIT (Reference Pulse Inhibit Input) signal • /G-SEL (Gain Selection Input) signal • /P-DET (Polarity Detection Input) signal • SEN (Absolute Data Request Input) signal • /PSEL (Reference Pulse Input Multiplication Switch Input) Signal • FSTP (Forced Stop Input) signal A signal can be allocated and the positive and negative logic can be changed.
Sequence Output Signals	Fixed Output	Allowable voltage range: 5 VDC to 30 VDC Number of output points: 1 (output method: a photocoupler output (isolated))
		Output signal: ALM (Servo Alarm Output) signal
	Output Signals That Can Be Allocated	Allowable voltage range: 5 VDC to 30 VDC Number of output points: 6 (3: output method: a photocoupler output (isolated)) (3: output method: an open-collector output (non-isolated))
		Output signals: • /COIN (Positioning Completion Output) signal • /V-CMP (Speed Coincidence Detection Output) signal • /TGON (Rotation Detection Output) signal • /S-RDY (Servo Ready Output) signal • /CLT (Torque Limit Detection Output) signal • /VLT (Speed Limit Detection Output) signal • /BK (Brake Output) signal • /WARN (Warning Output) signal • /NEAR (Near Output) signal • /PSELA (Reference Pulse Input Multiplication Switching Output) signal • ALO1, ALO2, and ALO3 (Alarm Code Output) signals A signal can be allocated and the positive and negative logic can be changed.

(3) Function

Item			Specification
Communications	RS-422A Communications (CN3)	Interfaces	Digital Operator (JUSP-OP05A-1-E) and personal computer (with SigmaWin+)
		1:N Communications	Up to N = 15 stations possible for RS-422A port
		Axis Address Setting	Set with parameters.
	USB Communications (CN7)	Interfaces	Personal computer (with SigmaWin+), digital operator (JUSP-OP07A-E)
		Communications Standard	Conforms to USB2.0 standard (12 Mbps).
Displays/Indicators			CHARGE indicator and five-digit seven-segment display
Panel Operator			Four push switches
Analog Monitor (CN5)			Number of points: 2 Output voltage range: ±10 VDC (effective linearity range: ±8 V) Resolution: 16 bits Accuracy: ±20 mV (Typ) Maximum output current: ±10 mA
Dynamic Brake (DB)			Activated when a servo alarm or overtravel (OT) occurs, or when the power to the main circuit or servo is OFF.
Regenerative Processing			Built-in (An external resistor must be connected to the SGDXS-470A to -780A.)
Overtravel (OT) Prevention			Stopping with dynamic brake, deceleration to a stop, or coasting to a stop for the P-OT (Forward Drive Prohibit Input) or N-OT (Reverse Drive Prohibit Input) signal
Protective Functions			Overcurrent, overvoltage, undervoltage, overload, regeneration error, etc.
Utility Functions			Gain tuning, alarm history, jogging operation, origin search, etc.
Safety Functions	Inputs		/HWBB1 and /HWBB2: Base block signals for power modules
	Output		EDM1: Monitors the status of built-in safety circuit (fixed output). *1
	Applicable Standards *2		ISO13849-1 PLe (Category 3) and IEC61508 SIL3

*1 Whether or not you use the EDM1 signal does not affect the performance level of safety parameters.

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

(4) Option

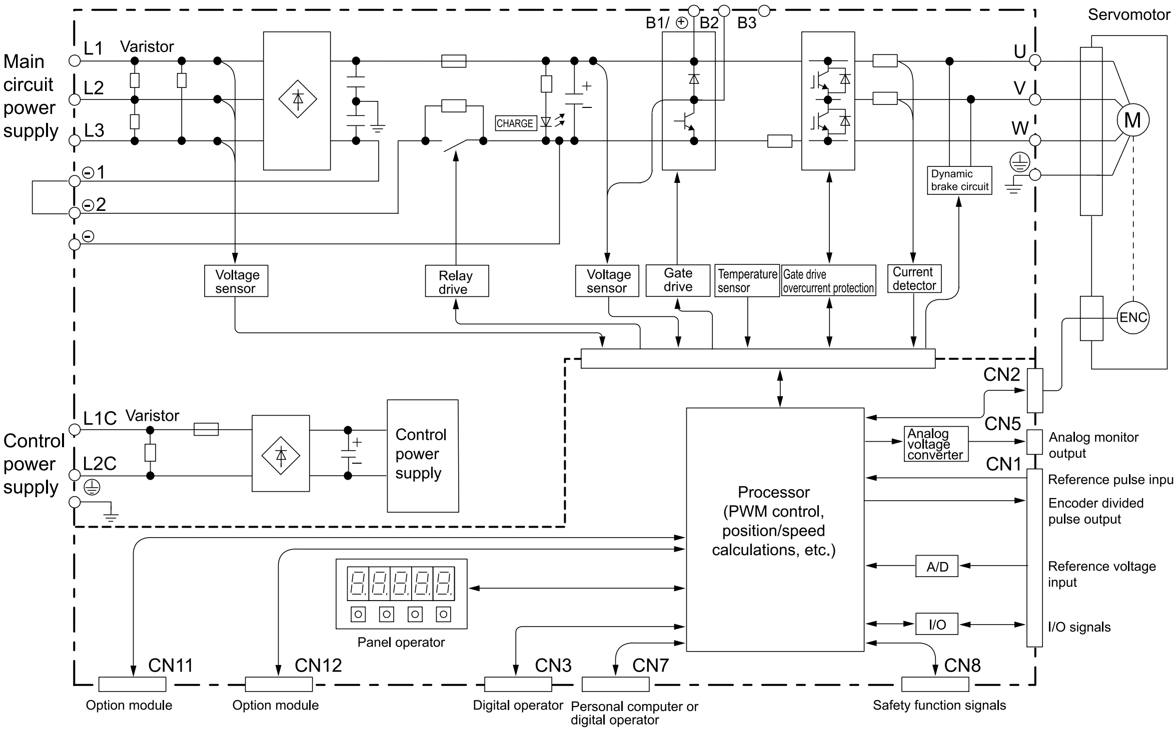
Item	Specification
Applicable Option Modules	Fully-closed module

(5) Control

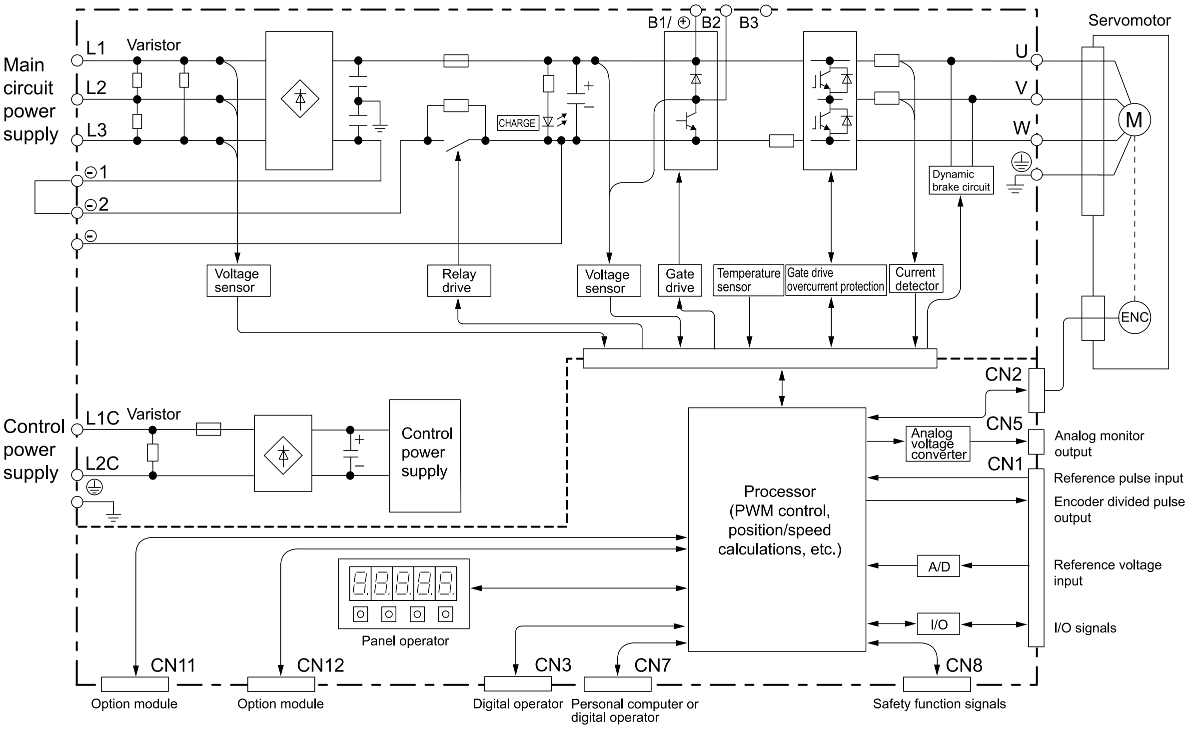
Item				Specification
Speed Control	Soft Start Time Setting			0 s to 10 s (Can be set separately for acceleration and deceleration.)
	Input Signal		Reference Voltage	• Maximum input voltage: ±12 V (forward motor rotation for positive reference). • 6 VDC at rated speed (default setting). Input gain setting can be changed.
			Input Impedance	30 kΩ
			Circuit Time Constant	30 μs
	Internal Set Speed Control		Rotation Direction Selection	With /P-CON (Proportional Control Input) signal.
			Speed Selection	With Forward/Reverse External Torque Limit signals (speed 1 to 3 selection). Servomotor stops or another control method is used when both signals are OFF.
Position Control	Feedforward Compensation			0% to 100%
	Output Signal Positioning Completed Width Setting			0 to 1073741824 reference units
	Input Signal	Reference Pulses	Reference Pulse Form	One of the following is selected: Sign + pulse train, CW + CCW pulse trains, and two-phase pulse trains with 90° phase differential
			Input Form	Line driver or open collector
			Maximum Input Frequency	• Line Driver Sign + pulse train or CW + CCW pulse trains: 4 Mpps Two-phase pulse trains with 90° phase differential: 1 Mpps • Open Collector Sign + pulse train or CW + CCW pulse trains: 200 kpps Two-phase pulse trains with 90° phase differential: 200 kpps
			Input Multiplication Switching	1 to 100 times
		Clear Signal		Position deviation clear Line driver or open collector
Torque Control	Input Signal		Reference Voltage	• Maximum input voltage: ±12 V (forward torque output for positive reference). • 3 VDC at rated torque (default setting). Input gain setting can be changed.
			Input Impedance	30 kΩ
			Circuit Time Constant	16 μs

2.2 Block Diagrams

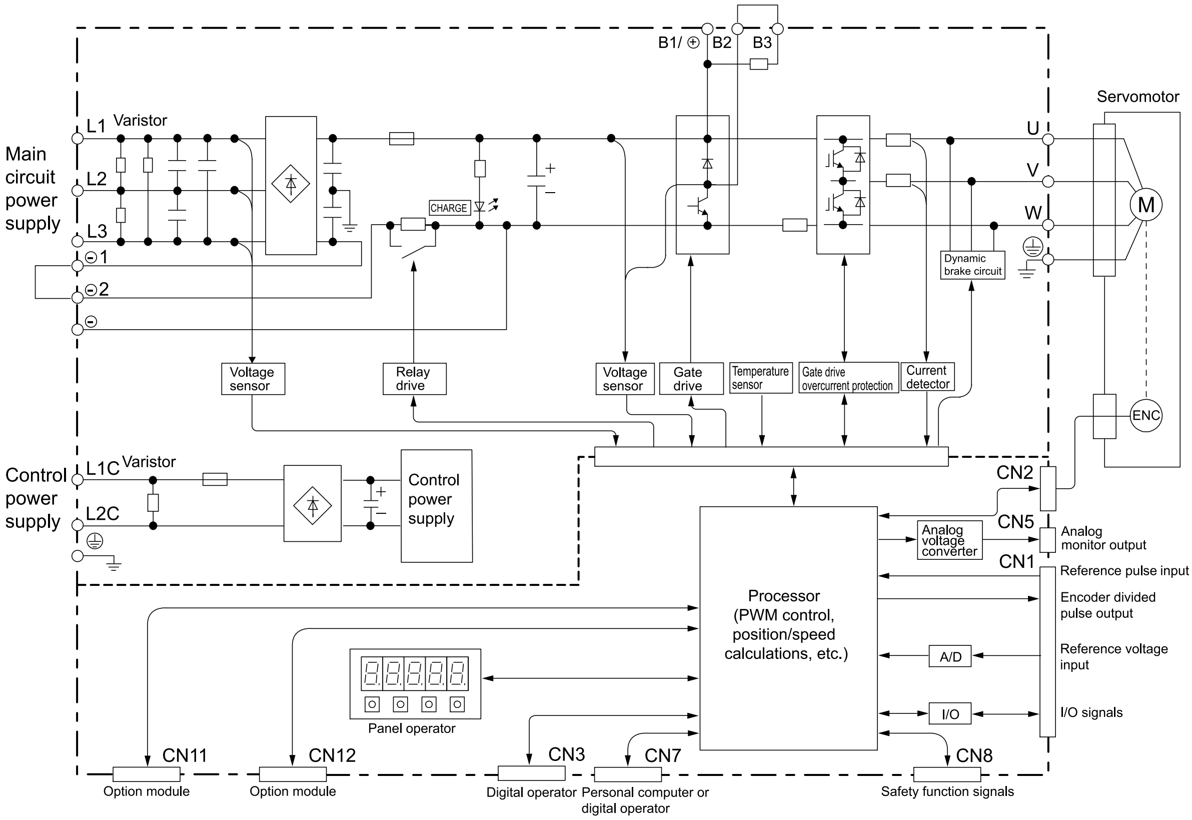
2.2.1 SGDXS-R70A, -R90A, -1R6A



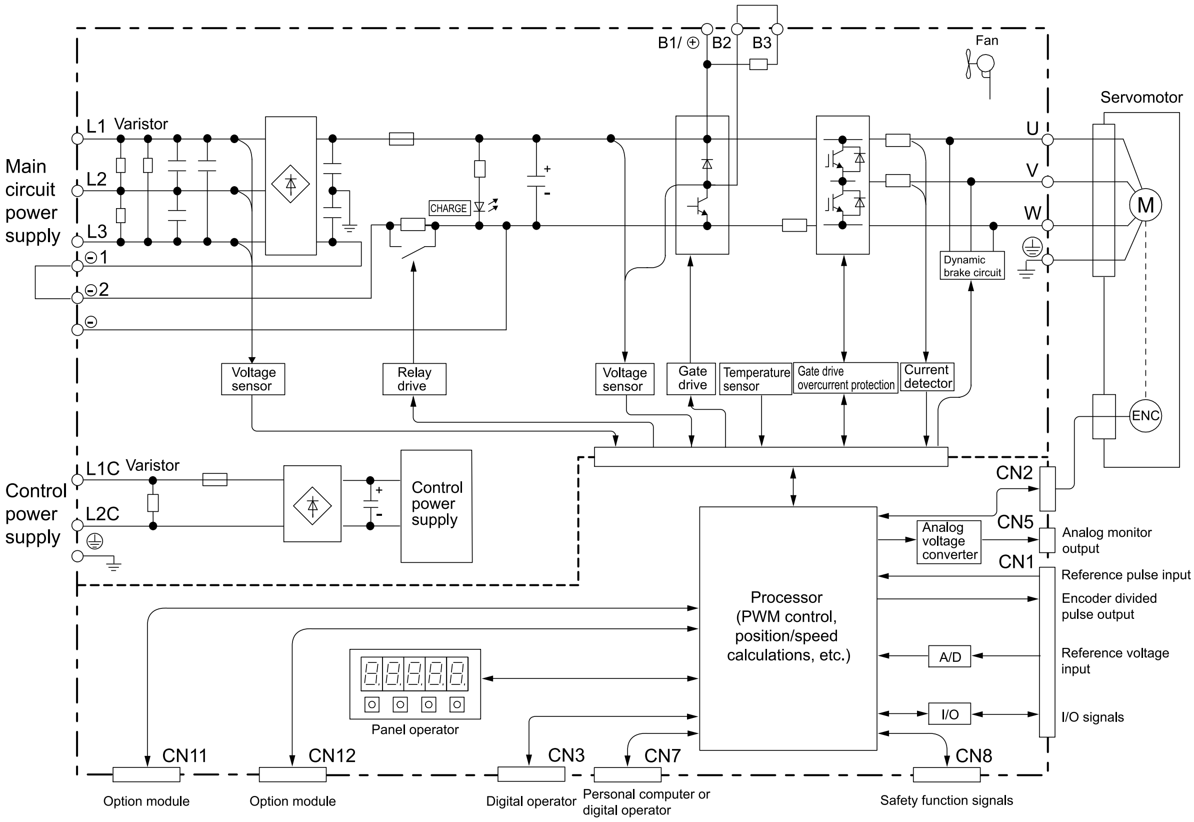
2.2.2 SGDXS-2R8A



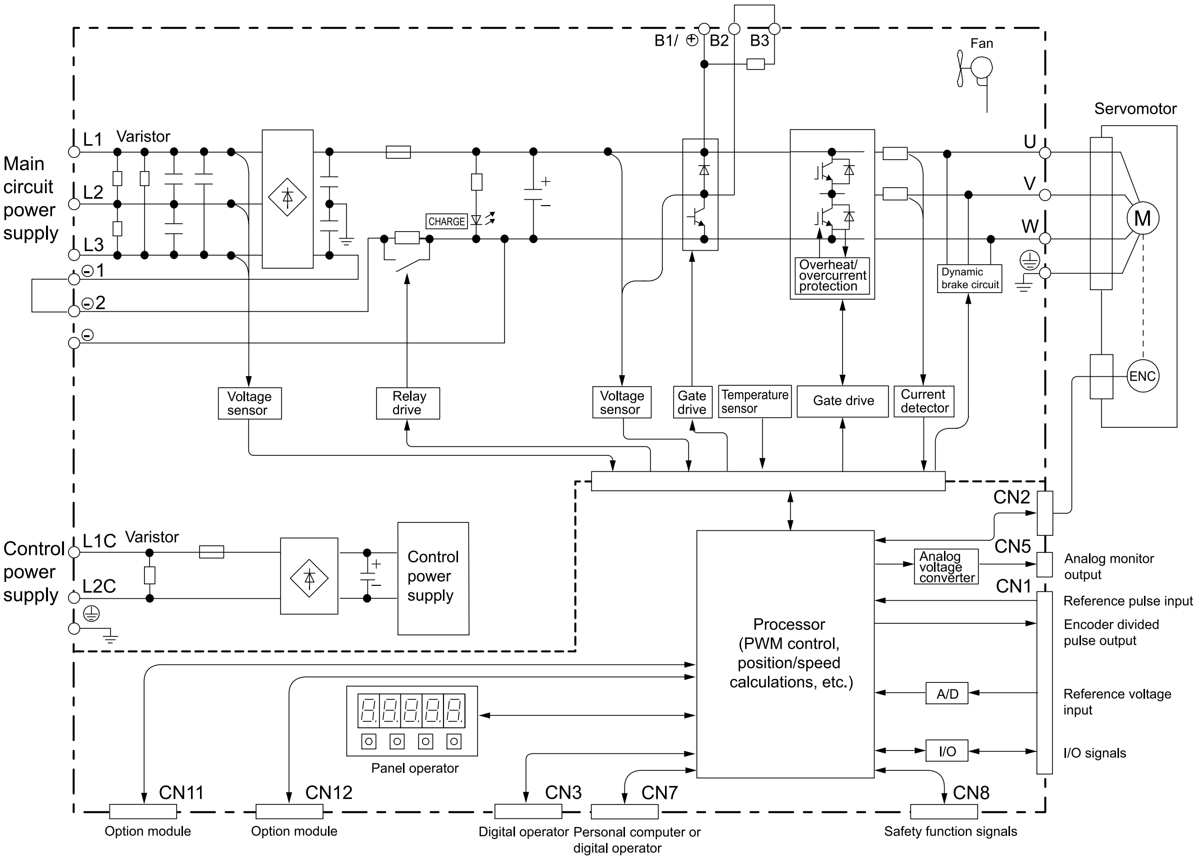
2.2.3 SGDXS-3R8A



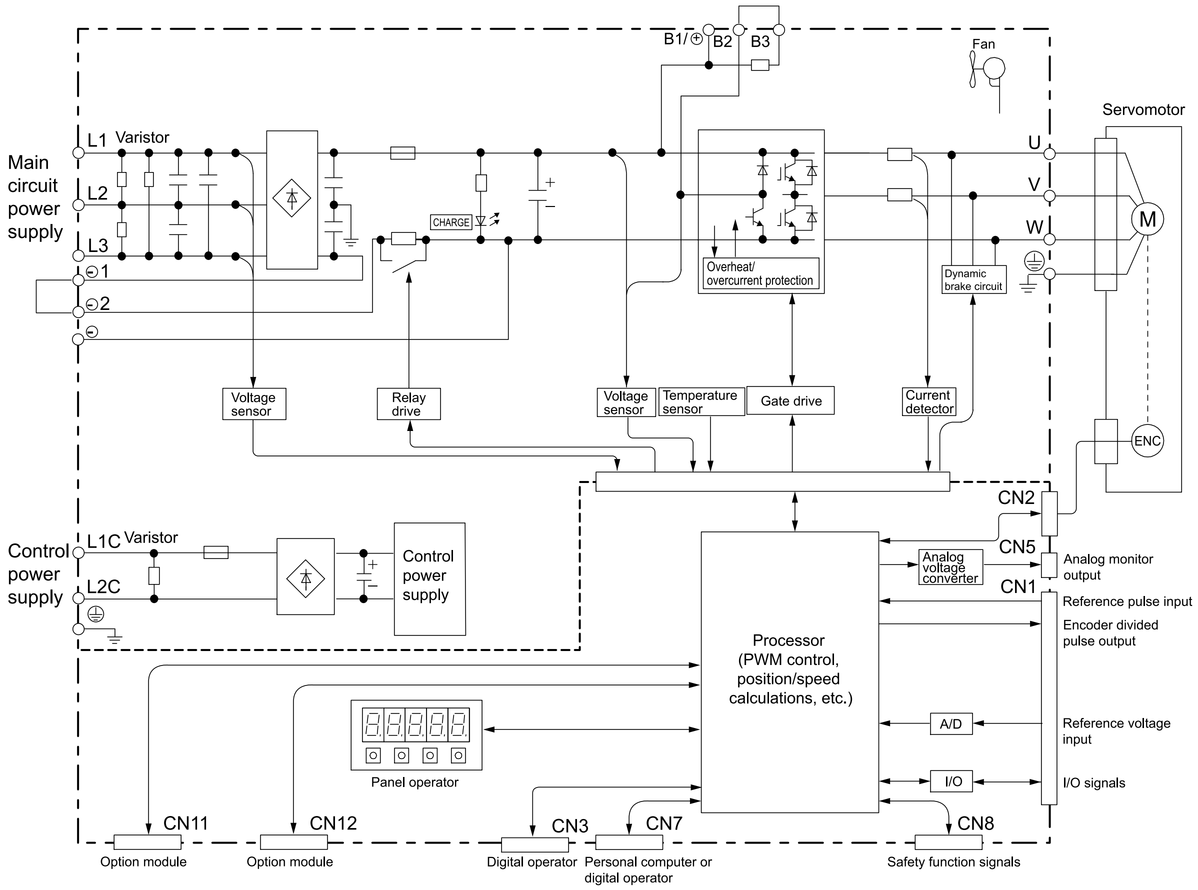
2.2.4 SGDXS-5R5A, -7R6A



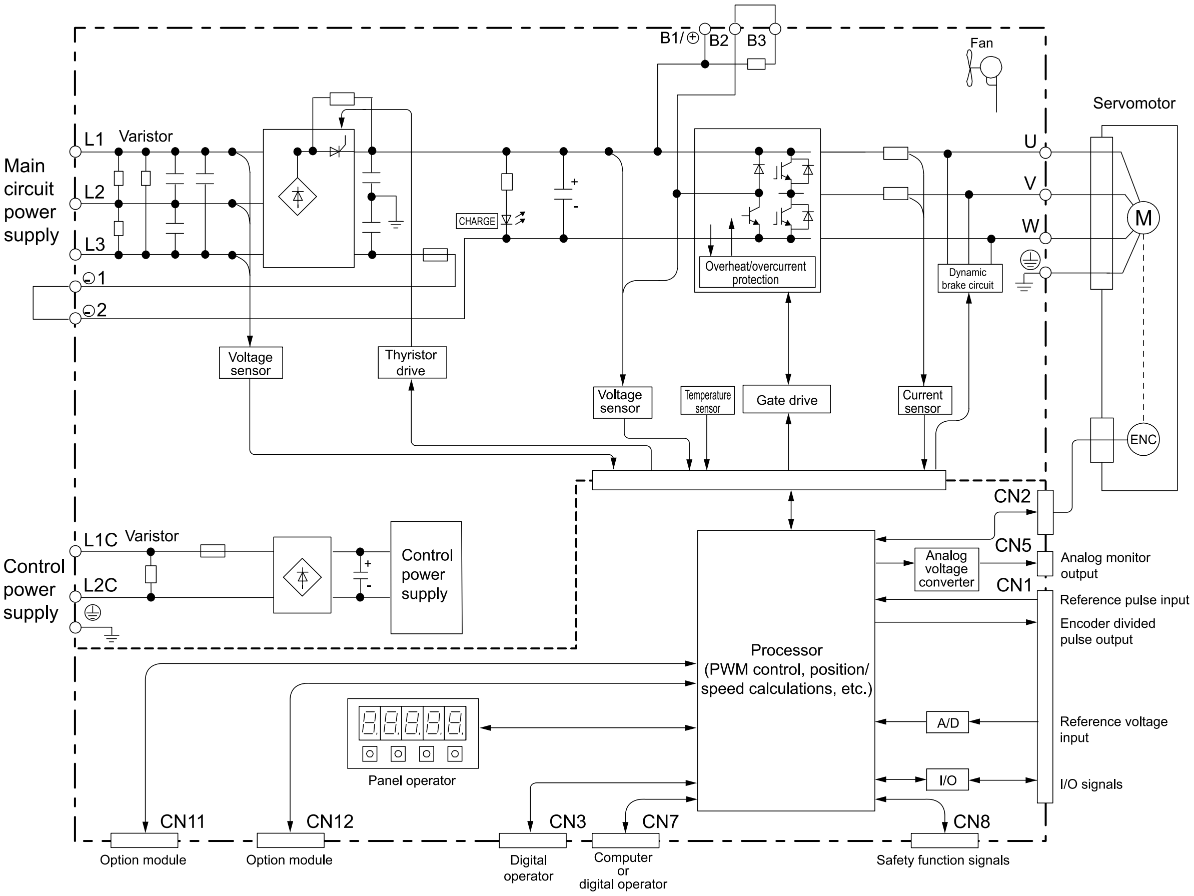
2.2.5 SGDXS-120A



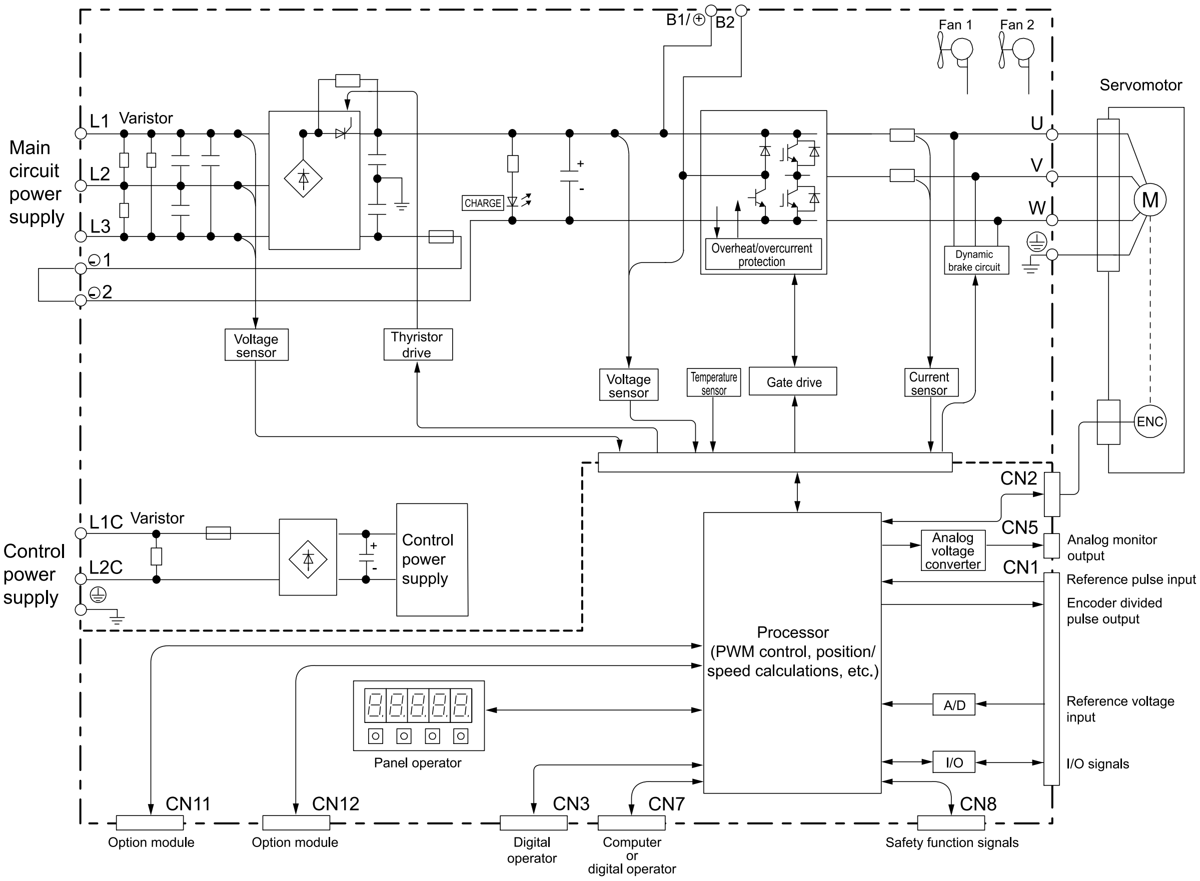
2.2.6 SGDXS-180A, -200A



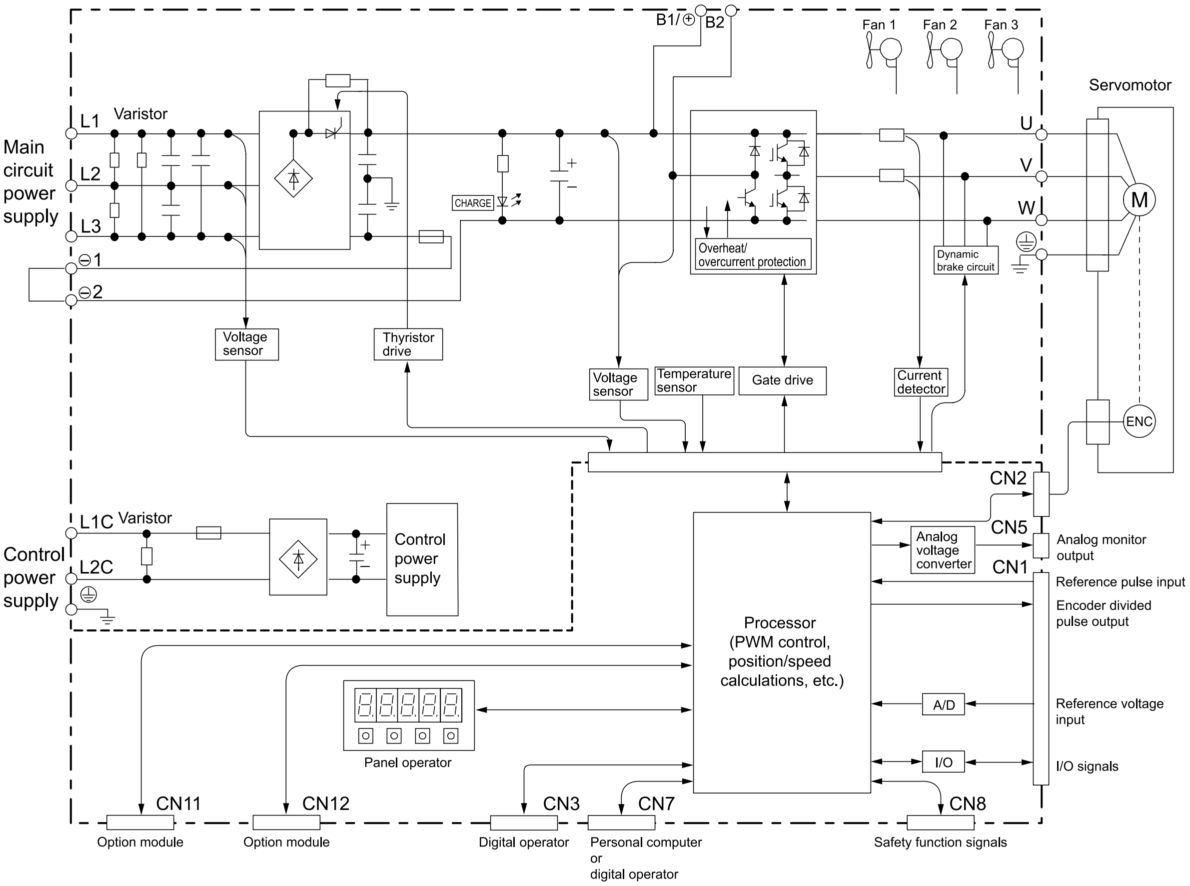
2.2.7 SGDXS-330A



2.2.8 SGDXS-470A, -550A



2.2.9 SGDXS-590A, -780A

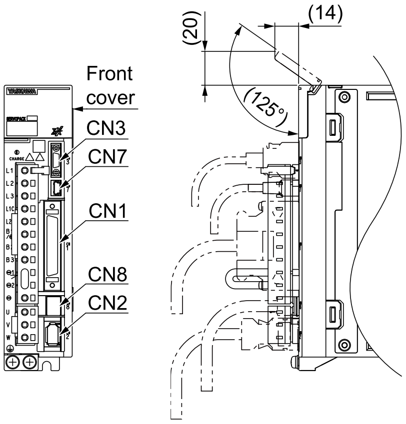


2.3 External Dimensions

2.3.1 Front Cover Dimensions and Connector Specifications

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

(1) Front Cover Dimensions



(2) Connector Specifications

Connector No.	Model	Number of Pins	Manufacturer
CN1	10250-52A2PL	50	3M Japan Limited
CN2	53984-0681	6	Molex Japan Co., Ltd.
CN3	HDR-EC14LFDTN-SLD-PLUS	14	Honda Tsushin Kogyo Co., Ltd.
CN7	2342993-1	5	Tyco Electronics Japan G.K.
CN8	2294415-1	8	Tyco Electronics Japan G.K.

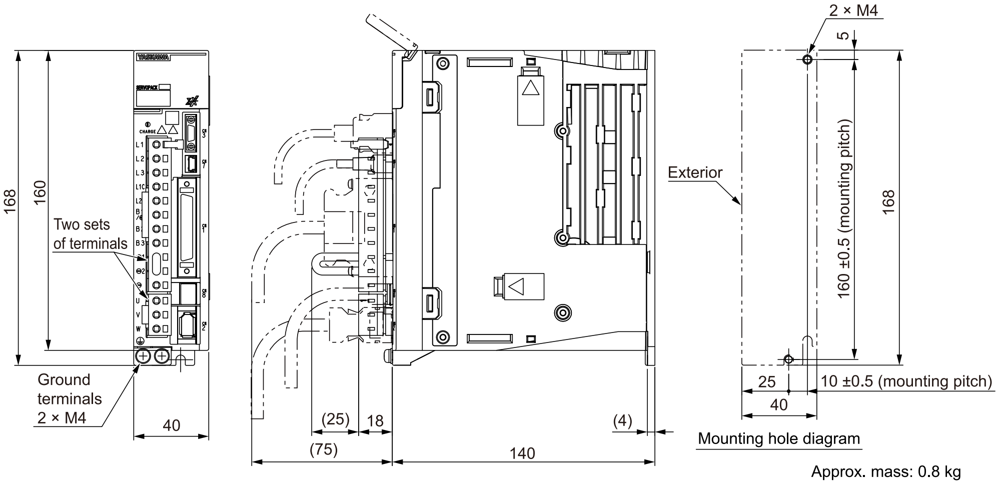
Note:

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

2.3.2 SERVOPACK External Dimensions

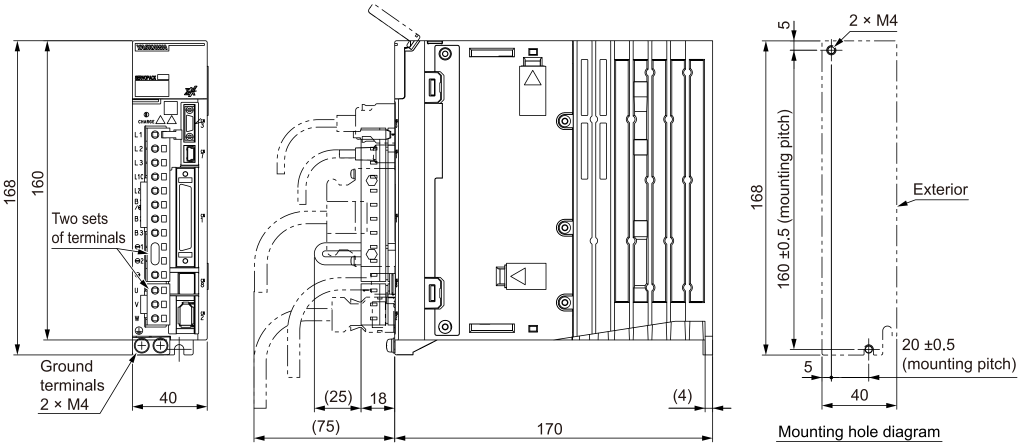
(1) Base-mounted SERVOPACKs

(a) SGDXS-R70A, -R90A, -1R6A



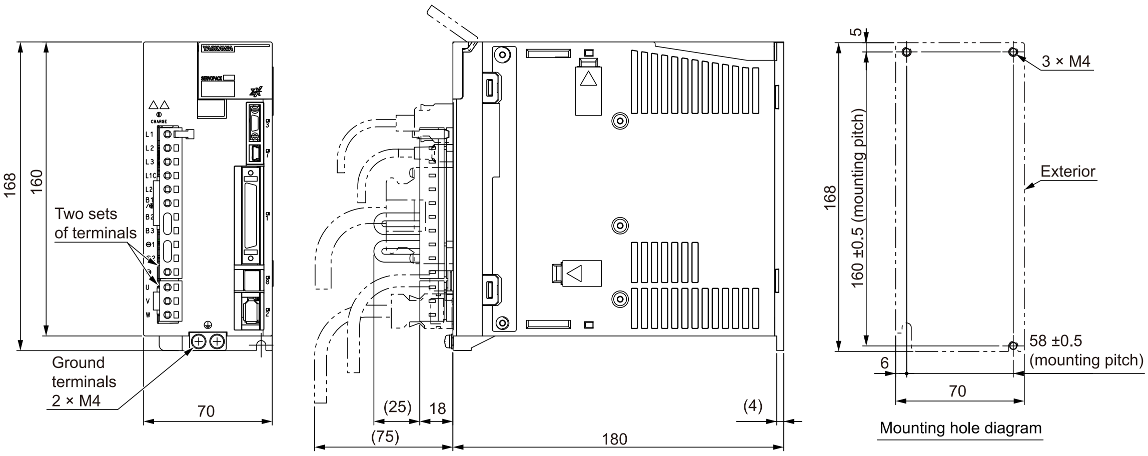
Approx. mass: 0.8 kg
Unit: mm

(b) SGDXS-2R8A



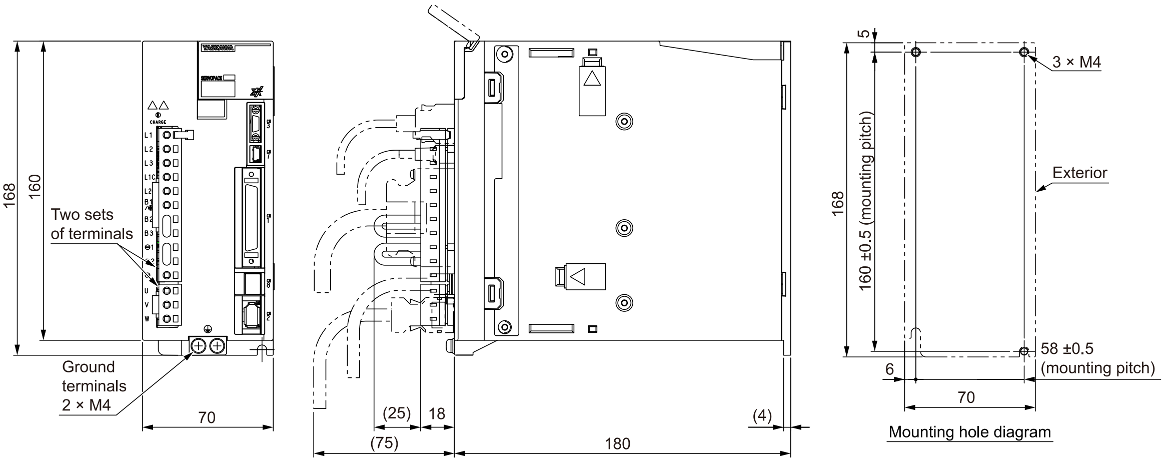
Approx. mass: 1.1 kg
Unit: mm

(c) SGDXS-3R8A



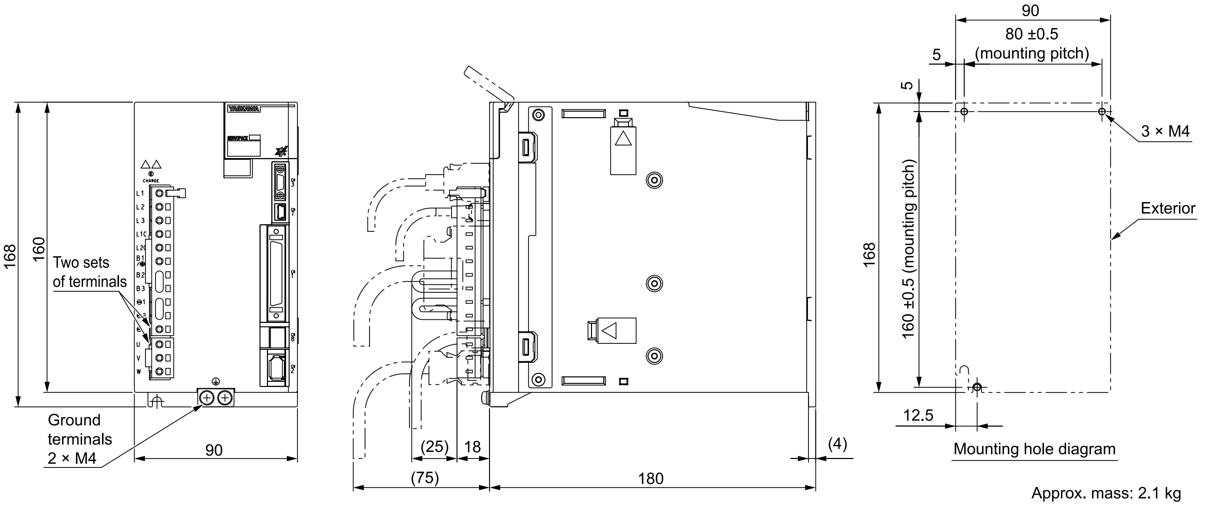
Approx. mass: 1.7 kg
Unit: mm

(d) SGDXS-5R5A, -7R6A



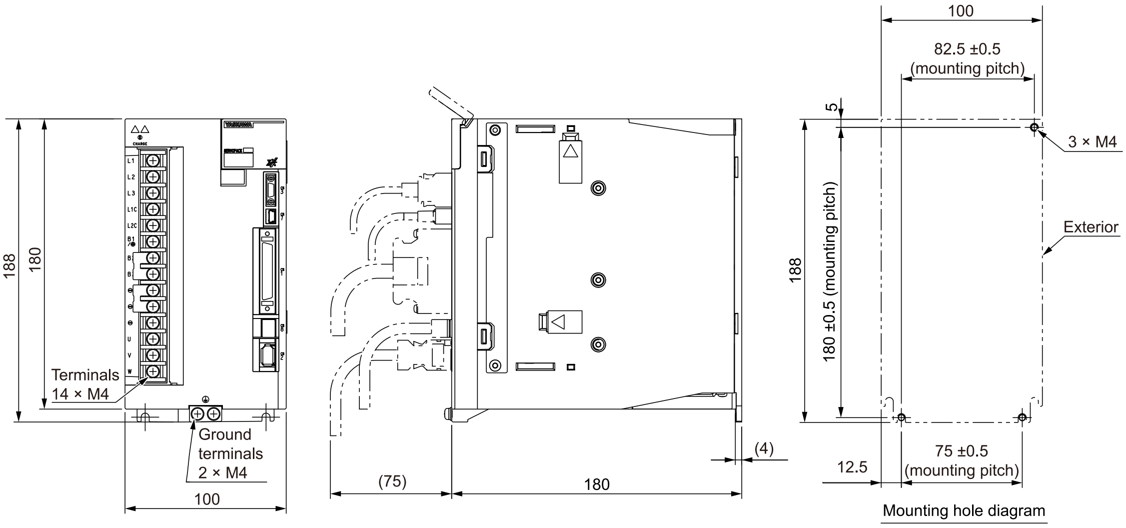
Approx. mass: 1.6 kg
Unit: mm

(e) SGDXS-120A



Approx. mass: 2.1 kg
Unit: mm

(f) SGDXS-180A, -200A

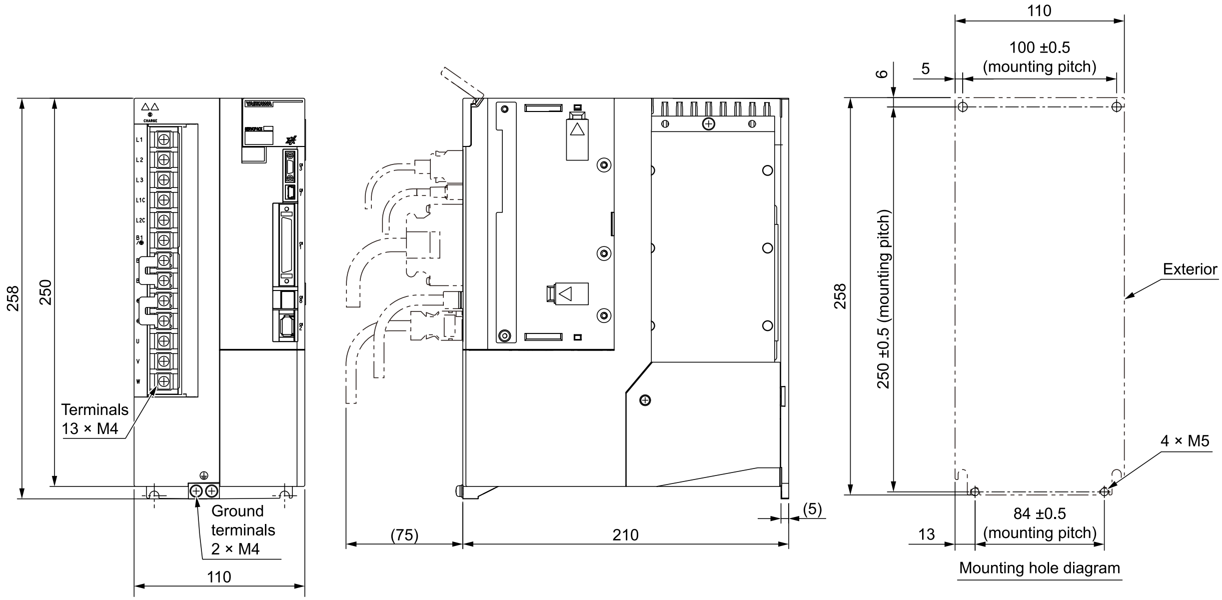


Approx. mass: 2.8 kg
Unit: mm

Note:

These drawings show the SERVOPACK with the terminal cover removed.

(g) SGDXS-330A

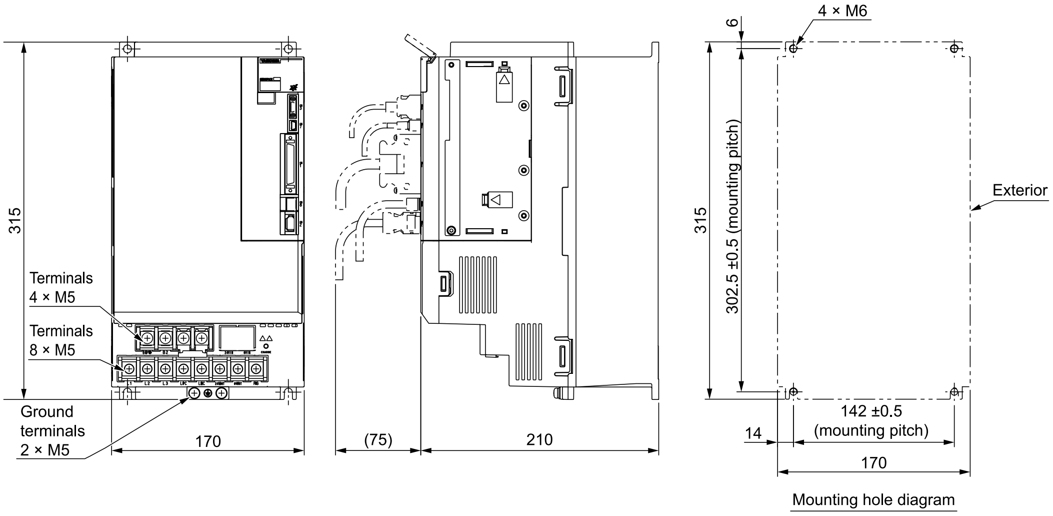


Approx. mass: 4.4 kg
Unit: mm

Note:

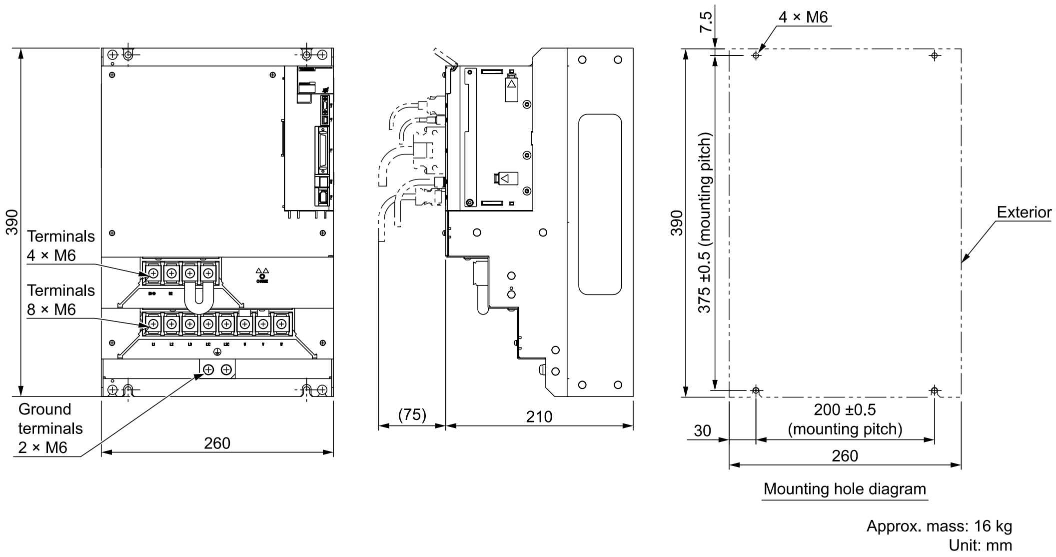
These drawings show the SERVOPACK with the terminal cover removed.

(h) SGDXS-470A, -550A



Approx. mass: 9.0 kg
Unit: mm

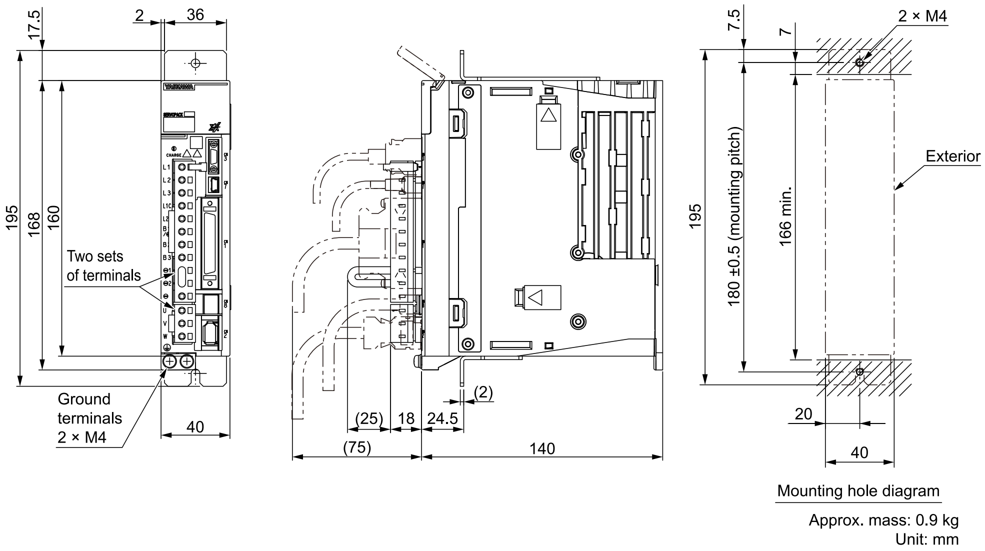
(i) SGDXS-590A, -780A



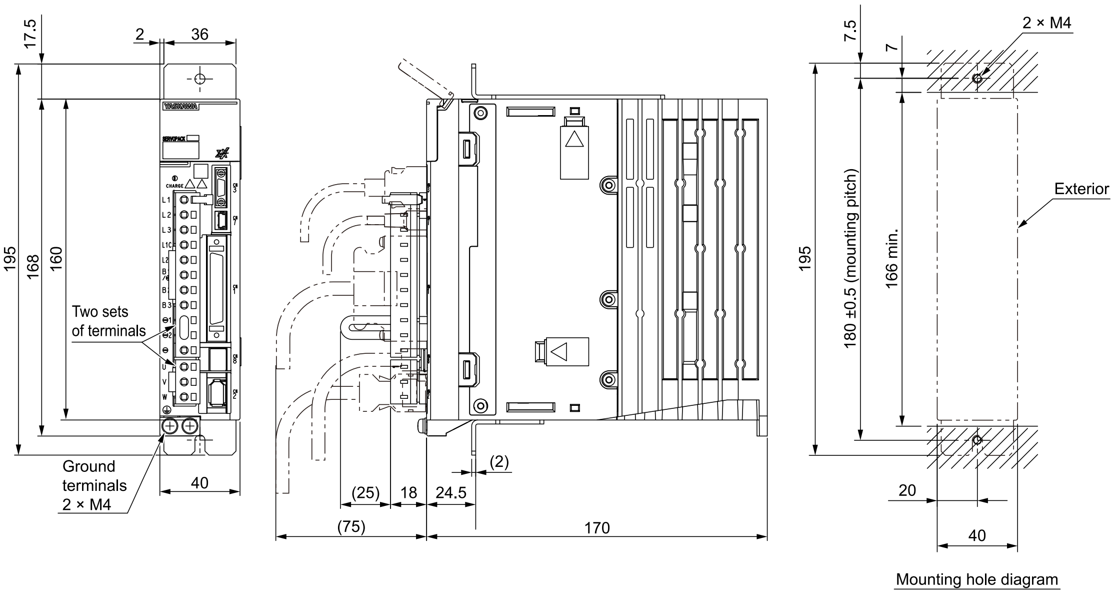
(2) Rack-mounted SERVOPACKs

Hardware Option Code: 0001

(a) SGDXS-R70A, -R90A, -1R6A

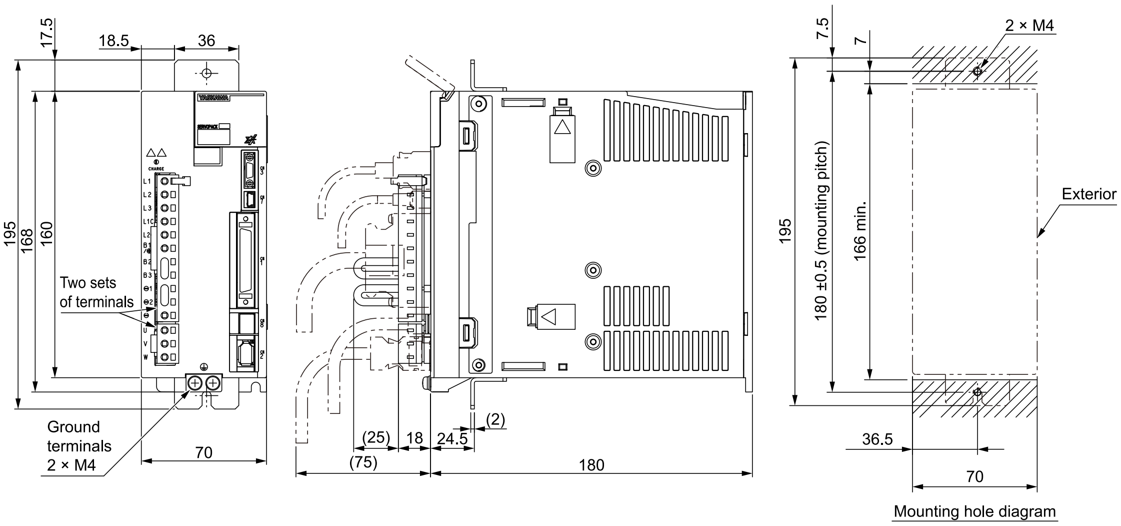


(b) SGDXS-2R8A



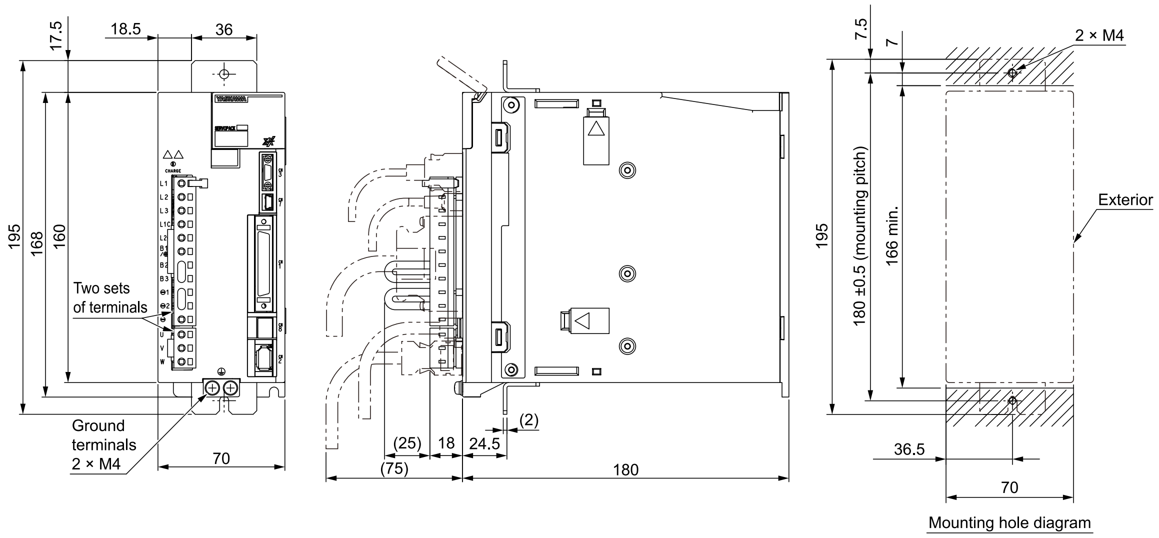
Approx. mass: 1.1 kg
Unit: mm

(c) SGDXS-3R8A



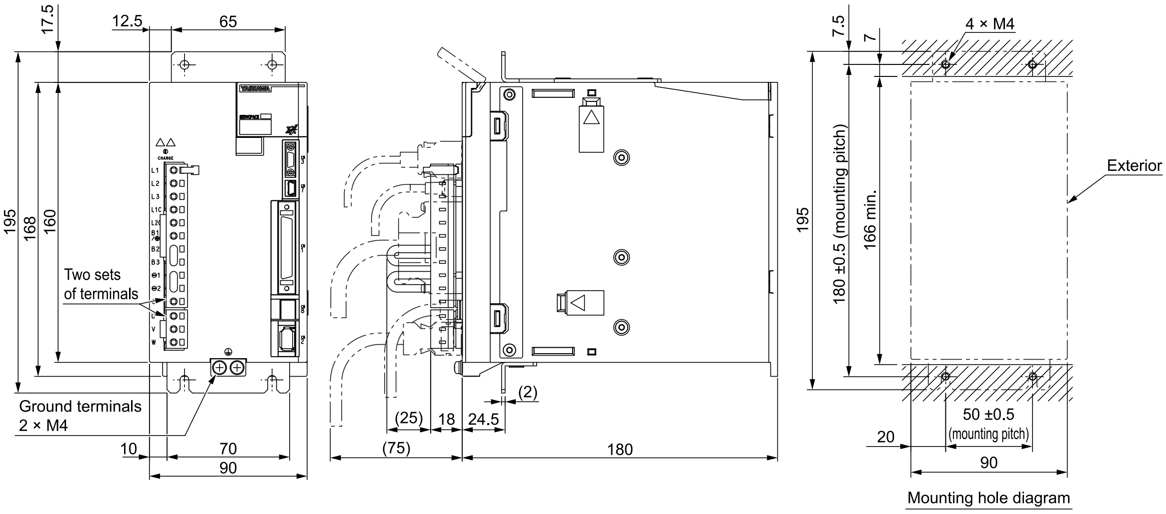
Approx. mass: 1.7 kg
Unit: mm

(d) SGDXS-5R5A, -7R6A



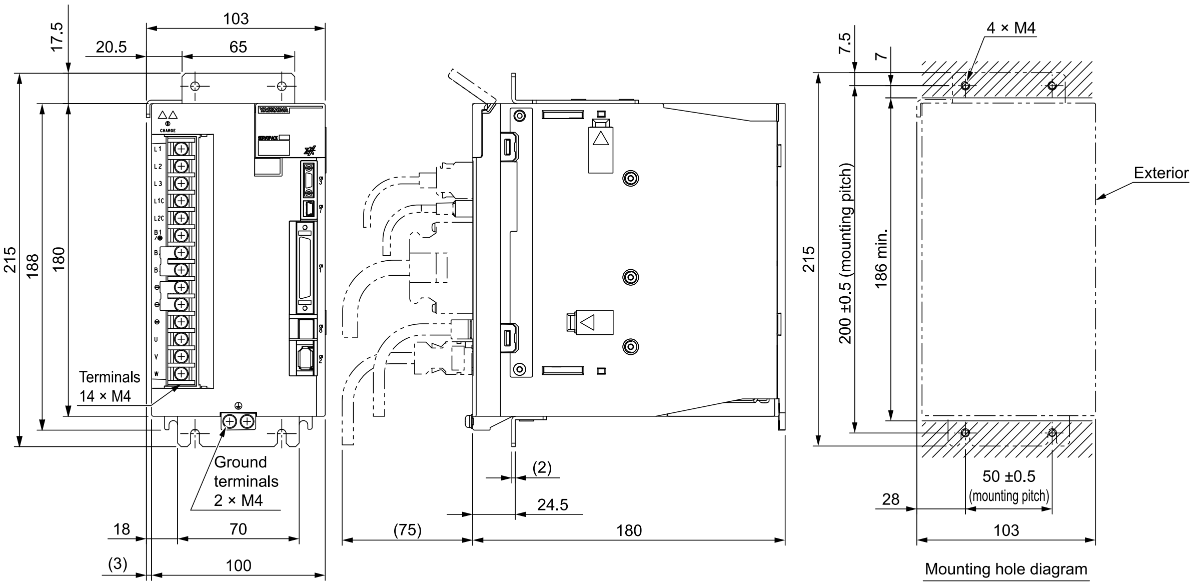
Approx. mass: 1.7 kg
Unit: mm

(e) SGDXS-120A



Approx. mass: 2.2 kg
Unit: mm

(f) SGDXS-180A, -200A

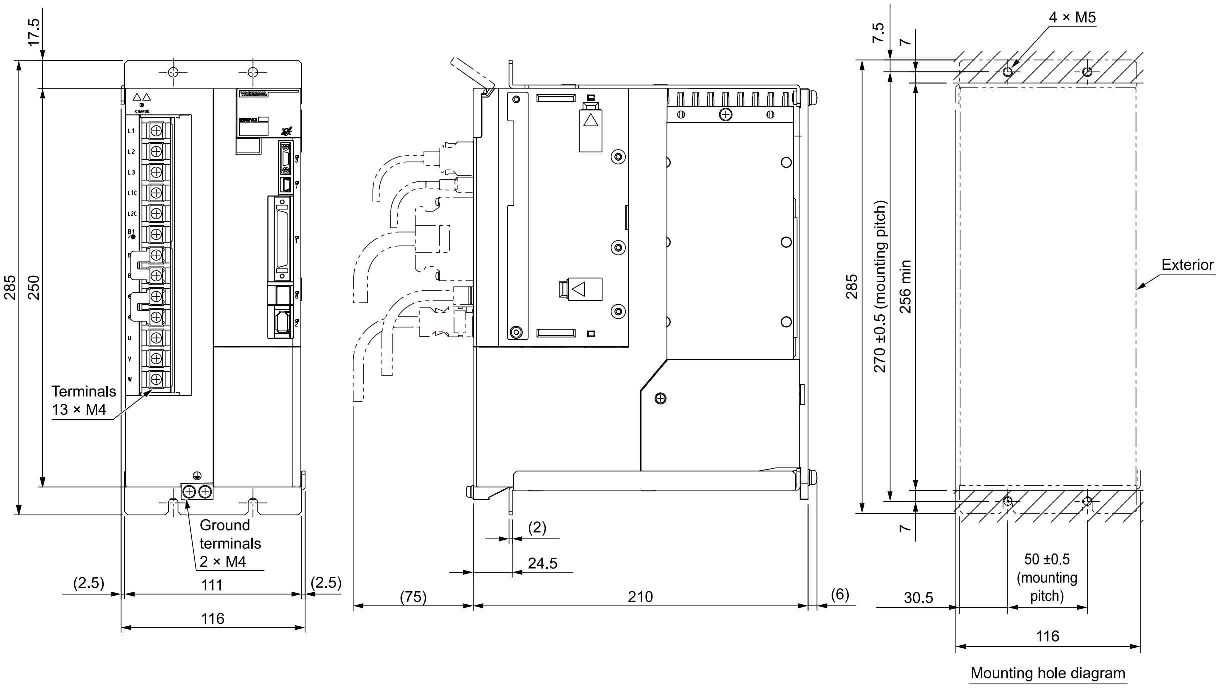


Approx. mass: 2.9 kg
Unit: mm

Note:

These drawings show the SERVOPACK with the terminal cover removed.

(g) SGDXS-330A



Approx. mass: 4.9 kg
Unit: mm

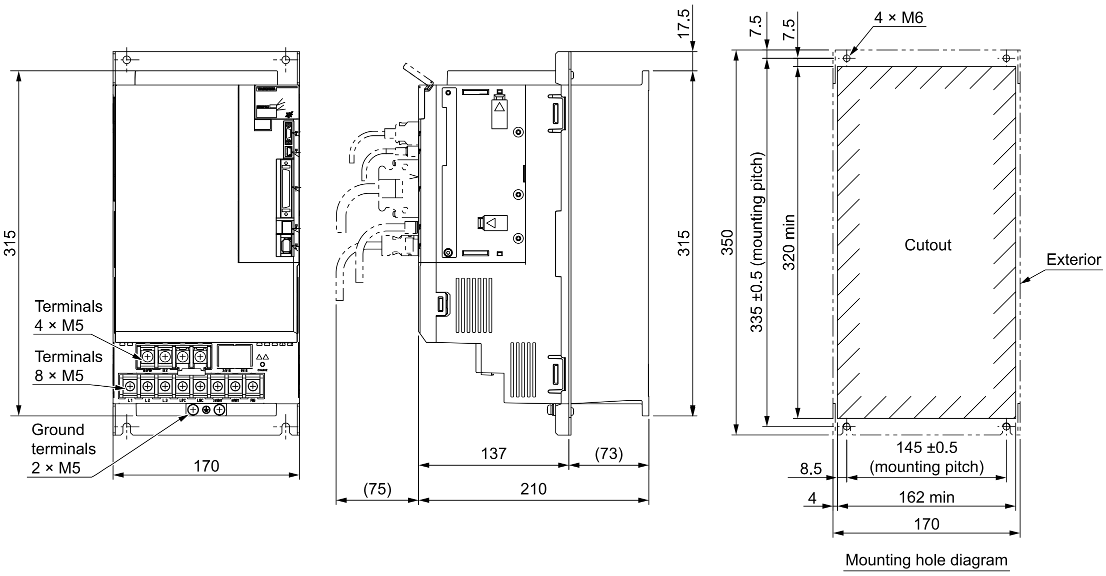
Note:

These drawings show the SERVOPACK with the terminal cover removed.

(3) Duct-ventilated SERVOPACKs

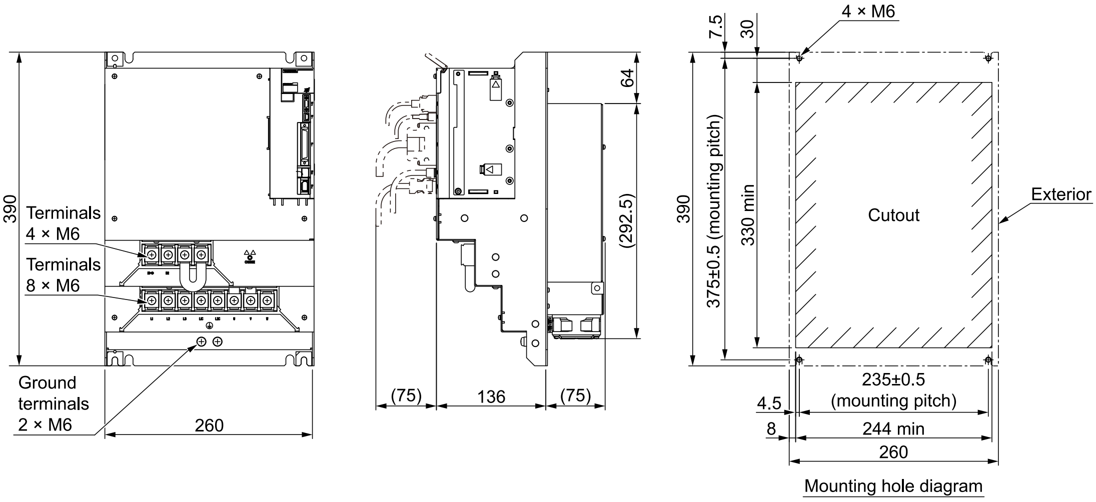
Hardware Option Code: 0001

(a) SGDXS-470A, -550A



Approx. mass: 9.0 kg
Unit: mm

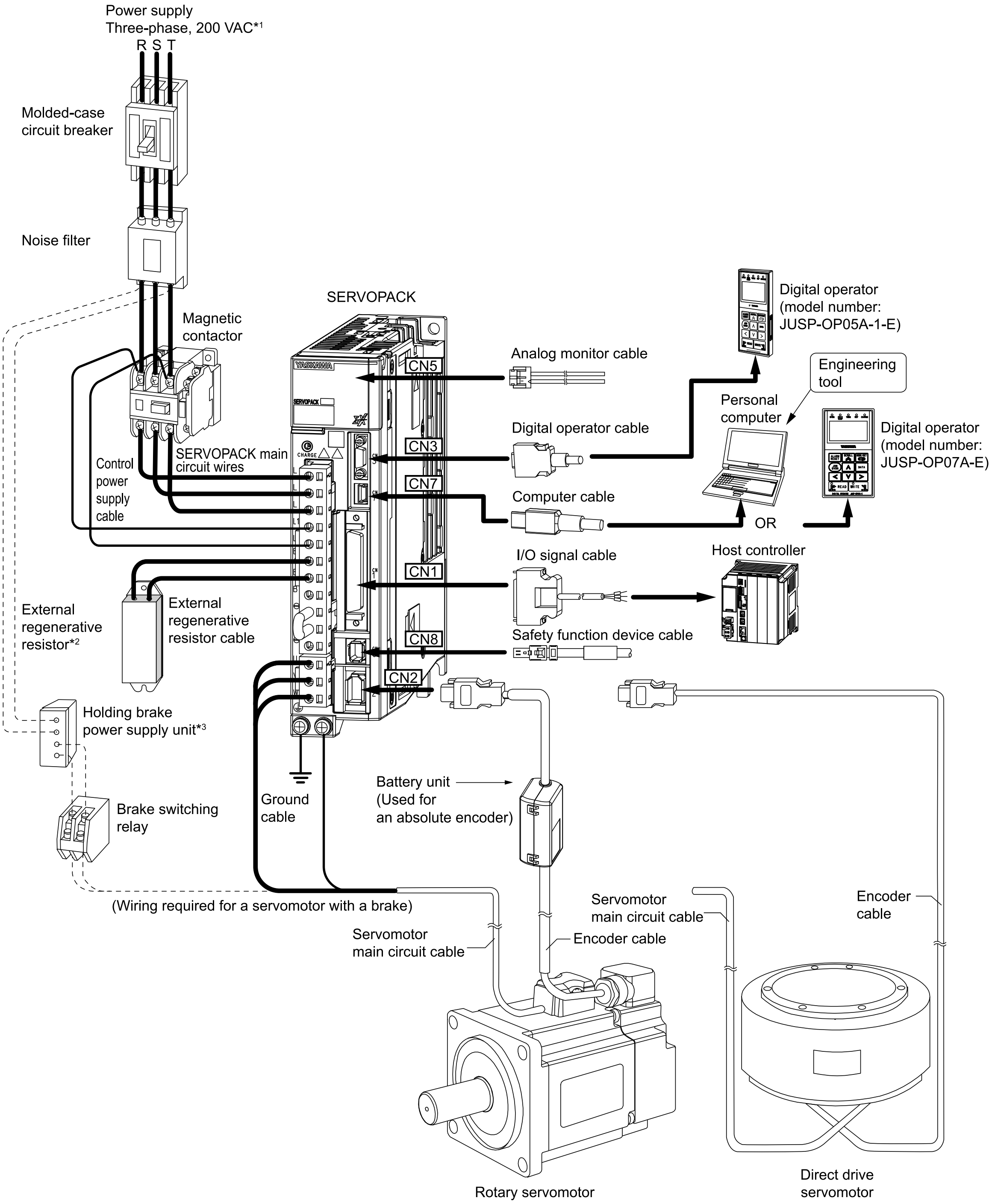
(b) SGDXS-590A, -780A



Approx. mass: 15 kg
Unit: mm

2.4 Examples of Standard Connections between SERVOPACKs and Peripheral Devices

2.4.1 Rotary Servomotor

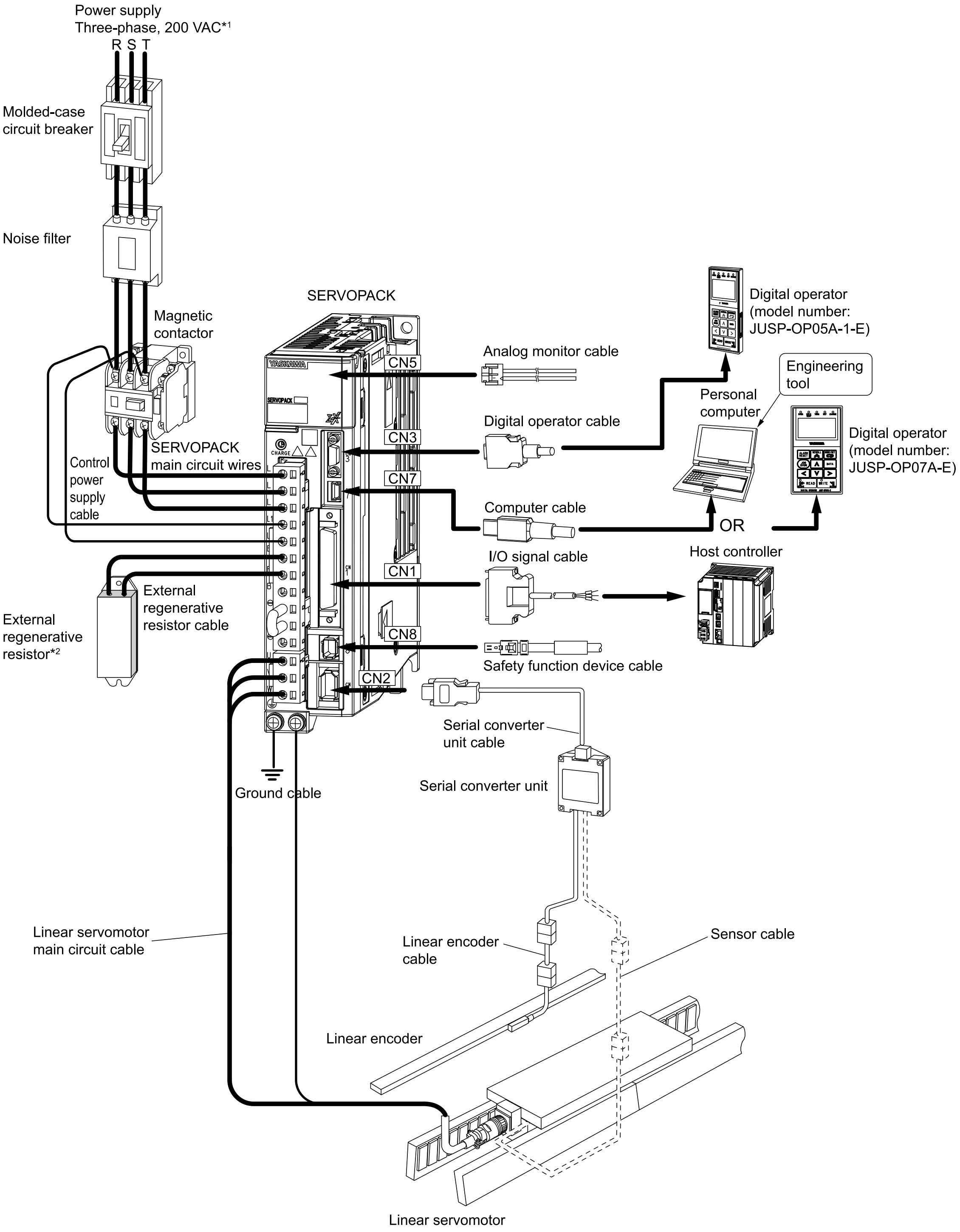


*1 This example is for a SERVOPACK with a three-phase, 200-VAC power supply input. The pin layout of the main circuit connector depends on the voltage.

*2 External regenerative resistors are not provided by Yaskawa.

*3 The power supply for the holding brake is not provided by Yaskawa. Select a power supply based on the holding brake specifications. If you use a 24-V brake, install a separate power supply for the 24-VDC power supply from other power supplies, such as the one for the I/O signals of the CN1 connector. If the power supply is shared, the I/O signals may malfunction.

2.4.2 Linear Servomotor



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*1 This example is for a SERVOPACK with a three-phase, 200-VAC power supply input. The pin layout of the main circuit connector depends on the voltage.

*2 External regenerative resistors are not provided by Yaskawa.

3

SERVOPACK Installation

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

3.1 Installation Precautions

Refer to the following section for the surrounding installation conditions.

☞ *2.1.3 Specification on page 70*

- Installation Near Sources of Heat
  Implement measures to prevent temperature increases caused by radiant or convection heat from heat sources so that the surrounding temperature of the SERVOPACK meets the surrounding 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.
- Others
  Do not install the SERVOPACK in a location subject to high temperatures, high humidity, water drops, cutting oil, excessive dust, excessive dirt, excessive iron powder, corrosive gasses, or radioactivity.

3.2 Mounting Types and Orientation

The SERVOPACKs come in the following mounting types: base-mounted, rack-mounted, and duct-ventilated types.

Applicable SERVOPACK models for each mounting type are listed below.

Mounting Type	SERVOPACK Model: SGDXS-
Base-mounted SERVOPACK	All models
Rack-mounted SERVOPACK	R70A, R90A, 1R6A, 2R8A, 3R8A, 5R5A, 7R6A, 120A, 180A, 200A, 330A
Duct-ventilated SERVOPACK	470A, 550A, 590A, 780A

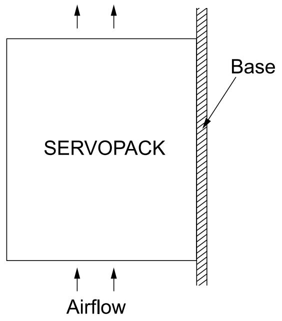
Regardless of the mounting type, mount the SERVOPACK vertically, as shown in the following figures.

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

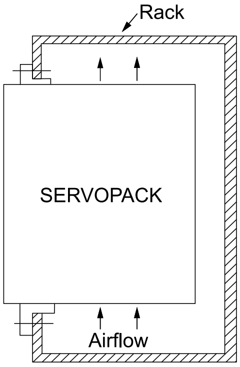
Note:

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

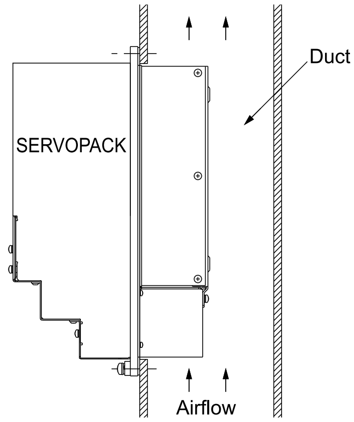
- Base-mounted SERVOPACK



- Rack-mounted SERVOPACK



- Duct-ventilated SERVOPACK

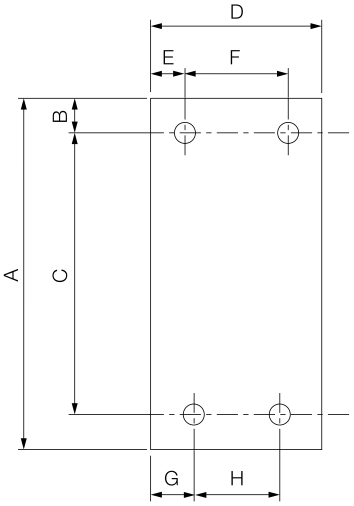


3.3 Mounting Hole Dimensions

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

Note:

To mount the SERVOPACK, prepare a screwdriver that is longer than the depth of the SERVOPACK.



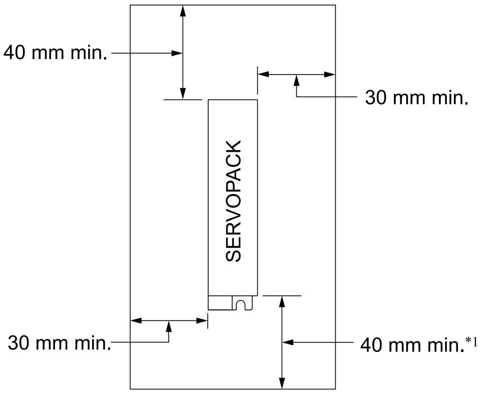
3.3.1 Σ-X-series Mounting Hole Dimensions

SERVOPACK Model SGDXS-	Dimensions (mm)								Screw Size	Number of Screws
	A	B	C	D	E	F	G	H		
R70A, R90A, 1R6A	168	5	160±0.5	40	35	–	25	–	M4	2
2R8A	168	5	160±0.5	40	5	–	25	–	M4	2
3R8A, 5R5A, or 7R6A	168	5	160±0.5	70	6	58±0.5	64	–	M4	3
120A, 120A□□□0008	168	5	160±0.5	90	5	80±0.5	12.5	–	M4	3
180A, 200A	188	5	180±0.5	100	95	–	12.5	75±0.5	M4	3
330A	258	6	250±0.5	110	5	100±0.5	13	84±0.5	M5	4
470A, 550A	315	6	302.5±0.5	170	14	142±0.5	14	142±0.5	M6	4
590A, 780A	390	7.5	375±0.5	260	30	200±0.5	30	200±0.5	M6	4

3.4 Mounting Interval

3.4.1 Installing One SERVOPACK in a Control Panel

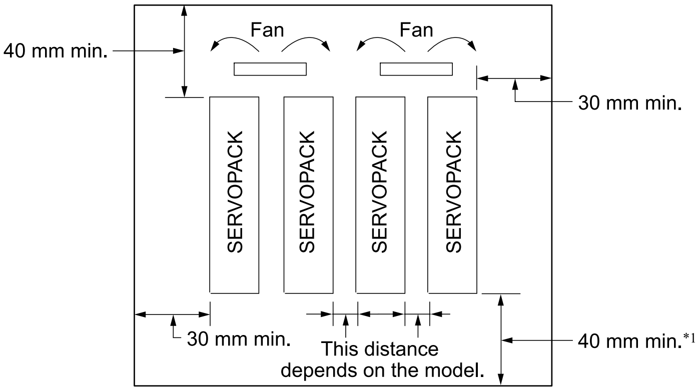
Provide the following spaces around the SERVOPACK.



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

3.4.2 Installing More Than One SERVOPACK in a Control Panel

When multiple SERVOPACKs are installed close together in a enclosed space, the surrounding temperature of the SERVOPACKs may locally exceed the surrounding air temperature range, and air circulation due to natural convection may be insufficient. In this case, you must take measures to disperse the localized hot spots, such as using fans. When using fans, install them as shown below.



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

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

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

Note:

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

3.5 Monitoring the Installation Environment

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

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

- Using the SigmaWin+: [Life Monitor] - [Installation Environment Monitor] - [SERVOPACK]
- Using a panel operator or digital operator: Un025 (Installation Environment Monitor [%])

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

- Lower the surrounding temperature.
- Decrease the load.
- Increase the spacing between SERVOPACKs.
- Make the air around the SERVOPACK circulate by convection.

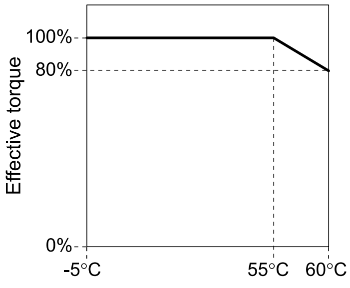
Information The value of the SERVOPACK Installation Environment Monitor will increase by about 10% for each 10°C increase in the surrounding temperature.

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

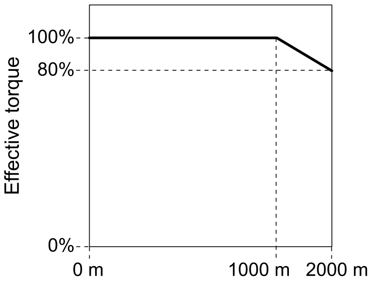
3.6 Derating Specifications

If you use the SERVOPACK at a surrounding air temperature of 55°C to 60°C or at an altitude of 1000 m to 2000 m, you must apply the derating rates given in the following graphs.

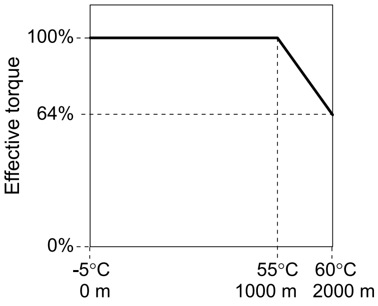
3.6.1 SGDXS-R70A, -R90A, -1R6A, -2R8A



Surrounding air temperature

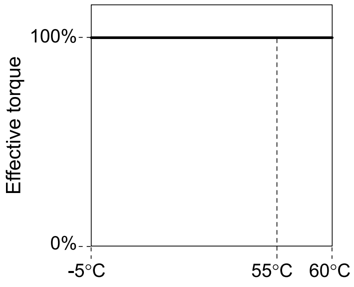


Altitude

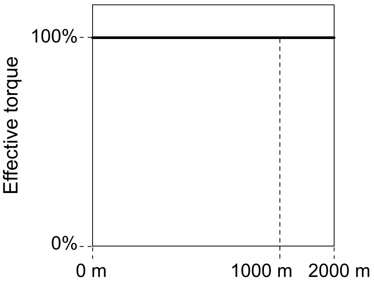


Surrounding air temperature and altitude

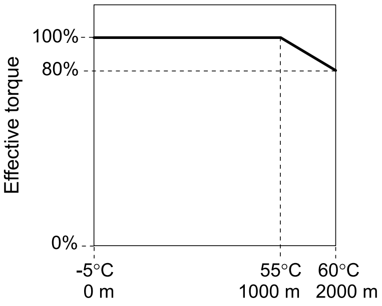
3.6.2 SGDXS-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, -330A, -470A, -550A, -590A, -780A



Surrounding air temperature



Altitude



Surrounding air temperature and altitude

3.7 EMC Installation Conditions

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

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

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

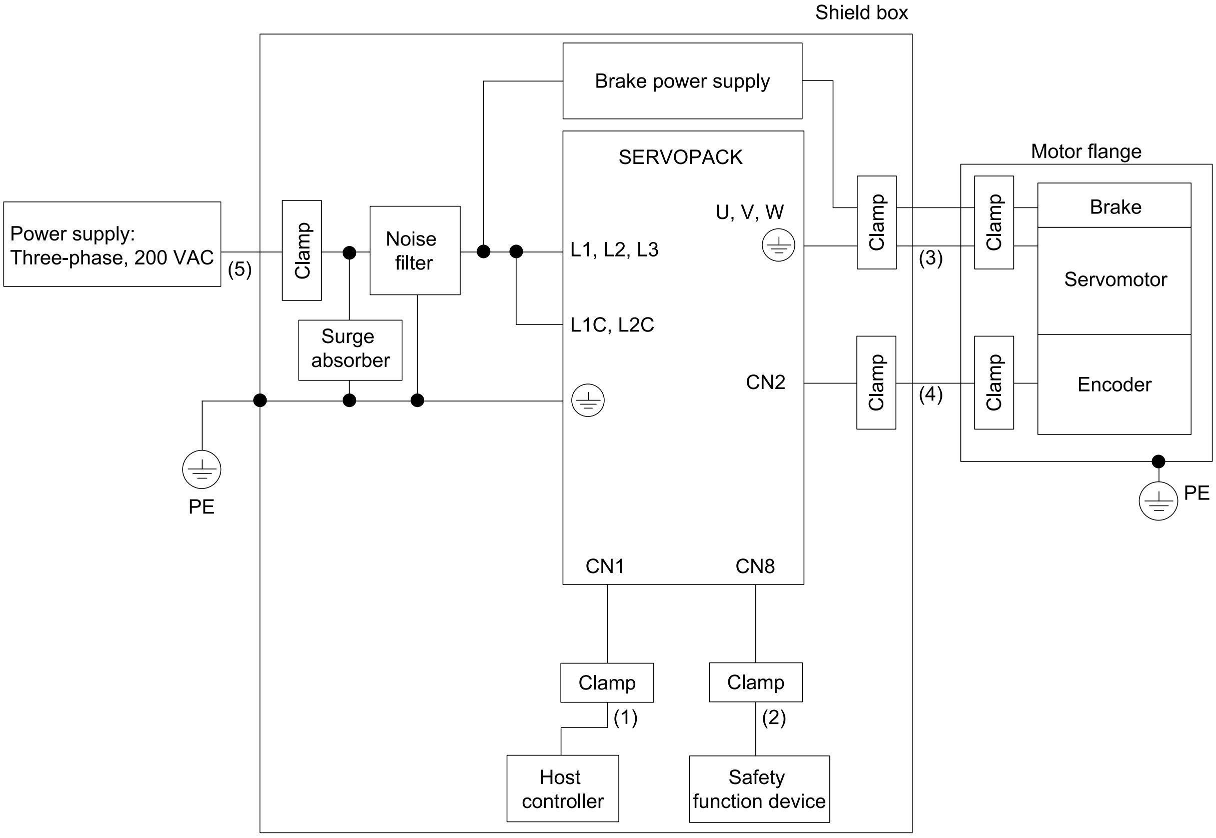
⚠ WARNING

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

⚠ CAUTION

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

3.7.1 Three-Phase, 200 VAC



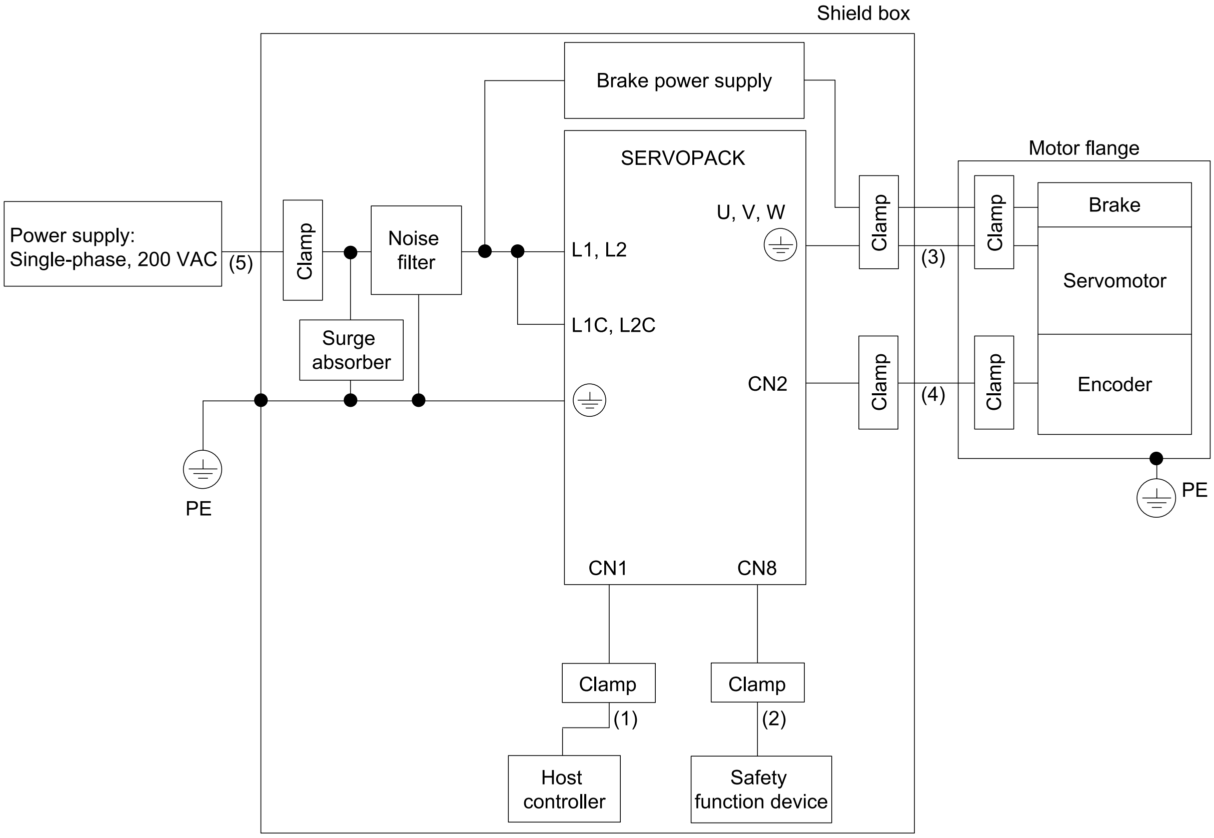
No.	Cable Name	Specification
(1)	I/O signal cable	Shield wire
(2)	Safety function device cable	Shield wire
(3)	Servomotor main circuit cable	Shield wire

Continued on next page.

Continued from previous page.

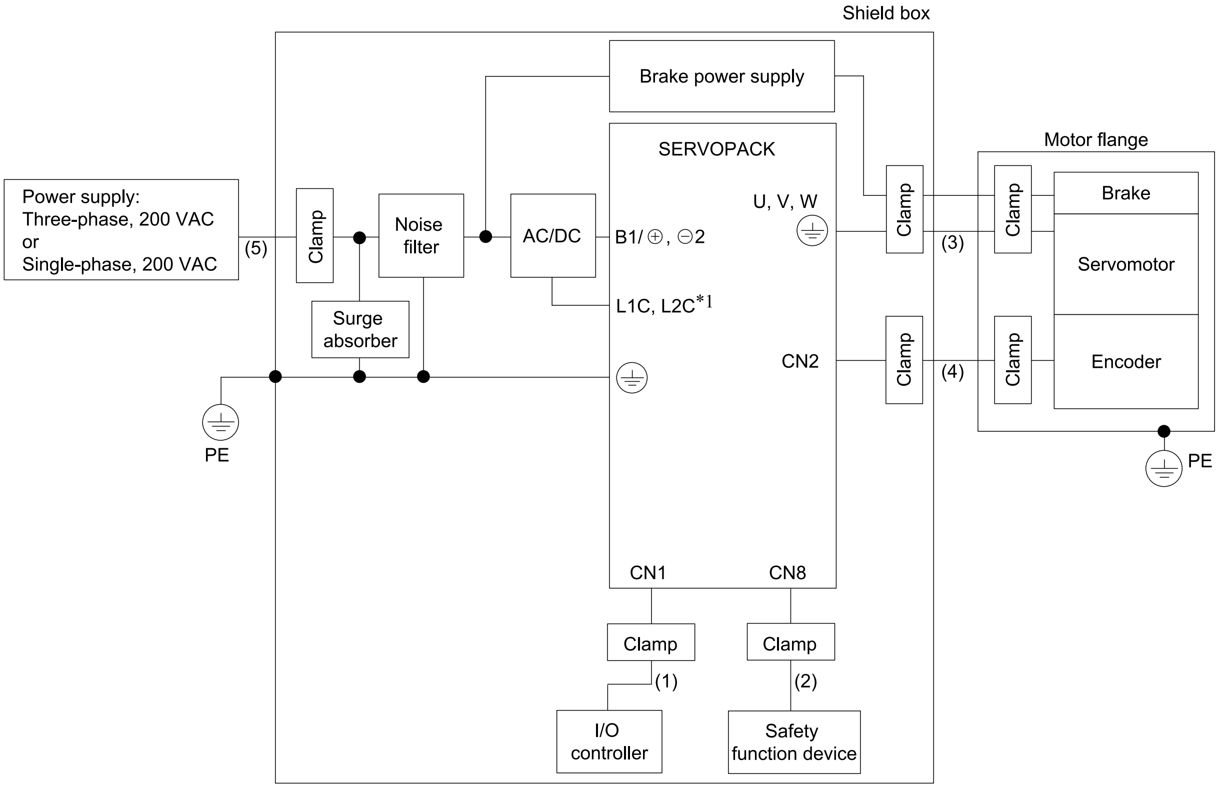
No.	Cable Name	Specification
(4)	Encoder cable	Shield wire
(5)	Main circuit power cable	Shield wire

3.7.2 Single-Phase, 200 VAC



No.	Cable Name	Specification
(1)	I/O signal cable	Shield wire
(2)	Safety function device cable	Shield wire
(3)	Servomotor main circuit cable	Shield wire
(4)	Encoder cable	Shield wire
(5)	Main circuit power cable	Shield wire

3.7.3 270 VDC



[1] You can also use a single-phase 200-VAC power supply instead of a 270-VDC power supply for input to the L1C and L2C control power supply terminals.

Code	Cable Name	Specification
(1)	I/O signal cable	Shield wire
(2)	Safety function device cable	Shield wire
(3)	Servomotor main circuit cable	Shield wire
(4)	Encoder cable	Shield wire
(5)	Main circuit power cable	Shield wire

4

Wiring and Connecting SERVOPACKs

Provides information on wiring and connecting SERVOPACKs to power supplies and peripheral devices.

4.1 Wiring and Connecting SERVOPACKs

4.1.1 General Precautions

⚠ DANGER

Do not change any wiring while power is being supplied.

There is a risk of electric shock or injury.

⚠ WARNING

Wiring and inspections must be performed only by qualified engineers.

There is a risk of electric shock or product failure.

Check all wiring and power supplies carefully.

Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures. If a short-circuit failure occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident that may result in death or injury. There is also a risk that some parts damaged by the short-circuit failure may fall from the SERVOPACK.

Always use the specified terminals to connect the SERVOPACK and peripheral devices. For the power supply wiring in particular, confirm that the connections are made with the terminals shown below.

- **Connect an AC power supply to the L1, L2, and L3 terminals and the L1C and L2C terminals on the SERVOPACK.**
- **Connect a DC power supply to the B1/⊕ and ⊖2 terminals and the L1C and L2C terminals on the SERVOPACK.**

There is a risk of failure or fire.

If you use a SERVOPACK with the dynamic brake hardware option, connect an external dynamic brake resistor that is suitable for the machine and equipment specifications to the specified terminals.

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

⚠ CAUTION

Wait for at least 20 minutes (or 100 minutes when using DC power supply input) after turning OFF the power and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the main circuit terminals while the CHARGE indicator is lit because high voltage may still remain in the SERVOPACK even after turning OFF the power.

There is a risk of electric shock.

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

Failures caused by incorrect wiring or incorrect voltage application in the brake circuit may cause the SERVOPACK to fail, damage the equipment, or cause an accident resulting in death or injury.

Check the wiring to be sure it has been performed correctly. Connectors and pin layouts are sometimes different for different models. Always confirm the pin layouts in technical documents for your model before operation.

There is a risk of failure or malfunction.

⚠ CAUTION

Connect wires to main circuit terminals and motor connection terminals securely with the specified methods and tightening torque.

Insufficient tightening may cause wires and terminal blocks to generate heat due to faulty contact, possibly resulting in fire.

Use shielded twisted-pair cables or screened unshielded multi-twisted-pair cables for I/O signal cables and encoder cables.

The maximum wiring length is 3 m for I/O signal cables and 50 m for servomotor main circuit cables and encoder cables.

Observe the following precautions when wiring the SERVOPACK's main circuit terminals.

- **Turn ON the power to the SERVOPACK only after all wiring, including the main circuit terminals, has been completed.**
- **If a connector is used for the main circuit terminals, remove the main circuit connector from the SERVOPACK before you wire it.**
- **Insert only one wire per insertion hole in the main circuit terminals.**
- **When you insert a wire, make sure that the conductor wire (e.g., whiskers) does not come into contact with adjacent wires and cause a short-circuit.**

Install molded-case circuit breakers and other safety measures to provide protection against short circuits in external wiring.

There is a risk of fire or failure.

NOTICE

Whenever possible, use the cables specified by Yaskawa. If you use any other cables, confirm the rated current and application environment of your model and use the wiring materials specified by Yaskawa or equivalent materials.

Securely tighten connector screws and lock mechanisms.

Insufficient tightening may result in connectors falling off during operation.

Do not bundle power lines (e.g., the main circuit cable) and low-current lines (e.g., the I/O signal cables or encoder cables) together or run them through the same duct. If you do not place power lines and low-current lines in separate ducts, separate them by at least 30 cm.

If the cables are too close to each other, malfunctions may occur due to noise affecting the low-current lines.

Install a battery at either the host controller or on the encoder cable.

If you install batteries both at the host controller and on the encoder cable at the same time, you will create a loop circuit between the batteries, resulting in a risk of damage or burning.

When connecting a battery, connect the polarity correctly.

There is a risk of battery rupture or encoder failure.

Important

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

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

- Use the cables specified by Yaskawa. Design and arrange the system so that each cable is as short as possible. Refer to the following manual or catalog for information on the specified cables.

  Σ-X-Series Catalog (Catalog No.: KAEP C710812 03)

  Σ-X-Series Peripheral Device Selection Manual (Manual No.: SIEP C710812 12)
- The signal cable conductors are as thin as 0.2 mm^2 or 0.3 mm^2. Do not subject them to excessive bending stress or tension.

4.1.2 Countermeasures against Noise

Important

The SERVOPACK is designed as an industrial device.

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

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

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

- Install the input reference device and noise filter as close to the SERVOPACK as possible.
- Always install a surge absorber for relays, solenoids, and magnetic contactor coils.
- Do not place the following cables in the same duct or bundle them together. Also, separate the cables from each other by at least 30 cm.
  - Main circuit cables and I/O signal cables
  - Main circuit cables and encoder cables
- Do not share the power supply with an electric welder or electrical discharge machine. If the SERVOPACK is placed near a high-frequency generator, install noise filters on the input side on the main circuit power supply cable and control power supply cable even if the same power supply is not shared with the high-frequency generator. Refer to the following section for information on connecting noise filters.

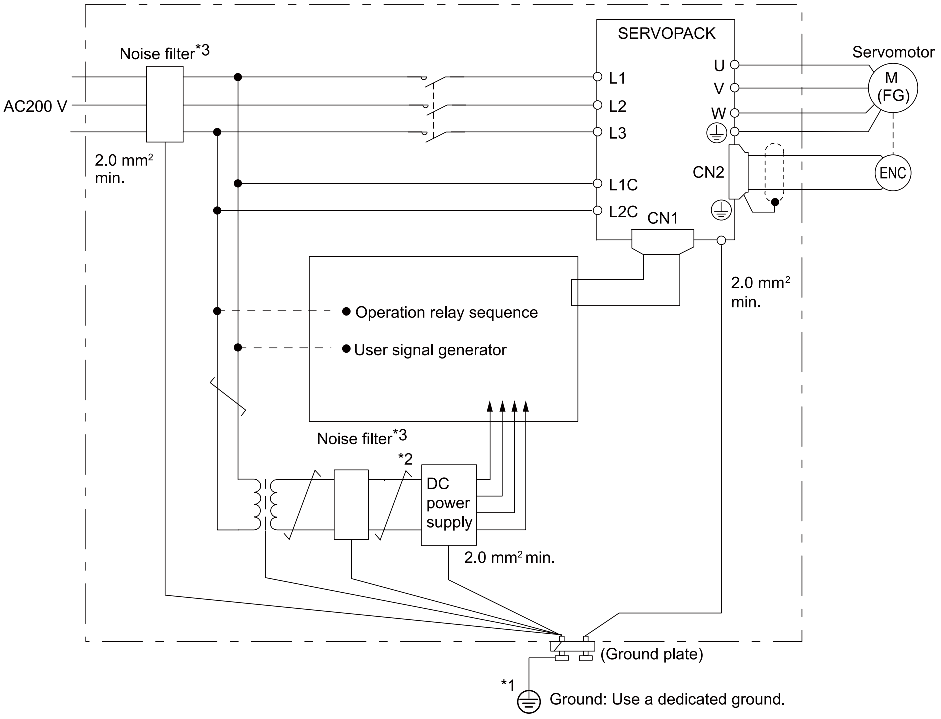
  ☞ *(1) Noise Filters on page 107*
- Implement suitable grounding measures. Refer to the following section for information on grounding measures.

  ☞ *4.1.3 Grounding on page 109*

(1) Noise Filters

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

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



*1 For the ground wire, use a wire with a thickness of at least 2.0 mm ^{2} (preferably, flat braided copper wire).

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

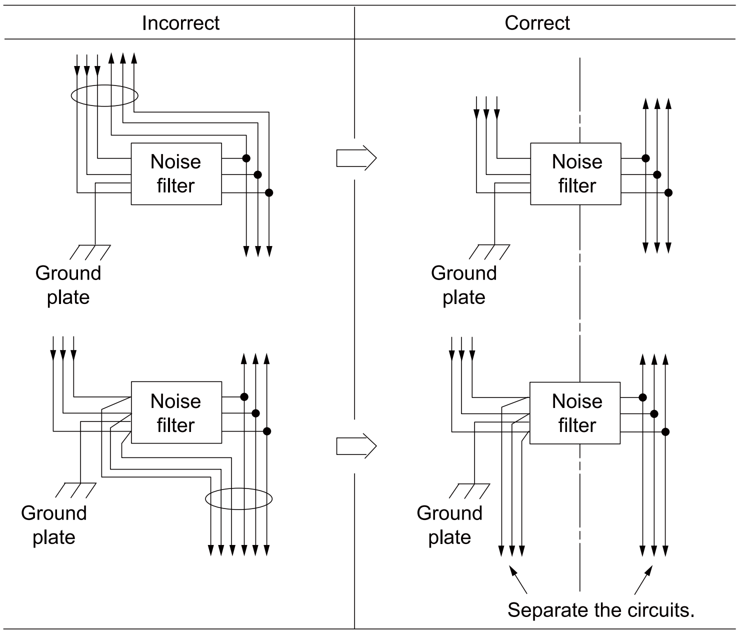
*3 Refer to the following section for precautions when using noise filters.

☞ *(2) Noise Filter Wiring and Connection Precautions on page 108*

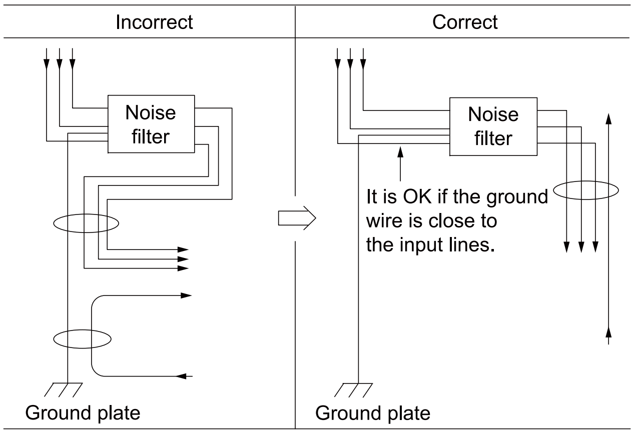
(2) Noise Filter Wiring and Connection Precautions

Always observe the following precautions when wiring or connecting noise filters.

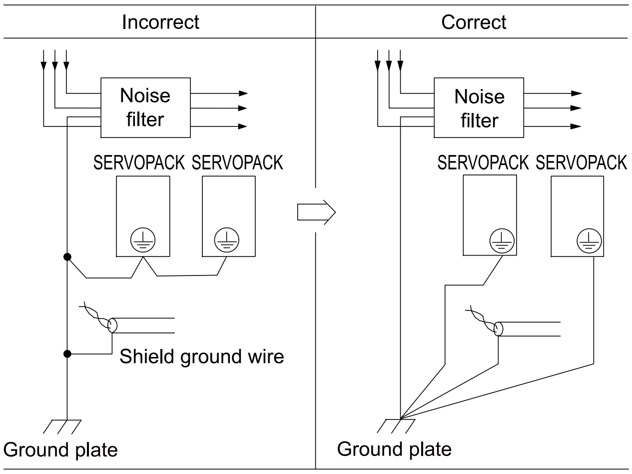
- Separate input lines from output lines. Do not place input lines and output lines in the same duct or bundle them together.



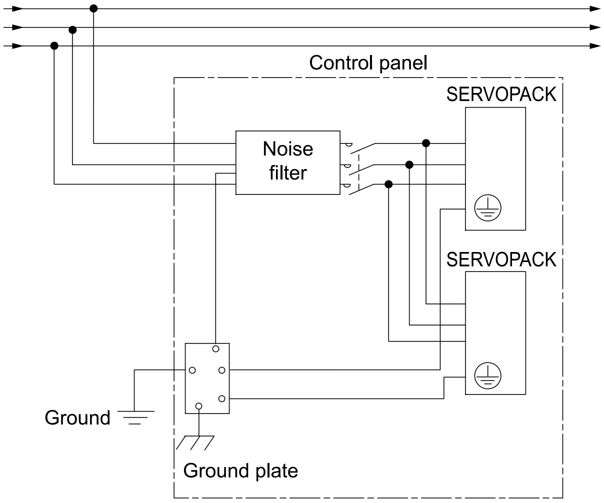
- Separate the noise filter ground wire from the output lines. Do not place the noise filter ground wire, output lines, and other signal lines in the same duct or bundle them together.



- 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.

(1) Motor Frame Ground or Motor Ground

If you ground the servomotor through the machine, switching noise current can flow from the main circuit of the SERVOPACK through the stray capacitance of the servomotor. To prevent this, always connect the FG terminal of the servomotor main circuit cable connected to the servomotor to the ground terminal ⏚ on the SERVOPACK. Also be sure to ground the ground terminal ⏚. Always connect the shield wire of the encoder cable connected to the servomotor to the connector case (shell).

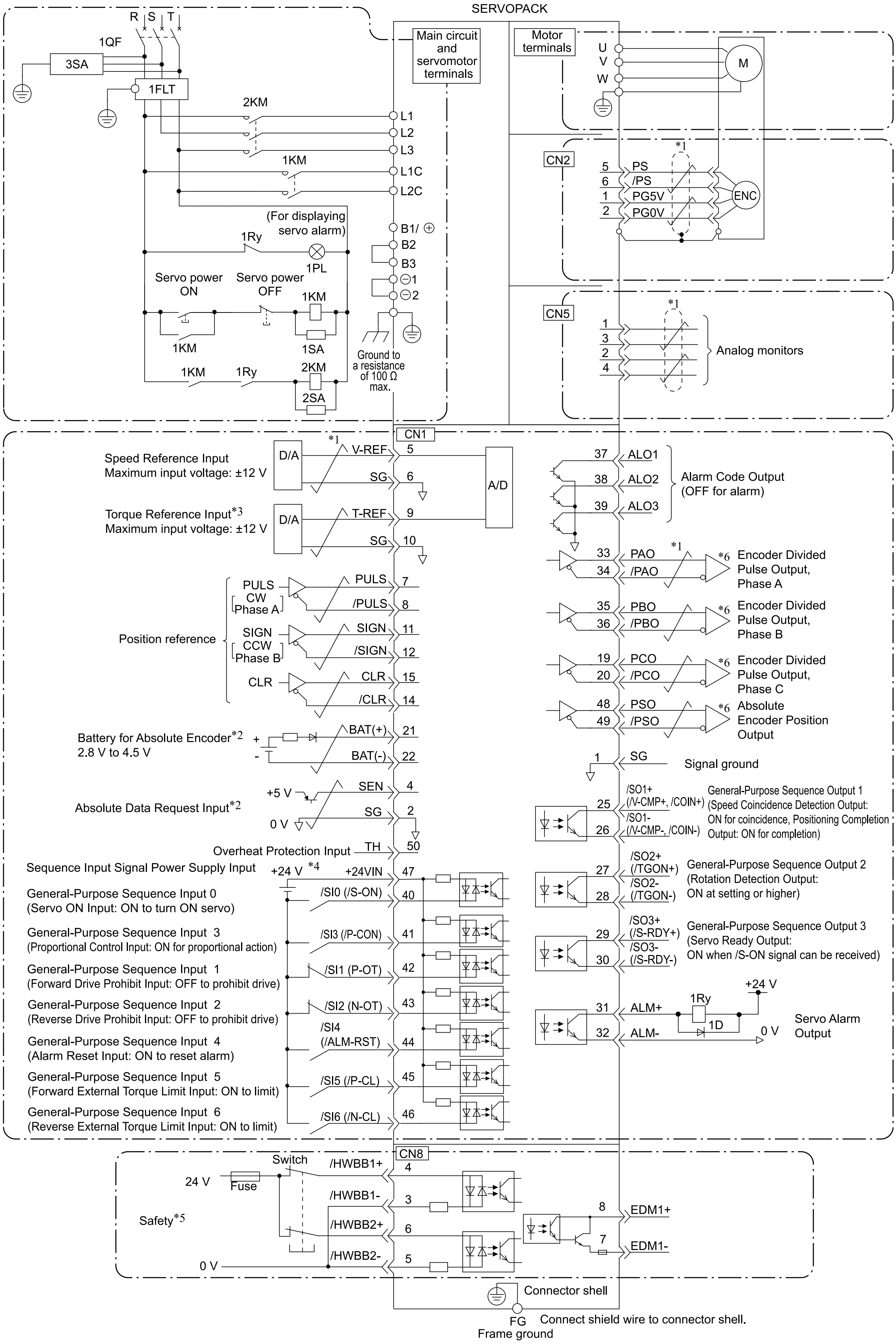
Ground both the moving coil and magnetic way of a linear servomotor.

(2) Noise on I/O Signal Cables

If noise enters the I/O signal cable, connect the shield of the I/O signal cable to the connector shell to ground it. If the servomotor main circuit cable is placed in a metal conduit, ground the conduit and its junction box. For all grounding, ground at one point only.

4.2 Basic Wiring Diagrams

This section provide the basic wiring diagrams.



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*1 represents twisted-pair wires.

*2 Connect these when using an absolute encoder. If the encoder cable with a battery unit is connected, do not connect a backup battery.

*3 You can enable this function with a parameter setting.

*4 The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.

*5 Refer to the following chapter if you use a Safety Function device.
☞ *4.6 Connecting Safety Function Signals on page 148*
If you do not use the Safety Function, insert the safety jumper connector (provided as an accessory) into CN8 when you use the SERVOPACK.

*6 Always use line receivers to receive the output signals.

Note:

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

Refer to the reference sections given in the diagrams for details.

Item	Reference
Main circuit terminals	*4.3 Wiring the Power Supply to the SERVOPACK on page 113*
Motor terminals	*4.4 Wiring Servomotors on page 125*
CN1	*4.5 I/O Signal Connections on page 135*
CN2	*4.4 Wiring Servomotors on page 125*
CN5	*4.10 Using the Analog Monitors on page 153*
CN8	*4.6 Connecting Safety Function Signals on page 148*

4.3 Wiring the Power Supply to the SERVOPACK

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

📖 Σ-X-Series Catalog (Catalog No.: KAEP C710812 03)

📖 Σ-X-Series Peripheral Device Selection Manual (Manual No.: SIEP C710812 12)

4.3.1 Terminal Symbols and Terminal Names

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

CAUTION

Wire all connections correctly according to the following table and the reference information.

There is a risk of SERVOPACK failure or fire if incorrect wiring is performed.

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

- Three-phase, 200-VAC power supply input
- Single-phase, 200-VAC power supply input
- DC power supply input

Information A single-phase AC power supply or a DC power supply can be connected to the control power supply terminals.

(1) Three-Phase, 200-VAC Power Supply Input

<table>
<tr><th>Terminal Symbols</th><th>Terminal Name</th><th colspan="2">Specifications and Reference</th></tr>
<tr><td>L1, L2, L3</td><td>Main circuit power input terminals for AC power input</td><td colspan="2">Three-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz</td></tr>
<tr><td rowspan="2">L1C, L2C</td><td rowspan="2">Control power supply terminals</td><td>AC power supply</td><td>Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz</td></tr>
<tr><td>DC power supply</td><td>L1C: 270 VDC to 324 VDC, -15% to +10%, L2C: 0 VDC
or
L2C: 270 VDC to 324 VDC, -15% to +10%, L1C: 0 VDC</td></tr>
<tr><td rowspan="4">B1/⊕, B2, B3</td><td rowspan="4">Regenerative resistor terminals</td><td colspan="2">☞ *4.3.5 Wiring Regenerative Resistors on page 121*</td></tr>
<tr><td colspan="2">For SGDXS-R70A, -R90A, -1R6A, -2R8A
If the regenerative capacity is insufficient, connect an external regenerative resistor between B1/⊕and B2. The external regenerative resistor is not included. Obtain it separately.</td></tr>
<tr><td colspan="2">For SGDXS-3R8A,- 5R5A, -7R6A, -120A, -180A, -200A, -330A
If the internal regenerative resistor is insufficient, remove the jumper (lead or short bar) between B2 and B3 and connect an external regenerative resistor between B1/⊕ and B2. The external regenerative resistor is not included. Obtain it separately.</td></tr>
<tr><td colspan="2">For SGDXS-470A, -550A, -590A, -780A
Connect a regenerative resistor unit between B1/⊕ and B2. Obtain a regenerative resistor unit separately. These models do not have a B3 terminal.</td></tr>
<tr><td rowspan="2">⊖1,⊖2</td><td rowspan="2">DC reactor terminals</td><td colspan="2">☞ *4.3.6 Wiring Reactors for Harmonic Suppression on page 123*</td></tr>
<tr><td colspan="2">These terminals are used to connect a DC reactor for harmonic suppression.</td></tr>
</table>

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Terminal Symbols	Terminal Name	Specifications and Reference
⊖	–	None. (Do not connect anything to this terminal.) **Note:** SGDXS-330A to -780A do not have a ⊖ terminal.

(2) Single-Phase, 200-VAC Power Supply Input

Terminal Symbols	Terminal Name	Specifications and Reference	
L1, L2	Main circuit power input terminals for AC power input	Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz	
L1C, L2C	Control power supply terminals	AC power supply	Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz
		DC power supply	L1C: 270 VDC to 324 VDC, -15% to +10%, L2C: 0 VDC or L2C: 270 VDC to 324 VDC, -15% to +10%, L1C: 0 VDC
B1/⊕, B2, B3	Regenerative resistor terminals	☞ *4.3.5 Wiring Regenerative Resistors on page 121*	
		For SGDXS-R70A, -R90A, -1R6A, -2R8A If the regenerative capacity is insufficient, connect an external regenerative resistor between B1/⊕and B2. The external regenerative resistor is not included. Obtain it separately.	
		For SGDXS-5R5A, -120A□□□0008 If the internal regenerative resistor is insufficient, remove the jumper (lead) between B2 and B3 and connect an external regenerative resistor between B1/⊕ and B2. The external regenerative resistor is not included. Obtain it separately.	
⊖1,⊖2	DC reactor terminals	☞ *4.3.6 Wiring Reactors for Harmonic Suppression on page 123*	
		These terminals are to connect a DC reactor for power supply harmonic suppression.	
L3,⊖	–	None. (Do not connect anything to this terminal.)	

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

- SGDXS-R70A, -R90A, -1R6A, -2R8A, -5R5A

If you use a single-phase, 200-VAC power supply input for the SERVOPACK's main circuit power supply, set parameter Pn00B to n.□1□□ (use a three-phase power supply input as a single-phase power supply input). Refer to the following section for details.

☞ *5.3.2 Single-phase AC Power Supply Input/Three-phase AC Power Supply Input Setting on page 168*

Information You do not need to change the setting of Pn00B to n.□1□□ (use a three-phase power supply input as a single-phase power supply input) for a SERVOPACK with a single-phase 200-VAC power supply input (model numbers: SGDXS-120A□□□0008).

(3) DC Power Supply Input

Terminal Symbols	Terminal Name	Specifications and Reference	
L1C, L2C	Control power supply terminals	AC power supply	Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz
		DC power supply	L1C: 270 VDC to 324 VDC, -15% to +10%, L2C: 0 VDC or L2C: 270 VDC to 324 VDC, -15% to +10%, L1C: 0 VDC
B1/⊕	Main circuit power supply input terminals for DC power supply input	270 VDC to 324 VDC, -15% to +10%	
⊖2		0 VDC	

Continued on next page.

Continued from previous page.

Terminal Symbols	Terminal Name	Specifications and Reference
L1, L2, L3, B2, B3,⊖1,⊖	–	None. (Do not connect anything to this terminal.) **Note:** • SGDXS-470A to -780A do not have a B3 terminal. • SGDXS-330A to -780A do not have a ⊖ terminal.

If you use a DC power supply input to the SERVOPACK, make sure to set parameter Pn001 to n.□1□□ (DC power supply input supported) before inputting the power. Refer to the following section for details.

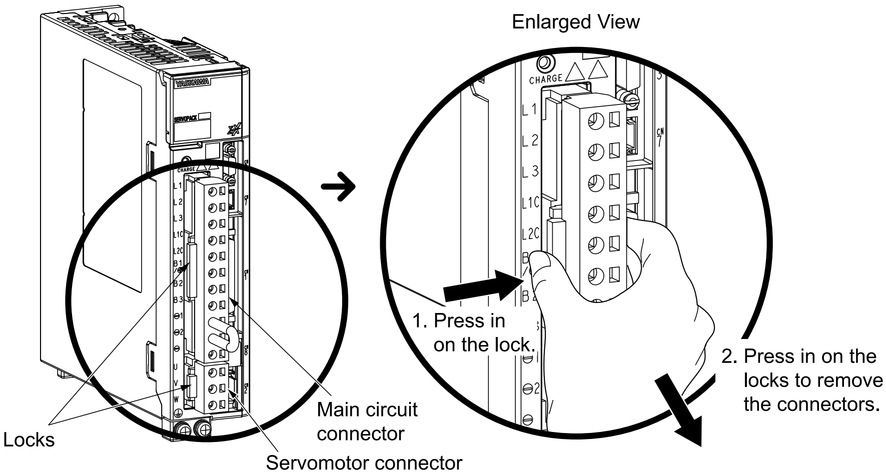
☞ *5.3.1 AC Power Supply Input/DC Power Supply Input Setting on page 167*

4.3.2 Wiring Procedure for Main Circuit Connector

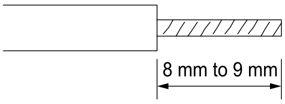
- Required Items

Required Items	Remarks
Spring Opener or Flatblade Screwdriver	– Spring opener SERVOPACK accessory (You can also use model 1981045-1 from Tyco Electronics Japan G.K.)
	– Flat-blade screwdriver Commercially available screwdriver with tip width of 3.0 mm to 3.5 mm

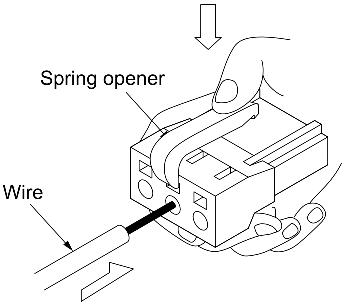
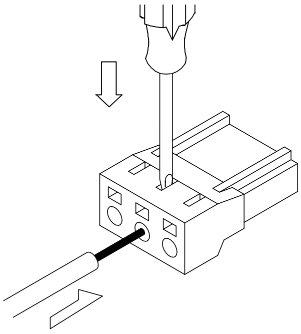
1. **Remove the main circuit connector and motor connector from the SERVOPACK.**



2. **Remove the sheath from the wire to connect.**



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

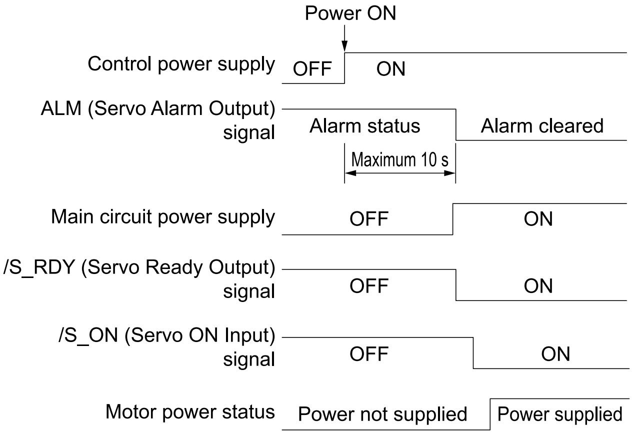
Using a Spring Opener	Using a Flat- blade Screwdriver
Open the insertion hole with the spring opener as shown in the figure.  	Firmly insert a flat-blade screwdriver into the screwdriver insertion hole to open the wire insertion hole. 

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

4.3.3 Power ON Sequence

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

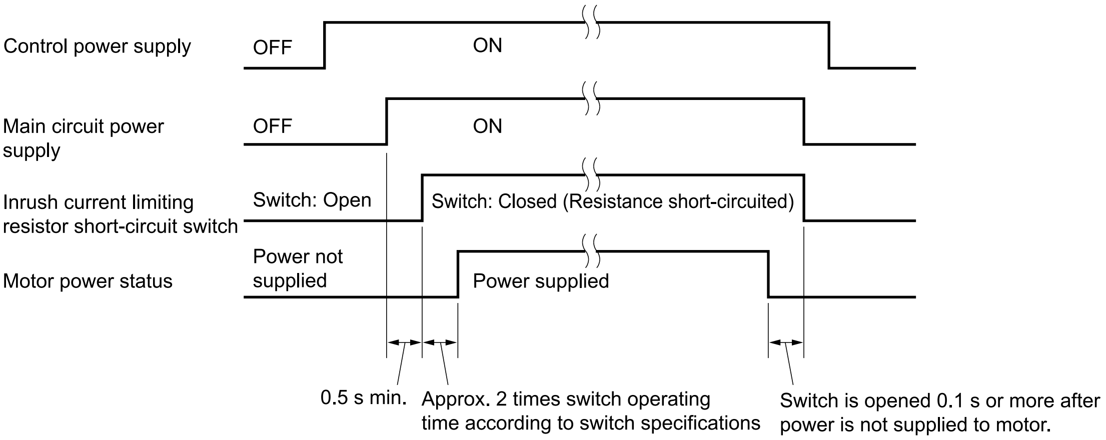
- The ALM (Servo Alarm Output) signal is output for up to ten seconds when the control power is turned ON. Take this into consideration when you design the power ON sequence, and turn ON the main circuit power to the SERVOPACK when the ALM signal is OFF (alarm cleared).



Information If the servo ON state cannot be achieved by turning ON the /S_ON signal, the /S_RDY signal is not ON. Check the status of the /S_RDY signal. Refer to the following section for details.

☞ *6.1.9 /S-RDY (Servo Ready Output) Signal on page 228*

- If you use a DC power supply input with any of the following SERVOPACKs, use the power ON sequence shown below: SGDXS-330A, -470A, -550A, -590A, -780A.



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

Important

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

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

⚠ **CAUTION**

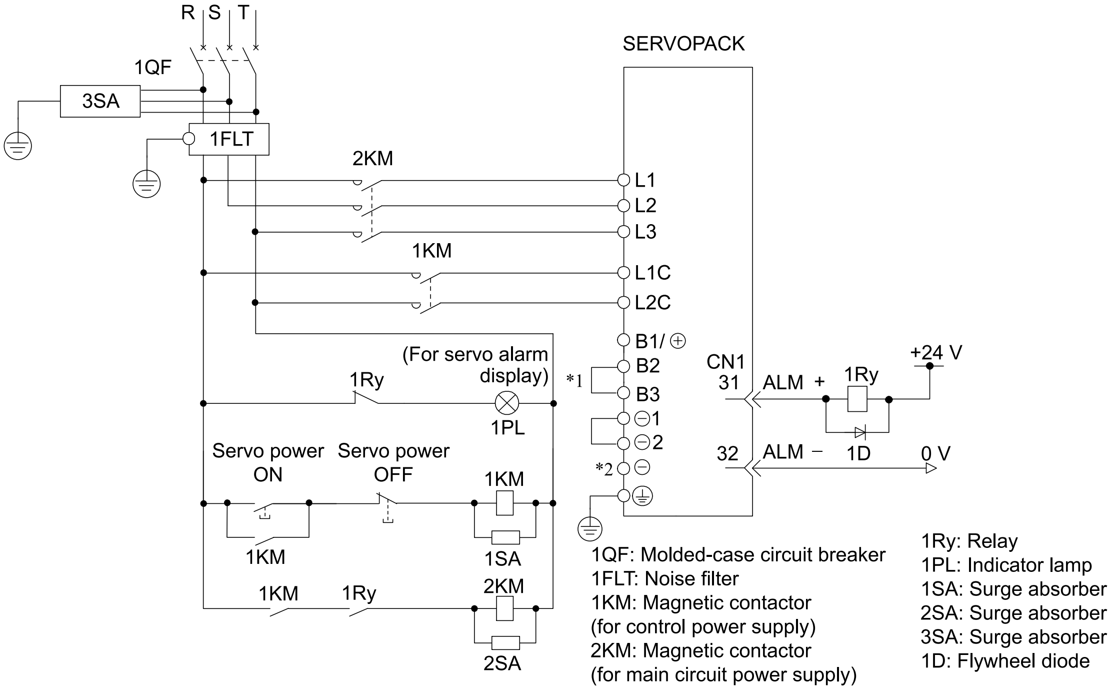
Wait for at least 20 minutes (or 100 minutes when using DC power supply input) after turning OFF the power and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the main circuit terminals while the CHARGE indicator is lit because high voltage may still remain in the SERVOPACK even after turning OFF the power.

There is a risk of electric shock.

4.3.4 Power Supply Wiring Diagrams

(1) Using Only One SERVOPACK

(a) Wiring Example for Three-Phase, 200 VAC Power Supply Input: SGDXS-R70A, -1R6A, -2R8A, -3R8A, -5R5A, -7R6A, -120A, -180A, -200A, -330A

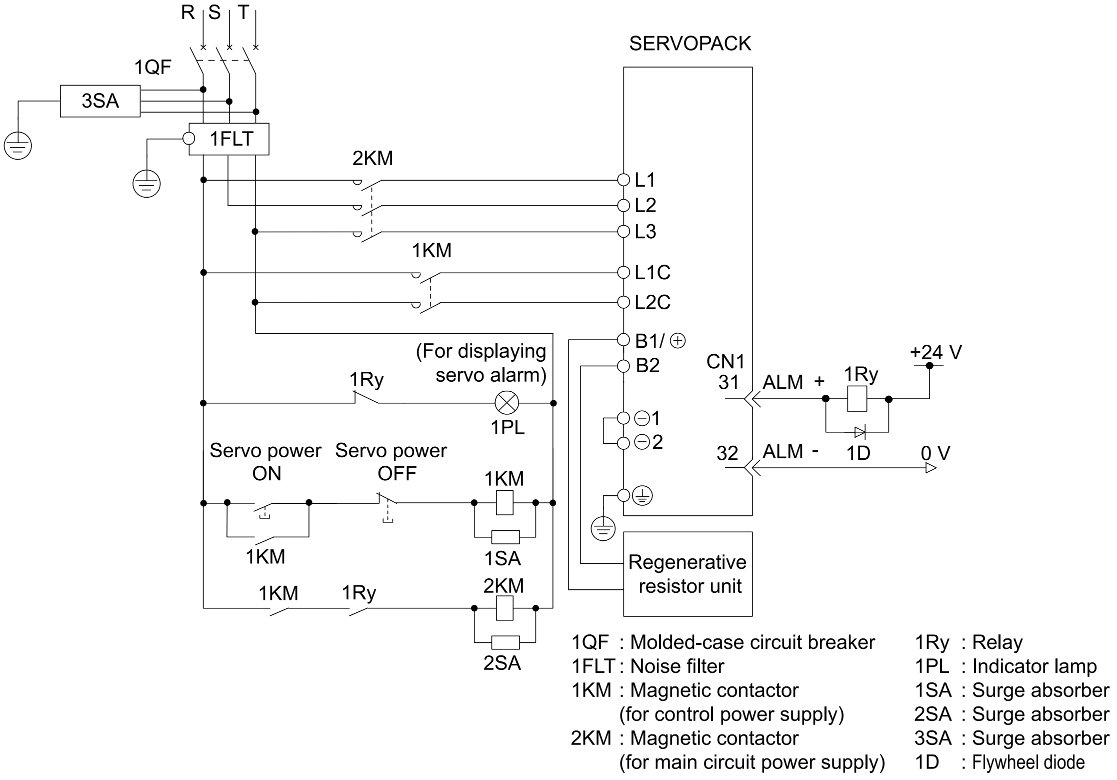


1QF: Molded-case circuit breaker
1FLT: Noise filter
1KM: Magnetic contactor (for control power supply)
2KM: Magnetic contactor (for main circuit power supply)
1Ry: Relay
1PL: Indicator lamp
1SA: Surge absorber
2SA: Surge absorber
3SA: Surge absorber
1D: Flywheel diode

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

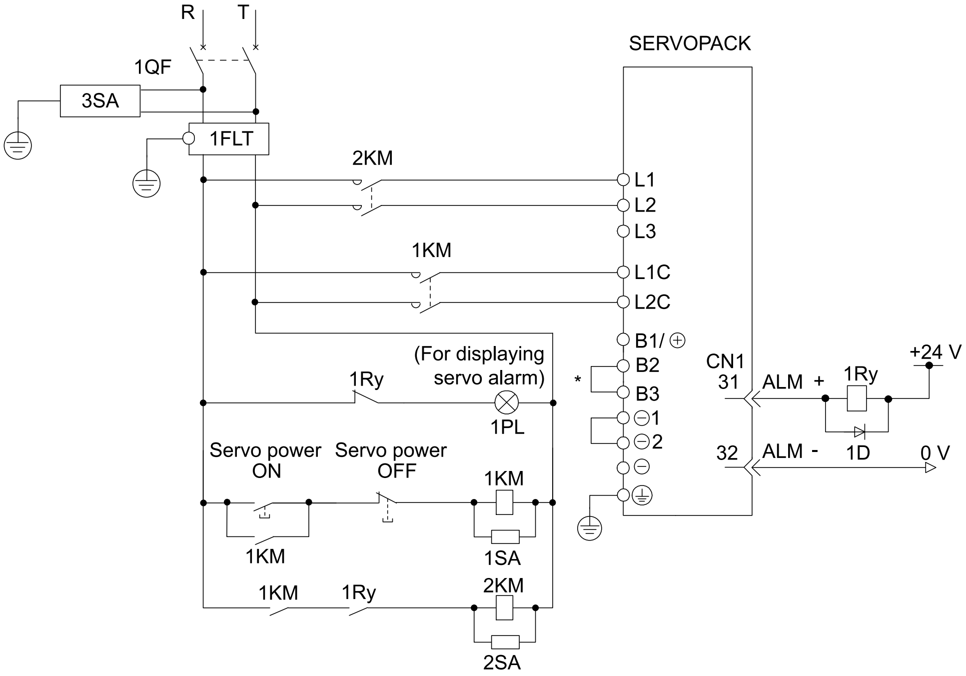
*2 A SGDXS-330A SERVOPACK does not have a ⊖terminal.

(b) Wiring Example for Three-Phase, 200 VAC Power Supply Input: SGDXS-470A, -550A, -590A, -780A



1QF : Molded-case circuit breaker
1FLT : Noise filter
1KM : Magnetic contactor (for control power supply)
2KM : Magnetic contactor (for main circuit power supply)
1Ry : Relay
1PL : Indicator lamp
1SA : Surge absorber
2SA : Surge absorber
3SA : Surge absorber
1D : Flywheel diode

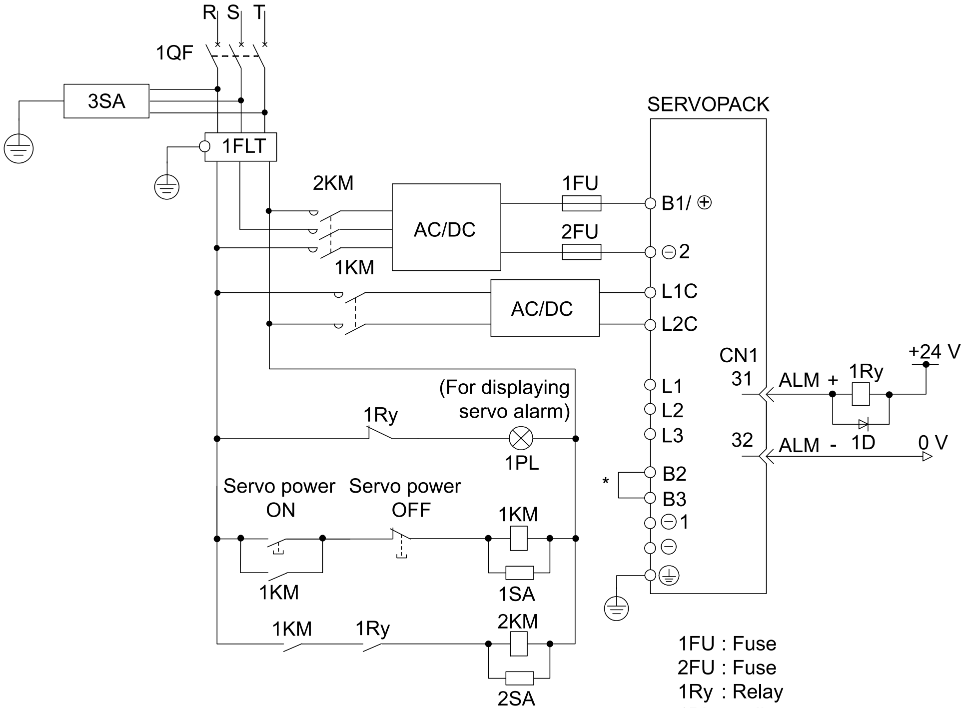
(c) Wiring Example for Single-Phase, 200-VAC Power Supply Input



1QF : Molded-case circuit breaker
1FLT : Noise filter
1KM : Magnetic contactor (for control power supply)
2KM : Magnetic contactor (for main circuit power supply)
1Ry : Relay
1PL : Indicator lamp
1SA : Surge absorber
2SA : Surge absorber
3SA : Surge absorber
1D : Flywheel diode

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

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

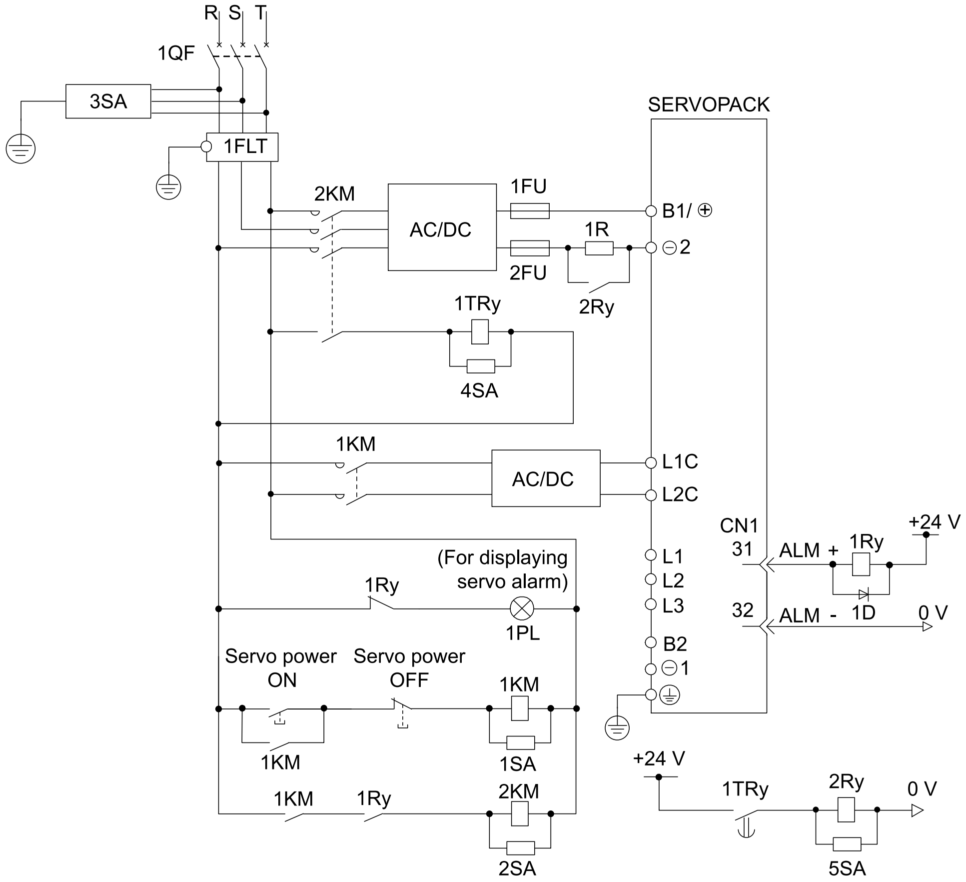


1FU : Fuse
2FU : Fuse
1Ry : Relay
1PL : Indicator lamp
1SA : Surge absorber
2SA : Surge absorber
3SA : Surge absorber
1D : Flywheel diode

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

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

(e) Wiring Example for DC Power Supply Input: SGDXS-330A, -470A, -550A, -590A, -780A



1QF : Molded-case circuit breaker
1FLT : Noise filter
1KM : Magnetic contactor (for control power supply)
2KM : Magnetic contactor
(for main circuit power supply, auxiliary contact)
1FU : Fuse, positive side
2FU : Fuse, negative side
1Ry : Relay
2Ry : Relay (for inrush current suppression resistor short)
1TRy : Timer relay
1PL : Indicator lamp

1SA : Surge absorber
2SA : Surge absorber
3SA : Surge absorber
4SA : Surge absorber
5SA : Surge absorber
1D : Flywheel diode
1R : External inrush current suppression resistor

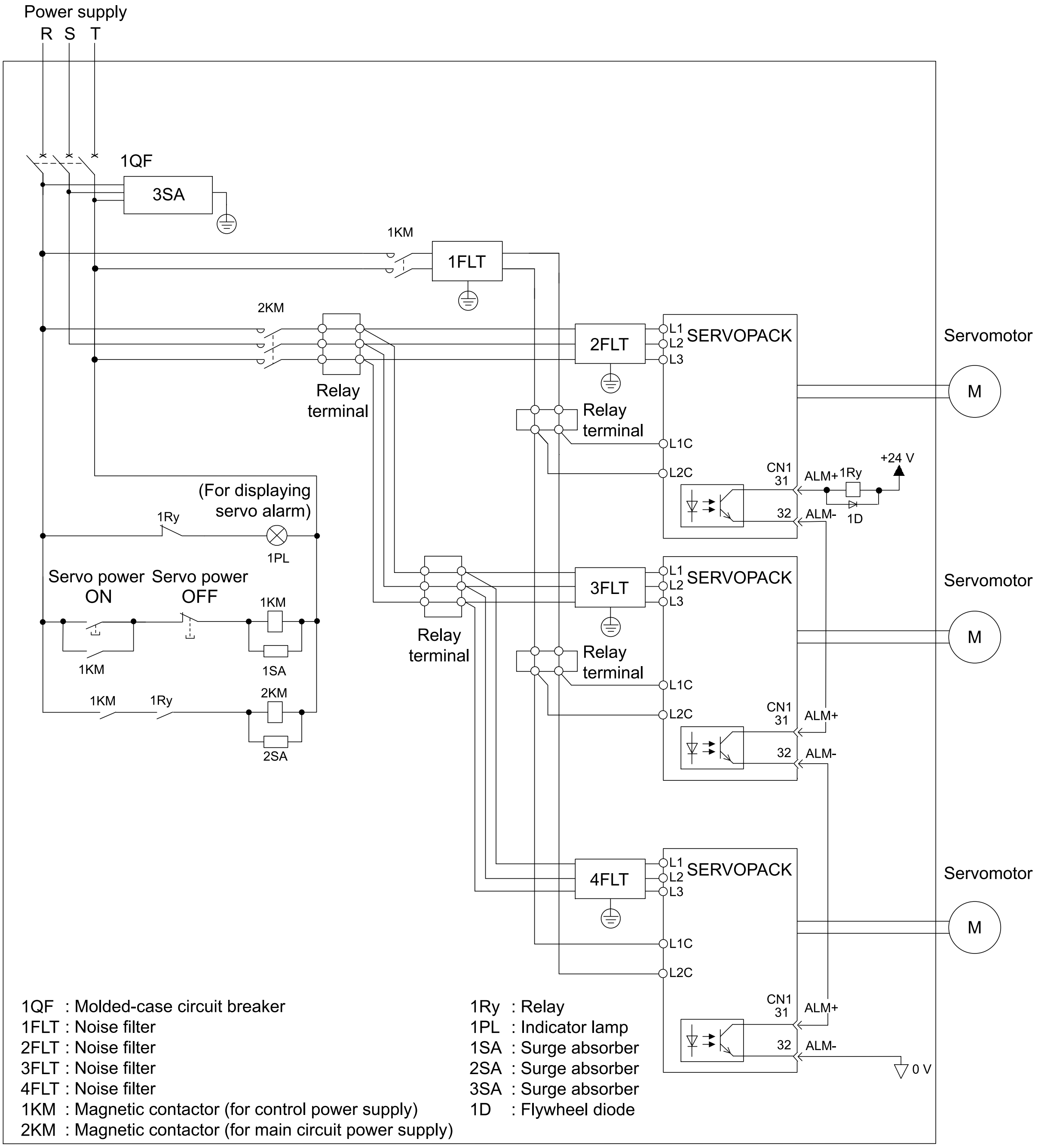
(2) Using More Than One SERVOPACK

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

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

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

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



1QF : Molded-case circuit breaker
1FLT : Noise filter
2FLT : Noise filter
3FLT : Noise filter
4FLT : Noise filter
1KM : Magnetic contactor (for control power supply)
2KM : Magnetic contactor (for main circuit power supply)
1Ry : Relay
1PL : Indicator lamp
1SA : Surge absorber
2SA : Surge absorber
3SA : Surge absorber
1D : Flywheel diode

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

🕮 Σ-X-Series Σ-XS/Σ-XW SERVOPACK Safety Precautions (Manual No.: TOMP C710812 00)

4.3.5 Wiring Regenerative Resistors

This section describes how to connect external regenerative resistors.

Refer to the following manual to select external regenerative resistors.

🕮 Σ-X-Series Peripheral Device Selection Manual (Manual No.: SIEP C710812 12)

⚠ WARNING

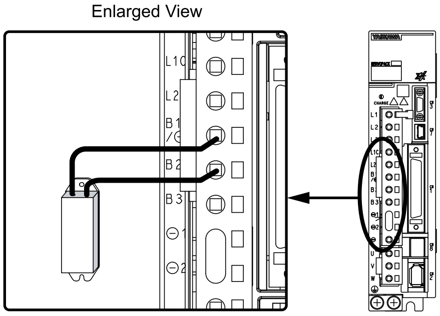
Be sure to wire regenerative resistors correctly. Do not connect B1/ ⊕and B2.

Doing so may result in fire or damage to the regenerative resistor or SERVOPACK.

(1) Connecting Regenerative Resistors

(a) SERVOPACK Models SGDXS-R70A, -R90A, -1R6A, and -2R8A,

1. **Connect the external regenerative resistor between the B1/⊕ and B2 terminals on the SERVOPACK.**



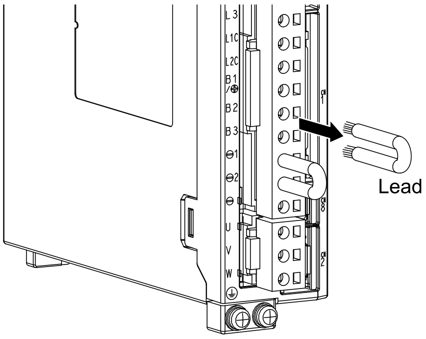
2. **Set Pn600 (Regenerative Resistor Capacity) and the Pn603 (Regenerative Resistance).**

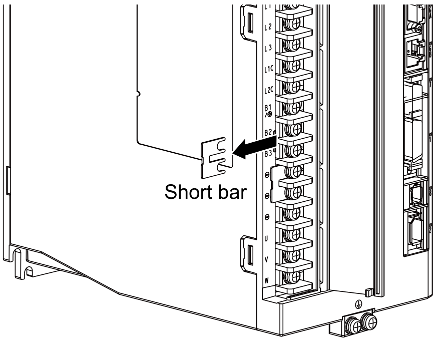
Refer to the following section for details on the settings.

☞ *5.19 Setting the Regenerative Resistor Capacity on page 212*

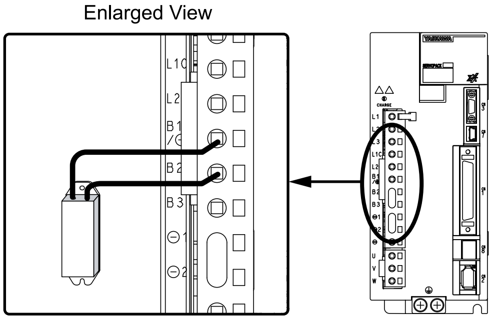
(b) SERVOPACK Models SGDXS-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, -330A

1. **Remove the jumper (lead or short bar) from between the B2 and B3 terminals on the SERVOPACK.**





2. **Connect the external regenerative resistor between the B1/⊕ and B2 terminals.**



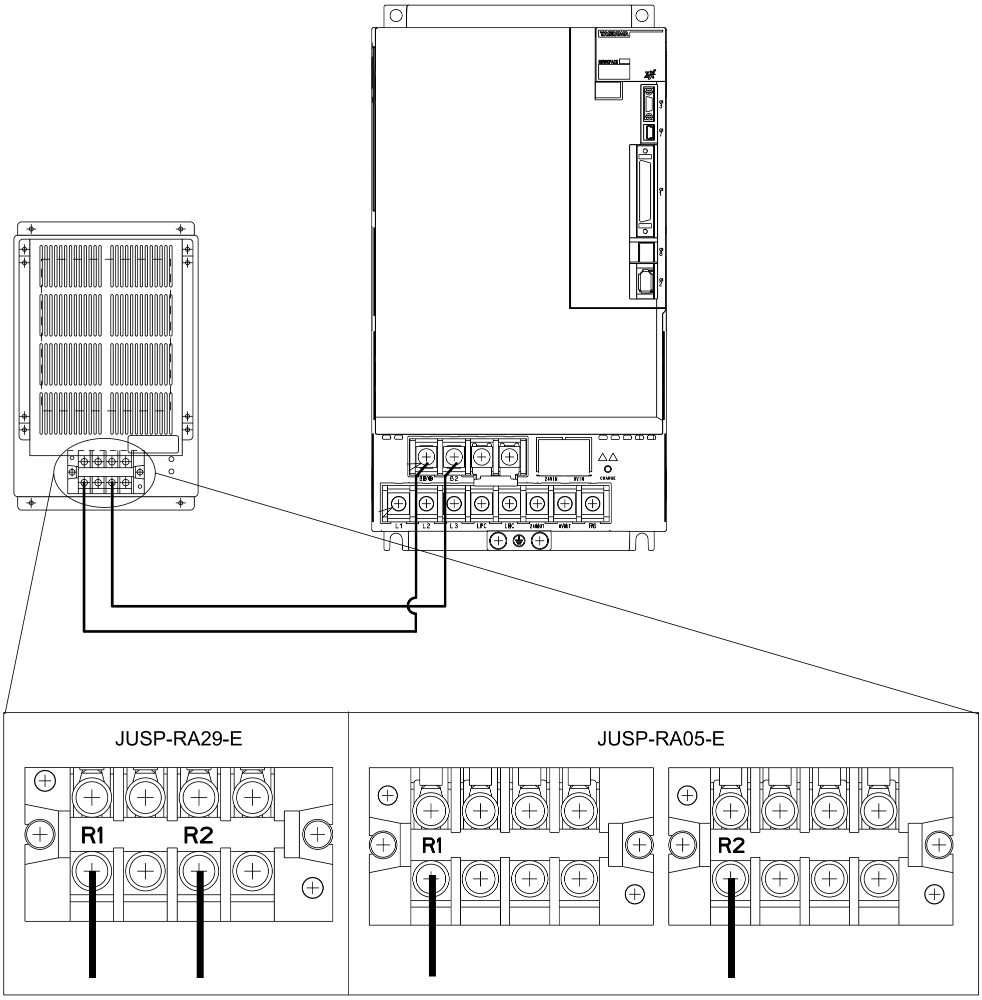
3. **Set Pn600 (Regenerative Resistor Capacity) and Pn603 (Regenerative Resistance).**

Refer to the following section for details on the settings.

☞ *5.19 Setting the Regenerative Resistor Capacity on page 212*

(c) SERVOPACK Models SGDXS-470A, -550A, -590A, and -780A

1. **Connect the R1 and R2 terminals on the regenerative resistor unit to the B1/⊕ and B2 terminals on the SERVOPACK.**



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

   Refer to the following section for details on the settings.

   ☞ *5.19 Setting the Regenerative Resistor Capacity on page 212*

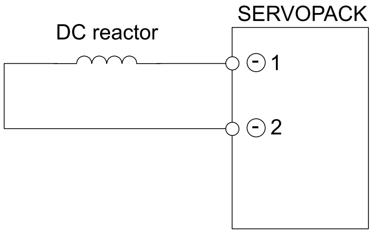
4.3.6 Wiring Reactors for Harmonic Suppression

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

📖 Σ-X-Series Peripheral Device Selection Manual (Manual No.: SIEP C710812 12)

Refer to the following figures to connect reactors.

< SERVOPACK with Three-Phase, 200-VAC Power Supply Input >



Note:

1. Connection terminals ⊖1 and ⊖2 for a DC reactor are connected when the SERVOPACK is shipped. Remove the lead wire and connect a DC reactor.
2. Reactors are optional products. (Purchase them separately.)

4.4 Wiring Servomotors

4.4.1 Terminal Symbols and Terminal Names

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

Terminal/Connector Symbols	Terminal/Connector Name	Remarks
U, V, W	Servomotor terminals	Refer to the following section for the wiring procedure. ☞ *4.3.2 Wiring Procedure for Main Circuit Connector on page 115*
⏚	Ground terminal	-
CN2	Encoder connector	-

4.4.2 Pin Layout of Connector for Encoder Cables (CN2)

(1) When Using a Rotary Servomotor

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

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

(2) When Using a Direct Drive Servomotor

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

(3) When Using a Linear Servomotor

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

4.4.3 Wiring the SERVOPACK to the Encoder

(1) When Using an Absolute Encoder

If you use an absolute encoder but not a booster unit, use one of the following methods to wire the devices.

- Use the encoder cable included with the JUSP-BA01-E battery unit.
- Install a battery on the host controller.

If you use a booster unit and an absolute encoder, use the encoder cable included with the JUSP-BA01-E battery unit.

Refer to the following section for the battery replacement procedure.

☞ *13.1.3 Replacing the Battery on page 577*

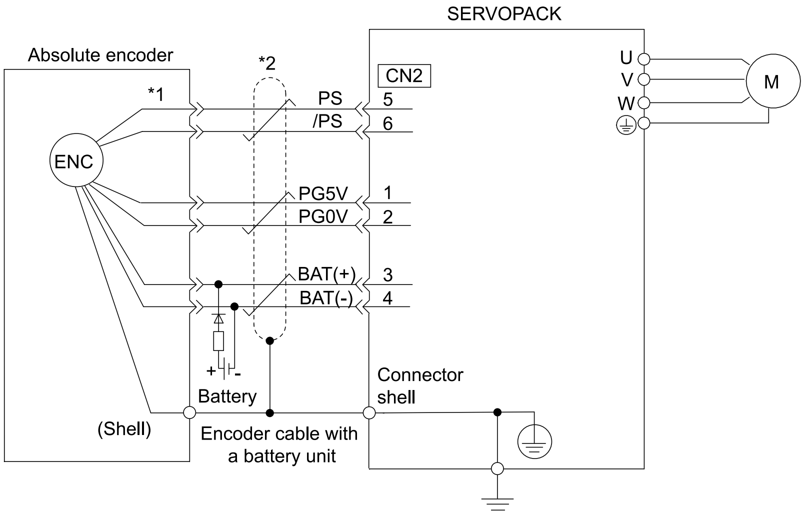
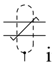


Figure 4.1 Wiring Example When Using an Encoder Cable with a Battery Unit

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

*2  indicates shielded twisted-pair cable.

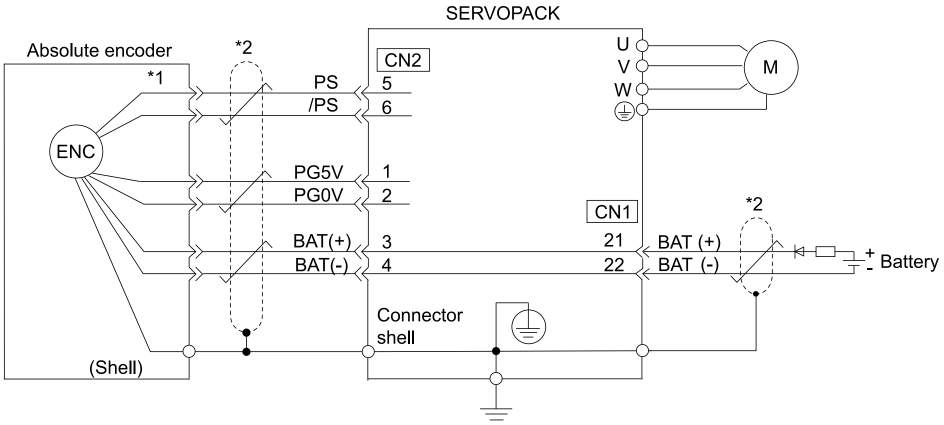


Figure 4.2 Wiring Example When Installing a Battery on the Host Controller

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

*2 indicates shielded twisted-pair cable.

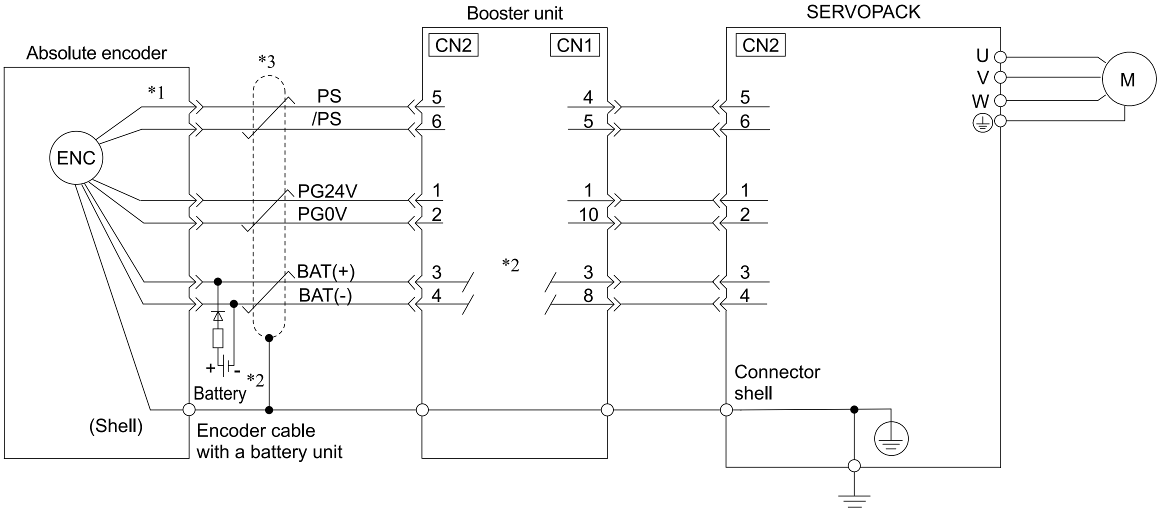


Figure 4.3 Wiring Example When Using a Booster Unit and Absolute Encoder

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

*2 CN1-3 and CN2-3 as well as CN1-8 and CN2-4 on the booster unit are not connected internally. For this reason, connect the battery to the encoder as shown in the figure when you use a booster unit and an absolute encoder.

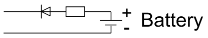
*3 indicates shielded twisted-pair cable.

Important

- When Installing a Battery on the Encoder Cable
  Use the encoder cable with a battery unit that is specified by Yaskawa.
  Refer to the following manual for details.

  Σ-X-series Peripheral Device Selection Manual (Manual No.: SIEP C710812 12)

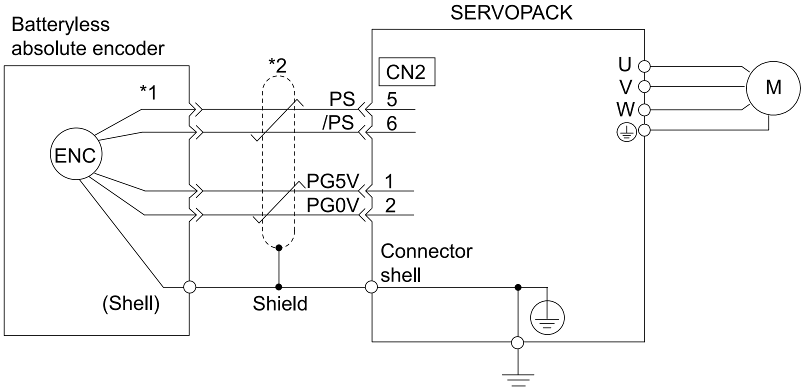
- When Installing a Battery on the Host Controller
  Insert a diode near the battery to prevent reverse current flow.
  <Circuit Example>



Required Component Specifications

- Schottky Diode
  Reverse voltage: Vr ≧ 40 V
  Forward voltage: Vf ≦ 0.37 V
  Reverse current: Ir ≦ 5 μA
  Junction temperature: Tj ≧ 125°C
- Resistor
  Resistance: 22 Ω
  Tolerance: ±5% max.
  Rated power: 0.25 W min.

(2) When Using a Batteryless Absolute Encoder



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

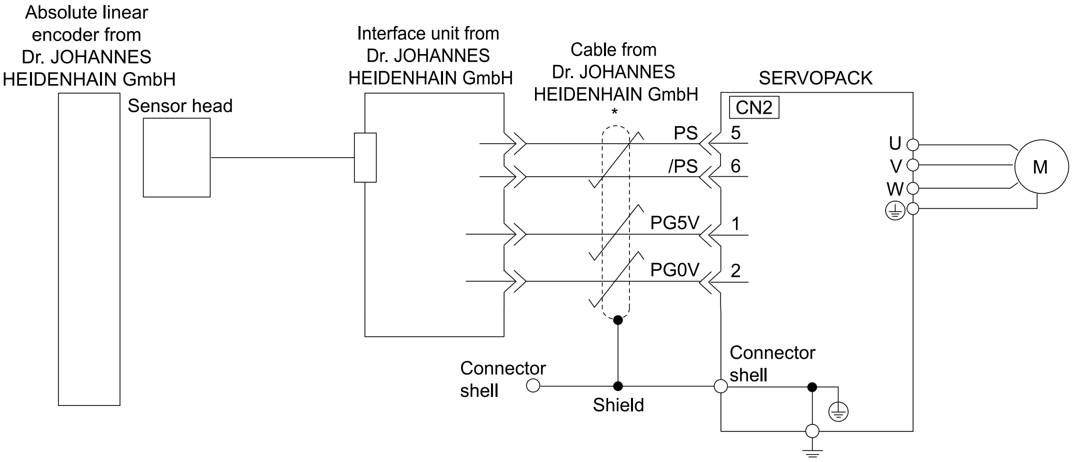
*2 represents a shielded twisted-pair cable.

(3) When Using an Absolute Linear Encoder

The wiring depends on the manufacturer of the linear encoder.

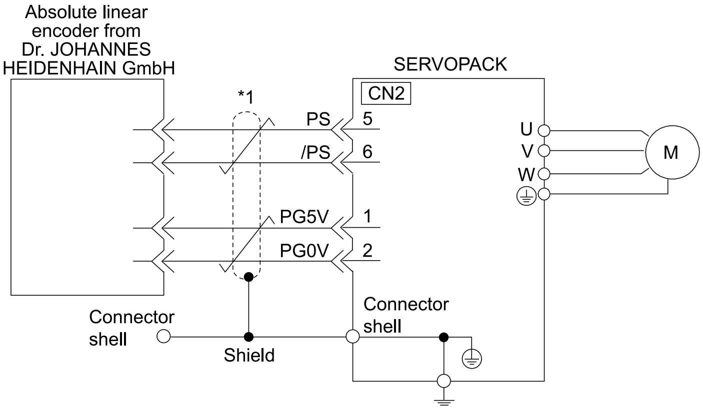
(a) Connections to Linear encoder from Dr. JOHANNES HEIDENHAIN GmbH

◆ **LC115, LC415**



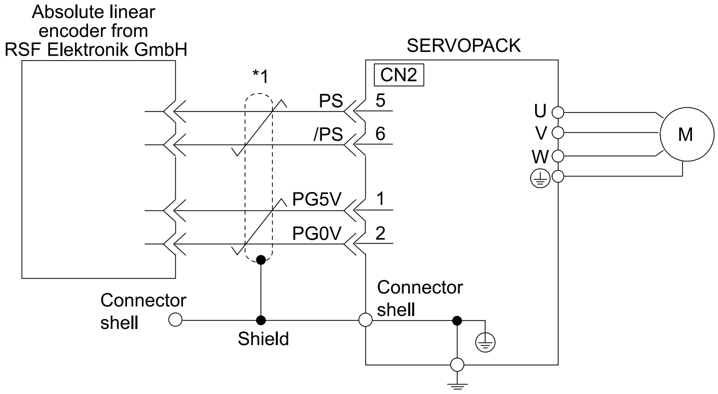
*1 represents a shielded twisted-pair cable.

◆ **LIC4190 Series and LIC2190 Series**



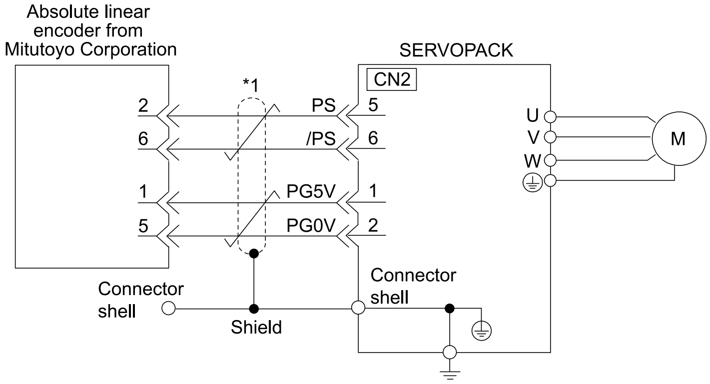
*1 represents a shielded twisted-pair cable.

(b) Connections to Linear Encoder from RSF Elektronik GmbH



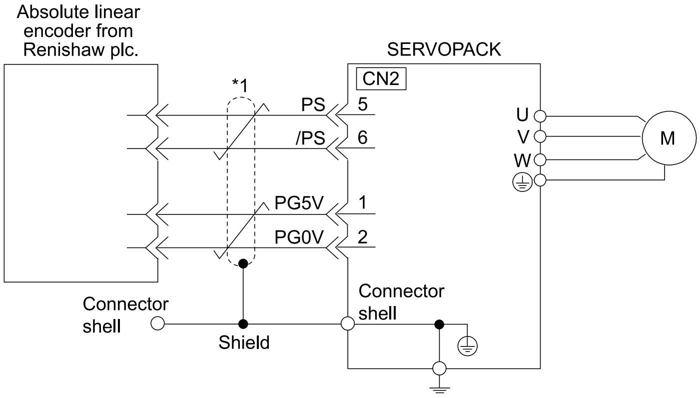
*1 represents a shielded twisted-pair cable.

(c) Connections to Absolute Linear Encoder from Mitutoyo Corporation



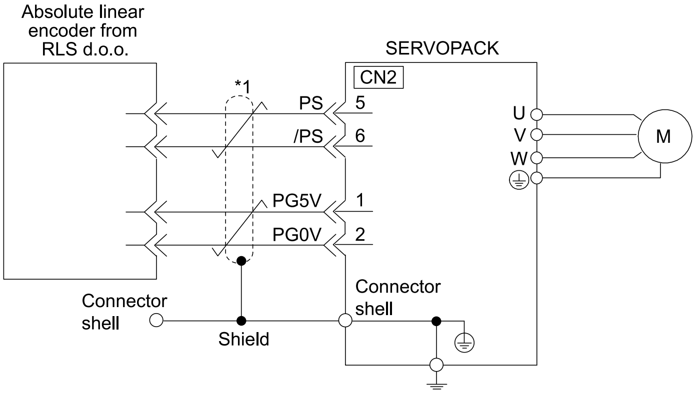
*1 represents a shielded twisted-pair cable.

(d) Connections to Absolute Linear Encoder from Renishaw PLC



*1 represents a shielded twisted-pair cable.

(e) Connections to Linear Encoder from RLS d.o.o.



*1 represents a shielded twisted-pair cable.

(f) Connections to Absolute Linear Encoder from Magnescale Co., Ltd.

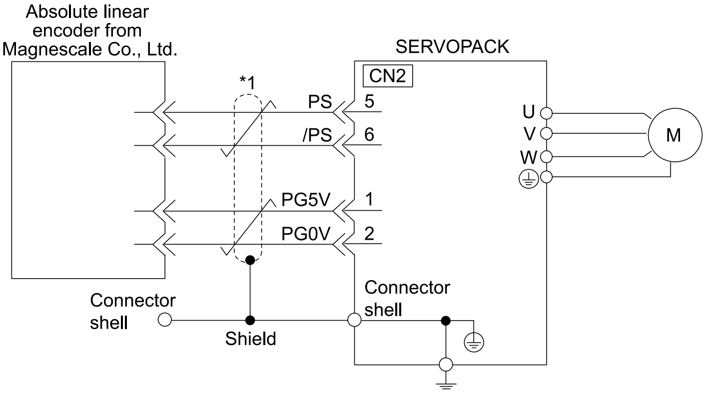
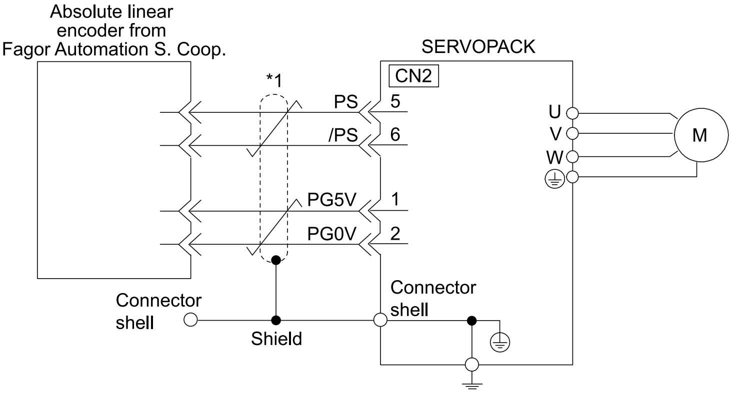


Figure 4.4 SR77, SR87, SQ47, and SQ57

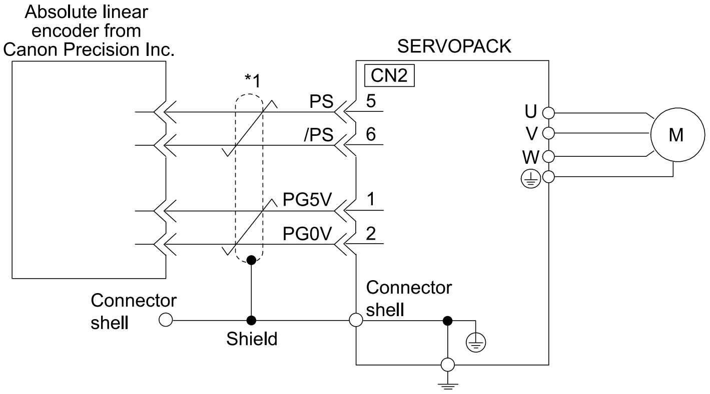
*1 represents a shielded twisted-pair cable.

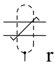
(g) Connections to Linear Encoder from Fagor Automation S. Coop.



*1 represents a shielded twisted-pair cable.

(h) Connections to Absolute Linear Encoder from Canon Precision Inc.

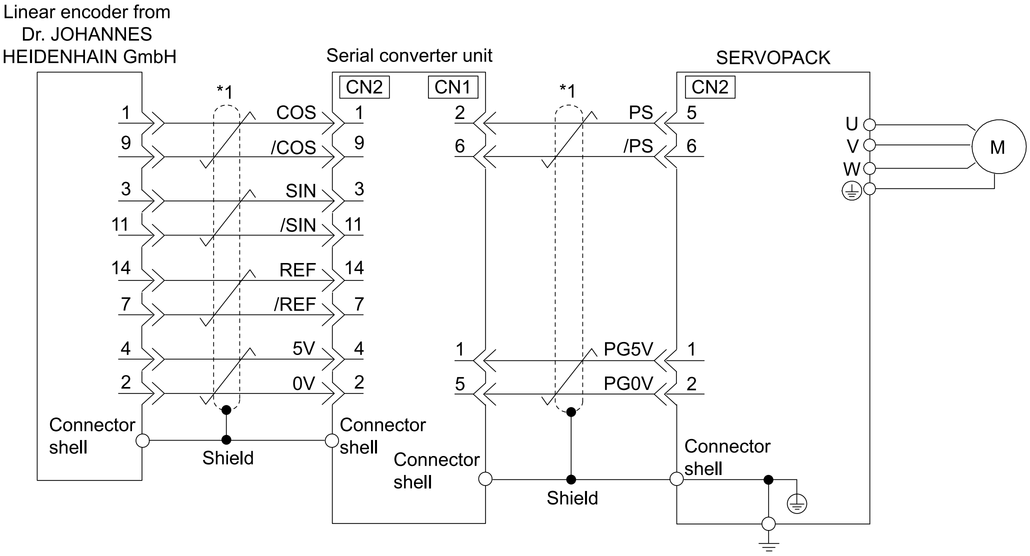


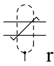
*1  represents a shielded twisted-pair cable.

(4) When Using an Incremental Linear Encoder

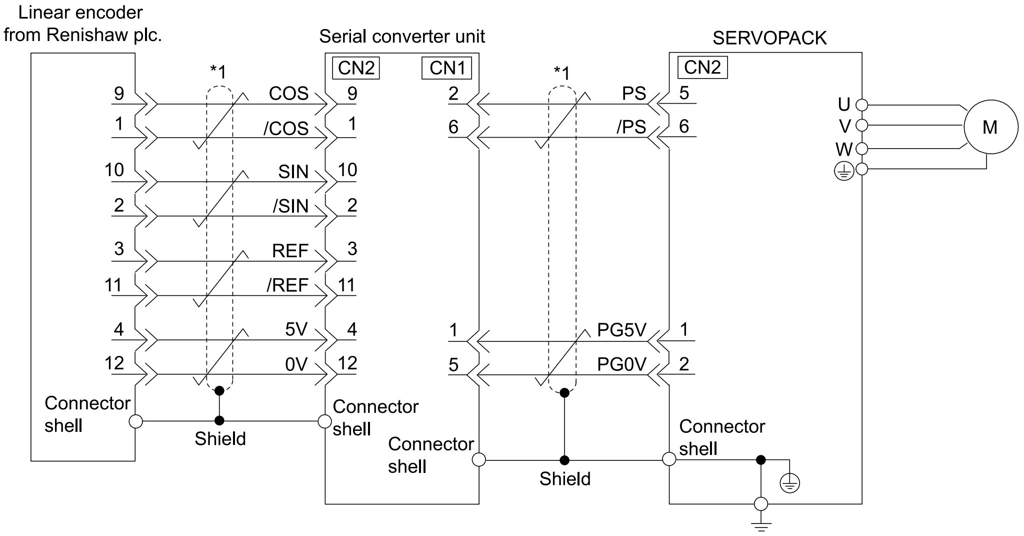
The wiring depends on the manufacturer of the linear encoder.

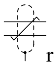
(a) Connections to Linear Encoder from Dr. JOHANNES HEIDENHAIN GmbH



*1  represents a shielded twisted-pair cable.

(b) Connections to Linear Encoder from Renishaw PLC

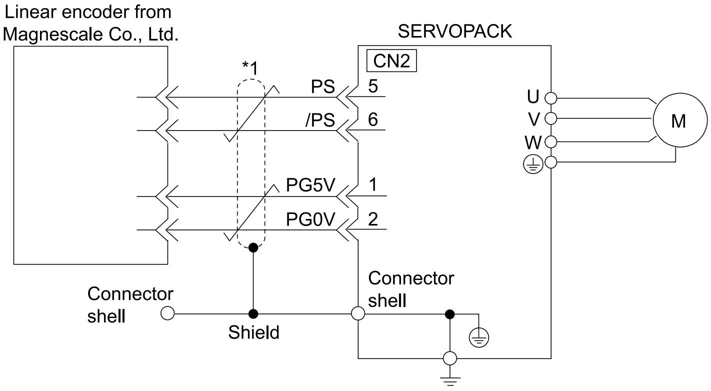


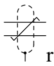
*1  represents a shielded twisted-pair cable.

(c) Connections to Linear Encoder from Magnescale Co., Ltd.

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

◆ SR75 and SR85



*1  represents a shielded twisted-pair cable.

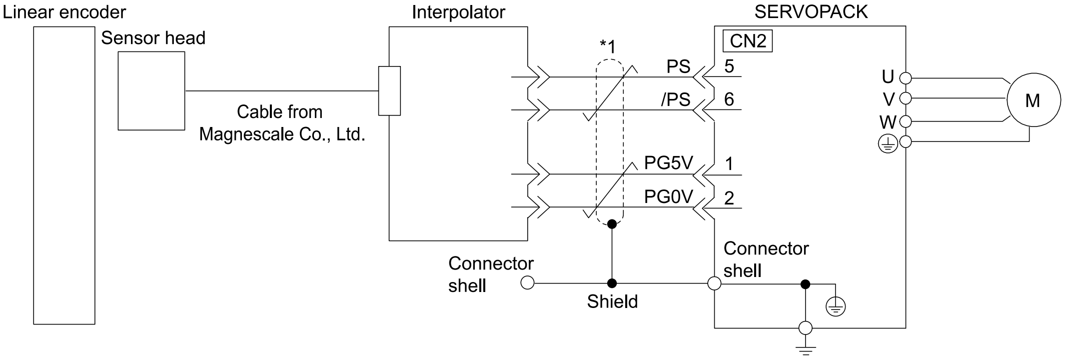
◆ SL700, SL710, SL720, SL730, SQ10

- PL101-RY, MQ10-FLA, or MQ10-GLA Interpolator

The following table gives the linear encoder and interpolator combinations.

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

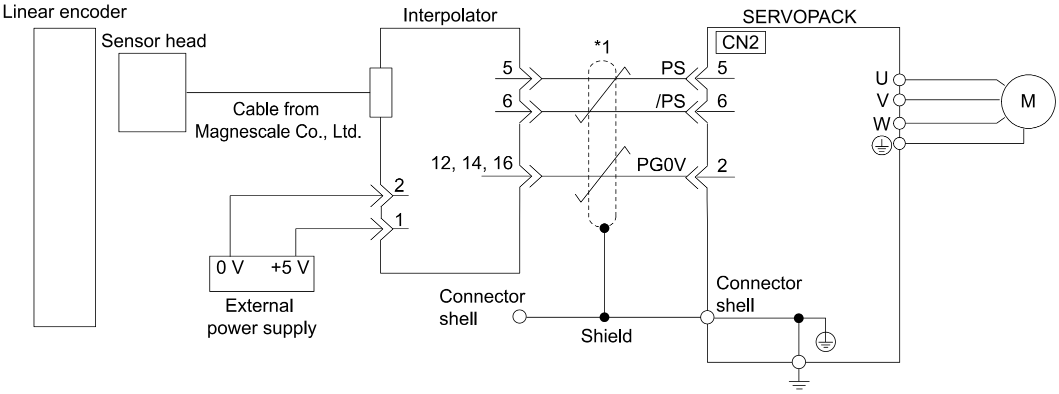
*1 This is the model of the sensor head with interpolator.
*2 This is the model of the interpolator.



*1 represents a shielded twisted-pair cable.

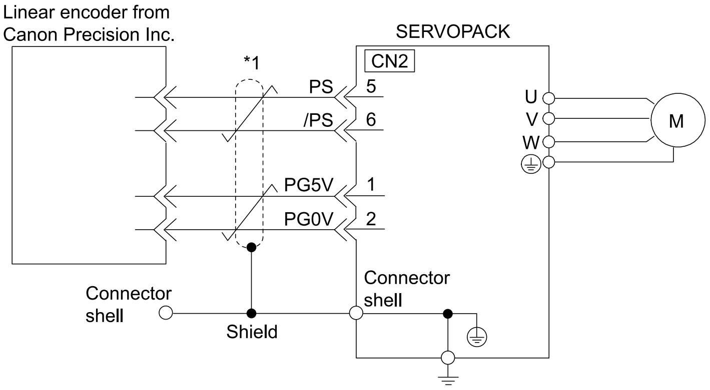
◆ SL700, SL710, SL720, and SL730

- MJ620-T13 Interpolator



*1 represents a shielded twisted-pair cable.

(d) Connections to Linear Encoder from Canon Precision Inc.



*1 represents a shielded twisted-pair cable.

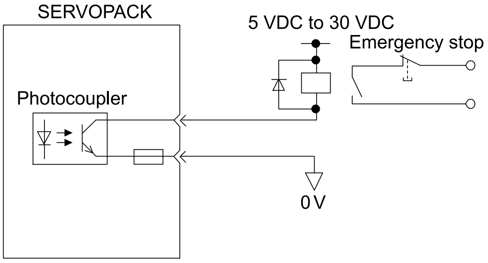
4.4.4 Wiring the SERVOPACK to the Holding Brake

Important

- If you use a rotary servomotor, select a surge absorber according to the brake current and brake power supply. Refer to the relevant manual in the following list for details.

  📖 Σ-X-series Peripheral Device Selection Manual (Manual No.: SIEP C710812 12)

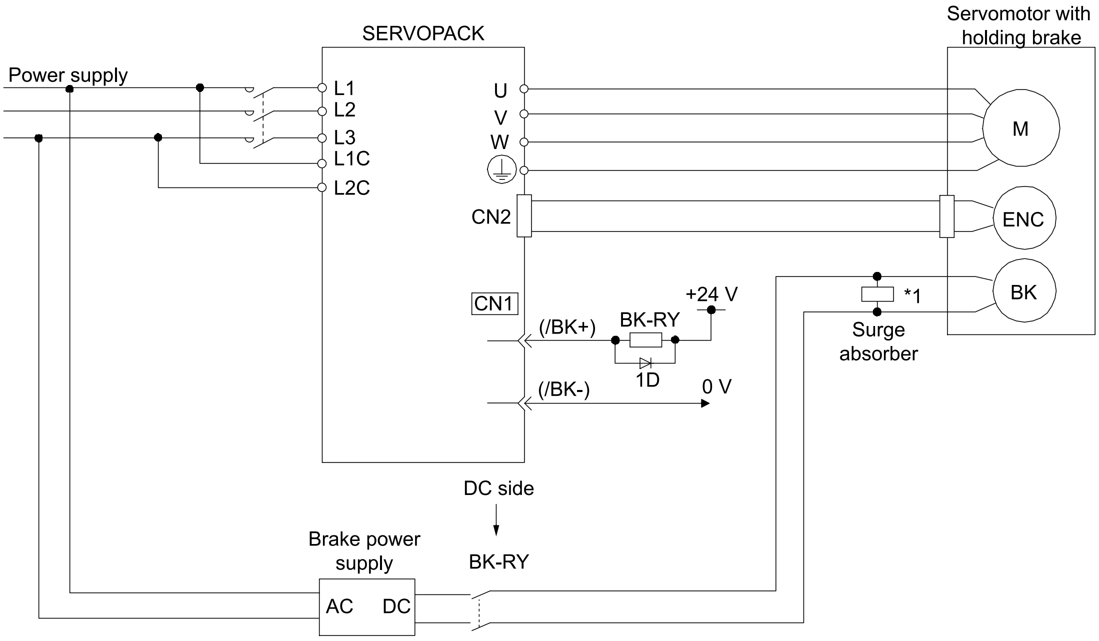
- After the surge absorber is connected, check the brake operation delay time in your application. The surge absorber may affect the brake operation delay time.
  Configure the relay circuit to activate the holding brake for an emergency stop.
  < Relay Circuit Example >



- The /BK (Brake Output) signal cannot be used with the default settings. You must allocate the output signal. Refer to the following section for details.

  ☞ *5.13.2 /BK (Brake Output) Signal on page 192*

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



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

*1 Install the surge absorber near the brake terminals on the servomotor.

4.5 I/O Signal Connections

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

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

(1) Input Signals

Default settings are given in parentheses.

Control Method	Signal	Pin No.	Name	Function	Reference Page
All Control Method	/SI0 *1 (/S-ON)	40	General-Purpose Sequence Input 0 (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).)	170
	/SI3 *1 (/P-CON)	41	General-Purpose Sequence Input 3 (Proportional Control Input)	You can allocate the input signal to use with a parameter. (Changes the speed control loop from PI (proportional/integral) to P (proportional) control when turned ON.)	476
	/SI1 *1 (P-OT)	42	General-Purpose Sequence Input 1 (Forward Drive Prohibit Input)	You can allocate the input signal to use with a parameter. (Stops servomotor drive (to prevent overtravel when the moving part of the machine exceeds the range of movement.)	186
	/SI2 *1 (N-OT)	43	General-Purpose Sequence Input 2 (Reverse Drive Prohibit Input)		
	/SI5 *1 (/P-CL)	45	General-Purpose Sequence Input 5 (Forward External Torque Limit Input)	You can allocate the input signal to use with a parameter. (Activates/deactivates external torque limiting.)	282
	/SI6 *1 (/N-CL)	46	General-Purpose Sequence Input 6 (Reverse External Torque Limit Input)		
	/SI4 *1 (/ALM-RST)	44	General-Purpose Sequence Input 4 (Alarm Reset Input)	You can allocate the input signal to use with a parameter. (Clears alarms.)	610
	+24VIN	47	Sequence Input Signal Power Supply Input	Inputs the sequence input signal power supply. Allowable voltage range: 24 VDC ±20% The 24-VDC power supply is not provided by Yaskawa.	145
	SEN	4 (2)	Absolute Data Request Input (SEN)	Inputs the position data request signal for an absolute encoder.	292, 304
	BAT+	21	Battery for Absolute Encoder (+)	These are the pins to connect the absolute encoder backup battery. **Note:** • Do not connect these pins if you use the encoder cable with a battery unit. • Do not connect these pins if you use a booster unit. Always use an encoder cable with a battery unit to connect the booster unit and absolute encoder.	125
	BAT-	22	Battery for Absolute Encoder (-)		
	TH	50	Overheat Protection Input	Inputs the overheat protection signal from a linear servomotor or from a sensor attached to the machine.	324
Speed Control	V-REF	5 (6)	Speed Reference	Inputs the speed reference. Maximum input voltage: ±12 V	229

Continued on next page.

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Control Method	Signal	Pin No.	Name	Function	Reference Page
Position Control	PULS /PULS	7 8	Pulse Reference Input	One of the following input pulse forms is set. • Sign + pulse train • CW + CCW pulse trains • 90° phase-differential pulses	247
	SIGN /SIGN	11 12	Sign Reference Input		
	CLR /CLR	15 14	Position Deviation Clear Input	Clears the position deviation during position control.	249
Torque Control	T-REF	9 (10)	Torque Reference Input	Inputs the torque reference. Maximum input voltage: ±12 V	256

*1 You can change the allocations. Refer to the following section for details.
☞ *6.1.3 Input Signal Allocations on page 220*

Note:

1. Pin numbers in parentheses ( ) indicate signal grounds.
2. If forward drive prohibition or reverse drive prohibition is used, the SERVOPACK is stopped by software controls. If the application does not satisfy the safety requirements, add external safety circuits as required.

(2) Output Signals

Default settings are given in parentheses.

Control Method	Signal	Pin No.	Name	Function	Reference Page
All Control Method	ALM+	31	Servo Alarm Output	Turns OFF (opens) when an error is detected.	225
	ALM-	32			
	/SO2+ *1 (/TGON+)	27	General-Purpose Sequence Output 2 (Rotation Detection Output)	You can allocate the output signal to use with a parameter. (Turns ON (closes) when the servomotor speed exceeds a set value.)	227
	/SO2- *1 (/TGON-)	28			
	/SO3+ *1 (/S-RDY+)	29	General-Purpose Sequence Output 3 (Servo Ready Output)	You can allocate the output signal to use with a parameter. (Turns ON (closes) when the SERVOPACK is ready to acknowledge the /SON (Servo ON) signal.)	228
	/SO3- *1 (/S-RDY-)	30			
	PAO	33	Encoder Divided Pulse Output, Phase A	Output the encoder divided pulse output signals with a 90° phase differential.	292, 304
	/PAO	34			
	PBO	35	Encoder Divided Pulse Output, Phase B		
	/PBO	36			
	PCO	19	Encoder Divided Pulse Output, Phase C	Outputs the origin signal once every encoder rotation.	
	/PCO	20			
	PSO	48	Absolute Encoder Position Output	Outputs the position data of the absolute encoder.	
	/PSO	49			
	ALO1 *1	37 (1)	Alarm Code Output	Output a 3-bit alarm code.	226
	ALO2 *1	38 (1)			
	ALO3 *1	39 (1)			
	FG	Shell	Frame Ground	Connected to the frame ground if the shield of the I/O signal cable is connected to the connector shell.	–
Speed Control	/SO1+ *1 (/V-CMP+)	25	General-Purpose Sequence Output 1 (Speed Coincidence Detection Output)	You can allocate the output signal to use with a parameter. (Turns ON (closes) if the motor speed is within the set range and matches the reference speed value when speed control is selected.)	242
	/SO1- *1 (/V-CMP-)	26			
Position Control	/SO1+ *1 (/COIN+)	25	General-Purpose Sequence Output 1 (Positioning Completion Output)	You can allocate the output signal to use with a parameter. (Turns ON (closes) if the position deviation reaches the set value when position control is selected.)	252
	/SO1- *1 (/COIN-)	26			
	PL1	3	Open-Collector Power Output for Reference Pulses	Outputs the open-collector power supply for reference pulses.	145
	PL2	13			
	PL3	18			
–	–	16 17 23 24	–	Do not use these terminals.	–

*1 You can change the allocations. Refer to the following section for details.
☞ *6.1.4 Output Signal Allocations on page 224*

Note:

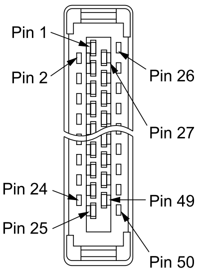
Pin numbers in parentheses ( ) indicate signal grounds.

4.5.2 I/O Signal Connector (CN1) Pin Layout

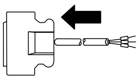
The following figure gives the pin layout of the I/O signal connector (CN1) for the default settings.

Note:

The connector on this SERVOPACK is the same as the connector on the Σ-XT SERVOPACK. Before trial operation, confirm that the connector is connected correctly.



The illustration to the left and the following table are from the direction of the following arrow without the connector shell attached.



2	SG	Signal Ground	1	SG	Signal Ground	27	/SO2+ (/TGON+)	General-Purpose Sequence Output 2	26	/SO1- (/V-CMP-)	General-Purpose Sequence Output 1
4	SEN	Absolute Data Request Input (SEN)	3	PL1	Open-Collector Power Output for Reference Pulses	29	/SO3+ (/S-RDY+)	General-Purpose Sequence Output 3	28	/SO2- (/TGON-)	General-Purpose Sequence Output 2
6	SG	Signal Ground	5	V-REF	Speed Reference Input	31	ALM+	Servo Alarm Output	30	/SO3- (/S-RDY-)	General-Purpose Sequence Output 3
8	/PULS	Pulse Reference Input	7	PULS	Pulse Reference Input	33	PAO	Encoder Divided Pulse Output, Phase A	32	ALM-	Servo Alarm Output
10	SG	Signal Ground	9	T-REF	Torque Reference Input	35	PBO	Encoder Divided Pulse Output, Phase B	34	/PAO	Encoder Divided Pulse Output, Phase A
12	/SIGN	Sign Reference Input	11	SIGN	Sign Reference Input	37	ALO1	Alarm Code Output	36	/PBO	Encoder Divided Pulse Output, Phase B
14	/CLR	Position Deviation Clear Input	13	PL2	Open-Collector Power Output for Reference Pulses	39	ALO3	Alarm Code Output	38	ALO2	Alarm Code Output
16	–	–	15	CLR	Position Deviation Clear Input	41	/SI3 (/P-CON)	General-Purpose Sequence Input 3	40	/SI0 (/S-ON)	General-Purpose Sequence Input 0
18	PL3	Open-Collector Power Output for Reference Pulses	17	–	–	43	/SI2 (N-OT)	General-Purpose Sequence Input 2	42	/SI1 (P-OT)	General-Purpose Sequence Input 1
20	/PCO	Encoder Divided Pulse Output, Phase C	19	PCO	Encoder Divided Pulse Output, Phase C	45	/SI5 (/P-CL)	General-Purpose Sequence Input 5	44	/SI4 (/ALM-RST)	General-Purpose Sequence Input 4
22	BAT-	Battery for Absolute Encoder (-)	21	BAT+	Battery for Absolute Encoder (+)	47	+24VIN	Sequence Input Signal Power Supply Input	46	/SI6 (/N-CL)	General-Purpose Sequence Input 6

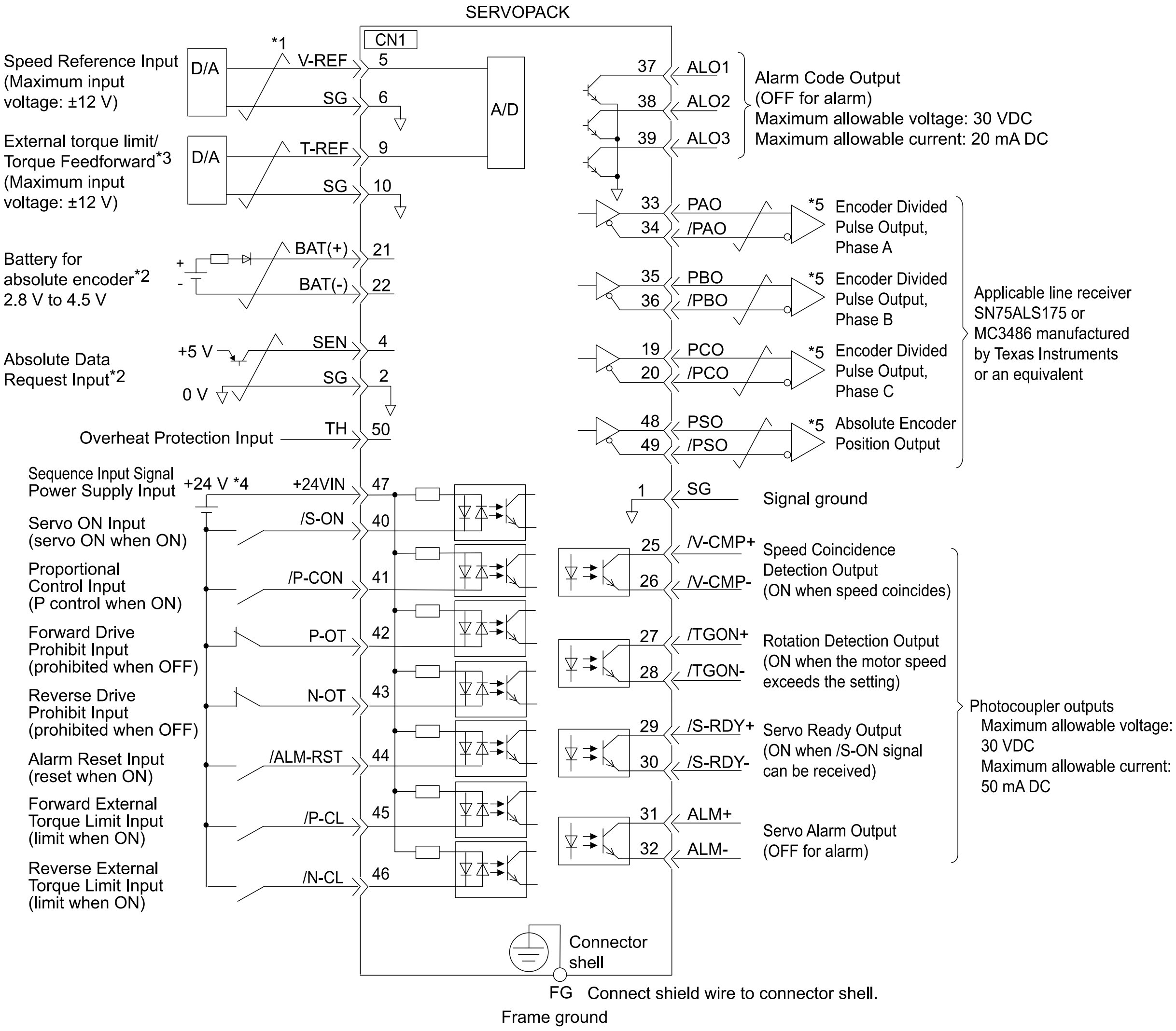
Continued on next page.

Continued from previous page.

24	–	–	23	–	–	49	/PSO	Absolute Encoder Position Output	48	PSO	Absolute Encoder Position Output
–	–	–	25	/SO1+ (/V-CMP+)	General-Purpose Sequence Output 1	–	–	–	50	TH	Overheat Protection Input

4.5.3 I/O Signal Wiring Examples

(1) Speed Control with a Rotary Servomotor

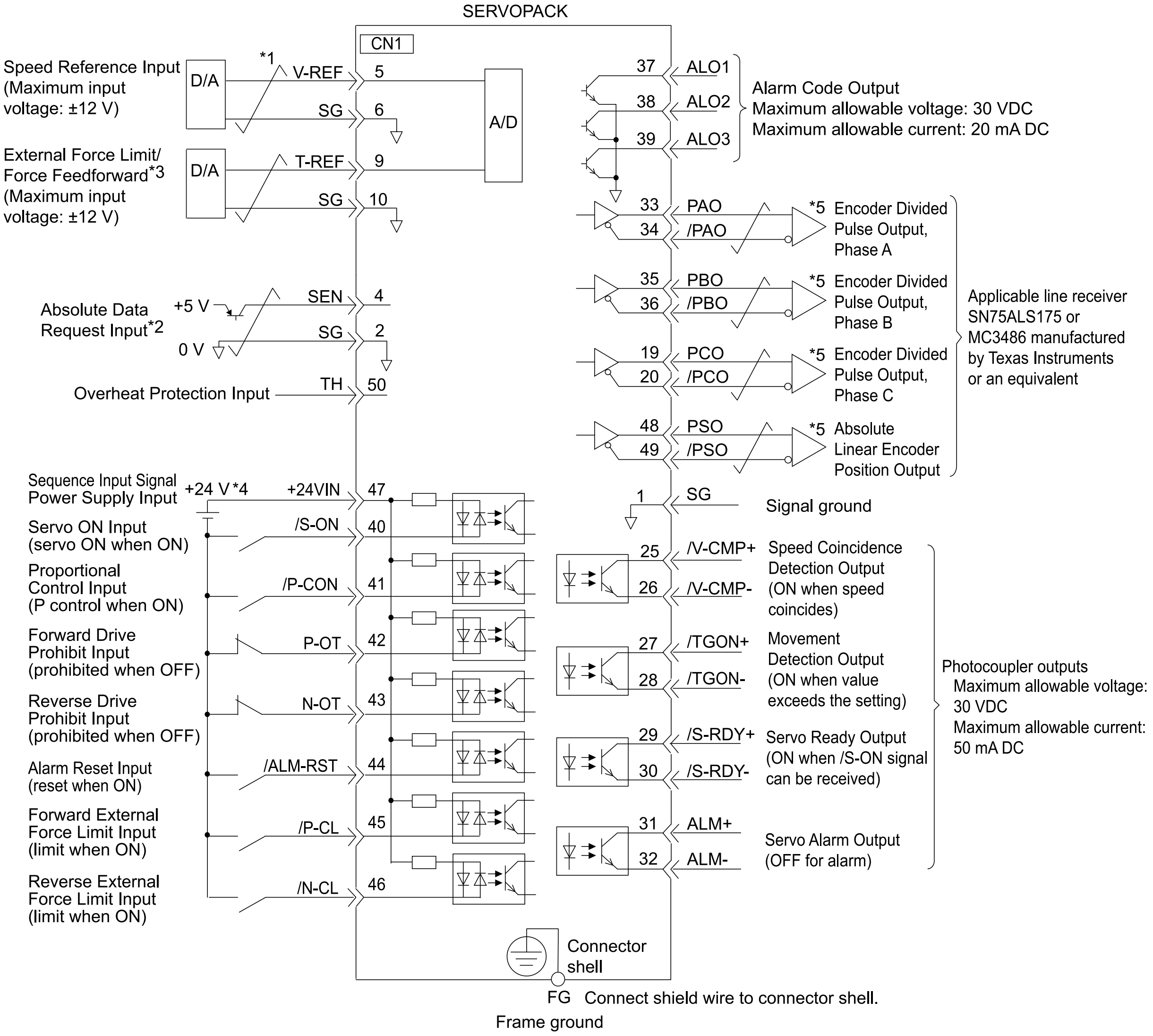


*1 ⌿ represents twisted-pair wires.
*2 Connect these when using an absolute linear encoder.
*3 You can enable this function with a parameter setting.
*4 The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.
*5 Always use line receivers to receive the output signals.

Note:

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

(2) Speed Control with a Linear Servomotor



*1 represents twisted-pair wires.

*2 Connect these when using an absolute linear encoder.

*3 You can enable this function with a parameter setting.

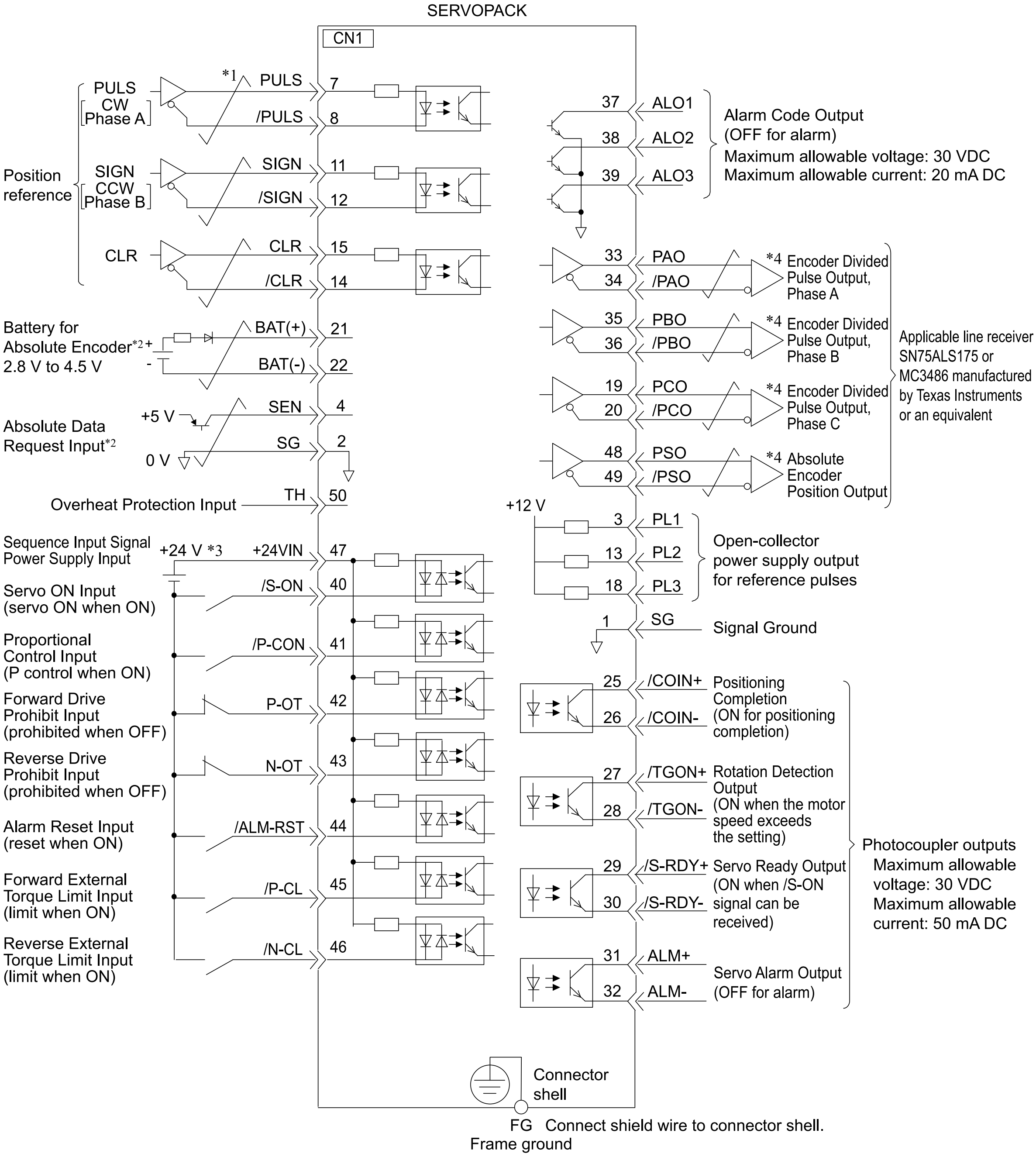
*4 The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.

*5 Always use line receivers to receive the output signals.

Note:

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

(3) Position Control with a Rotary Servomotor

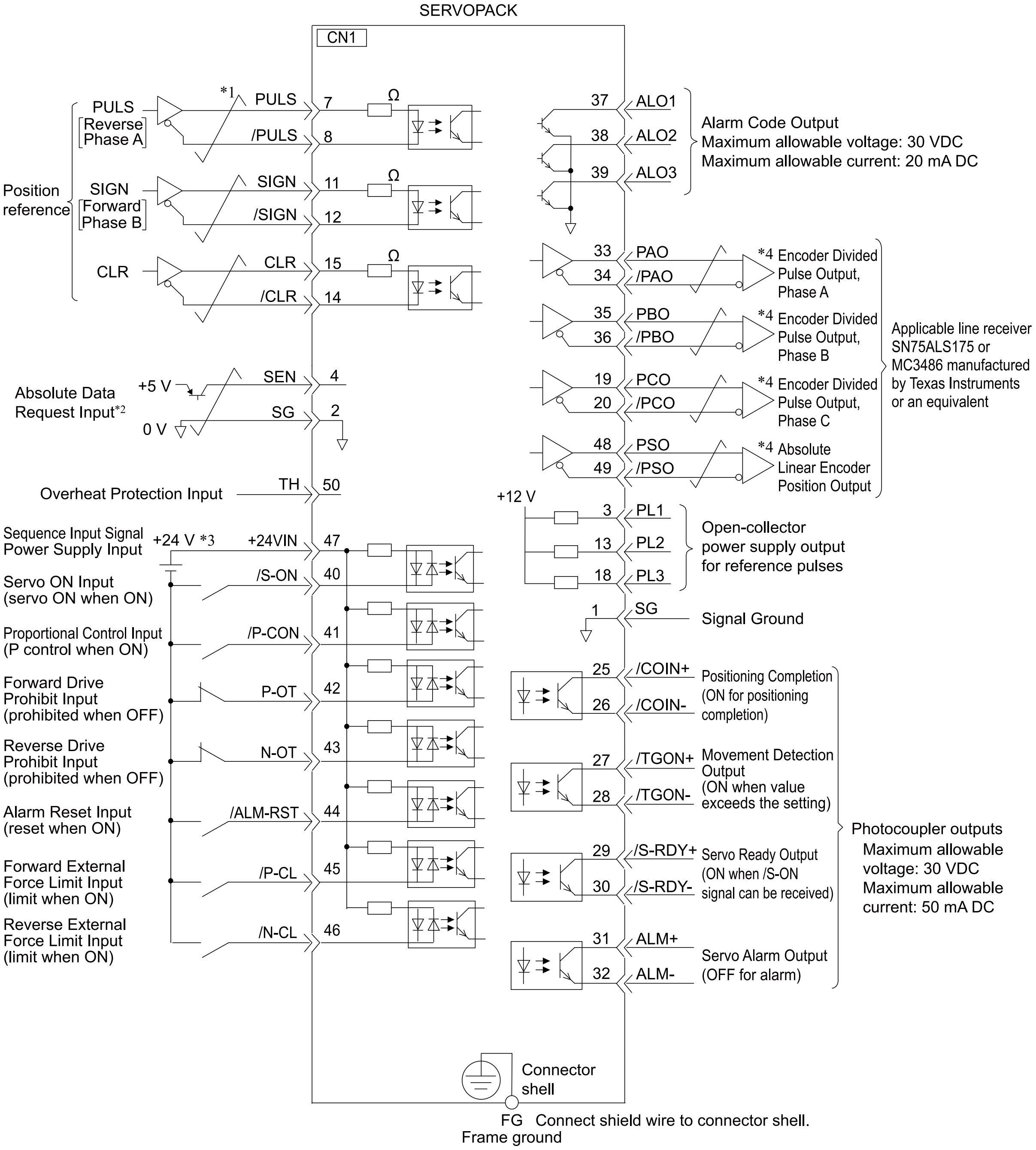


*1 represents twisted-pair wires.
*2 Connect these when using an absolute encoder. If the encoder cable with a battery unit is connected, do not connect a backup battery.
*3 The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.
*4 Always use line receivers to receive the output signals.

Note:

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

(4) Position Control with a Linear Servomotor

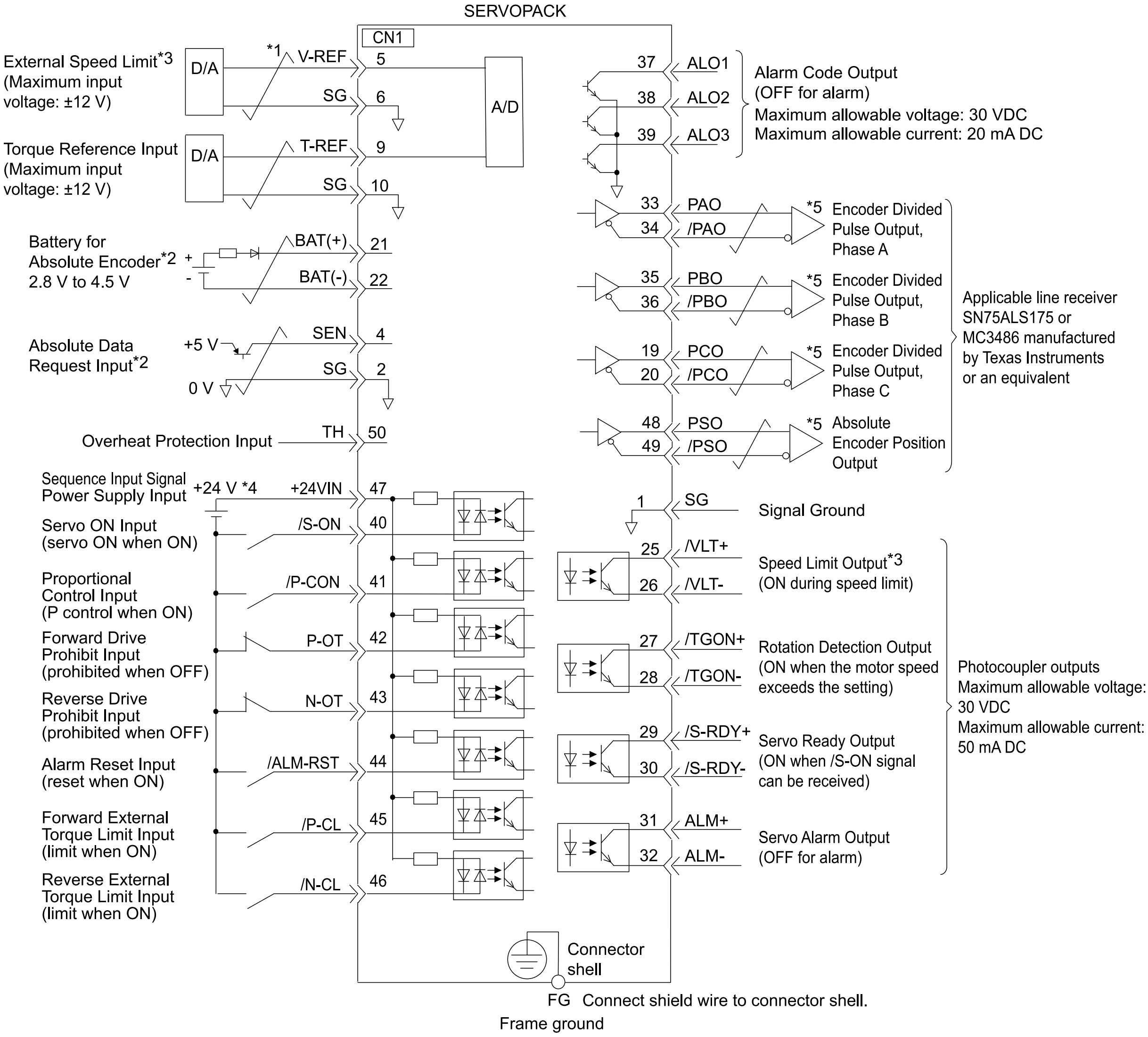


*1 represents twisted-pair wires.
*2 Connect these when using an absolute linear encoder.
*3 The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.
*4 Always use line receivers to receive the output signals.

Note:

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

(5) Torque Control with a Rotary Servomotor

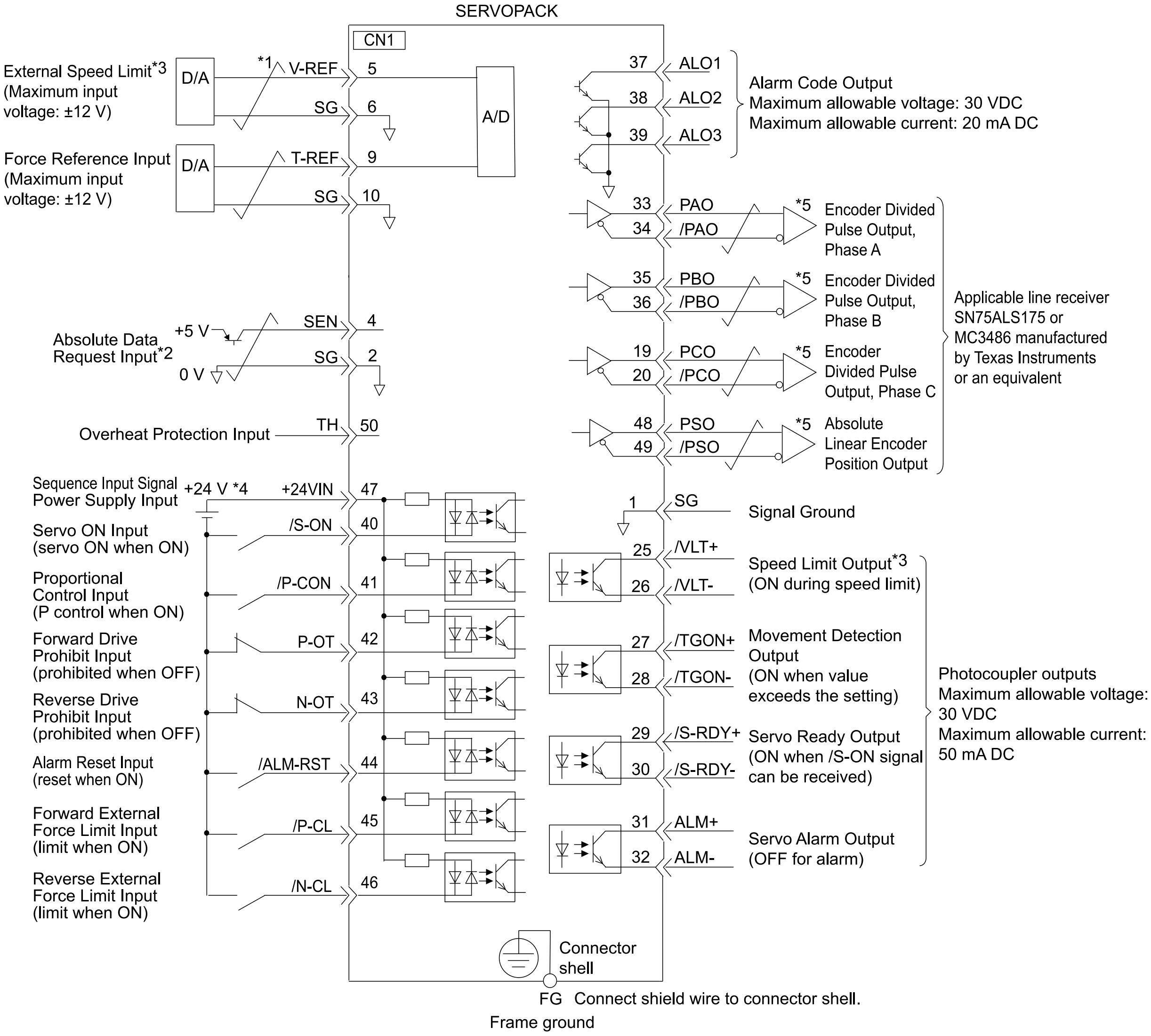


*1 represents twisted-pair wires.
*2 Connect these when using an absolute encoder. If the encoder cable with a battery unit is connected, do not connect a backup battery.
*3 You can enable this function with a parameter setting.
*4 The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.
*5 Always use line receivers to receive the output signals.

Note:

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

(6) Torque Control with a Linear Servomotor



*1 represents twisted-pair wires.
*2 Connect these when using an absolute linear encoder.
*3 You can enable this function with a parameter setting.
*4 The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.
*5 Always use line receivers to receive the output signals.

Note:

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

4.5.4 I/O Circuits

(1) Reference Input Circuits

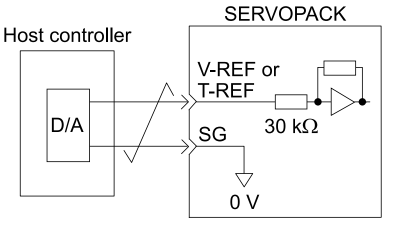
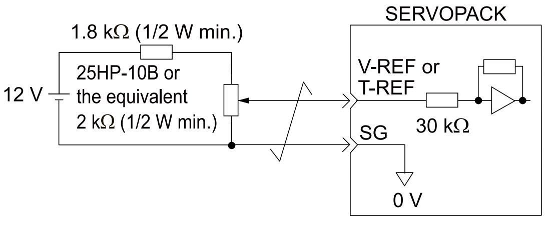
(a) Analog Input Circuits

This section describes CN1 connector terminals 5-6 (Speed Reference Input) and 9-10 (Torque Reference Input).

The analog signals are used as either speed or torque reference signals. The input impedance is as follows:

- Speed Reference Input: 30 kΩ
- Torque Reference Input: 30 kΩ

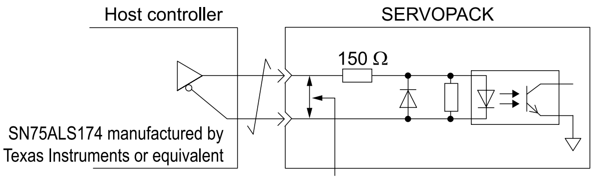
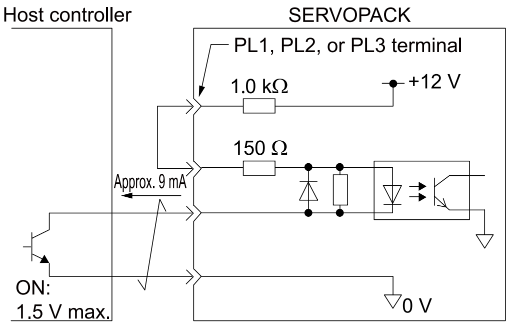
The maximum allowable voltage for input signals is ±12 V.

Analog Voltage Input Circuit (Example for D/A)	Analog Voltage Input Circuit (Wiring Example for Forward Operation)
	

(b) Position Reference Input Circuits

This section describes CN1 connector terminals 7-8 (Reference Pulse Input), 11-12 (Reference Sign Input), and 15-14 (Clear Input).

The output circuits for the reference pulses and Position Deviation Clear signal from the host controller can be either line-driver outputs or open-collector outputs. The following diagrams show these by output type.

Line-Driver Output Circuits	Open-Collector Output Circuits (12-V Power Supply in SERVOPACK)
 2.9 V ≤ (High level) − (Low level) ≤ 3.6 V If the above formula is not satisfied, the inputs to the SERVOPACK will be unstable. Pulses may be missed from the reference pulse input, reference inversion may occur for the reference sign input, and the clear signal may turn OFF for the clear input.	

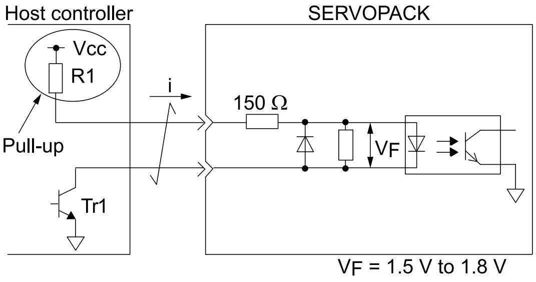
Precaution When Host Controller Uses Open-Collector Output with User-Supplied Power Supply

Important

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)	Output Current (i)
24 VDC	1.8 kΩ to 2.7 kΩ	20 mA max.
12 V max.	820 Ω to 1.5 kΩ	
5 V max.	180 Ω to 470 Ω	

< Circuit Example for Open-Collector Outputs >



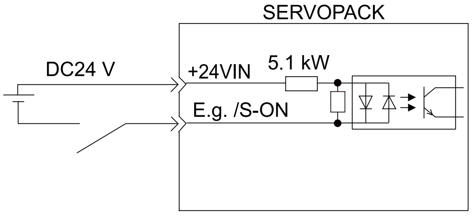
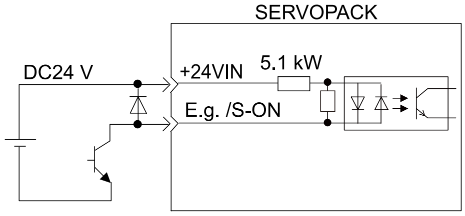
V_F = 1.5 V to 1.8 V

(2) Sequence Input Circuits

(a) Photocoupler Input Circuits

This section describes CN1 connector terminals 40 to 47.

The circuits are connected through relay or open-collector transistor circuits. If you connect through a relay, use a extremely low-current relay. If you do not use a extremely low-current relay, a poor contact may result.

Examples for Relay Circuits	Examples for Open-Collector Circuits
	

Note:

For the external power supply (24 VDC), use a power supply with a capacity of 50 mA or higher.

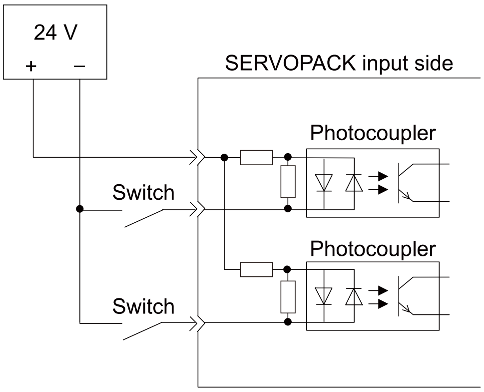
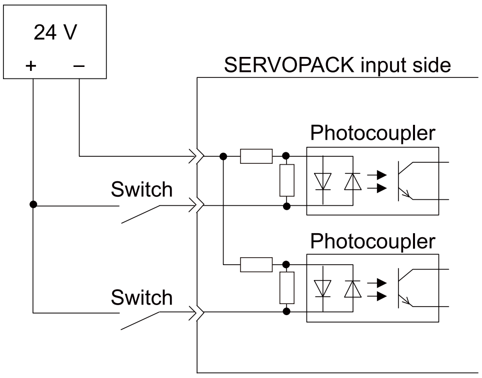
Information Refer to the following sections for the interface for the SEN signal input circuit.

- When Using an Absolute Encoder
  ☞ *(2) Connecting the SEN (Absolute Data Request Input) Signal on page 295*
- When Using an Absolute Linear Encoder
  ☞ *(2) Connecting the SEN (Absolute Data Request Input) Signal on page 306*

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

Note:

The connection examples in *4.5.3 I/O Signal Wiring Examples on page 139* are for sink circuit connections.

Sink Circuits	Source Circuits
	

Input signal status		Input signal status	
Switch	Photocoupler	Switch	Photocoupler
Close	ON	Close	ON
Open	OFF	Open	OFF

(3) Sequence Output Circuits

Important

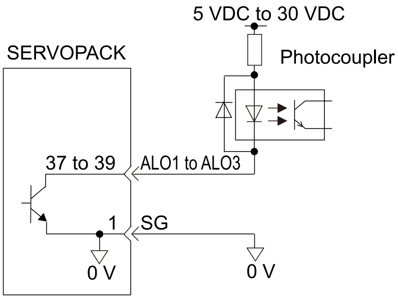
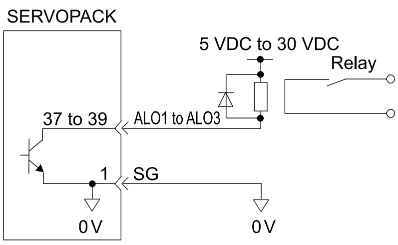
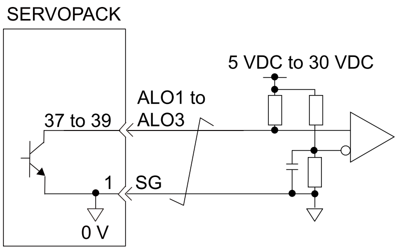
Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures.

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

(a) Open-Collector Output Circuits

This section describes CN1 connector terminals 37 to 39 (Alarm Code Output).

The Alarm Code (ALO1, ALO2, and ALO3) signals are output from open-collector transistor output circuits. Connect an open-collector output circuit to a photocoupler, relay, or line-receiver circuit.

Example for Photocoupler Circuit	Example for Relay Circuit	Example for Line-Receiver Circuit
		

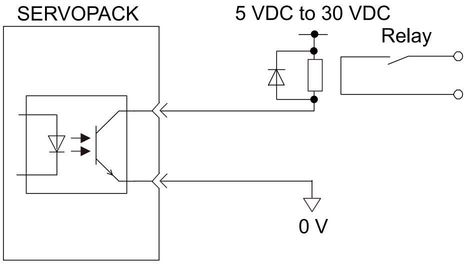
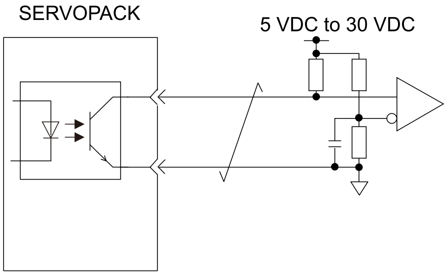
Note:

The maximum allowable voltage and maximum allowable current for open-collector output circuits are as follows:

- Maximum allowable voltage: 30 VDC
- Maximum allowable current: 20 mA DC

(b) Photocoupler Output Circuits

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

Examples for Relay Circuits	Example for Line Receiver Circuit
	

Note:

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

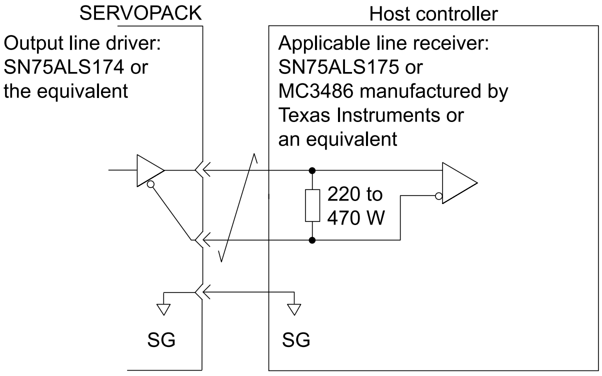
- Maximum allowable voltage: 30 VDC
- Current range: 5 mA to 50 mA DC

(c) Line-Driver Output Circuits

This section describes CN1 connector pins 33-34 (Phase-A Signal), 35-36 (Phase-B Signal), 19-20 (Phase-C Signal) and 48-49 (Phase-S Signal).

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

<Example for Line-Receiver Circuit>



4.6 Connecting Safety Function Signals

This section describes the wiring required to use a safety function.

Refer to the following chapter for details on the safety function.

☞ *12 Safety Functions on page 563*

4.6.1 Pin Layout of Safety Function Signals (CN8)

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

Whether or not you use the EDM1 signal does not affect the performance level of safety parameters.

4.6.2 I/O Circuits

Important

For Safety Function signal connections, the input signal is the 0-V common and the output signal is a source output. This is opposite to other signals described in this manual. To avoid confusion, the ON and OFF status of signals for the Safety Function are defined as follows:

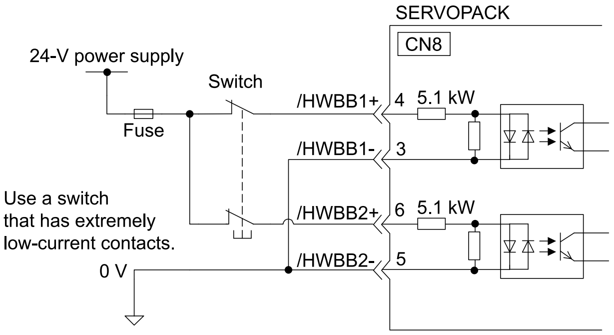
ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.

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

(1) Safety Input Circuits

Use a 0-V common to connect the Safety Function signals. You must connect redundant input signals.

< Input Signal Connection Example >



(a) Input (HWBB) Signal Specifications

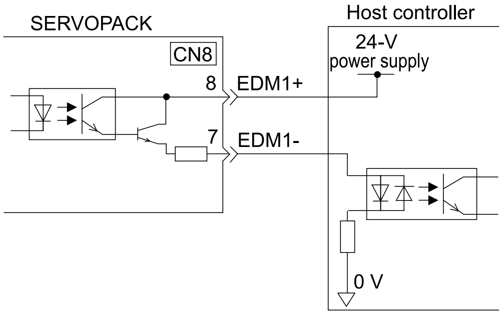
Type	Signal	Connector Pin No.	Status	Meaning
Input	/HWBB1	CN8-4 CN8-3	ON (closed)	Does not activate the HWBB (normal operation).
			OFF (open)	Activates the HWBB (motor current interruption request).
	/HWBB2	CN8-6 CN8-5	ON (closed)	Does not activate the HWBB (normal operation).
			OFF (open)	Activates the HWBB (motor current interruption request).

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

Item	Characteristics	Remarks
Internal Impedance	5.1 kΩ	–
Allowable Voltage Range	+24 V± 20%	For the 24-V power supply, use an SELV power supply.
Response Time	4 ms	Time from /HWBB1 and /HWBB2 signals turning OFF until HWBB is activated

(2) Diagnostic Output Circuits

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



(a) EDM1 Output Signal Specifications

Type	Signal	Connector Pin No.	Status	Meaning
Output	EDM1	CN8-8 CN8-7	ON	Both the /HWBB1 and /HWBB2 signals are operating normally.
			OFF	The /HWBB1 signal, the /HWBB2 signal, or both are not operating.

The electrical characteristics of the EDM1 signal are as follows:

Item	Characteristics	Remarks
Maximum Allowable Voltage	30 VDC	–
Maximum Allowable Current	50 mA DC	–
Maximum ON Voltage Drop	1.0 V	Voltage between EDM1+ and EDM1- when current is 50 mA
Response Time	4 ms	Time from a change in /HWBB1 or /HWBB2 until a change in EDM1

4.7 Connecting the SigmaWin+

To connect a computer on which the SigmaWin+ is installed, connect CN7 on the SERVOPACK.

Important

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

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

📖 Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

4.8 Connecting a Digital Operator

There are two types of digital operators that can be connected to the SERVOPACK. The connector to use depends on your digital operator.

Digital Operator Type	Connector on SERVOPACK
JUSP-OP05A-1-E	CN3
JUSP-OP07A-E	CN7

Important Do not connect the two types of digital operator at the same time.

Refer to the following manual for the operating procedures for the digital operator.

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

4.9 Connecting a Computer

To connect a computer with an RS-422 cable, connect CN3 on the SERVOPACK.

Important

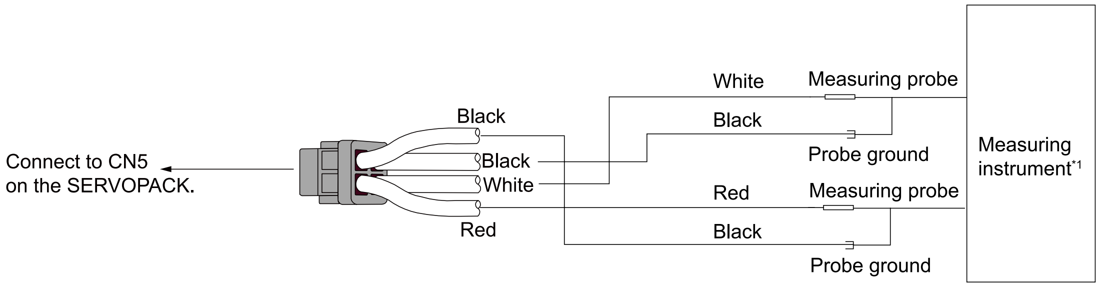
To connect a computer in applications that use the SigmaWin+, refer to the following section.

☞ *4.7 Connecting the SigmaWin+ on page 150*

4.10 Using the Analog Monitors

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

- Wiring Example



*1 The measuring instrument is not provided by Yaskawa.

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

☞ *9.3 Monitoring Machine Operation Status and Signal Waveforms on page 511*

5

Basic Functions That Require Setting before Operation

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

5.1 Parameter (Pn□□□) Operations

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.

Important

When you edit parameters with the SigmaWin+, setup parameters and tuning parameters are displayed.

When you edit parameters with a panel operator or digital operator, only setup parameters are displayed by default. To edit tuning parameters, set Pn00B to n.□□□1 (display all parameters).

Pn00B	n.□□□X	Operator Parameter Display Selection Speed Pos Trq		When Enabled
		0 Default	Display only setup parameters.	After restart
		1	Display all parameters.	

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

(1) Setup Parameters

You can use the panel operator, digital operator, or SigmaWin+ to set the setup parameters individually.

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

(2) 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 section for details.

☞ *8.7 Autotuning without a Host Reference on page 394*

☞ *8.8 Autotuning with a Host Reference on page 407*

☞ *8.9 Custom Tuning on page 422*

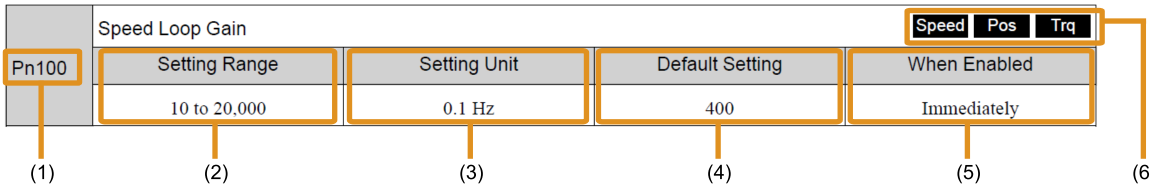
You can also set the tuning parameters individually to make adjustments. Refer to the following section for details.

☞ *8.15 Manual Tuning on page 478*

5.1.2 Notation for Parameters

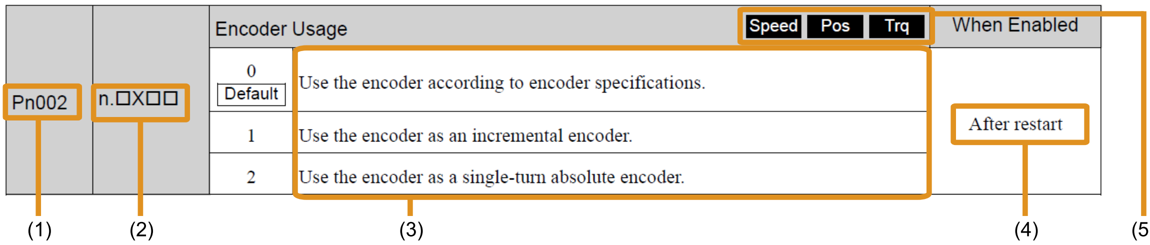
The notation depends on whether the parameter requires a numeric setting (parameter for numeric setting) or requires the selection of a function (parameter for selecting functions).

(1) Parameters for Numeric Settings



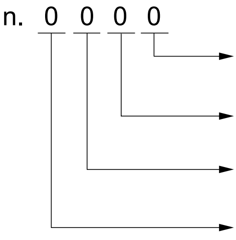
No.	Description
(1)	Parameter number
(2)	This is the setting range for the parameter.
(3)	This is the setting unit (setting increment) that you can set for the parameter.
(4)	This is the parameter setting before shipment.
(5)	This is when any change made to the parameter will become effective.
(6)	The control methods for which the parameters apply are given. **Speed**: A parameter that can be used in speed control. **Pos**: A parameter that can be used in position control. **Trq**: A parameter that can be used in torque control. "Torque" is used even for linear servomotor parameters. Grayed-out icons (Speed, Pos, Trq) indicate parameters that cannot be used in the corresponding control method.

(2) Parameters for Selecting Functions



No.	Description
(1)	Parameter number
(2)	The notation “n.□□□□” indicates a parameter for selecting functions. The digit shown as "X" is the content being explained in this parameter. Notation Example (see below)
(3)	This column explains the selections for the function. In the above example, the first line gives an explanation of when Pn002 = n.□0□□ is set.

Notation Example



Notation Examples for Pn002

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

Continued on next page.

Continued from previous page.

No.	Description
(4)	This is when any change made to the parameter will become effective.
(5)	The control methods for which the parameters apply are given. **Speed**: A parameter that can be used in speed control. **Pos**: A parameter that can be used in position control. **Trq**: A parameter that can be used in torque control. "Torque" is used even for linear servomotor parameters. Grayed-out icons (Speed, Pos, Trq) indicate parameters that cannot be used in the corresponding control method.

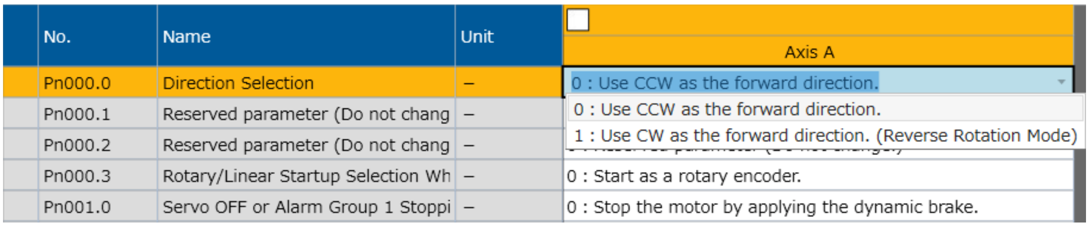
5.1.3 Parameter Setting Methods

You can use the SigmaWin+, a digital operator, or the panel operator to set parameters.

Use the following procedure to set the parameters.

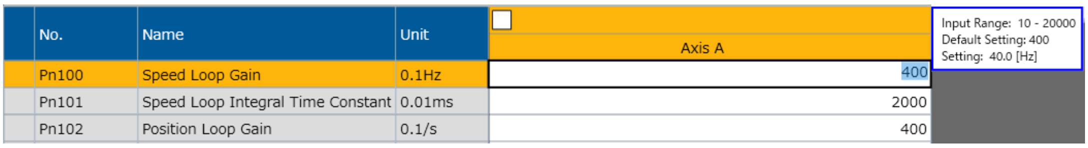
(1) Setting Parameters with the SigmaWin+

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Click [Edit Parameters] in the [Menu] window.**
   The [Edit Parameters] window will be displayed.
3. **Double-click the cell with the setting of the parameter to change.**
   - Parameters for Numeric Settings



No.	Name	Unit	Axis A
Pn000.0	Direction Selection	–	0 : Use CCW as the forward direction.
Pn000.1	Reserved parameter (Do not chang	–	0 : Use CCW as the forward direction.
Pn000.2	Reserved parameter (Do not chang	–	1 : Use CW as the forward direction. (Reverse Rotation Mode)
Pn000.3	Rotary/Linear Startup Selection Wh	–	0 : Start as a rotary encoder.
Pn001.0	Servo OFF or Alarm Group 1 Stoppi	–	0 : Stop the motor by applying the dynamic brake.

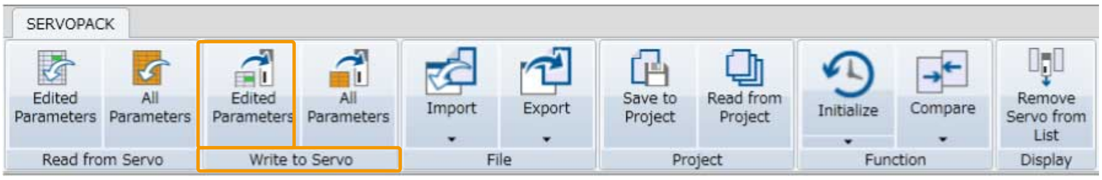
   - Parameters for Selecting Functions



No.	Name	Unit	Axis A
Pn100	Speed Loop Gain	0.1Hz	400
Pn101	Speed Loop Integral Time Constant	0.01ms	2000
Pn102	Position Loop Gain	0.1/s	400

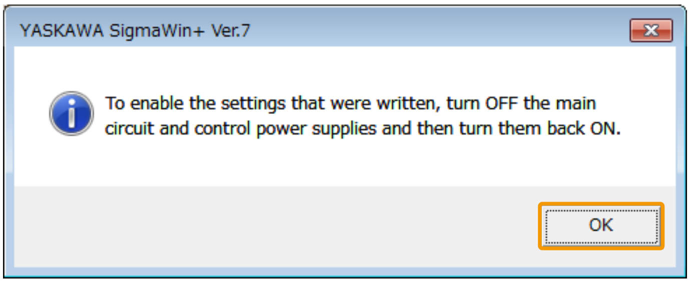
Input Range: 10 - 20000
Default Setting: 400
Setting: 40.0 [Hz]

4. **Change the setting of the parameter.**
5. **Press the [Enter] key.**
   The background of the edited parameter cell will change to green.
6. **Click [Edited Parameters] in the [Write to Servo] group.**



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

7. **Click the [OK] button.**



YASKAWA SigmaWin+ Ver.7

To enable the settings that were written, turn OFF the main circuit and control power supplies and then turn them back ON.

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

This concludes the procedure to set the parameters.

(2) Setting Parameters with a Digital Operator

Refer to the following manual for information on setting the parameters with a digital operator.

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

(3) Setting Parameters with the Panel Operator

Refer to the following section for information on setting the parameters with the panel operator.

☞ *14.2 Parameter (Pn□□□) Operations on the Panel Operator on page 638*

5.1.4 Write Prohibition Setting

You can prohibit writing parameters from the panel operator or the digital operator. Even if you do, you will still be able to change parameter settings from the SigmaWin+.

(1) Preparations

No preparations are required.

(2) Applicable Tools

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

Tool	Fn No./Function Name	Reference
Panel Operator	Fn010	☞ *14.4.15 Write Prohibition Setting (Fn010) on page 653*
Digital Operator	Fn010	📖 Σ-7/Σ-X Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Others] – [Write Prohibition Setting]	☞ *(3) Operating Procedure on page 161*

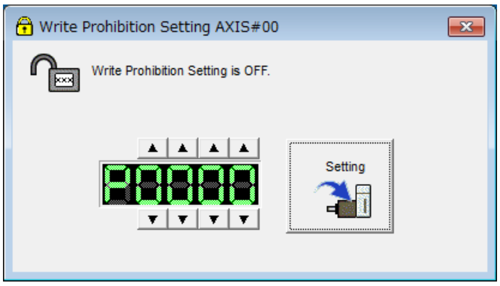
(3) Operating Procedure

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

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Click [Write Prohibition Setting] in the [Menu] window.**

   The [Write Prohibition Setting] window will be displayed.

3. **Press the [▼], [▲] for the rightmost digit and set one of the following.**

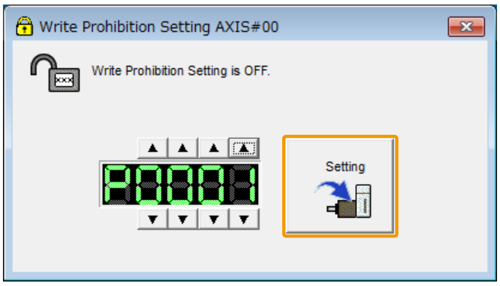

Write Prohibition Setting AXIS#00

Write Prohibition Setting is OFF.

0000: Writing is permitted (default setting).

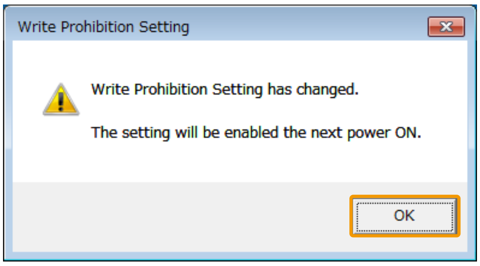
0001: Writing is prohibited.

4. **Click the [Setting] button.**


Write Prohibition Setting AXIS#00

Write Prohibition Setting is OFF.

5. **Click the [OK] button.**


Write Prohibition Setting

Write Prohibition Setting has changed.

The setting will be enabled the next power ON.

The setting will be written to the SERVOPACK.

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

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

(4) Restrictions

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

SigmaWin+		Panel Operator or Digital Operator		When Writing Is Prohibited	Reference
Button in Menu Window	**SigmaWin+ Function Name**	**Fn No.**	**Utility Function Name**		
Basic Functions	Initialize *1	**Fn005**	Initialize Parameters	Cannot be executed.	☞ *5.1.5 Initialize Parameters on page 164*
	Software Reset	**Fn030**	Software Reset	Can be executed.	☞ *6.14 Software Reset on page 312*
	Product Information	**Fn011**	Display Servomotor Model	Can be executed.	☞ *9.1 Monitoring Product Information on page 502*
		Fn012	Display Software Version	Can be executed.	
		Fn01E	Display SERVOPACK and Servomotor IDs	Can be executed.	
		Fn01F	Display Servomotor ID from Feedback Option Module	Can be executed.	
Encoder Setting	Reset Absolute Encoder	**Fn008**	Reset Absolute Encoder	Cannot be executed.	☞ *5.17 Resetting the Absolute Encoder on page 206*
	Multi-turn Limit Setup	**Fn013**	Multiturn Limit Setting after Multiturn Limit Disagreement Alarm	Cannot be executed.	☞ *6.12.9 A.CC0 (Multiturn Limit Disagreement Alarm) on page 301*
	Search Origin *2	**Fn003**	Origin Search	Cannot be executed.	☞ *7.6.2 Origin Search on page 349*
	Zero Point Position Setting	**Fn020**	Set Absolute Linear Encoder Origin	Cannot be executed.	☞ *5.18 Setting the Origin of the Absolute Encoder on page 209*
	Polarity Detection	**Fn080**	Polarity Detection	Cannot be executed.	☞ *5.11 Polarity Detection on page 182*
Trouble-shooting	Display Alarm	**Fn000**	Display Alarm History	Can be executed.	☞ *13.2.4 Displaying the Alarm History on page 612*
		Fn006	Clear Alarm History	Cannot be executed.	☞ *13.2.5 Clearing the Alarm History on page 613*
		Fn014	Reset Option Module Configuration Error	Cannot be executed.	☞ *13.2.6 Resetting Option Module Configuration Error on page 614*
	Reset Motor Type Alarm	**Fn021**	Reset Motor Type Alarm	Cannot be executed.	☞ *13.2.7 Resetting Motor Type Alarms on page 616*
Operation	Jog	**Fn002**	Jog	Cannot be executed.	☞ *7.3 Trial Operation for the Servomotor without a Load on page 333*
	Program JOG Operation	**Fn004**	Jog Program	Cannot be executed.	☞ *7.6.1 Program Jogging on page 344*
Tuning	Tuning - Autotuning without Host Reference	**Fn201**	Advanced Autotuning without Reference	Cannot be executed.	☞ *8.7 Autotuning without a Host Reference on page 394*
	Tuning - Autotuning with Host Reference	**Fn202**	Advanced Autotuning with Reference	Cannot be executed.	☞ *8.8 Autotuning with a Host Reference on page 407*
	Tuning - Custom Tuning	**Fn203**	One-Parameter Tuning	Cannot be executed.	☞ *8.9 Custom Tuning on page 422*
	Tuning - Custom Tuning - Adjust Anti-resonance Control	**Fn204**	Adjust Anti-resonance Control	Cannot be executed.	☞ *8.10 Anti-Resonance Control Adjustment on page 431*
	Tuning - Custom Tuning - Vibration Suppression	**Fn205**	Vibration Suppression	Cannot be executed.	☞ *8.11 Vibration Suppression on page 438*
	Response Level Setting	**Fn200**	Tuning-less Level Setting	Cannot be executed.	☞ *8.4 Tuning-less Function on page 368*

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SigmaWin+		Panel Operator or Digital Operator		When Writing Is Prohibited	Reference
Button in Menu Window	**SigmaWin+ Function Name**	**Fn No.**	**Utility Function Name**		
Diagnostic	Easy FFT	**Fn206**	Easy FFT	Cannot be executed.	☞ *8.16.2 Easy FFT on page 495*
Others	Adjust the Speed and Torque Reference Offset	**Fn009**	Autotune Analog (Speed/ Torque) Reference Offset	Cannot be executed.	☞ *(a) Automatically Adjusting the Speed Reference Offset on page 236* ☞ *6.7.2 Adjusting the Torque Reference Offset on page 257*
		Fn00A	Manually Adjust Speed Reference Offset	Cannot be executed.	☞ *(b) Manually Adjusting the Speed Reference Offset on page 237*
		Fn00B	Manually Adjust Torque Reference Offset	Cannot be executed.	☞ *(2) Manually Adjusting the Torque Reference Offset on page 259*
	Adjust the Analog Monitor Output	**Fn00C**	Adjust Analog Monitor Output Offset	Cannot be executed.	☞ *9.3.3 Using the Analog Monitors on page 513*
		Fn00D	Adjust Analog Monitor Output Gain	Cannot be executed.	
	Adjust the Motor Current Detection Signal Offsets	**Fn00E**	Autotune Motor Current Detection Signal Offset	Cannot be executed.	☞ *6.16 Adjusting the Motor Current Detection Signal Offset on page 317*
		Fn00F	Manually Adjust Motor Current Detection Signal Offset	Cannot be executed.	
	Initialize Vibration Detection Level	**Fn01B**	Initialize Vibration Detection Level	Cannot be executed.	☞ *6.15 Vibration Detection Level Initialization on page 314*
	Write Prohibited Setting	**Fn010**	Write Prohibition Setting	Can be executed.	☞ *5.1.4 Write Prohibition Setting on page 161*

*1 An [Initialize] button will be displayed in the [Edit Parameters] window.

*2 Cannot be used when connecting a linear servomotor.

5.1.5 Initialize Parameters

You can return the parameters to their default settings.

This function will not initialize the settings of the parameters that are adjusted for the Fn009, Fn00A, Fn00B, Fn00C, Fn00D, Fn00E, and Fn00F utility functions.

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

(1) Preparations

Always check the following before you initialize the parameter settings.

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

(2) Applicable Tools

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

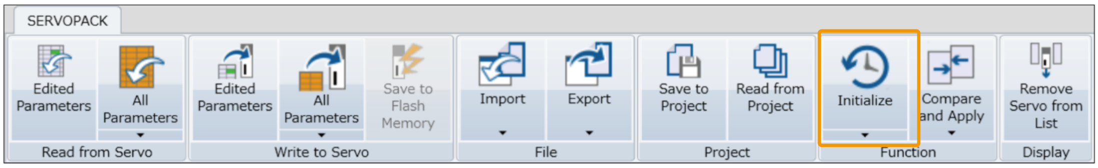
Tool	Fn No./Function Name	Reference
Panel Operator	Fn005	☞ *14.4.5 Initialize Parameters (Fn005) on page 647*
Digital Operator	Fn005	📖 Σ-7/Σ-X Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Basic Functions] – [Edit Parameters]	☞ *(3) Operating Procedure on page 165*

(3) Operating Procedure

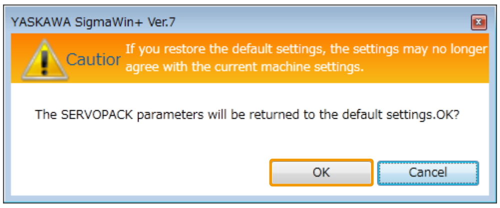
Use the following procedure to initialize the parameter settings.

1. **Click the [▤] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Click [Edit Parameters] in the [Menu] window.**

   The [Edit Parameters] window will be displayed.
3. **Select any parameter of the axis to initialize.**
4. **Click [Initialize] in [Function] group.**



5. **Click the [OK] button.**

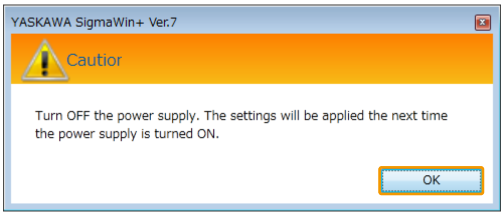


If you restore the default settings, the settings may no longer agree with the current machine settings.

The SERVOPACK parameters will be returned to the default settings.OK?

Click the [Cancel] button to cancel initialization. The [Edit Parameters] window will return.

6. **Click the [OK] button.**



Turn OFF the power supply. The settings will be applied the next time the power supply is turned ON.

7. **Turn the power 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 Control Method Selection

You can use the SERVOPACK for speed control, position control, or torque control.

You set the control method in Pn000 = n.□□X□ (Control Method Selection).

Control Method Selection

Pn000 = n.□□X□	Control Method	Outline	Reference
n.□□0□ (default setting)	Speed control	The speed of the servomotor is controlled with an analog voltage speed reference. Use speed control in the following cases. • To control speed • For position control using encoder pulse outputs from the SERVOPACK to form a position loop in the host controller	☞ *6.5 Speed Control on page 233*
n.□□1□	Position control	The position of the machine is controlled with a pulse train position reference. The position is controlled with the number of input pulses, and the speed is controlled with the input pulse frequency. Use position control when positioning is required.	☞ *6.6 Position Control on page 246*
n.□□2□	Torque control	The torque output by the servomotor is controlled with an analog voltage torque reference. Use torque control to output the required torque for operations such as pressing.	☞ *6.7 Torque Control on page 256*
n.□□3□	Internal set speed control	Three internal set speeds that are preset in the SERVOPACK are used as references to perform speed control. An analog reference is not necessary for this control method.	☞ *6.9 Internal Set Speed Control on page 270*
n.□□4□	Switching between internal set speed control and speed control	These are switching methods that you can use to change between two of the above four control methods. You can select the combination that is required for the application.	☞ *6.10 Selecting Combined Control Methods on page 275*
n.□□5□	Switching between internal set speed control and position control		
n.□□6□	Switching between internal set speed control and torque control		
n.□□7□	Switching between position control and speed control		
n.□□8□	Switching between position control and torque control		
n.□□9□	Switching between torque control and speed control		
n.□□A□	Switching between speed control and speed control with zero clamping	You can use zero clamping for speed control.	☞ *6.5.4 Zero Clamping on page 240*
n.□□B□	Switching between normal position control and position control with reference pulse inhibition	You can use reference pulse inhibition for position control.	☞ *6.6.7 Reference Pulse Inhibition Function on page 254*

5.3 Power Supply Type Settings for the Main Circuit and Control Circuit

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

5.3.1 AC Power Supply Input/DC Power Supply Input Setting

Set Pn001 = n.□X□□ (Main Circuit Power Supply AC/DC Input Selection) to specify whether to use an AC or DC power supply input for the main circuit power supply to the SERVOPACK.

If the setting of Pn001 = n.□X□□ does not agree with the actual power supply input, an A.330 alarm (Main Circuit Power Supply Wiring Error) will occur.

Examples of When an A.330 Alarm (Main Circuit Power Supply Wiring Error) Occurs

- A DC power supply was input between the B1/⊕ - ⊖2 terminals when Pn001 is set to n.□0□□ (set to use an AC power supply).
- An AC power supply was input to the L1, L2, and L3 terminals when Pn001 is set to n.□1□□ (set to use a DC power supply).

Pn001	n.□X□□	Main Circuit Power Supply AC/DC Input Selection **Speed** **Pos** **Trq**		When Enabled
		0 Default	Input AC power as the main circuit power supply using the L1, L2, and L3 terminals (do not use shared converter).	After restart
		1	Input DC as the main circuit power supply using the B1/⊕, ⊖2 terminals or the B1 and ⊖2 terminals (use an external converter or the shared converter).	

WARNING

Always use the specified terminals to connect the SERVOPACK and peripheral devices. For the power supply wiring in particular, confirm that the connections are made with the terminals shown below.

- **Connect an AC power supply to the L1, L2, and L3 terminals and the L1C and L2C terminals on the SERVOPACK.**
- **Connect a DC power supply to the B1/⊕ and ⊖2 terminals and the L1C and L2C terminals on the SERVOPACK.**

There is a risk of failure or fire.

Always specify a DC power supply Pn001 = n.□1□□ (DC power supply input) before you input for the main circuit power supply.

If you input without specifying a DC power supply Pn001 = n.□1□□ (DC power supply input), the SERVOPACK's internal elements may burn and may cause fire or damage to the equipment.

Install fuses on the power supply line if you use DC power.

The servomotor returns regenerative energy to the power supply. If you use a SERVOPACK with a DC power supply input, regenerative energy is not processed. Process the regenerative energy at the power supply.

If you use a DC power supply input with any of the following SERVOPACKs, externally connect an inrush current limiting circuit and use the power ON and OFF sequences recommended by Yaskawa: SGDXS-330A, -470A, -550A, -590A, -780A.

There is a risk of equipment damage.

⚠ **CAUTION**

Wait for at least 20 minutes (or 100 minutes when using DC power supply input) after turning OFF the power and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the main circuit terminals while the CHARGE indicator is lit because high voltage may still remain in the SERVOPACK even after turning OFF the power.

There is a risk of electric shock.

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

☞ *4.3.4 Power Supply Wiring Diagrams on page 118*

5.3.2 Single-phase AC Power Supply Input/Three-phase AC Power Supply Input Setting

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

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

- SGDXS-R70A, -R90A, -1R6A, -2R8A, -5R5A

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

Information You do not need to change the setting of Pn00B to n.□1□□ (use a three-phase power supply input as a single-phase power supply input) for a SERVOPACK with a single-phase 200-VAC power supply input (model numbers: SGDXS-120A□□□0008).

Pn00B	n.□X□□	Power Input Selection for Three-phase SERVOPACK **Speed** **Pos** **Trq**		When Enabled
		0 Default	Use a three-phase power supply input.	After restart
		1	Use a three-phase power supply input as a single-phase power supply input.	

Important

1. If you use a single-phase power supply input without setting Pn00B to n.□1□□ (use a three-phase power supply input as a single-phase power supply input), an A.F10 alarm (Power Supply Line Open Phase) will occur.
2. Not all SERVOPACKs can be run on a single-phase AC power supply input. If you connect a single-phase AC power supply input to a SERVOPACK that does not support single-phase power, an A.F10 alarm (Power Supply Line Open Phase) will occur.
3. If you use a single-phase 200-VAC power supply input, the torque-rotation speed characteristic of the servomotor will not be the same as for a three-phase AC power supply input. Decide whether to use a single-phase or three-phase AC power supply input after checking the characteristics given in the servomotor manual or catalog.

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

☞ *(c) Wiring Example for Single-Phase, 200-VAC Power Supply Input on page 119*

5.4 Automatic Detection of Connected Motor

You can use a SERVOPACK to operate either a rotary servomotor or a linear servomotor.

If you connect the servomotor encoder to the CN2 connector on the SERVOPACK, the SERVOPACK will automatically determine which type of servomotor is connected. Therefore, you normally do not need to specify the servomotor type.

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

Pn000	n.X□□□	Rotary/Linear Servomotor Startup Selection When Encoder Is Not Connected Speed Pos Trq		When Enabled
		0 Default	When an encoder is not connected, start as SERVOPACK for rotary servomotor.	After restart
		1	When an encoder is not connected, start as SERVOPACK for linear servomotor.	

5.5 Functions and Settings for the /S-ON (Servo ON Input) Signal

The /S-ON (Servo ON Input) signal is used to enable servomotor operation.

This section describes the function of and settings for the /S-ON signal.

5.5.1 Function of the /S-ON (Servo ON Input) Signal

Type	Signal	Connector Pin No.	Signal Status	Function
Input	/S-ON	CN1-40 (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.

You can use Pn50A = n.□□X□ (/S-ON (Servo ON Input) Signal Allocation) to allocate the /S-ON signal to a different input signal terminal. Refer to the following section for details on input signal allocation.

☞ *6.1.3 Input Signal Allocations on page 220*

Important

- Always input the /S-ON signal before you input a speed, position, or torque reference to start the servomotor. Never input the reference first and then use the /S-ON signal or turn ON the AC power to start the servomotor. Doing so will degrade internal elements and may cause an accident.
- Input the /S-ON signal while the servomotor is stopped. You cannot turn ON the servo while the servomotor is operating.

5.5.2 Setting to Keep the Servo ON and Supply Power to the Motor Continuously

You can set Pn50A = n.□□X□ (/S-ON (Servo ON Input) Signal Allocation) to 7 (the signal is always active) to keep the servo ON and supply power to the motor continuously.

		/S-ON (Servo ON Input) Signal Allocation	Speed Pos Trq	When Enabled
Pn50A	n.□□X□	0 Default	Active when CN1-40 input signal is ON (closed).	After restart
		1	Active when CN1-41 input signal is ON (closed).	
		2	Active when CN1-42 input signal is ON (closed).	
		3	Active when CN1-43 input signal is ON (closed).	
		4	Active when CN1-44 input signal is ON (closed).	
		5	Active when CN1-45 input signal is ON (closed).	
		6	Active when CN1-46 input signal is ON (closed).	
		7	The signal is always active.	
		8	The signal is always inactive.	
		9	Active when CN1-40 input signal is OFF (open).	
		A	Active when CN1-41 input signal is OFF (open).	
		B	Active when CN1-42 input signal is OFF (open).	
		C	Active when CN1-43 input signal is OFF (open).	
		D	Active when CN1-44 input signal is OFF (open).	
		E	Active when CN1-45 input signal is OFF (open).	
		F	Active when CN1-46 input signal is OFF (open).	

Important

- If you set this parameter to keep the servo ON continuously, power will be supplied to the motor as soon the main circuit power to the SERVOPACK is turned ON. If there is already a speed, position, or torque reference input, the servomotor or machine may perform unexpected operation. Always implement safety measures.
- If a resettable alarm occurs and operation is disabled (power is not supplied to the motor), operation will be automatically enabled (power will be supplied to the motor) when the alarm is reset. If you set this parameter to keep the servo ON continuously, the servomotor or machine may perform unexpected operation when an alarm is reset.

5.6 Motor Direction Setting

You can change the direction of servomotor rotation without changing the polarity of the speed or position reference by setting Pn000 to n.□□□X (Rotation Direction Selection).

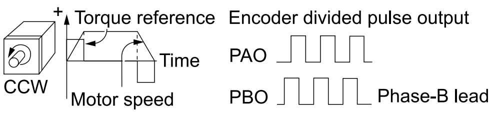
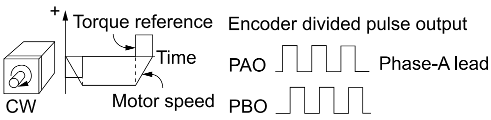
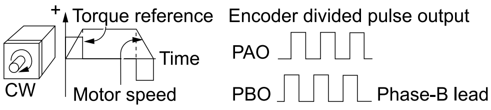
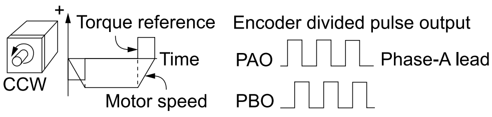
This causes the rotation direction of the servomotor to change, but the polarity of the signals, such as encoder divided pulse output, output from the SERVOPACK do not change. Set the appropriate direction for your system.

Refer to the following section for details on the encoder divided pulse output.

☞ *6.8 Encoder Divided Pulse Output on page 264*

5.6.1 Rotary Servomotors

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

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

Note:

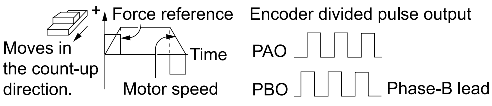
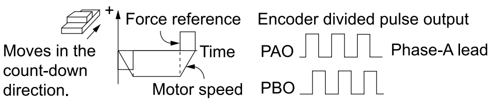
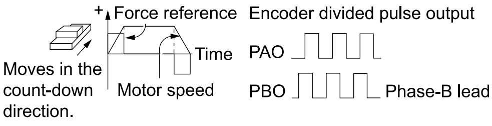
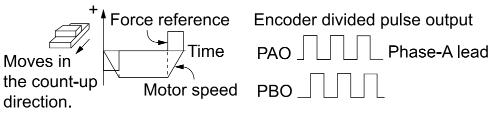
The trace waveforms of the SigmaWin+ are shown in the above table for the torque reference and motor speed diagrams. If you measure them on a measuring instrument, e.g., with an analog monitor, the polarity will be reversed.

5.6.2 Linear Servomotors

Important

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

☞ *5.9 Selecting the Phase Sequence for a Linear Servomotor on page 179*

Parameter		Forward/ Reverse Reference	Motor Direction and Encoder Divided Pulse Outputs	Applicable Overtravel Signal (OT)
Pn000	n.□□□0 Use the direction in which the linear encoder counts up as the forward direction. (default setting)	Forward reference		P-OT (Forward Drive Prohibit Input) Signal
		Reverse reference		N-OT (Reverse Drive Prohibit Input) Signal
	n.□□□1 Use the direction in which the linear encoder counts up as the reverse direction.	Forward reference		P-OT (Forward Drive Prohibit Input) Signal
		Reverse reference		N-OT (Reverse Drive Prohibit Input) Signal

Note:

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

5.7 Setting the Linear Encoder Pitch

If you connect a linear encoder to the SERVOPACK through a serial converter unit, you must set the scale pitch of the linear encoder in Pn282.

If a serial converter unit is not connected, the setting of Pn282 will be invalid.

Term

Serial Converter Unit :

The serial converter unit converts the signal from the linear encoder into a form that can be read by the SERVOPACK.

Scale Pitch :

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

Pn282	Linear Encoder Scale Pitch			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 6553600	0.01 µm	0	After restart

You will not be able to control the linear servomotor if Pn282 is not set correctly. Check the following table and always set the correct value before you operate the linear servomotor.

Type of Linear Encoder	Manufacturer	Model	Serial Converter Unit Model	Linear Encoder Scale Pitch [µm]
Incremental	Heidenhain Corporation	LIDA48□	JZDP-H003-□□□-E	20
			JZDP-J003-□□□-E	
		LIF48□	JZDP-H003-□□□-E	4
			JZDP-J003-□□□-E	
	Renishaw PLC	RGH22B	JZDP-H005-□□□-E	20
			JZDP-J005-□□□-E	

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

Information **Linear Encoder Scale Pitch**

If you do not use a serial converter unit, the linear encoder pitch is automatically set, and the setting of Pn282 will be invalid. Refer to the following sections for details.

☞ ◆ *Feedback Resolution of Linear Encoder: Incremental Linear Encoder on page 202*

☞ ◆ *Feedback Resolution of Linear Encoder: Absolute Linear Encoder on page 202*

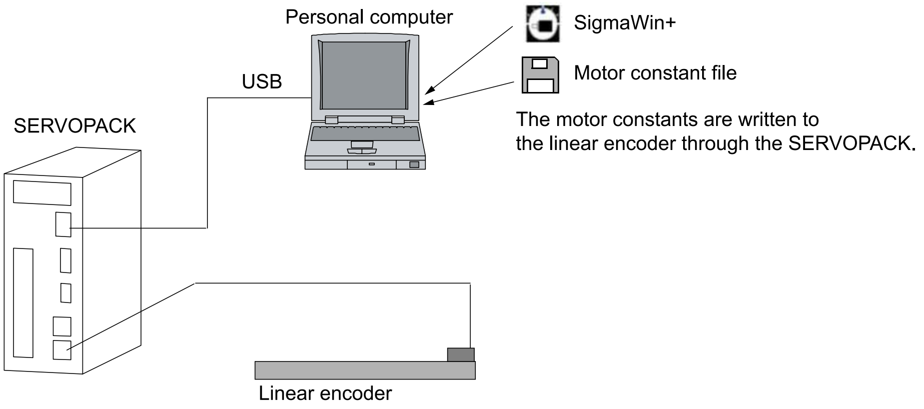
5.8 Writing Linear Servomotor Parameters

If you connect a linear encoder to the SERVOPACK without going through a serial converter unit, you must use the SigmaWin+ to write the motor constants to the linear encoder. The motor constants contain the information that is required by the SERVOPACK to operate the linear servomotor.

⚠ WARNING

Check if the servomotor and linear encoder information to write is correct.

There is a risk of the servomotor running out of control, device damage, personal injury, and fire by writing incorrect motor constants.



The motor constants are written to the linear encoder through the SERVOPACK.

Important

Serial number information is not included in the motor constants. You cannot use the monitor functions of the SERVOPACK to monitor the serial number.

If you attempt to monitor the serial number, ********** will be displayed.

5.8.1 Precautions

- If the encoder parameters are not written to the linear encoder, an A.CA0 alarm (Encoder Parameter Error) will occur. Consult the manufacturer of the linear encoder.
- If the motor constants are not written to the linear encoder, an A.CA0 alarm (Encoder Parameter Error) will not occur, but the following alarms will occur.
  A.040 (Parameter Setting Error), A.041 (Encoder Output Pulse Setting Error), A.050 (Combination Error), A.051 (Unsupported Device Alarm), A.550 (Maximum Motor Speed Setting Error), A.710 (Instantaneous Overload), A.720 (Continuous Overload), and A.C90 (Encoder Communications Error)

5.8.2 Applicable Tools

The following table lists the tools that you can use to write the parameters to the linear servomotor.

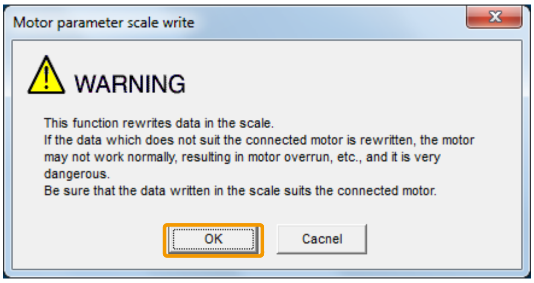
Tool	Fn No./Function Name	Reference
Panel Operator	You cannot write linear servomotor parameters from the panel operator.	
Digital Operator	You cannot write linear servomotor parameters from the digital operator.	
SigmaWin+	[Encoder Setting] – [Motor Parameter Scale Write]	☞ *5.8.3 Operating Procedure on page 176*

5.8.3 Operating Procedure

Use the following procedure to write the motor constants to the linear encoder.

1. **Prepare the motor constant file to write to the linear encoder.**
2. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
3. **Select [Motor Parameter Scale Write] in the [Menu] window.**

   The [Motor Parameter Scale Write] window will be displayed.
4. **Click the [OK] button.**



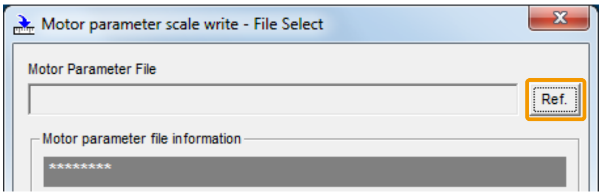
WARNING

This function rewrites data in the scale.
If the data which does not suit the connected motor is rewritten, the motor may not work normally, resulting in motor overrun, etc., and it is very dangerous.
Be sure that the data written in the scale suits the connected motor.

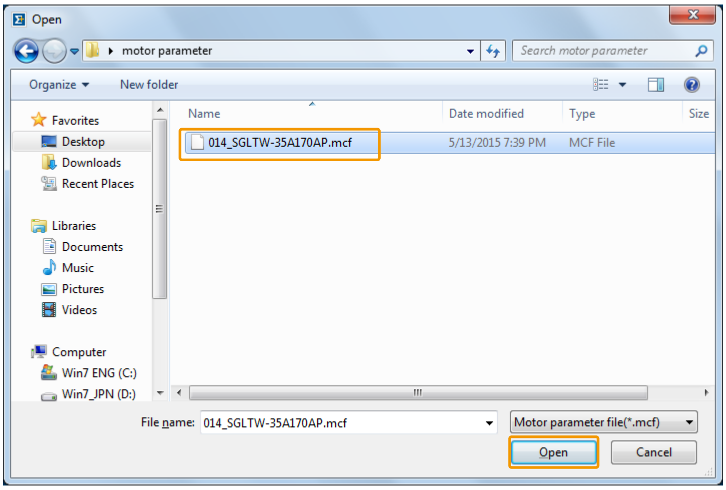
Click the [Cancel] button to cancel writing the motor constant scale to the linear encoder. The Main Window will return.

If the write is completed normally, the [Motor Parameter Scale Write - File Select] window will be displayed.

5. **Click the [Ref.] button.**



6. **Select the motor constant file that you prepared and click the [Open] button.**

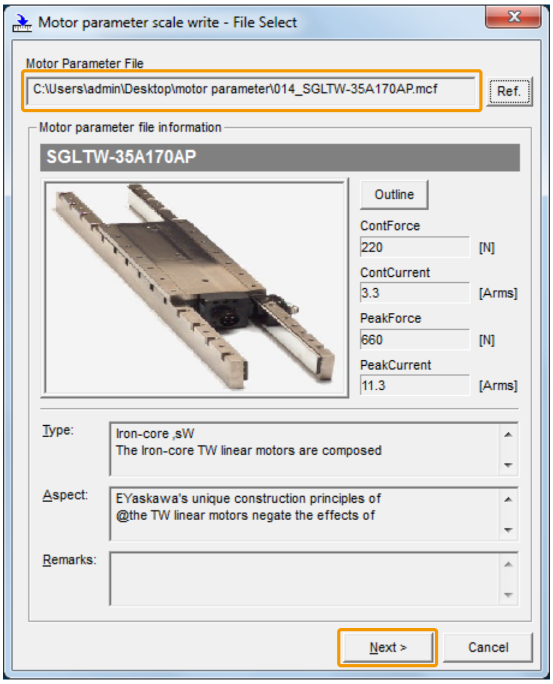


Name	Date modified	Type	Size
014_SGLTW-35A170AP.mcf	5/13/2015 7:39 PM	MCF File	

File name: 014_SGLTW-35A170AP.mcf

Motor parameter file(*.mcf)

7. **Confirm that the motor constant file information that is displayed is suitable for your servomotor, and then click the [Next] button.**


Motor parameter scale write - File Select

Motor Parameter File: C:\Users\admin\Desktop\motor parameter\014_SGLTW-35A170AP.mcf

Motor parameter file information

SGLTW-35A170AP

ContForce: 220 [N]
ContCurrent: 3.3 [Arms]
PeakForce: 660 [N]
PeakCurrent: 11.3 [Arms]

Type: Iron-core ,sW
The Iron-core TW linear motors are composed

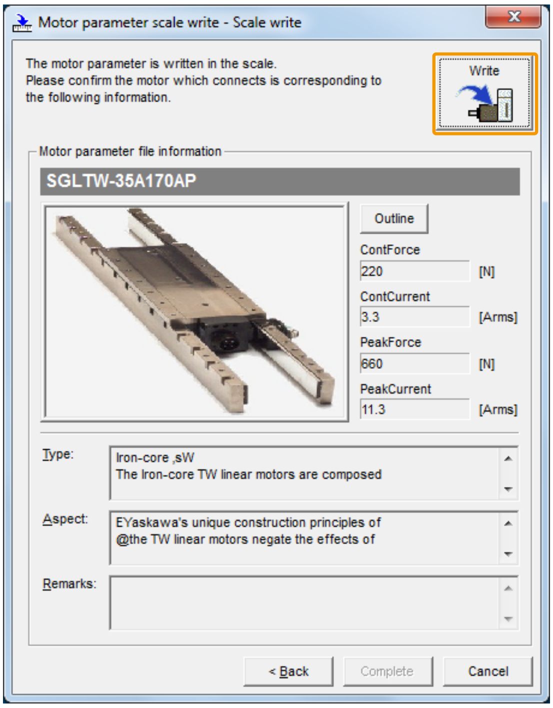
Aspect: EYaskawa's unique construction principles of
@the TW linear motors negate the effects of

Remarks:

Information
- Click the [Outline] button to display the dimensional drawing.
- Click the image of the servomotor to enlarge the view.

Click the [Cancel] button to cancel writing the motor constant scale to the linear encoder. The Main Window will return.

8. **Click the [Write] button.**


Motor parameter scale write - Scale write

The motor parameter is written in the scale.
Please confirm the motor which connects is corresponding to the following information.

Motor parameter file information

SGLTW-35A170AP

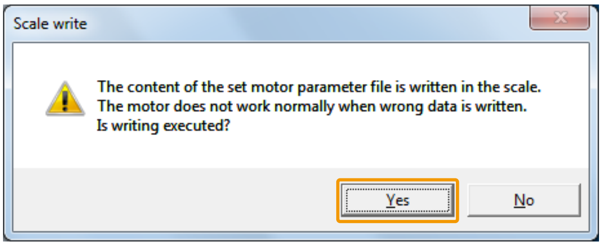
ContForce: 220 [N]
ContCurrent: 3.3 [Arms]
PeakForce: 660 [N]
PeakCurrent: 11.3 [Arms]

Type: Iron-core ,sW
The Iron-core TW linear motors are composed

Aspect: EYaskawa's unique construction principles of
@the TW linear motors negate the effects of

Remarks:

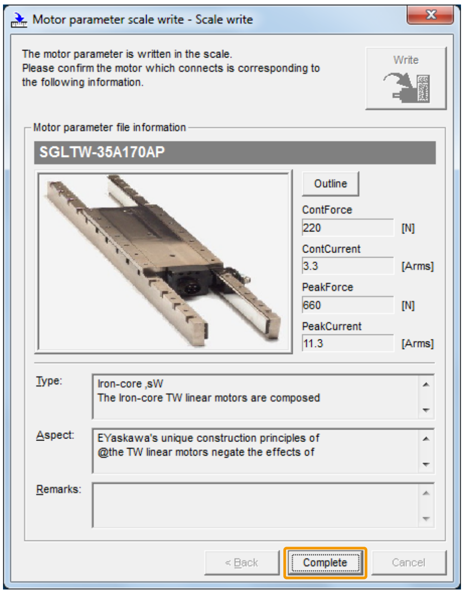
9. **Click the [Yes] button.**



The content of the set motor parameter file is written in the scale.
The motor does not work normally when wrong data is written.
Is writing executed?

Click the [No] button to cancel writing the motor constant scale to the linear encoder.
If you click the [Yes] button, writing the motor constant scale will start.

10. **Click the [Complete] button.**



The motor parameter is written in the scale.
Please confirm the motor which connects is corresponding to the following information.

Motor parameter file information

SGLTW-35A170AP

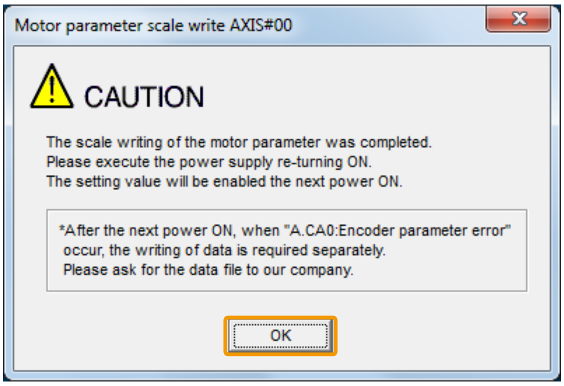
ContForce: 220 [N]
ContCurrent: 3.3 [Arms]
PeakForce: 660 [N]
PeakCurrent: 11.3 [Arms]

Type: Iron-core ,sW
The Iron-core TW linear motors are composed

Aspect: EYaskawa's unique construction principles of
@the TW linear motors negate the effects of

Remarks:

11. **Click the [OK] button.**



CAUTION

The scale writing of the motor parameter was completed.
Please execute the power supply re-turning ON.
The setting value will be enabled the next power ON.

*After the next power ON, when "A.CA0:Encoder parameter error" occur, the writing of data is required separately.
Please ask for the data file to our company.

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

This concludes the procedure to write the motor constants.

5.8.4 Confirming If the Motor Constants Have Been Written

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

If the motor constants have not been written, no information on the servomotor will be displayed.

☞ *9.1 Monitoring Product Information on page 502*

5.9 Selecting the Phase Sequence for a Linear Servomotor

You must select the phase sequence of the linear servomotor so that the forward direction of the linear servomotor is the same as the encoder's count-up direction. This is accomplished with the setting that synchronizes the position and direction of the servomotor and encoder.

Before you set Pn080 to n.□□X□ (Motor Phase Sequence Selection), check the following items.

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

Important

- If you do not confirm the above items before you attempt to operate the servomotor, the servomotor may not operate or it may run out of control. Always confirm these items before you operate the servomotor.
- To set Pn000 to n.□□□X (Direction Selection), first set Pn080 to n.□□X□ explained here, and then set Pn000 to n.□□□X.
- If you changed the setting of Pn080 = n.□□X□ (Motor Phase Sequence Selection) when using an absolute encoder, always detect the polarity afterward. If you change the setting of Pn080 = n.□□X□ after the polarity is detected, A.C10 (Servomotor Out of Control) will occur.

5.9.1 Related Parameters

Pn080	n.□□X□	Motor Phase Sequence Selection	Speed Pos Trq	When Enabled
		0 Default	Set a phase-A lead as a phase sequence of U, V, and W.	After restart
		1	Set a phase-B lead as a phase sequence of U, V, and W.	

5.9.2 Operating Procedure

Use the following procedure to select the phase sequence for a linear servomotor.

1. **Set Pn000 to n.□□□0 (use the direction in which the linear encoder counts up as the forward direction).**

   This setting is to make following confirmation work easier to understand.

2. **Click [Monitor] in the [Menu] window.**

   The [Operation] window will be displayed so that you can check the feedback pulse counter.

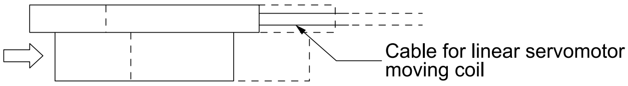
   To check the feedback pulse counter with the panel operator or digital operator, use Un00D (Feedback Pulse Counter).

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

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

   Setting Example

   In this example, assume that a linear encoder with a scale pitch of 20 μm and a resolution of 256 is used. If you manually move the moving coil 1 cm in the count-up direction of the linear encoder, the number of feedback pulses would be as follows: 1 cm/(20 μm/256) = 128000 pulses



If the value on the feedback pulse counter is 128000 pulses after you manually moved the linear servomotor in the direction of the cable, confirmation is complete.

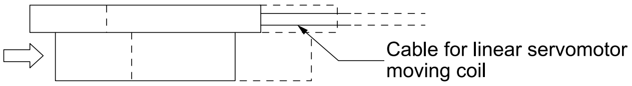
Note:

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

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

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

4. **Manually move the moving coil in the direction of the cable and check the value of the feedback pulse counter in the [Operation] window to confirm that it is counting up.**



Manually move the linear servomotor in the direction of the cable.

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

This concludes the procedure to set the phase sequence of the linear servomotor.

5.10 Polarity Sensor Setting

The polarity sensor detects the polarity of the servomotor. You must set a parameter to specify whether the linear servomotor that is connected to the SERVOPACK has a polarity sensor. Specify whether there is a polarity sensor in Pn080 = n.□□□X (Polarity Sensor Selection).

If the linear servomotor has a polarity sensor, set Pn080 to n.□□□0 (use polarity sensor) (default setting).

If the linear servomotor does not have a polarity sensor, set Pn080 to n.□□□1 (do not use polarity sensor). Turn the power OFF and ON again to enable the new setting.

Pn080	n.□□□X	Polarity Sensor Selection	Speed Pos Trq	When Enabled
		0 Default	Use polarity sensor.	After restart
		1	Do not use polarity sensor.	

Information If you set Pn080 to n.□□□0 (use polarity sensor) and the linear servomotor that is connected to the SERVOPACK does not have a polarity sensor, an A.C21 alarm (Polarity Sensor Error) will occur when you turn the power OFF and ON again.

5.11 Polarity Detection

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

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

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

Encoder Specification	Polarity Detection Execution Timing	Polarity Detection Execution Method
Incremental encoder	Each time the control power to the SERVOPACK is turned ON (Even after you execute polarity detection, the position of the polarity will be lost the next time the control power to the SERVOPACK is turned OFF.)	• Use the /S-ON (Servo ON Input) signal. • Use the /P-DET (Polarity Detection Input) signal. • Use the polarity detection function of the SigmaWin+. • Execute the Fn080 (Polarity Detection) utility function from the digital operator or panel operator.
Absolute encoder	Only for initial setup, or after the SERVOPACK, linear encoder, or servomotor has been replaced (The results of polarity detection is stored in the absolute encoder, so the polarity position is not lost when the control power is turned OFF.)	• Use the polarity detection function of the SigmaWin+. • Execute the Fn080 (Polarity Detection) utility function from the digital operator or panel operator.

Important If you changed the setting of Pn080 = n.□□X□ (Motor Phase Sequence Selection) when using an absolute encoder, always detect the polarity afterward. If you change the setting of Pn080 = n.□□X□ after the polarity is detected, A.C10 (Servomotor Out of Control) will occur.

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

5.11.1 Restrictions

(1) Assumed Conditions

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

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

(2) Preparations

Always check the following before you execute polarity detection.

- Pn080 must be set to n.□□□1 (do not use polarity sensor).
- The servo must be OFF.
- The main circuit power must be ON.
- There must be no hard wire base block (HWBB).
- There must be no alarms except for an A.C22 alarm (Phase Information Disagreement).
- The parameters must not be write prohibited. (This item applies only when using the SigmaWin+ or digital operator.)
- Pn00C must be set to n.□□□0 (test without a motor function is disabled).
- There must be no overtravel.
- If the motor constants have been written or the origin of the absolute linear encoder has been set, the power to the SERVOPACK must be turned OFF and ON again after completion of the writing or setting operation.

Important

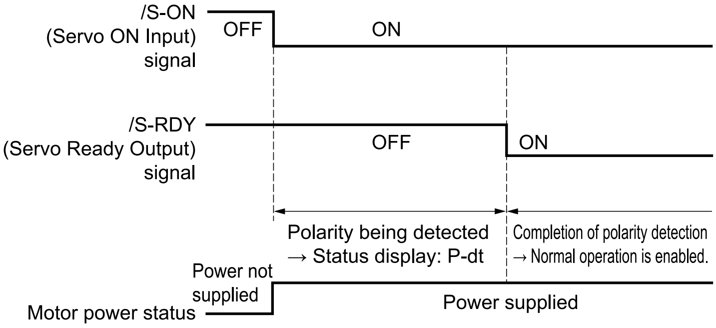
- Power is supplied to the servomotor during polarity detection. Be careful not to get an electric shock. Also, the moving coil of the linear servomotor may greatly move during detection. Do not approach the moving parts of the servomotor.
- Polarity detection is affected by many factors. For example, polarity detection may fail if the mass ratio or friction is too large or the cable tension is too strong.

5.11.2 Using the /S-ON (Servo ON Input) Signal to Perform Polarity Detection

You can use the /S-ON (Servo ON Input) signal to perform polarity detection only with an incremental linear encoder.

Polarity detection will be performed when you turn the control power to the SERVOPACK OFF and then ON again, and then input the /S-ON signal. As soon as polarity detection is completed, the /S-RDY (Servo Ready Output) signal will turn ON.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/S-ON	CN1-40 (default setting)	ON (closed)	The servo is turned ON (power is supplied to the motor), polarity detection is performed once, and then the servo is left ON. (The /S-RDY signal will turn ON.)
			OFF (open)	The servo is turned OFF (power is not supplied to the motor) and operation is disabled.



5.11.3 Using the /P-DET (Polarity Detection Input) Signal to Perform Polarity Detection

You can allocate the /P-DET (Polarity Detection Input) signal if you want to create a sequence on the host computer to monitor the /S-RDY (Servo Ready Output) signal and output the /S-ON (Servo ON Input) signal, or if you want to perform polarity detection at times other than when the /S-ON signal turns ON.

On the falling edge of the /P-DET signal, the servo will turn ON and polarity detection will be performed once. As soon as polarity detection is completed, the servo will turn OFF and the /S-RDY (Servo Ready Output) signal will turn ON. After polarity detection has been completed, it will not be executed again even if you turn ON the /P-DET signal.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/S-ON	CN1-40 (default setting)	ON (closed)	Turns ON the servo (supplies power to the motor) and enables operation.
			OFF (open)	Turns OFF the servo (stops power supply to the motor) and disables operation.
	/P-DET	Must be allocated.	ON (closed)	Executes polarity detection, only on the first falling edge of the signal after the power is turned ON.
			OFF (open)	–

Note:

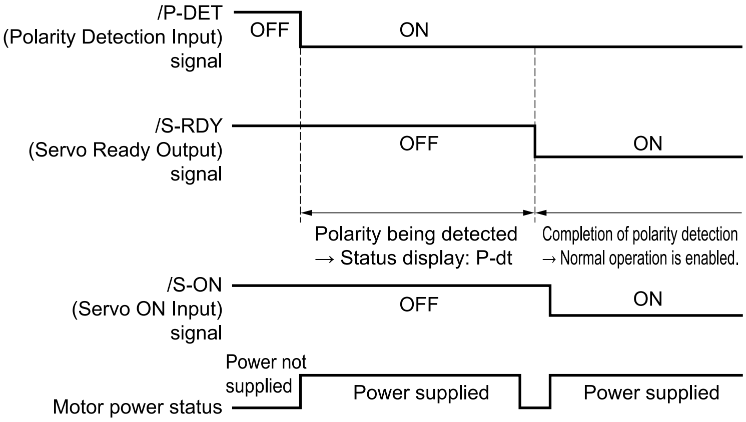
You must allocate the /P-DET signal to use it. Use the following parameters to allocate signals.

Pn50A = n.□□□1 or n.□□□2 (Sigma-7S-compatible I/O signal allocations mode or SigmaLINK II input signal allocation mode)

Pn50D = n.X□□□ (/P-DET (Polarity Detection Input) Signal Allocation)

Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*



5.11.4 Using a Tool Function to Perform Polarity Detection

(1) Applicable Tools

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

Tool	Fn No./Function Name	Reference
Panel Operator	Fn080	☞ *14.4.26 Polarity Detection (Fn080) on page 659*
Digital Operator	Fn080	🕮 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Encoder Setting] – [Polarity Detection]	☞ *(2) Operating Procedure on page 184*

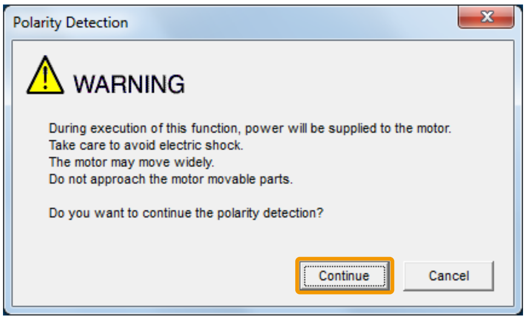
(2) Operating Procedure

Use the following procedure to perform polarity detection.

1. **Click the [▤] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Click [Polarity Detection] in the [Menu] window.**

   The [Polarity Detection] window will be displayed.

3. **Click the [Continue] button.**



Polarity Detection

WARNING

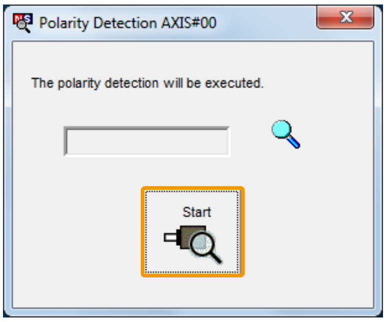
During execution of this function, power will be supplied to the motor.
Take care to avoid electric shock.
The motor may move widely.
Do not approach the motor movable parts.

Do you want to continue the polarity detection?

Click the [Cancel] button to cancel polarity detection. The Main Window will return.

4. **Click the [Start] button.**

Polarity detection will be executed.



Polarity Detection AXIS#00

The polarity detection will be executed.

This concludes the polarity detection procedure.

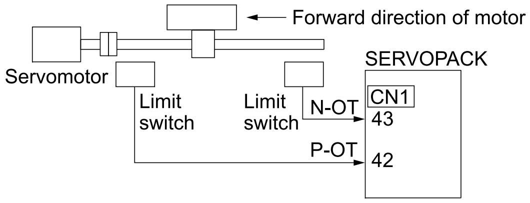
5.12 Overtravel Function and Settings

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

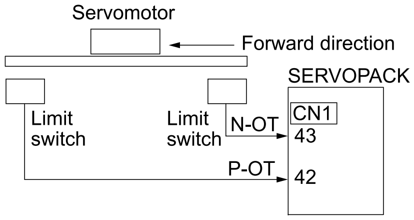
The overtravel signals include the P-OT (Forward Drive Prohibit Input) and the N-OT (Reverse Drive Prohibit Input) signals. You use the P-OT and N-OT signals to stop the machine by installing limit switches at the positions where you want to stop the machine that is operated by the servomotor.

A SERVOPACK wiring example is provided below.

Rotary Servomotors



Linear Servomotors



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

This section describes the parameters settings related to overtravel.

⚠ CAUTION

To prevent accidents that may result from poor contact or disconnections, use normally closed limit switches. Do not change the default settings of the polarity of the overtravel signals (P-OT and N-OT).

If you use a servomotor for a vertical axis, the /BK (Brake Output) signal will remain ON (i.e., the brake will be released) when overtravel occurs. This may result in the workpiece falling when overtravel occurs. To prevent the workpiece from falling, set Pn001 to n.□□1□ to place the servomotor in a zero-clamped state when it stops.

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

5.12.1 Overtravel Signals

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

Standard	Signal	Connector Pin No.	Signal Status	Meaning
Input	P-OT	CN1-42	ON	Forward drive is enabled (actual operation).
			OFF	Forward drive is prohibited (forward overtravel).
	N-OT	CN1-43	ON	Reverse drive is enabled (actual operation).
			OFF	Reverse drive is prohibited (reverse overtravel).

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

> Important
>
> When the servomotor stops due to overtravel during position control, the position deviation is held.
> You must input the CLR (Clear Input) signal to clear the position deviation.
> Refer to the following section for information on the CLR signal.
> ☞ *6.6.2 CLR (Position Deviation Clear Input) Signal Function and Settings on page 249*

5.12.2 Setting to Enable/Disable Overtravel

Enable and disable overtravel by setting parameters.

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

The parameters to use for the settings depend on the allocation method as shown below.

Allocation Method	Parameter to Use
Σ-7S-compatible I/O Signal Allocation	• Pn50A = n.□□□1 (use Sigma-7S-compatible I/O signal allocations) • Pn50A = n.X□□□ (P-OT (Forward Drive Prohibit Input) Signal Allocation) • Pn50B = n.□□□X (N-OT (Reverse Drive Prohibit Input) Signal Allocation)
Σ-LINK II Input Signal Allocation	• Pn50A = n.□□□2 (use Σ-LINK II input signal allocations) • Pn590 (P-OT (Forward Drive Prohibit Input) Signal Allocation) • Pn591 (N-OT (Reverse Drive Prohibit Input) Signal Allocation)

Refer to the following section for details on allocations.

☞ *6.1.2 Input Signal Allocations on page 220*

5.12.3 Motor Stopping Method for Overtravel

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

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

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

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

☞ *5.14 Motor Stopping Methods for Servo OFF and Alarms on page 195*

(1) Stopping the Servomotor by Setting Emergency Stop Torque

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

If Pn001 = n.□□X□ is set to 1 or 2, the servomotor will be decelerated to a stop using the torque set in Pn406 as the maximum torque.

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

Pn406	Emergency Stop Torque			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	800	Immediately

Note:

The setting unit is a percentage of the motor rated torque.

(2) Stopping the Servomotor by Setting the Deceleration Time

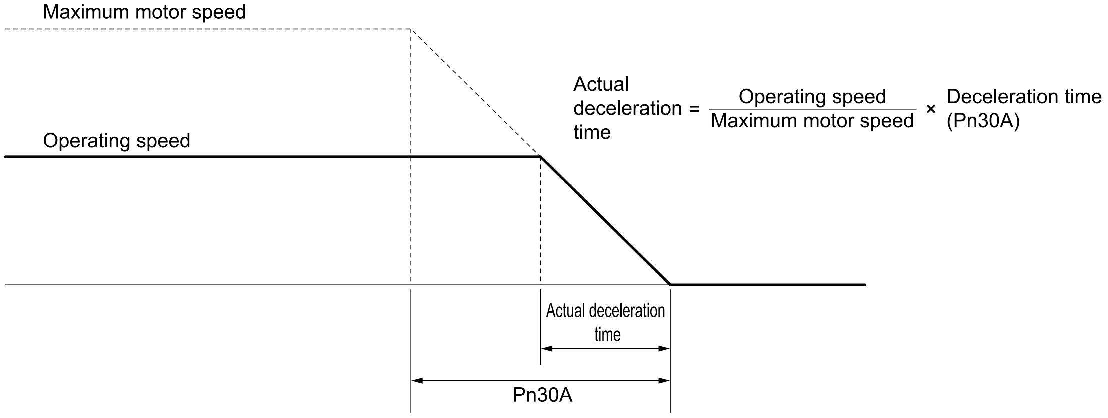
To specify the servomotor deceleration time and use it to stop the servomotor, set Pn30A (Deceleration Time for Servo OFF and Forced Stops).

The maximum torque value when stopping is the value set in Pn406 (Emergency Stop Torque).

Pn30A	Deceleration Time for Servo OFF and Forced Stops			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 12000	1 ms	0	Immediately

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

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



5.12.4 Overtravel Alarms

You can set the system to detect an A.d04 alarm (Overtravel) if overtravel occurs while the servo is ON. This function activates an alarm and stops the servomotor when the overtravel signal is input. An alarm occurs only if overtravel occurs while the servo is ON. An overtravel alarm will not be detected when the servo is OFF, even if overtravel occurs.

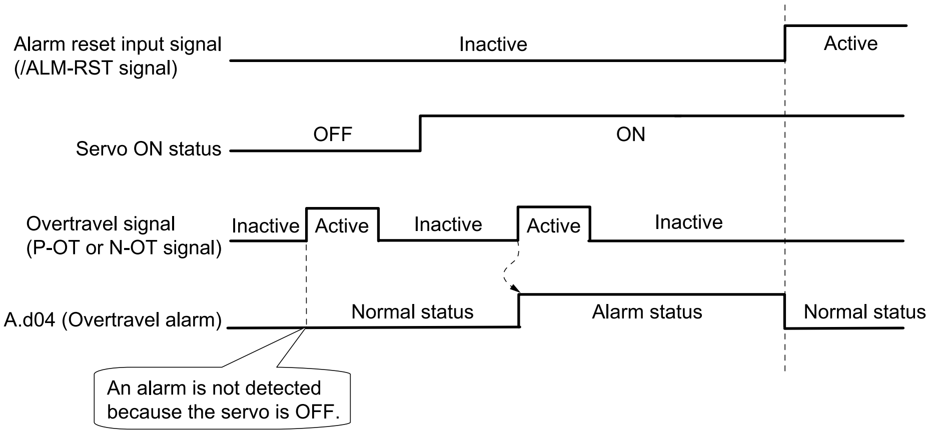
Note:

If the overtravel alarm is enabled, homing using a limit switch cannot be performed.

The following parameter is set for this function.

Pn00D	n.X□□□	Overtravel Warning Detection Selection Speed Pos Trq		When Enabled
		0 Default	Do not detect overtravel warnings.	After restart
		1	Detect overtravel warnings.	
		2	Detect overtravel alarms.	

A timing chart for alarm detection is provided below.



Information
- Alarms are detected for overtravel in the same direction as the reference.
- Alarms are not detected for overtravel in the opposite direction from the reference.
  Example: An alarm will not be output for a forward reference even if the N-OT signal turns ON.
- If the travel command is 0, an alarm will be detected with overtravel in either the forward or reverse direction.
- An alarm will not be detected when the servo is turned ON even if overtravel status exists.
- If software limits are enabled, an alarm will be detected in the same manner as overtravel if a software limit status exists.

5.12.5 Overtravel Warnings

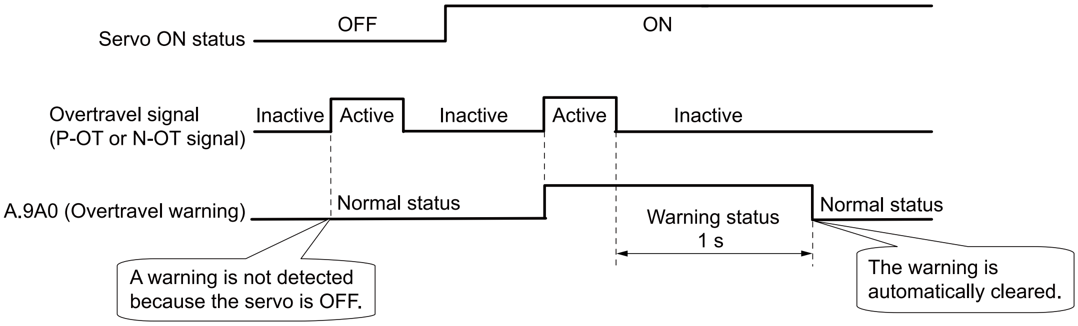
You can set the system to detect an A.9A0 warning (Overtravel) if overtravel occurs while the servo is ON. This allows the SERVOPACK to notify the host controller with a warning even when the overtravel signal is input only momentarily. An alarm occurs only if overtravel occurs while the servo is ON.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

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

The following parameter is set for this function.

		Overtravel Warning Detection Selection	Speed Pos Trq	When Enabled
Pn00D	n.X□□□	0 Default	Do not detect overtravel warnings.	After restart
		1	Detect overtravel warnings.	
		2	Detect overtravel alarms.	

A timing chart for warning detection is provided below.



Information

- Warnings are detected for overtravel in the same direction as the reference.
- Warnings are not detected for overtravel in the opposite direction from the reference.
  Example: A warning will not be output for a forward reference even if the N-OT signal turns ON.
- If the travel command is 0, a warning will be detected with overtravel in either the forward or reverse direction.
- A warning will not be detected when the servo is turned ON even if overtravel status exists.
- The warning status will be held for one second after the overtravel status no longer exists and it will then be cleared automatically.

5.12.6 Behavior Selection after Overtravel Release

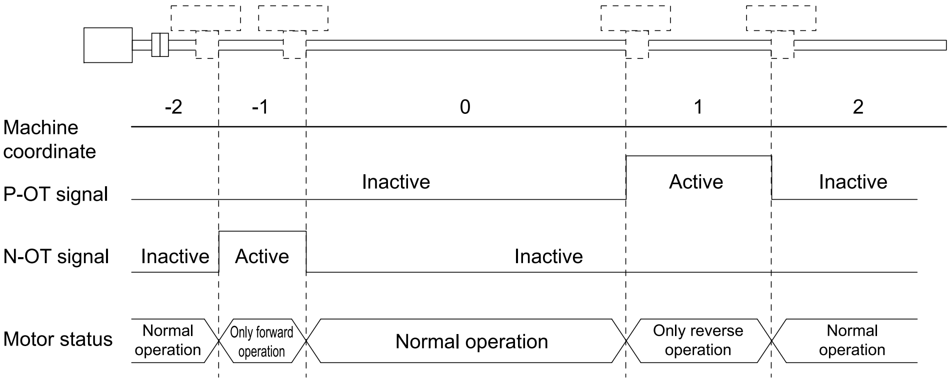
The servomotor is stopped when overtravel occurs. In the overtravel state, movement is possible in the direction opposite to the previous direction of movement.

However, the servomotor may stop by overrunning the overtravel limit switch depending on the stopping method. In this case, the servomotor will not be in the overtravel state and normal operation is possible again when you turn ON the servo. Therefore, operation is also possible that exceeds the area in which movement is allowed, which may cause damage to the machine or other accidents.

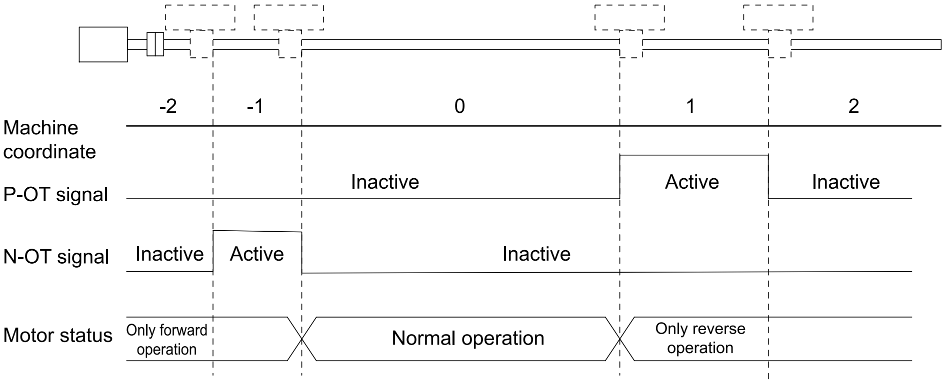
To avoid this, you can limit the movement direction when the OT signal is turned OFF (limit switch was overrun) after overtravel occurs by setting Pn022 to n.□□□1.

Pn022	n.□□□X	Overtravel Release Method Selection	Speed Pos Trq	When Enabled
		0 Default	Overtravel exists while the P-OT or N-OT signal is being input.	After restart
		1	Overtravel exists while the P-OT or N-OT signal is input and the current position of the workpiece is separated from the P-OT signal or N-OT signal.	

(1) When Pn022 is set to n.□□□0



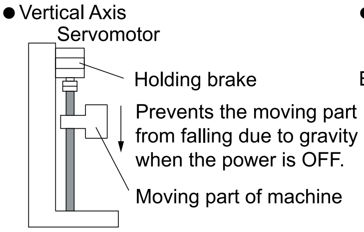
(2) When Pn022 is set to n.□□□1

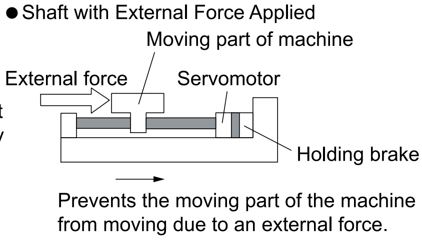


5.13 Holding Brake

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

The holding brake is used in the following cases.





Important

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

5.13.1 Brake Operating Sequence

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

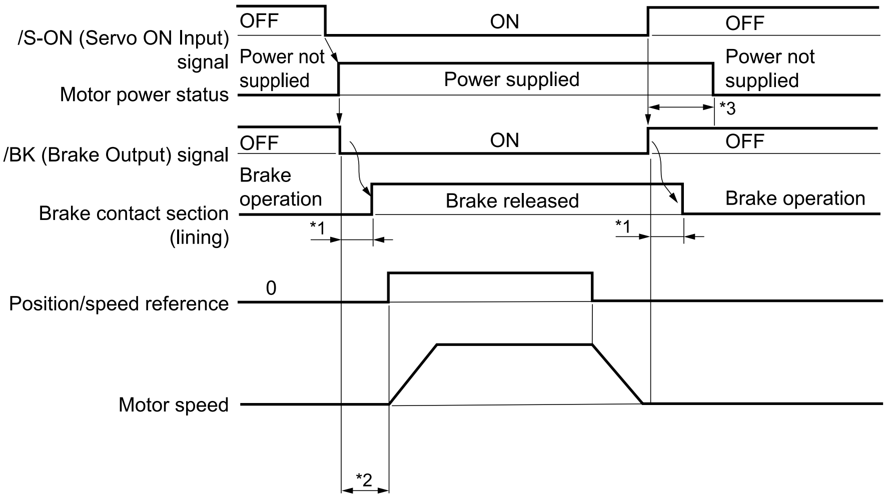
Term

Brake Release Delay Time :

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

Brake Operation Delay Time :

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



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

Model	Voltage	Brake Release Delay Time [ms]	Brake Operation Delay Time [ms]
SGMXJ-A5 to -04	24 VDC	60	100
SGMXJ-06, -08		80	
SGMXA-A5 to -04		60	
SGMXA-06 to -10		80	
SGMXA-15 to -25		170	80
SGMXA-30 to -70		100	
SGMXP-01		20	100
SGMXP-02, -04		40	
SGMXP-08, -15		20	
SGMXG-03 to -20		100	80
SGMXG-30 to -44		170	100
SGMXG-55 to -1A			80
SGMXG-1E		250	
SGM7M-A1 to -A3		60	100

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

*2 Before you output a reference from the host controller to the SERVOPACK, wait for at least 50 ms plus the brake release delay time after you turn ON the /S-ON signal.

*3 Use the following parameters to set the timing of when the brake will operate and when the servo will be turned OFF.

- Rotary servomotors: Pn506 (Brake Reference-Servo OFF Delay Time), Pn507 (Brake Reference Output Speed Level), and Pn508 (Servo OFF-Brake Command Waiting Time)
- Linear servomotors: Pn506 (Brake Reference-Servo OFF Delay Time), Pn508 (Servo OFF-Brake Command Waiting Time), and Pn583 (Brake Reference Output Speed Level)

(1) Connection Example

Refer to the following section for information on brake wiring.

☞ *4.4.4 Wiring the SERVOPACK to the Holding Brake on page 134*

5.13.2 /BK (Brake Output) Signal

The following settings are for the output signal that controls the brake.

The /BK signal is turned OFF (to operate the brake) when the servo is turned OFF or when an alarm is detected. You can adjust the timing of brake operation (i.e., the timing of turning OFF the /BK signal) with the setting of Pn506 (Servo OFF Delay Time).

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	/BK	Must be allocated.	ON (closed)	Releases the brake.
			OFF (open)	Activates the brake.

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

Note:

You must allocate the /BK signal to use it. Allocate the /BK signal to a terminal with Pn50F = n.□X□□ (/BK (Brake Output) Signal Allocation).

Refer to the following section for details.

☞ *6.1.4 Output Signal Allocations on page 224*

Important

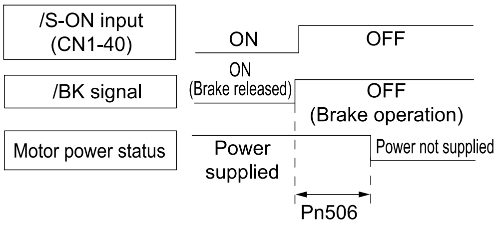
- Signals other than the /BK signal are allocated to the connector pins by default. To allocate connector pins to the BK signal, you must clear the allocations for the originally allocated signals.
  Example: Allocating the /BK Signal to CN1-25 and CN1-26
  By default, the /COIN (Positioning Completion Output) signal is allocated to CN1-25 and the /V-CMP (Speed Coincidence Detection Output) signal is allocated to CN1-26. Therefore, to allocate the connector pins to the /BK signal, you must change the settings of the following two parameters.
  - Set Pn50F = n.□1□□ (output the /BK signal from CN1-25 and CN1-26).
  - Set Pn50E = n.□□XX to a value other than 1. (This clears the allocations of the /COIN and /V-CMP signals to CN1-25 and CN1-26.)
- If you allocate more than one signal to the same output connector pin, a logical OR of the signals is output. Allocate the BK signal to its own output connector pin, i.e., do not use the same output terminal for another signal. For example, never allocate the /TGON (Rotation Detection Output) signal and /BK signal to the same output connector pin. If you did so, the /TGON signal would be turned ON by the falling speed on a vertical axis, and the brake would not operate.

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

When the servomotor is stopped, the /BK signal turns OFF as soon as the /S-ON signal turns OFF. Use Pn506 (Servo OFF Delay Time) to change the timing to turn OFF power to the motor after the /S-ON signal turns OFF.

Pn506	Brake Reference-Servo OFF Delay Time			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 50	10 ms	0	Immediately

- When the servomotor is used to control a vertical axis, the machine moving part may move slightly due to gravity or an external force. You can eliminate this slight motion by setting the Pn506 (Servo OFF Delay Time) so that power to the motor is stopped after the brake is applied.
- This parameter sets the timing of stopping power to the servomotor while the servomotor is stopped.



Important

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

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

If an alarm occurs while the servomotor is operating, the servomotor will start stopping and the /BK signal will be turned OFF. You can adjust the timing of /BK signal output by setting Pn508 (Servo OFF-Brake Command Waiting Time) and either Pn507 (Rotary Servomotor Brake Reference Output Speed Level) or Pn583 (Linear Servomotor Brake Reference Output Speed Level).

Note:

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

- Rotary Servomotors

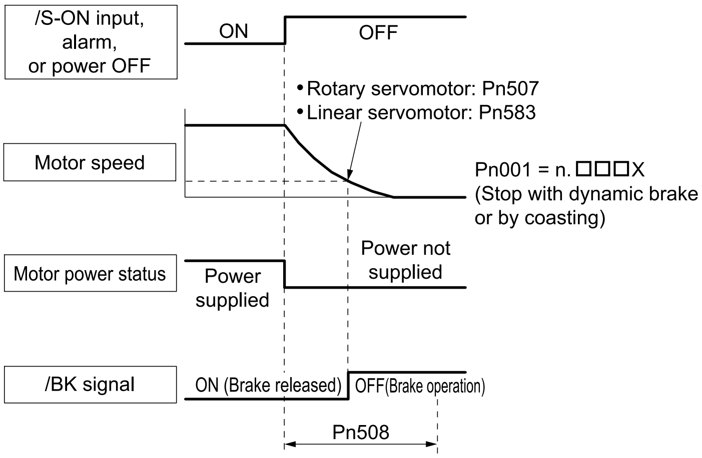
Pn507	Brake Reference Output Speed Level			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 min^{-1}	100	Immediately
Pn508	Servo OFF-Brake Command Waiting Time			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 100	10 ms	50	Immediately

- Linear Servomotors

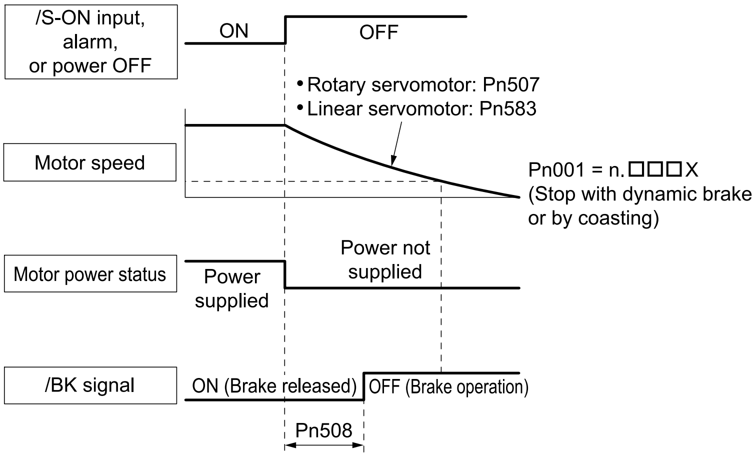
Pn583	Brake Reference Output Speed Level			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 mm/s	10	Immediately
Pn508	Servo OFF-Brake Command Waiting Time			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 100	10 ms	50	Immediately

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

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



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



Important

The servomotor will be limited to its maximum speed even if a value higher than its maximum speed is set in Pn507 (Rotary Servomotor Brake Reference Output Speed Level) or Pn583 (Linear Servomotor Brake Reference Output Speed Level).

5.14 Motor Stopping Methods for Servo OFF and Alarms

You can use the following methods to stop the servomotor when the servo is turned OFF or an alarm occurs. There are the following four stopping methods.

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

There are the following three conditions after stopping.

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

Important

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

Condition	Servomotor Stopping Method	
	For SGDXS-R70A, -1R6A, -2R8A, -3R8A, -5R5A, -7R6A, -120A, -180A, and -200A	SGDXS-330A, -470A, -550A, -590A, -780A
Main circuit power turned OFF before turning OFF the servo	Stopping with dynamic brake	
Control power turned OFF before turning OFF the servo	Stopping with dynamic brake	Coasting to a Stop

- If the servomotor must be stopped by coasting rather than with the dynamic brake when the main circuit power or the control power is turned OFF before the servo is turned OFF, use a SERVOPACK with the dynamic brake option.
- To minimize the coasting distance of the servomotor to come to a stop when an alarm occurs, zero-speed stopping is the default method for alarms to which it is applicable. However, depending on the application, stopping with the dynamic brake may be more suitable than zero-speed stopping.
  For example, when coupling two shafts (twin-drive operation), machine damage may occur if a zero-speed stopping alarm occurs for one of the coupled shafts and the other shaft stops with a dynamic brake. In such cases, change the stopping method to the dynamic brake.

5.14.1 Stopping Method for Servo OFF

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

Parameter		Servomotor Stopping Method	Status after Servomotor Stops	When Enabled
Pn001	**n.□□□0 (default setting)**	Dynamic brake *1	Dynamic brake *1	After restart
	n.□□□1		Coasting	
	n.□□□2	Coasting	Coasting	

*1 The servomotor will coast to a stop when the SERVOPACK is not equipped with a built-in dynamic brake resistor or an external dynamic brake resistor is not connected.

Note:

If Pn001 is set to n.□□□0 (stop the motor by applying the dynamic brake) and the servomotor is stopped or operates at a low speed, braking force may not be generated, just like it is not generated for coasting to a stop.

5.14.2 Servomotor Stopping Method for Alarms

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

Refer to the following section to see which alarms are in group 1 and which are in group 2.

☞ *13.2.1 List of Alarms on page 580*

(1) Motor Stopping Method for Group 1 Alarms

When a group 1 alarm occurs, the servomotor will stop according to the setting of Pn001 = n.□□□X. The default setting is to stop by applying the dynamic brake.

Refer to the following section for details.

☞ *5.14.1 Stopping Method for Servo OFF on page 195*

(2) Motor Stopping Method for Group 2 Alarms

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

- Pn001 = n.□□□X (Motor Stopping Method for Servo OFF and Group 1 Alarms)
- Pn00A = n.□□□X (Motor Stopping Method for Group 2 Alarms)
- Pn00B = n.□□X□ (Motor Stopping Method for Group 2 Alarms)

However, during torque control, the group 1 stopping method is always used. If you set Pn00B to n.□□1□ (apply dynamic brake or coast servomotor to a stop), you can use the same stopping method as group 1. If you are coordinating a number of servomotors, you can use this stopping method to prevent machine damage that may result because of differences in the stopping method.

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

Parameter			Servomotor Stopping Method	Status after Servomotor Stops	When Enabled
Pn00B	Pn00A	Pn001			
n.□□0□ (default setting)	–	n.□□□0 (default setting)	Zero-speed stopping	Dynamic brake	After restart
		n.□□□1		Coasting	
		n.□□□2			
n.□□1□	–	n.□□□0 (default setting)	Dynamic brake	Dynamic brake	
		n.□□□1		Coasting	
		n.□□□2	Coasting		
n.□□2□	n.□□□0	n.□□□0 (default setting)	Dynamic brake	Dynamic brake	
		n.□□□1		Coasting	
		n.□□□2	Coasting		
	n.□□□1 (default setting)	n.□□□0 (default setting)	Motor is decelerated using the torque set in Pn406 as the maximum torque.	Dynamic brake	
		n.□□□1		Coasting	
		n.□□□2			
	n.□□□2	n.□□□0 (default setting)		Coasting	
		n.□□□1			
		n.□□□2			
	n.□□□3	n.□□□0 (default setting)	Motor is decelerated according to setting of Pn30A.	Dynamic brake	
		n.□□□1		Coasting	
		n.□□□2			
	n.□□□4	n.□□□0 (default setting)		Coasting	
		n.□□□1			
		n.□□□2			

Note:

1. The setting of Pn00A is ignored if Pn00B is set to n.□□0□ or n.□□1□.
2. The setting of Pn00A = n.□□□X is enabled for position control and speed control. During torque control, the setting of Pn00A = n.□□□X will be ignored and only the setting of Pn001 = n.□□□X will be used.
3. Refer to the following section for details on Pn406 (Emergency Stop Torque).
   ☞ *(1) Stopping the Servomotor by Setting Emergency Stop Torque on page 187*
4. Refer to the following section for details on Pn30A (Deceleration Time for Servo OFF and Forced Stops).
   ☞ *(2) Stopping the Servomotor by Setting the Deceleration Time on page 188*

5.15 Motor Overload Detection Level

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

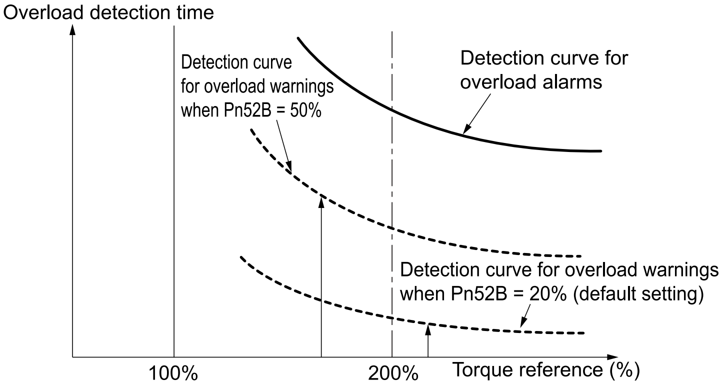
It is designed to prevent servomotor overheating.

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

5.15.1 Detection Timing for Overload Warnings (A.910)

With the default setting for overload warnings, an overload warning is detected in 20% of the time required to detect an overload alarm. You can change the time required to detect an overload warning by changing the setting of Pn52B (Overload Warning Level). 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 setting of Pn52B (Overload Warning Level) is changed from 20% to 50%. An overload warning is detected in half of the time required to detect an overload alarm.



Pn52B	Overload Warning Level			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 100	1%	20	After restart

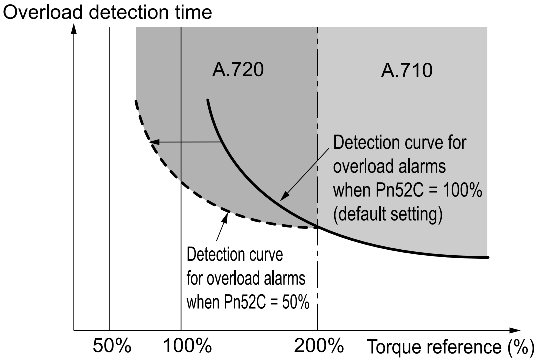
5.15.2 Detection Timing for Overload Alarms (A.720)

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

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

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

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



Note:

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

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

📖 Σ-X-Series Rotary Servomotor Product Manual (Manual No.: SIEP C230210 00)

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

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

5.16 Electronic Gear Settings

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

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

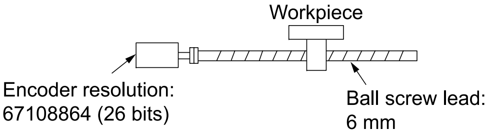
With the electronic gear, one reference unit is equal to the workpiece travel distance per reference pulse input to the SERVOPACK. In other words, if you use the SERVOPACK's electronic gear, pulses can be read as reference units.

Important

- If you set an electronic gear in the host controller, normally set the electronic gear ratio in the SERVOPACK to 1:1.
- If you enable reference pulse input multiplication switching, the reference unit is defined as the position data that is n times the reference pulses input from the host controller. ("n" is the reference pulse input multiplier.)

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

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



When the Electronic Gear Is Not Used

To move a workpiece 10 mm:
(1) Calculate the number of rotations.
The servomotor will move 6 mm for each rotation, so 10/6 rotations are required to move 10 mm.
(2) Calculate the required number of reference pulses.
One rotation is 67108864 pulses.
Therefore, "10/6 × 67108864 = 111848106.66... pulses"
(3) Input 111848107 pulses as the reference.

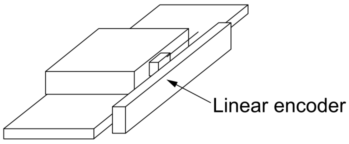
Calculating the number of reference pulses for each reference is necessary. = Troublesome

When the Electronic Gear Is Used

If you use reference units to move the workpiece 10 mm, when the reference unit is set to 1 μm, the travel amount is 1 μm per pulse.
To move the workpiece 10 mm (10000 μm),
10000 ÷ 1 = 10000 pulses, so 10000 pulses would be input.

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

- Linear Servomotors
  In this example, the following machine configuration is used to move the load 10 mm. We'll assume that the resolution of the serial converter unit is 256 and that the linear encoder pitch is 20 μm.



When the Electronic Gear Is Not Used

To move the load 10 mm:
10 × 1000 ÷ 20 × 256 = 128000 pulses,
so 128000 pulses is input as the reference.

Calculating the number of reference pulses for each reference is necessary. = Troublesome

When the Electronic Gear Is Used

To move the load 10 mm using reference units:
When the reference unit is set to 1 μm, the travel amount is 1 μm per pulse.
To move the load 10 mm (10000 μm),
10000/1 = 10000 pulses, so 10000 pulses is input as the reference.

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

5.16.1 Electronic Gear Ratio Settings

Set the electronic gear ratio using Pn20E and Pn210.

Important

- Set the electronic gear ratio within the following range.
  $0.001 \leq \text{Electronic gear ratio (B/A)} \leq 64000$
  If the electronic gear ratio is outside of this range, an A.040 alarm (Parameter Setting Error) will occur.
  If the electronic gear ratio in the device configuration exceeds this setting range, set Pn21D.
- When Pn21D is set to n.□□□1 (enable encoder resolution compatibility), the servomotor operates with the encoder bit count set by Pn21D = n.□□X□ (encoder resolution compatibility: bit count selection) instead of the encoder bit count in the servomotor specifications.
  Refer to the following section for details on the Pn21D.
  ☞ *5.20.1 Setting the Encoder Resolution Compatibility Selection on page 214*

Pn20E	Electronic Gear Ratio (Numerator) Speed **Pos** Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 1073741824	–	256	After restart
Pn210	Electronic Gear Ratio (Denominator) Speed **Pos** Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 1073741824	–	1	After restart

(1) Calculating the Settings for the Electronic Gear Ratio

(a) Rotary Servomotors

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

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

◆ Encoder Resolution

You can check the encoder resolution in the servomotor model number and with Pn21D = n.□□X□.

- When Pn21D is set to n.□□□0 (disable encoder bit count compatibility)
  You can check the encoder resolution in the servomotor model number. The encoder resolutions are given next.

Servomotor Model	Code for ■ in Interpreting Servomotor Model Number	Specification	Encoder Resolution
SGMXJ-□□□■□□□□□ SGMXA-□□□■□□□□□ SGMXP-□□□■□□□□□ SGMXG-□□□■□□□□□	U	26 bits (absolute encoder)	67108864
	W	26 bits (batteryless absolute encoder)	
SGM7M-□□□■□□□□□	3	20 bits (absolute encoder)	1048576
SGM7D-□□□■□□□□□ SGM7E-□□□■□□□□□ SGM7F-□□□■□□□□□	7	24 bits (multiturn absolute encoder)	16777216
	F	24 bits (incremental encoder)	

Information With fully-closed loop control, the number of external encoder pulses per motor rotation is the encoder resolution.

- When Pn21D is set to n.□□□1 (enable encoder bit count compatibility)
  Calculate the encoder resolution with "$2^{\text{Number of bits set in Pn21D = n.□□X□}}$".

Pn21D	n.□□X□	Encoder Resolution Compatibility: Resolution Selection **Speed** **Pos** Trq		When Enabled
		4	Operate as 20-bit encoder.	After restart
		6	Operate as 22-bit encoder.	
		8 Default	Operate as 24-bit encoder.	
		A	Operate as 26-bit encoder.	
		Other values	Reserved (Do not use.)	

Refer to the following section for details on Pn21D.

☞ *5.20.1 Setting the Encoder Resolution Compatibility Selection on page 214*

(b) Linear Servomotors

You can calculate the settings for the electronic gear ratio with the following equation:

- When Not Using a Serial Converter Unit

$$\text{Electronic gear ratio } \frac{B}{A} = \frac{\text{Pn20E}}{\text{Pn210}} = \frac{\text{Travel amount per reference unit (reference units)} \times \text{Number of divisions of the linear encoder}}{\text{Linear encoder scale pitch (setting in the following table)}}$$

- When Using a Serial Converter Unit

$$\text{Electronic gear ratio } \frac{B}{A} = \frac{\text{Pn20E}}{\text{Pn210}} = \frac{\text{Travel amount per reference unit (reference units)} \times \text{Number of divisions of the serial converter unit}}{\text{Linear encoder scale pitch (setting of Pn282)}}$$

◆

Feedback Resolution of Linear Encoder: Incremental Linear Encoder

The incremental linear encoder scale pitches and resolutions are given in the following table.

Calculate the electronic gear ratio using the values in the following table.

Manufacturer	Linear Encoder Model	Linear Encoder Scale Pitch [μm] *1	Relay Device between SERVOPACK and Linear Encoder	Resolution	Resolution
Dr. JOHANNES HEIDENHAIN GmbH	LIDA48□	20	JZDP-H003-□□□-E *2	256	0.078 μm
			JZDP-J003-□□□-E *2	4096	0.0049 μm
	LIF48□	4	JZDP-H003-□□□-E *2	256	0.016 μm
			JZDP-J003-□□□-E *2	4096	0.00098 μm
Renishaw PLC	RGH22B	20	JZDP-H005-□□□-E *2	256	0.078 μm
			JZDP-J005-□□□-E *2	4096	0.0049 μm
Magnescale Co., Ltd.	SR75-□□□□□LF *3	80	–	8192	0.0098 μm
	SR75-□□□□□MF	80	–	1024	0.078 μm
	SR85-□□□□□LF *3	80	–	8192	0.0098 μm
	SR85-□□□□□MF	80	–	1024	0.078 μm
	SL700 *3, SL710 *3, SL720 *3, SL730 *3	800	PL101-RY *4	8192	0.0977 μm
			MJ620-T13 *5		
	SQ10	400	MQ10-FLA *5	8192	0.0488 μm
			MQ10-GLA *5		
Canon Precision Inc.	PH03-36110	128	–	2048	0.0625 μm
	PH03-36120	128	–	2048	0.0625 μm

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

*2 This is the model of the serial converter unit.

*3 If you use an encoder pulse output with this linear encoder, the setting range of the encoder output resolution (Pn281) is restricted. Refer to the following section for details on the encoder output resolution (Pn281).

☞ *6.8.2 Setting for the Encoder Divided Pulse Output on page 267*

*4 This is the model of the head with interpolator.

*5 This is the model of the interpolator.

◆

Feedback Resolution of Linear Encoder: Absolute Linear Encoder

The absolute linear encoder scale pitches and resolutions are given in the following table.

Calculate the electronic gear ratio using the values in the following table.

Manufacturer	Linear Encoder Model	Linear Encoder Scale Pitch [μm] *1	Relay Device between SERVOPACK and Linear Encoder	Resolution	Resolution
Dr. JOHANNES HEIDENHAIN GmbH	LIC4190 Series	40.96	–	4096	0.01 μm
		20.48	–	4096	0.005 μm
		4.096	–	4096	0.001 μm
	LIC2190 Series	409.6	–	4096	0.1 μm
		204.8	–	4096	0.05 μm
	LC115	40.96	EIB3391Y *2	4096	0.01 μm
	LC415	40.96	EIB3391Y *2	4096	0.01 μm
RSF Elektronik GmbH	MC15Y Series	409.6	–	4096	0.1 μm
		204.8	–	4096	0.05 μm
Mitutoyo Corporation	ST781A/ST781AL	256	–	512	0.5 μm
	ST782A/ST782AL	256	–	512	0.5 μm
	ST783/ST783AL	51.2	–	512	0.1 μm
	ST784/ST784AL	51.2	–	512	0.1 μm
	ST788A/ST788AL	51.2	–	512	0.1 μm
	ST789A/ST789AL	25.6	–	512	0.05 μm
	ST1381	5.12	–	512	0.01 μm
	ST1382	0.512	–	512	0.001 μm
Renishaw PLC	EL36Y□□050F□□□	12.8	–	256	0.05 μm
	EL36Y□□100F□□□	25.6	–	256	0.1 μm
	EL36Y□□500F□□□	128	–	256	0.5 μm
	RL36Y□□050□□□□	12.8	–	256	0.05 μm
	RL36Y□□001□□□□	0.256	–	256	0.001 μm
RLS d.o.o.	LA11YA Series	2000	–	2048	0.9765 μm
		2000	–	4096	0.4882 μm
		2000	–	8192	0.2441 μm
Magnescale Co., Ltd.	SR77-□□□□□LF *3	80	–	8192	0.0098 μm
	SR77-□□□□□MF	80	–	1024	0.078 μm
	SR87-□□□□□LF *3	80	–	8192	0.0098 μm
	SR87-□□□□□MF	80	–	1024	0.078 μm
	SQ47/SQ57-□□□□□SF□□□□ SQ47/SQ57-□□□□□TF□□□	20.48	–	4096	0.005 μm
	SQ47/SQ57-□□□□□AF□□□ SQ47/SQ57-□□□□□FF□□□	40.96	–	4096	0.01 μm

Continued on next page.

Continued from previous page.

Manufacturer	Linear Encoder Model	Linear Encoder Scale Pitch [μm] *1	Relay Device between SERVOPACK and Linear Encoder	Resolution	Resolution
Fagor Automation S. Coop.	L2AK208	20	–	256	0.078 μm
	L2AK211	20	–	2048	0.0098 μm
	LAK209	40	–	512	0.078 μm
	LAK212	40	–	4096	0.0098 μm
	S2AK208	20	–	256	0.078 μm
	SV2AK208	20	–	256	0.078 μm
	G2AK208	20	–	256	0.078 μm
	S2AK211	20	–	2048	0.0098 μm
	SV2AK211	20	–	2048	0.0098 μm
	G2AK211	20	–	2048	0.0098 μm
Canon Precision Inc.	PH03-36E00	128	–	2048	0.0625 μm

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

*2 This is the model of the interpolator.

*3 If you use an encoder pulse output with this linear encoder, the setting range of Pn281 (Encoder Output Resolution) is restricted. Refer to the following section for details on Pn281 (Encoder Output Resolution).

☞ *6.8.2 Setting for the Encoder Divided Pulse Output on page 267*

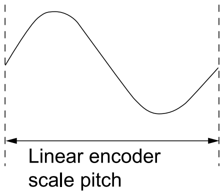
Information

Resolution

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

$$\text{Resolution (travel amount per feedback pulse)} = \frac{\text{Linear encoder scale pitch}}{\text{Number of divisions of serial converter unit or linear encoder}}$$

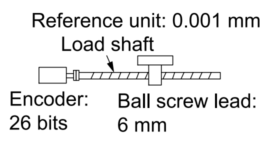
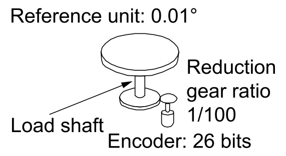
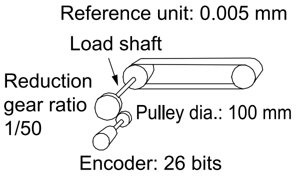
The SERVOPACK uses feedback pulses as the unit to control a servomotor.



5.16.2 Electronic Gear Ratio Setting Examples

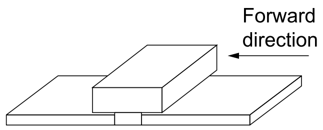
Setting examples are provided in this section.

(1) Rotary Servomotors

Step	Description	Machine Configuration		
		Ball Screw	Rotary Table	Belt and Pulley
				
1	Machine Specifications	• Ball screw lead: 6 mm • Gear ratio: 1/1	• Rotational angle per revolution: 360° • Gear ratio: 1/100	• Pulley dia.: 100 mm (pulley circumference: 314 mm) • Gear ratio: 1/50
2	Encoder Resolution	67108864 (26 bits)	16777216 (24 bits) **Note:** Use Pn21D (Encoder Resolution Setting) to use 67108864 (26 bits) as 16777216 (24 bits).	16777216 (24 bits) **Note:** Use Pn21D (Encoder Resolution Setting) to use 67108864 (26 bits) as 16777216 (24 bits).
3	Reference Unit	0.001 mm (1 μm)	0.01°	0.005 mm (5 μm)
4	Travel Distance per Load Shaft Revolution (Reference Units)	6 mm/0.001 mm = 6000	360°/0.01° = 36000	314 mm/0.005 mm = 62800
5	Electronic Gear Ratio	$\frac{B}{A} = \frac{67108864}{6000} \times \frac{1}{1}$	$\frac{B}{A} = \frac{16777216}{36000} \times \frac{100}{1}$	$\frac{B}{A} = \frac{16777216}{62800} \times \frac{50}{1}$
6	Parameter	• Pn20E = 67108864 • Pn210 = 6000 • Pn21D = n.□□□0	• Pn20E = 167772160 • Pn210 = 3600 • Pn21D = n.□□81	• Pn20E = 838860800 • Pn210 = 62800 • Pn21D = n.□□81

(2) Linear Servomotors

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

Step	Description	Machine Configuration
		Ball Screw
		Reference unit: 0.02 mm (20 μm) 
1	Linear Encoder Scale Pitch	0.02 mm (20 μm)
2	Reference Unit	0.001 mm (1 μm)
3	Electronic Gear Ratio	$\frac{B}{A} = \frac{1\ (\mu m)}{20\ (\mu m)} \times 256$
4	Parameter	Pn20E: 256 Pn210: 20

5.17 Resetting the Absolute Encoder

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

Reset the absolute encoder in the following cases.

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

⚠ **WARNING**

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

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

Information

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

5.17.1 Precautions on Resetting

- You cannot use the /ALM-RST (Alarm Reset Output) signal from the SERVOPACK to clear the A.810 alarm (Encoder Backup Alarm) or the A.820 alarm (Encoder Checksum Alarm). Always use the operation to reset the absolute encoder to clear these alarms.
- If an A.8□□ alarm (internal encoder monitoring alarm) occurs, turn OFF the power to reset the alarm.

5.17.2 Preparations

Always check the following before you reset an absolute encoder.

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

5.17.3 Applicable Tools

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

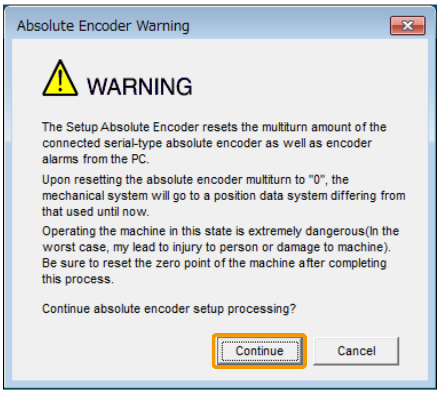
Tool	Fn No./Function Name	Reference
Panel Operator	Fn008	☞ *14.4.7 Reset Absolute Encoder (Fn008) on page 648*
Digital Operator	Fn008	📖 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Encoder Setting] – [Reset Absolute Encoder]	☞ *5.17.4 Operating Procedure on page 207*

5.17.4 Operating Procedure

Use the following procedure to reset the absolute encoder.

1. **Confirm that the servo is OFF.**
2. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
3. **Click [Reset Absolute Encoder] in the [Menu] window.**

   The [Absolute Encoder Reset] window will be displayed.
4. **Click the [Continue] button.**



Absolute Encoder Warning

WARNING

The Setup Absolute Encoder resets the multiturn amount of the connected serial-type absolute encoder as well as encoder alarms from the PC.

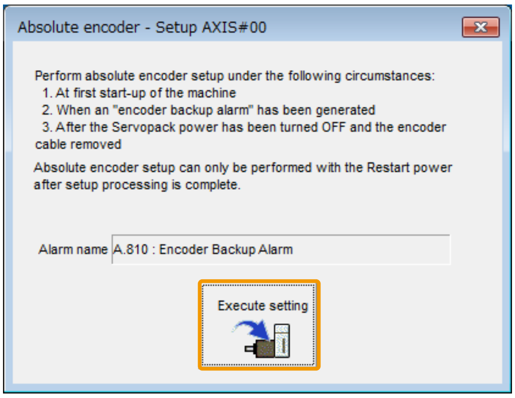
Upon resetting the absolute encoder multiturn to "0", the mechanical system will go to a position data system differing from that used until now.

Operating the machine in this state is extremely dangerous(In the worst case, my lead to injury to person or damage to machine). Be sure to reset the zero point of the machine after completing this process.

Continue absolute encoder setup processing?

Click the [Cancel] button to cancel resetting the absolute encoder. The Main Window will return.

5. **Click the [Execute setting] button.**



Absolute encoder - Setup AXIS#00

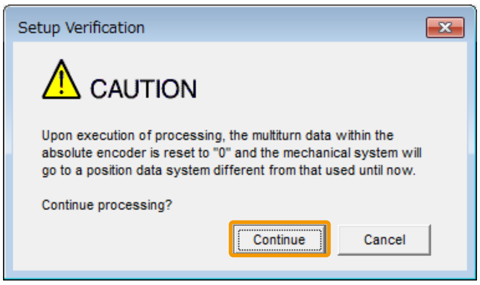
Perform absolute encoder setup under the following circumstances:
1. At first start-up of the machine
2. When an "encoder backup alarm" has been generated
3. After the Servopack power has been turned OFF and the encoder cable removed

Absolute encoder setup can only be performed with the Restart power after setup processing is complete.

Alarm name A.810 : Encoder Backup Alarm

The current alarm code and name will be displayed in the [Alarm name] box.

6. **Click the [Continue] button.**



Setup Verification

CAUTION

Upon execution of processing, the multiturn data within the absolute encoder is reset to "0" and the mechanical system will go to a position data system different from that used until now.

Continue processing?

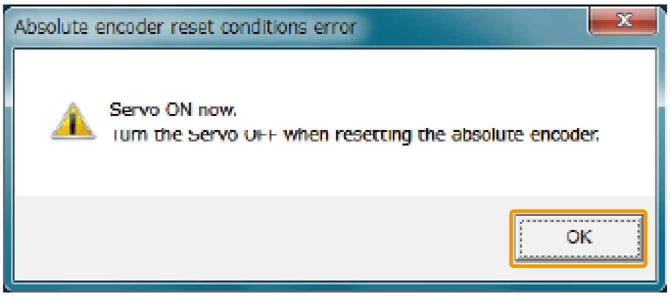
Click the [Cancel] button to cancel resetting the absolute encoder. The previous window will return.

7. **Click the [OK] button.**

   The absolute encoder will be reset.

   When Resetting Fails

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


Absolute encoder reset conditions error

Servo ON now.
Turn the Servo OFF when resetting the absolute encoder.

Click the [OK] button. The Main Window will return. Turn OFF the servo and repeat the procedure from step 1.

When Resetting Is Successful

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


Completion Warning Message

CAUTION

Absolute Encoder reset processing has been performed. The Multiturn amount in the absolute encoder has been to "0".
Be sure to reset the mechanical system to "0" after restarting power.

The Main Window will return.

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

This concludes the procedure to reset the absolute encoder.

5.18 Setting the Origin of the Absolute Encoder

5.18.1 Setting the Origin of the Absolute Linear Encoder

You can set any position as the origin in the following linear encoders.

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

Important

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

(1) Preparations

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

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

(2) Applicable Tools

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

Tool	Fn No./Function Name	Reference
Panel Operator	Fn020	☞ *14.4.23 Set Absolute Linear Encoder Origin (Fn020) on page 658*
Digital Operator	Fn020	📖 Σ-7/Σ-X-Sseries Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Encoder Setting] – [Zero Point Position Setting]	☞ *(3) Operating Procedure on page 209*

(3) Operating Procedure

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

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Click [Zero Point Position Setting] in the [Menu] window.**

   The [Set Origin] window will be displayed.

3. **Click the [Continue] button.**

Set Origin

WARNING

The set origin sets the current position to the connected absolute linear scale as the zero-point position.
Always refer to the user's manual before executing this function.
Note the following points:

1.Always make the settings for the mechanical system again after the set origin.

The absolute position of the connected absolute linear scale is cleared to 0 and the previously defined mechanical system will change to a different coordinate system.
Operating the machine in this state is extremely dangerous.
Failure to observe this warning may result in personal injury and/or damage to the machine.
Be sure to reset the zero point for the mechanical system after the set origin.

2.Satisfy the following conditions before executing this function:

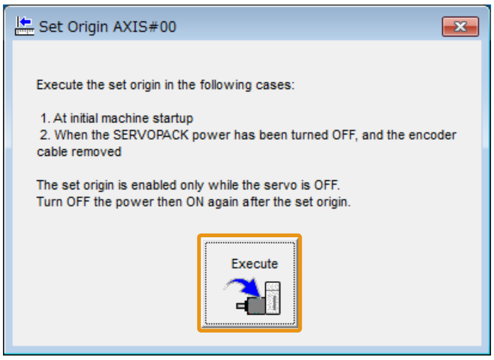
The following conditions must be satisfied to execute the set origin:
a. Servo OFF
b. The polarity detection has been completed.
Check the SERVOPACK status.

3.Always turn the SERVOPACK power OFF then ON again after the set origin.

The set zero point position will be valid after turning OFF the power then ON again.
Always turn OFF the SERVOPACK power then ON again after the set origin.

Do you want to continue the set origin?

4. **Click the [Execute] button.**



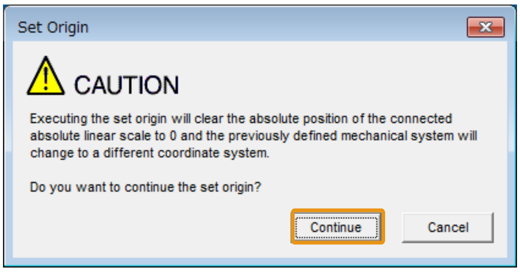
Set Origin AXIS#00

Execute the set origin in the following cases:

1. At initial machine startup
2. When the SERVOPACK power has been turned OFF, and the encoder cable removed

The set origin is enabled only while the servo is OFF.
Turn OFF the power then ON again after the set origin.

5. **Click the [Continue] button.**



Set Origin

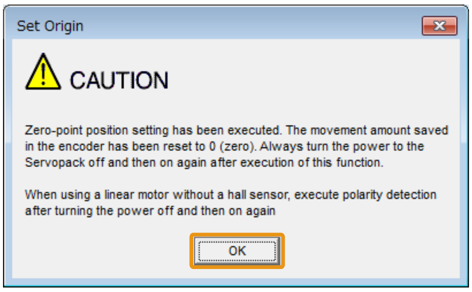
CAUTION

Executing the set origin will clear the absolute position of the connected absolute linear scale to 0 and the previously defined mechanical system will change to a different coordinate system.

Do you want to continue the set origin?

Click the [Cancel] button to cancel setting the origin of the absolute linear encoder. The previous window will return.

6. **Click the [OK] button.**



Set Origin

CAUTION

Zero-point position setting has been executed. The movement amount saved in the encoder has been reset to 0 (zero). Always turn the power to the Servopack off and then on again after execution of this function.

When using a linear motor without a hall sensor, execute polarity detection after turning the power off and then on again

7. **Turn the power to the SERVOPACK OFF and ON again.**

8. **If you use a linear servomotor that does not have a polarity sensor, perform polarity detection.**

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

   ☞ *5.11 Polarity Detection on page 182*

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

5.19 Setting the Regenerative Resistor Capacity

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

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

Refer to the following manual to select the capacity of a regenerative resistor.

📖 Σ-X-Series Peripheral Device Selection Manual (Manual No.: SIEP C710812 12)

⚠ WARNING

If you use an external regenerative resistor, set Pn600 and Pn603 to suitable values.

If you set an unsuitable value, A.320 alarms (Regenerative Overload) cannot be detected correctly, and the external regenerative resistor may suffer a wire break or personal injury or fire may result.

Use an regenerative resistor with a suitable capacity for the external regenerative resistor.

If you use an external regenerative resistor with an unsuitable capacity, personal injury or fire may result.

Pn600	Regenerative Resistor Capacity			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to SERVOPACK's maximum applicable motor capacity	10 W	0	Immediately
Pn603	Regenerative Resistance			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	10 mΩ	0	Immediately

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

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

Note:

1. To use the SERVOPACK's built-in regenerative resistor or Yaskawa's regenerative resistor unit, set Pn600 to 0.
2. An A.320 alarm will be displayed if the setting is not suitable.

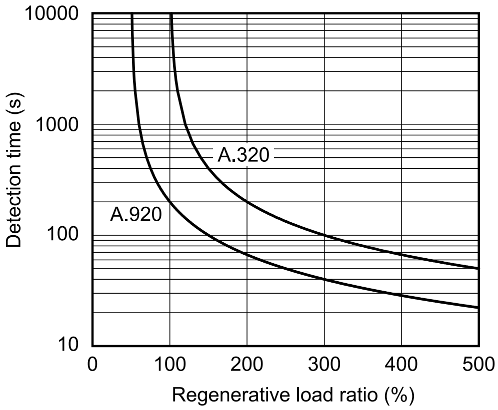
Example

For a self-cooling 100-W external regenerative resistor, set Pn600 (Regenerative Resistor Capacity) to 2 (×10 W) (100 W × 20% = 20 W).

Important

- When an external regenerative resistor is used at the normal rated load ratio, the resistor temperature increases to between 200°C and 300°C. Always apply derating. Consult the manufacturer for the resistor's load characteristics.
- For safety, use an external regenerative resistor with a thermoswitch.

A.320 (Regenerative Overload) and A.920 (Regenerative Overload) alarms are detected by the following overload protection characteristics.



The regenerative load ratio differs on whether the regenerative resistor is built-in or external as described next.

- When the regenerative resistor is built-in: Permissible power consumption [W] of the built-in regenerative resistor is detected as regenerative load ratio 100%
- When the regenerative resistor is external: Setting of Pn600 is detected as regenerative load ratio 100%

Refer to the following section for the permissible power consumption of the built-in regenerative resistor.

☞ *2.1.1 Ratings on page 66*

You can use the [Operation] monitor in the SigmaWin+ or the Un00A monitor on panel operator of the SERVOPACK to check the regenerative load ratio. Refer to the following sections for details.

☞ *9.2.2 Operation Monitor, Status Monitor, and I/O Monitor on page 504*

☞ *14.3 Monitor Display (Un□□□) Operations on the Panel Operator on page 640*

5.20 Σ-V/Σ-7 Compatible Function and Settings

The Σ-V/Σ-7 compatible function allows you to easily replace a Σ-V/Σ-7-Series SERVOPACK with a Σ-X-Series SERVOPACK in an existing servo system.

5.20.1 Setting the Encoder Resolution Compatibility Selection

When a Σ-X rotary servomotor is connected to a Σ-X-Series SERVOPACK, the servomotor can be operated with an encoder resolution that differs from the servomotor specifications.

First set Pn21D to n.□□□1 (enable encoder resolution compatibility), and then set the encoder resolution in Pn21D = n.□□X□.

Important

After setting the parameters, check the details of the settings again. If this settings are incorrect, unexpected machine operation, failure, or personal injury may occur.

Pn21D	n.□□□X	Encoder Resolution Compatibility Selection	Speed Pos Trq	When Enabled
		0 Default	Disable encoder resolution compatibility.	After restart
		1	Enable encoder resolution compatibility.	
Pn21D	n.□□X□	Encoder Resolution Compatibility: Resolution Selection	Speed Pos Trq	When Enabled
		4	Operate as 20-bit encoder.	After restart
		6	Operate as 22-bit encoder.	
		8 Default	Operate as 24-bit encoder.	
		A	Operate as 26-bit encoder.	
		Other values	Reserved (Do not use.)	

(1) Restrictions

Encoder bit count compatibility cannot be used when any of the following conditions apply.

- When fully-closed loop control is being used.
- When the bit count of the encoder in the connected servomotor is less than the bit count selected in Pn21D = n.□□X□.
- When a linear servomotor is connected.
- When the encoder resolution of the connected servomotor is not 2^n.

6

Application Functions

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

6.1 Changing Allocations of I/O Signals

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

Information Refer to the following section for the default settings of the I/O signal connector (CN1) and pin numbers for which allocations can be changed.

☞ *4.5.1 I/O Signal Connector (CN1) Names and Functions on page 135*

6.1.1 Changing Allocations of I/O Signals

Use the following procedure to change the signals allocated to pins on the I/O signal connector (CN1) and the polarity of the signals.

Information This section gives the procedure using the SigmaWin+. Signal allocations and polarity can also be set with parameters. Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

☞ *6.1.4 Output Signal Allocations on page 224*

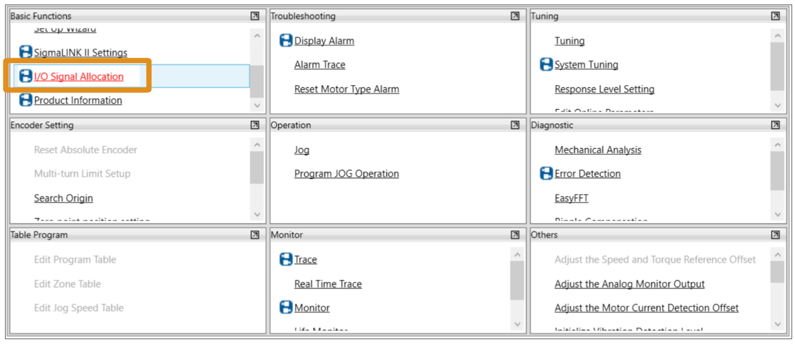
Important If you use Σ-LINK II, you must also set the peripheral devices in addition to the I/O signal allocations. Refer to the following chapter instead of this procedure if you use Σ-LINK II.

☞ *11 Σ-LINK II Function on page 541*

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

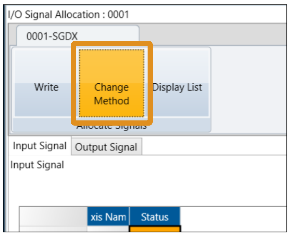
   The [Menu] window will be displayed.

2. **Click [I/O Signal Allocation] in the [Basic Functions] area.**



   The [I/O Signal Allocation] window will be displayed.

3. **Click [Change Method].**

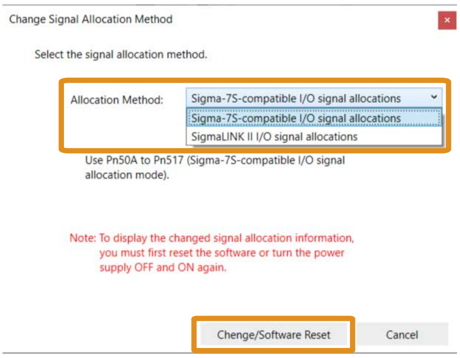


   The [Change Signal Allocation Method] window will be displayed.

4. **Select the allocation methods and click the [Change/Software Reset] button.**

   Refer to the following sections for details on allocation methods.

   ☞ *6.1.2 Input Signal Allocations on page 220*



Change Signal Allocation Method

Select the signal allocation method.

Allocation Method: Sigma-7S-compatible I/O signal allocations

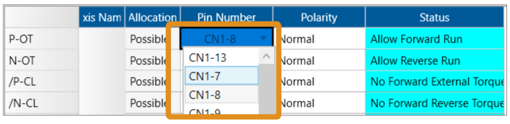
Use Pn50A to Pn517 (Sigma-7S-compatible I/O signal allocation mode).

Note: To display the changed signal allocation information, you must first reset the software or turn the power supply OFF and ON again.

The software will be reset to change the set allocation methods. The [I/O Signal Allocation] dialog box will return when the software is reset.

5. **Click the [Input Signal] tab or [Output Signal] tab for the signal allocations to change.**

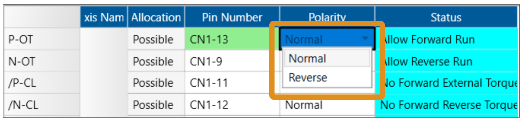
6. **Double-click the [Pin Number] cell on the row of the signal with the allocation to change, select the pin number, and then press the [Enter] key.**



	xis Nam	Allocation	Pin Number	Polarity	Status
P-OT		Possibl	CN1-8	Normal	Allow Forward Run
N-OT		Possibl		Normal	Allow Reverse Run
/P-CL		Possibl		Normal	No Forward External Torque
/N-CL		Possibl		Normal	No Forward Reverse Torque

The background of the cell with the changed signal allocation will change to green.

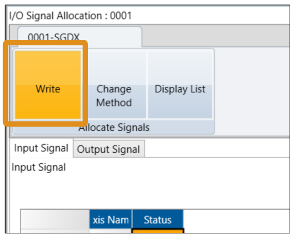
7. **Double-click the [Polarity] cell on the row of the signal with the polarity to change, select the polarity, and then press the [Enter] key.**



	xis Nam	Allocation	Pin Number	Polarity	Status
P-OT		Possible	CN1-13	Normal	llow Forward Run
N-OT		Possible	CN1-9		llow Reverse Run
/P-CL		Possible	CN1-11		o Forward External Torque
/N-CL		Possible	CN1-12	Normal	No Forward Reverse Torque

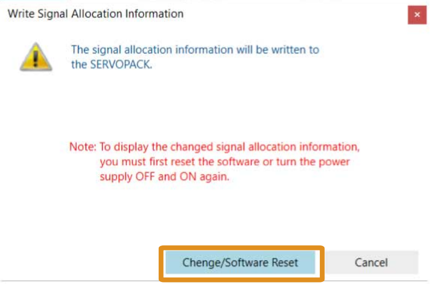
The background of the cell with the changed polarity will change to green.

8. **Click [Write].**



The [Write Signal Allocation Information] dialog box will be displayed.

9. **Click the [Change/Software Reset] button.**



Write Signal Allocation Information

The signal allocation information will be written to the SERVOPACK.

Note: To display the changed signal allocation information, you must first reset the software or turn the power supply OFF and ON again.

The software will be reset, the changes to the I/O signal allocations and polarities will be applied, and the backgrounds of the cell will return to white.

This concludes the procedure.

6.1.2 Input Signal Allocations

There are the following three methods to allocate input signals.

Allocation Method			Reference
Using the Default Settings			• Input Signals ☞ *(1) Using the Default Settings on page 221* • Output Signals ☞ *(2) Output Signals on page 136*
Changing I/O Signal Allocations	Σ-7S-compatible I/O Signal Allocations	Use Pn50A to Pn517 to allocate pin numbers to I/O signals.	• Input Signals ☞ *(2) Σ-7S-Compatible Input Signal Allocations on page 221* • Output Signals ☞ *6.1.4 Output Signal Allocations on page 224*
	Σ-LINK II Input Allocations	• When the Σ-LINK II Is Not Used Use Pn50A to Pn517j, Pn590, Pn591, Pn598, and Pn599 to allocate pin numbers to I/O signals.	• Input Signals ☞ *(3) Σ-LINK II Input Signal Allocations on page 222* • Output Signals ☞ *6.1.4 Output Signal Allocations on page 224*
		• When the Σ-LINK II Is Used Use Pn50A to Pn517, Pn590, Pn591, Pn598, and Pn599 to allocate pin numbers or communications data to input signals.	

Information When Σ-LINK II is not used, "Σ-7S-Compatible I/O Signal Allocations" and "Σ-LINK II-Compatible I/O Signal Allocations" differ only in the parameters used to allocate I/O signals. The signals and pin numbers to allocate are the same for both methods.

Information Different parameters are used in "Σ-7S-Compatible I/O Signal Allocations" and "Σ-LINK II Input Signal Allocations" to assign the following four signals only. For signals other than the following four signals, use the same parameters for either mode.

- P-OT (Forward Drive Prohibit Input) Signal
- N-OT (Reverse Drive Prohibit Input) Signal
- /P-CL (Forward External Torque Limit Input) Signal
- /N-CL (Reverse External Torque Limit Input) Signal

Specify the allocation method to use in Pn50A = n.□□□X (Input Signal Allocation Mode).

Pn50A	n.□□□X	Input Signal Allocation Mode	Speed Pos Trq	When Enabled
		0 Default	Use the sequence input signal terminals with the default allocations.	After restart
		1	Use Pn50A to Pn517 (Sigma-7S-compatible I/O signal allocation mode).	
		2	Use Pn50A to Pn517, Pn590, Pn591, Pn598, Pn599 (SigmaLINK II input signal allocation mode).	

Information Output signal allocations can also be changed regardless of the setting of Pn50A = n.□□□X.

6.1.3 Input Signal Allocations

This section describes the parameters used to change allocations and the relationship between pin numbers and polarity by allocation method of input signals.

Important

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

(1) Using the Default Settings

The default settings for signal allocations are given in the following table.

If you change the control method that is set in Pn000 = n.□□X□ when the signal allocations have the default settings, the signals will be allocated automatically as required for the specified control method, as given in the following table.

For example, if Pn000 is set to n.□□3□ (the control method is set to internal set speed control with contact commands), the /P-CON signal (CN1-41) will be allocated as the /SPD-D signal, the /P-CL signal (CN1-45) as the /SPD-A signal, and the /N-CL signal (CN1-46) as the /SPD-B signal.

Pn000 = n.□□X□	**Control Method Selection**	**CN1 Pin No.**						
		CN1-40	**CN1-41**	**CN1-42**	**CN1-43**	**CN1-44**	**CN1-45**	**CN1-46**
0	Speed control	/S-ON	/P-CON	P-OT	N-OT	/ALM-RST	/P-CL	/N-CL
1	Position control							
2	Torque control							
3	Internal set speed control		/SPD-D				/SPD-A	/SPD-B
4	Switching between internal set speed control and speed control with analog references							
5	Switching between internal set speed control and position control							
6	Switching between internal set speed control and torque control							
7	Switching between position control and speed control		/C-SEL				/P-CL	/N-CL
8	Switching between position control and torque control							
9	Switching between torque control and speed control							
A	Switching between speed control with analog references and speed control with zero clamping		/ZCLAMP					
B	Switching between normal position control and position control with reference pulse inhibition		/INHIBIT					

(2) Σ-7S-Compatible Input Signal Allocations

The parameters used to change allocations of input signals are shown in the following table.

Signal		**Parameter**
/S-ON	Servo ON Input	Pn50A = n.□□X□
/P-CON	Proportional Control Input	Pn50A = n.□X□□
P-OT *1	Forward Drive Prohibit Input	Pn50A = n.X□□□
N-OT *1	Reverse Drive Prohibit Input	Pn50B = n.□□□X
/ARM-RST	Alarm Reset Input	Pn50B = n.□□X□
/P-CL *1	Forward External Torque Limit Input	Pn50B = n.□X□□
/N-CL *1	Reverse External Torque Limit Input	Pn50B = n.X□□□
/SPD-D	Motor Direction Input	Pn50C = n.□□□X
/SPD-A	Internal Set Speed Selection Input	Pn50C = n.□□X□
/SPD-B	Internal Set Speed Selection Input	Pn50C = n.□X□□
/C-SEL	Control Selection Input	Pn50C = n.X□□□

Continued on next page.

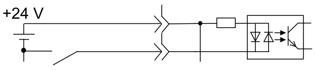
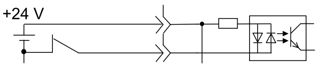
Continued from previous page.

Signal		Parameter
/ZCLAMP	Zero Camping Input	Pn50D = n.□□□X
/INHIBIT	Reference Pulse Inhibit Input	Pn50D = n.□□X□
/G-SEL	Gain Selection Input	Pn50D = n.□X□□
/P-DET	Polarity Detection Input	Pn50D = n.X□□□
SEN	Absolute Data Request Input	Pn515 = n.□□□X
/PSEL	Reference Pulse Input Multiplication Switch Input	Pn515 = n.□□X□
FSTP	Forced Stop Input	Pn516 = n.□□□X

*1 This signal has different parameters to set in "Σ-LINK II Input Signal Allocations".

(a) Relationship between Parameter Settings, Allocated Pins, and Polarities

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

Parameter Setting	Pin No.	Description
0	CN1–40	 A reverse signal (a signal with "/" before the signal abbreviation, such as the /S-ON signal) is active when the contacts are ON (closed). A signal that does not have "/" before the signal abbreviation (such as the P-OT signal) is active when the contacts are OFF (open).
1	CN1–41	
2	CN1–42	
3	CN1–43	
4	CN1–44	
5	CN1–45	
6	CN1–46	
7	–	The input signal is not allocated to a connector pin and it is always active. If the signal is processed on a signal edge, then it is always inactive.
8	–	The input signal is not allocated to a connector pin and it is always inactive. Set the parameter to 8 if the signal is not used.
9	CN1–40	 A reverse signal (a signal with "/" before the signal abbreviation, such as the /S-ON signal) is active when the contacts are OFF (open). A signal that does not have "/" before the signal abbreviation (such as the P-OT signal) is active when the contacts are ON (closed).
A	CN1–41	
B	CN1–42	
C	CN1–43	
D	CN1–44	
E	CN1–45	
F	CN1–46	

< Example 1 >

When Pn50A is set to n.5□□□, the P-OT (Forward Drive Prohibit Input) signal is active (enable forward drive) when CN1-45 is ON (open).

< Example 2 >

When Pn50A is set to n.8□□□, the P-OT (Forward Drive Prohibit Input) signal is always inactive.

(3) Σ-LINK II Input Signal Allocations

The parameters used to change allocations of input signals are shown in the following table.

Signal		Parameter	Parameter Settings Reference Page
/S-ON	Servo ON Input	Pn50A = n.□□X□	222
/P-CON	Proportional Control Input	Pn50A = n.□X□□	
P-OT *1	Forward Drive Prohibit Input	Pn590	223
N-OT *1	Reverse Drive Prohibit Input	Pn591	
/ARM-RST	Alarm Reset Input	Pn50B = n.□□X□	222
/P-CL *1	Forward External Torque Limit Input	Pn598	223
/N-CL *1	Reverse External Torque Limit Input	Pn599	
/SPD-D	Motor Direction Input	Pn50C = n.□□□X	222
/SPD-A	Internal Set Speed Selection Input	Pn50C = n.□□X□	
/SPD-B	Internal Set Speed Selection Input	Pn50C = n.□X□□	
/C-SEL	Control Selection Input	Pn50C = n.X□□□	
/ZCLAMP	Zero Camping Input	Pn50D = n.□□□X	
/INHIBIT	Reference Pulse Inhibit Input	Pn50D = n.□□X□	
/G-SEL	Gain Selection Input	Pn50D = n.□X□□	
/P-DET	Polarity Detection Input	Pn50D = n.X□□□	
SEN	Absolute Data Request Input	Pn515 = n.□□□X	
/PSEL	Reference Pulse Input Multiplication Switch Input	Pn515 = n.□□X□	
FSTP	Forced Stop Input	Pn516 = n.□□□X	

*1 This signal has different parameters to set in "Σ-7S-Compatible Input Signal Allocations".

(a) Relationship between Parameter Settings and Allocated Pin Numbers

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

Parameter Setting	Description
n.□040	Allocate the signal to CN1-40.
n.□041	Allocate the signal to CN1-41.
n.□042	Allocate the signal to CN1-42.
n.□043	Allocate the signal to CN1-43.
n.□044	Allocate the signal to CN1-44.
n.□045	Allocate the signal to CN1-45.
n.□046	Allocate the signal to CN1-46.
n.□100	Allocate the signal to SigmaLINK II Sequence Input 0.
n.□101	Allocate the signal to SigmaLINK II Sequence Input 1.
n.□102	Allocate the signal to SigmaLINK II Sequence Input 2.
n.□103	Allocate the signal to SigmaLINK II Sequence Input 3.
n.□104	Allocate the signal to SigmaLINK II Sequence Input 4.
n.□105	Allocate the signal to SigmaLINK II Sequence Input 5.
n.□106	Allocate the signal to SigmaLINK II Sequence Input 6.
n.□107	Allocate the signal to SigmaLINK II Sequence Input 7.

Important

If you will not use Σ-LINK II, always set n.□0□□ (allocate signal to CN1-□). If you set n.□1□□ (allocate the signal to SigmaLINK II Sequence Input □), the signal input will not function.

(b) Relationship between Parameter Settings and Polarities

The following table shows the relationship between the input signal parameter settings and polarities.

Parameter Setting	Description
n.0□□□	The signal is always inactive.
n.1□□□	Active when input signal is ON (closed).
n.2□□□	Active when input signal is OFF (open).
n.3□□□	The signal is always active.

6.1.4 Output Signal Allocations

Important

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

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

Signal		Parameter
/COIN	Positioning Completion Output	Pn50E = n.□□□X
/V-CMP	Speed Coincidence Detection Output	Pn50E = n.□□X□
/TGON	Rotation Detection Output	Pn50E = n.□X□□
/S-RDY	Servo Ready Output	Pn50E = n.X□□□
/CLT	Torque Limit Detection Output	Pn50F = n.□□□X
/VLT	Speed Limit Detection Output	Pn50F = n.□□X□
/BK	Brake Output	Pn50F = n.□X□□
/WARN	Warning Output	Pn50F = n.X□□□
/NEAR	Near Output	Pn510 = n.□□□X
/PSELA	Reference Pulse Input Multiplication Gain Switching Output	Pn510 = n.□X□□
/PM	Preventative Maintenance Output	Pn514 = n.□X□□
ALO1	Alarm Code Output	Pn517 = n.□□□X
ALO2		Pn517 = n.□□X□
ALO3		Pn517 = n.□X□□

(1) Relationship between Parameter Settings and Allocated Pin Numbers

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

Parameter Setting	Description
0	Disable (signal output is not used)
1	Output the allocated signal from the CN1-25 or CN1-26 output terminal.
2	Output the allocated signal from the CN1-27 or CN1-28 output terminal.
3	Output the allocated signal from the CN1-29 or CN1-30 output terminal.
4	Output the allocated signal from the CN1-37 output terminal.
5	Output the allocated signal from the CN1-38 output terminal.
6	Output the allocated signal from the CN1-39 output terminal.

(2) Output Signal Polarity Switching

The polarity of output signals is switched using Pn512 and Pn513.

Pn512	n.□□□X	Output Signal Inversion for CN1-25 and CN1-26 Terminals	Speed Pos Trq	When Enabled
		0 Default	The signal is not inverted.	After restart
		1	The signal is inverted.	
Pn512	n.□□X□	Output Signal Inversion for CN1-27 and CN1-28 Terminals	Speed Pos Trq	When Enabled
		0 Default	The signal is not inverted.	After restart
		1	The signal is inverted.	
Pn512	n.□X□□	Output Signal Inversion for CN1-29 and CN1-30 Terminals	Speed Pos Trq	When Enabled
		0 Default	The signal is not inverted.	After restart
		1	The signal is inverted.	
Pn512	n.X□□□	Output Signal Inversion for CN1-37 Terminal	Speed Pos Trq	When Enabled
		0 Default	The signal is not inverted.	After restart
		1	The signal is inverted.	
Pn513	n.□□□X	Output Signal Inversion for CN1-38 Terminal	Speed Pos Trq	When Enabled
		0 Default	The signal is not inverted.	After restart
		1	The signal is inverted.	
Pn513	n.□□X□	Output Signal Inversion for CN1-39 Terminal	Speed Pos Trq	When Enabled
		0 Default	The signal is not inverted.	After restart
		1	The signal is inverted.	

6.1.5 ALM (Servo Alarm Output) Signal

This signal is output when the SERVOPACK detects an error.

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

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	ALM	CN1-31 and CN1-32	ON (closed)	Normal SERVOPACK status
			OFF (open)	SERVOPACK alarm

(1) Alarm Reset Methods

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

☞ *13.2.3 Alarm Reset on page 610*

6.1.6 ALO1 to ALO3 (Alarm Code Output) Signals

The ALO1 to ALO3 (Alarm Code Output) signals report alarms and warnings that occur in the SERVOPACK. Use the alarm code output signals as required to display the contents of the alarm at the host controller (e.g., HMI).

Refer to the following sections for the relationship between the alarm code output and the alarms/warnings.

☞ *13.2.1 List of Alarms on page 580*

☞ *13.3.1 Warnings Table on page 618*

(1) ALO1 to ALO3 (Alarm Code Output) Signals

The ALO1 to ALO3 signals are allocated to the following output signal terminals (CN1) by default.

Type	Signal	Name	Pin No.
Output	ALO1	Alarm Code Output	CN1-37
	ALO2		CN1-38
	ALO3		CN1-39
	SG	Signal ground for alarm code output	CN1-1

Note:

You can allocate the ALO1 to ALO3 signals to another connector pins. Refer to the following section for details.

☞ *6.1.4 Output Signal Allocations on page 224*

6.1.7 /WARN (Warning Output) Signal

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

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

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

Note:

You must allocate the /WARN signal to use it. Use Pn50F = n.X□□□ (/WARN (Warning Output) Signal Allocation) to allocate the signal to a connector pin.

Refer to the following section for details.

☞ *6.1.4 Output Signal Allocations on page 224*

(1) Setting the Warning Code Output

You can use the ALO1 to ALO3 (Alarm Code Output) signals to output warning codes. Use Pn001 = n.X□□□ (Warning Code Output Selection) to set the output.

Refer to the following sections for details on the warnings.

☞ *13.3.1 Warnings Table on page 618*

Pn001	n.X□□□	Warning Code Output Selection Speed Pos Trq		When Enabled
		0 Default	Output only alarm codes on the ALO1, ALO2, and ALO3 terminals.	After restart
		1	Output both warning codes and alarm codes on the ALO1, ALO2, and ALO3 terminals. However, while an warning code is being output, the ALM (Servo Alarm Output) signal will remain ON (normal state).	

6.1.8 /TGON (Rotation Detection Output) Signal

The /TGON signal indicates that the servomotor is operating.

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

The /TGON signal is allocated to CN1-27 and CN1-28 by default.

Type	Signal	Connector Pin No.	Signal Status	Servomotor	Meaning
Output	/TGON	CN1-27, -28 (default setting)	ON (closed)	Rotary servomotor	The servomotor is operating at the setting of Pn502 or faster.
				Linear servomotor	The Servomotor is operating at the setting of Pn581 or faster.
			OFF (open)	Rotary servomotor	The servomotor is operating at a speed that is slower than the setting of Pn502.
				Linear servomotor	The servomotor is operating at a speed that is slower than the setting of Pn581.

Note:

Use Pn50E = n.□X□□ (/TGON (Rotation Detection Output) Signal Allocation) to allocate the /TGON signal to another connector pin. Refer to the following section for details.

☞ *6.1.4 Output Signal Allocations on page 224*

(1) Setting the Rotation Detection Level

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

- Rotary Servomotors

Pn502	Rotation Detection Level Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 10000	1 min^{-1}	20	Immediately

- Linear Servomotors

Pn581	Zero Speed Level Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 10000	1 mm/s	20	Immediately

6.1.9 /S-RDY (Servo Ready Output) Signal

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

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

- Main circuit power is ON.
- There is no hard wire base block state.
- There are no alarms.
- There is no forced stop state (= the Forced Stop Input (FSTP) signal is ON).
- If an absolute encoder is used, the SEN (Absolute Data Request Input) signal is ON (high level).
- If a servomotor without a polarity sensor is used, polarity detection has been completed [*1].
- If an absolute encoder is used, the SERVOPACK must be ready to accept the /S-ON (Servo ON Input) signal and, if the SEN signal is ON (high level), the output of the position data from the absolute encoder to the host controller must have been completed.

[*1] Do not include this condition if the /S-ON (Servo ON Input) signal is input for the first time after the control power was turned ON. In that case, when the first /S-ON signal is input, polarity detection is started immediately and the /S-RDY signal turns ON at the completion of polarity detection.
The /S-RDY signal is allocated to CN1-29 and CN1-30 by default.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	/S-RDY	CN1-29, -30 (default setting)	ON (closed)	Ready to receive the /S-ON (Servo ON Input) signal.
			OFF (open)	Not ready to receive the /S-ON (Servo ON Input) signal.

Note:

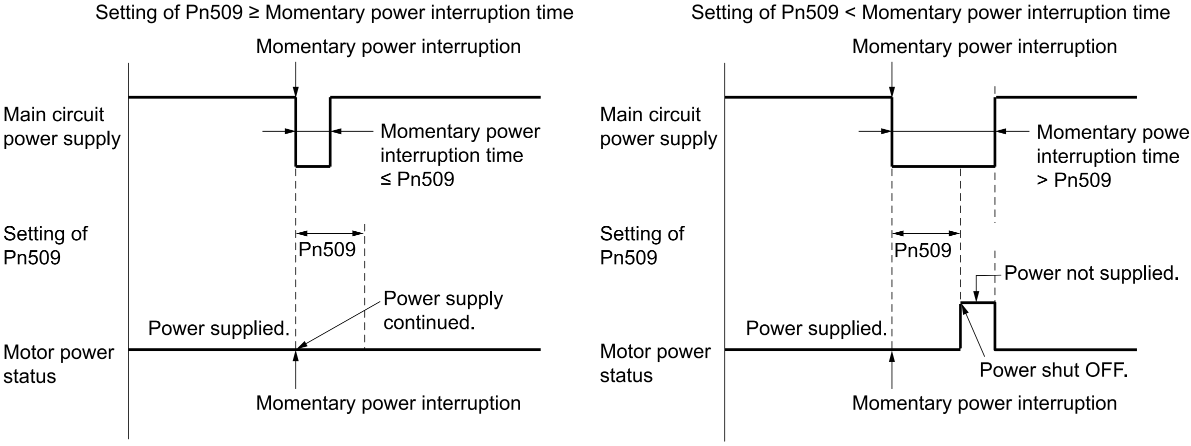
- Use Pn50E = n.X□□□ (/S-RDY (Servo Ready Output) Signal Allocation) to allocate the /S-RDY signal to another connector pin. Refer to the following section for details.
  ☞ *6.1.4 Output Signal Allocations on page 224*
- Refer to the following section for information on the hard wire base block and the /S-RDY signal.
  ☞ *12.2.7 /S-RDY (Servo Ready Output) Signal on page 568*

6.2 Operation for Momentary Power Interruptions

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

Pn509	Momentary Power Interruption Hold Time			**Speed** **Pos** **Trq**
	Setting Range	Setting Unit	Default Setting	When Enabled
	20 to 50000	1 ms	20	Immediately

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



Information

- If the momentary power interruption time exceeds the setting of Pn509, the /S-RDY (Servo Ready Output) signal will turn OFF.
- If uninterruptible power supplies are used for the control power supply and main circuit power supply, the SERVOPACK can withstand a power interruption that lasts longer than 50000 ms.
- The holding time of the SERVOPACK control power supply is approximately 100 ms. If control operations become impossible during a momentary power interruption of the control power supply, the setting of Pn509 will be ignored and the same operation will be performed as for when the power is turned OFF normally.
- The detection delay time for main circuit power OFF is approximately 16 ms. Therefore, the actual time that power will continue being supplied to the motor will increase from the setting of Pn509 by the amount of the detection delay time.

Important

The holding time of the main circuit power supply depends on the output from the SERVOPACK. If the load on the servomotor is large and an A.410 alarm (Undervoltage) occurs, the setting of Pn509 will be ignored.

6.3 SEMI F47 Function

The SEMI F47 function detects an A.971 warning (Undervoltage) and limits the output current if the DC main circuit power supply voltage to the SERVOPACK drops to a specified value or lower because the power was momentarily interrupted or the main circuit power supply voltage was temporarily reduced.

This function complies with the SEMI F47 standards for semiconductor manufacturing equipment.

You can combine this function with the setting of Pn509 (Momentary Power Interruption Hold Time) to allow the servomotor to continue operating without stopping for an alarm or without recovery work even if the power supply voltage drops.

6.3.1 Execution Sequence

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

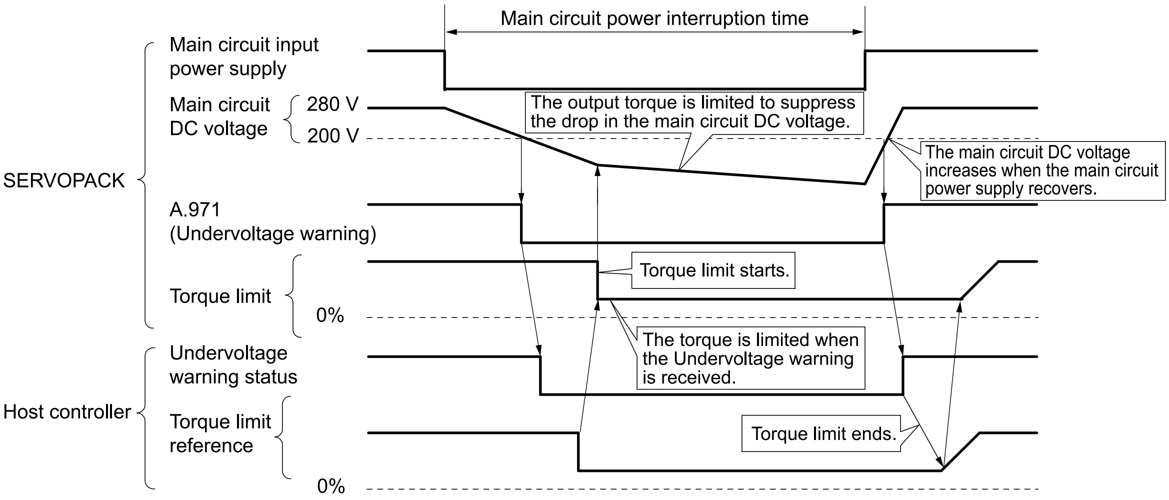
The default setting is Pn008 = n.□□0□ (do not detect undervoltage warning).

Pn008	n.□□X□	Function Selection for Undervoltage	Speed Pos Trq	When Enabled
		0 Default	Do not detect undervoltage.	After restart
		1	Detect undervoltage warning and limit torque at host controller.	
		2	Detect undervoltage warning and limit torque with Pn424 and Pn425 (i.e., only in SERVOPACK).	

(1) When Pn008 is set to n.□□1□ (Execution with the Host Controller)

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

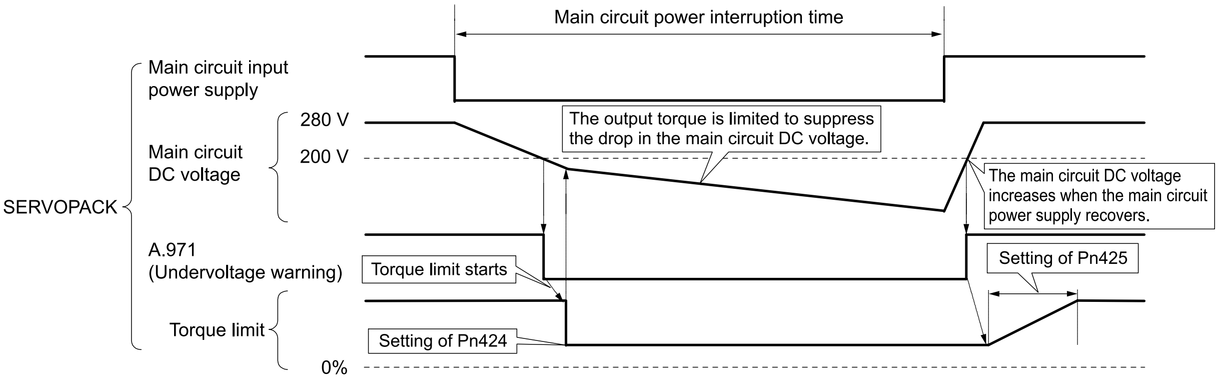
The host controller removes the torque limit after the Undervoltage warning is cleared.



(2) When Pn008 is set to n.□□2□ (Execution with the SERVOPACK)

The torque is limited in the SERVOPACK in response to an Undervoltage warning.

The SERVOPACK controls the torque limit for the set time after the Undervoltage warning is cleared.



6.3.2 Related Parameters

The following parameters are related to the SEMI F47 function.

Pn424	Torque Limit at Main Circuit Voltage Drop			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 100	1%	50	Immediately
Pn425	Release Time for Torque Limit at Main Circuit Voltage Drop			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 1000	1 ms	100	Immediately
Pn509	Momentary Power Interruption Hold Time			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	20 to 50000	1 ms	20	Immediately

Note:

1. The setting unit for Pn424 (Torque Limit at Main Circuit Voltage Drop) is set as percentage of the motor rated torque.
2. If you will use the SEMI F47 function, set the time to 1000 ms.

Important

- This function handles momentary power interruptions for the voltage and time ranges stipulated in SEMI F47. An uninterruptible power supply (UPS) is required as a backup for momentary power interruptions that exceed these voltage and time ranges.
- Set the host controller or SERVOPACK torque limit so that a torque reference that exceeds the specified acceleration torque will not be output when the power supply for the main circuit is restored.
- For a vertical axis, do not limit the torque to a value that is lower than the holding torque.
- This function limits torque within the range of the SERVOPACK's capability for power interruptions. It is not intended for use under all load and operating conditions. Set the parameters while monitoring operation on the actual machine.
- You can set the momentary power interruption hold time to increase the amount of time from when the power is turned OFF until power to the motor is stopped.
  To stop the power to the motor immediately, use the /S-ON (Servo ON Input) signal.

6.4 Setting the Maximum Motor Speed

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

- Rotary Servomotors

Pn316	Maximum Motor Speed			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	1 min^{-1}	10000	After restart

- Linear Servomotors

Pn385	Maximum Motor Speed			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 100	100 mm/s	50	After restart

You can achieve the following by lowering the maximum speed of the servomotor.

- If the servomotor speed exceeds the setting, an A.510 alarm (Overspeed) will occur.
- With a linear servomotor, you can increase the upper limit for the setting of Pn281 (Encoder Output Resolution). Refer to the following section for details.
  ☞ *6.8 Encoder Divided Pulse Output on page 264*

Changing the setting of the parameter is effective in the following cases.

- To protect the machine by stopping machine operation with an alarm when the set speed is reached or exceeded
- To limit the speed so that the load is driven beyond the allowable moment load of inertia
  Refer to relevant manual from the following list for the relationship between the speed and the allowable moment of load inertia.

  📖 Σ-X-Series Rotary Servomotor Product Manual (Manual No.: SIEP C230210 00)

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

  📖 Σ-7-Series Linear Servomotor Product Manual (Manual No.: SIEP S800001 37)
- To increase the encoder output resolution and increase the position resolution managed by the host controller (for a linear servomotor)

6.5 Speed Control

There are two types of speed control: speed control with an analog voltage reference and speed control with internal set speeds. This section describes speed control with an analog voltage reference.

You input a speed reference into the SERVOPACK with an analog voltage to operate the servomotor at the reference speed. Refer to the following section for information on speed control with internal set speeds.

☞ *6.9 Internal Set Speed Control on page 270*

- If you create a position loop in the host controller, you use the SERVOPACK for speed control.
- If you need to control only the speed of the servomotor, you use the SERVOPACK for speed control.

You select speed control with the parameter Pn000 = n.□□X□ (Control Method Selection).

Set Pn000 to n.□□0□ to set the control method to speed control.

		Control Method Selection **Speed** **Pos** **Trq**		When Enabled
Pn000	n.□□X□	0 Default	Speed control with analog references	After restart
		1	Position control with pulse train references	
		2	Torque control with analog references	
		3	Internal set speed control with contact commands	
		4	Switching between internal set speed control with contact references and speed control with analog references	
		5	Switching between internal set speed control with contact references and position control with pulse train references	
		6	Switching between internal set speed control with contact references and torque control with analog references	
		7	Switching between position control with pulse train references and speed control with analog references	
		8	Switching between position control with pulse train references and torque control with analog references	
		9	Switching between torque control with analog references and speed control with analog references	
		A	Switching between speed control with analog references and speed control with zero clamping	
		B	Switching between position control with pulse train references and position control with reference pulse inhibition	

6.5.1 Basic Settings for Speed Control

This section describes the use of the V-REF (Speed Reference Input) signal, /SPD-D (Motor Direction Input) signal, speed reference input gain, and speed reference offset adjustment in speed control with analog voltages.

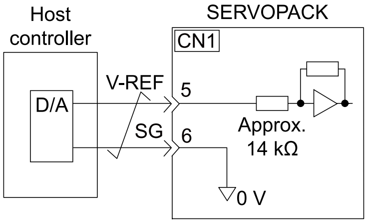
(1) V-REF (Speed Reference Input) Signal

Input the V-REF (Speed Reference Input) signal to the SERVOPACK to operate the servomotor at a speed that is proportional to the input voltage.

Type	Signal	Connector Pin No.	Meaning
Input	V-REF	CN1-5	Speed reference input signal
	SG	CN1-6	Signal ground for speed reference input signal

Maximum input voltage: ±12 VDC

If you will use a host controller, such as a programmable controller, for position control, connect the above output pins to the speed reference output terminals on the host controller.



Note:

Always use twisted-pair cables to control noise.

(2) /SPD-D (Motor Direction Input) Signal

You can turn the /SPD-D signal ON and OFF to change the direction of the servomotor.

Type	Signal	Connector Pin No.	Meaning
Input	/SPD-D	Must be allocated.	Changes the servomotor direction.

Note:

You must allocate the /SPD-D signal to use it. Use the following parameters to allocate the signal to a terminal.

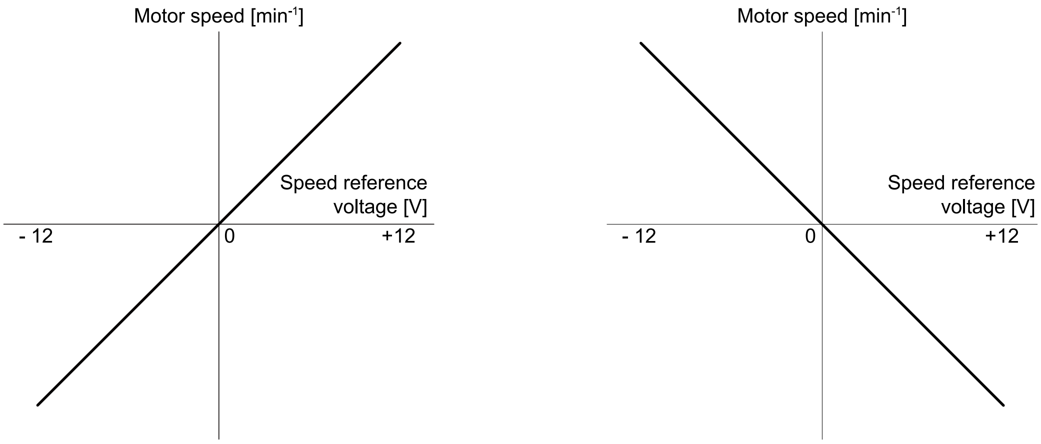
- Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (SigmaLINK II input signal allocation mode)
- Pn50C = n.□□□X (/SPD-D (Motor Direction) Signal Allocation)

Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

(3) Relation between the /SPD-D (Motor Direction Input) Signal and V-REF (Speed Reference Input) Signal

The following graphs show the relationship between the V-REF (Speed Reference Input) signal and the speed reference depending on whether the /SPD-D signal is ON or OFF.



/SPD-D (Motor Direction Input) Signal: OFF

/SPD-D (Motor Direction Input) Signal: ON

Speed Reference Input Example

If Pn300 is set to 600, the motor would operate at the rated speed for 6.00 V. (default setting)

- Rotary Servomotors

Speed Reference Input	/SPD-D Signal	Rotation Direction	Motor Speed	For SGMXA Servomotor
+6 V	ON	Reverse	Rated speed	-3000 min^{-1}
	OFF	Forward		3000 min^{-1}
-3 V	ON	Forward	1/2 of rated speed	1500 min^{-1}
	OFF	Reverse		-1500 min^{-1}
+1 V	ON	Reverse	1/6 of rated speed	-500 min^{-1}
	OFF	Forward		500 min^{-1}

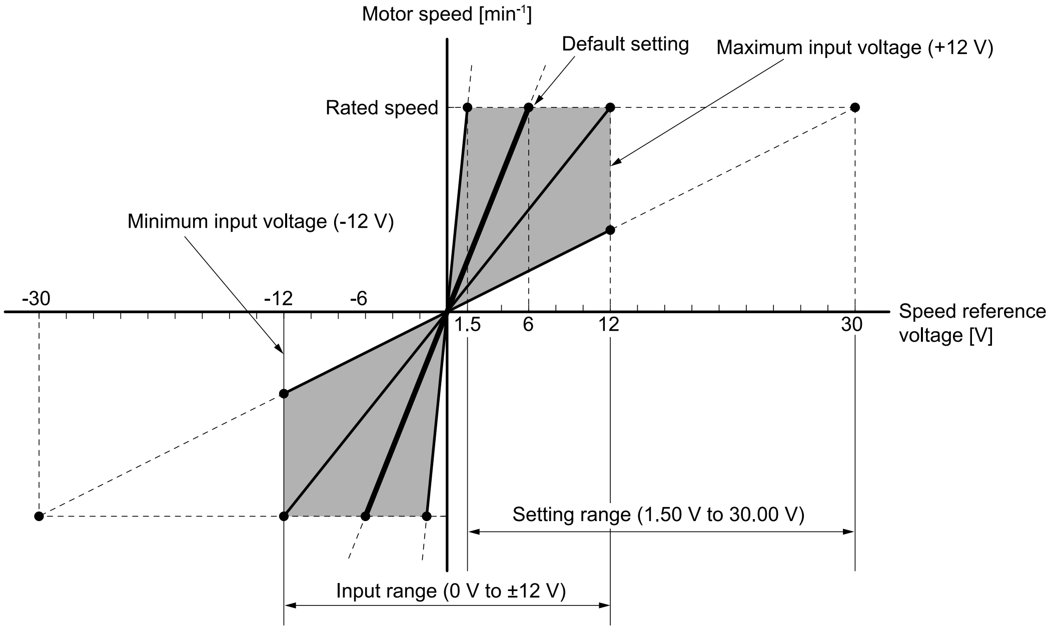
- Linear Servomotors

Speed Reference Input	/SPD-D Signal	Rotation Direction	Movement Speed	For SGLGW-30A Linear Servomotor
+6 V	ON	Reverse	Rated speed	-1500 mm/s
	OFF	Forward		1500 mm/s
-3 V	ON	Forward	1/2 of rated speed	750 mm/s
	OFF	Reverse		-750 mm/s
+1 V	ON	Reverse	1/6 of rated speed	-250 mm/s
	OFF	Forward		250 mm/s

(4) Setting Pn300 (Speed Reference Input Gain)

The reference voltage for the motor rated speed is set to Pn300 (Speed Reference Input Gain) to define the relationship between the position reference voltage and the motor speed.

Pn300	Speed Reference Input Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	150 to 3000	0.01 V/ Rated speed	600	Immediately

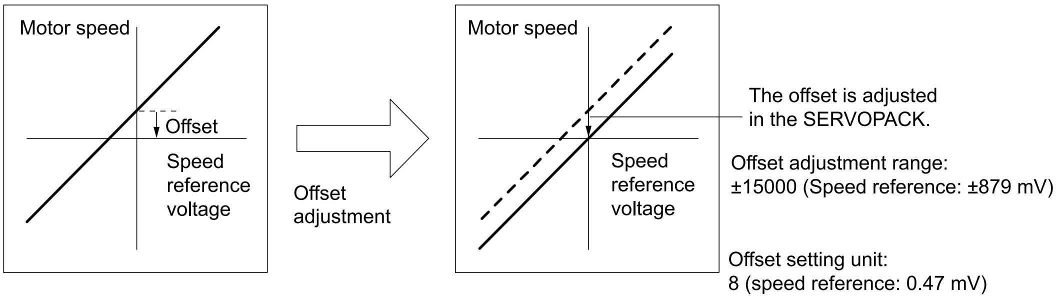


(5) Adjusting the Speed Reference Offset

With speed control, the servomotor may sometimes rotate at a very low speed for a speed reference of 0 V (with a reference speed of 0 or when the speed reference is stopped). This occurs because the internal reference in the SERVOPACK has a slight offset.

If the servomotor moves at a very low speed, the offset needs to be eliminated by adjusting the offset.

You can adjust the speed reference offset either automatically or manually.



(a) Automatically Adjusting the Speed Reference Offset

To automatically adjust the speed reference offset, the offset is measured and the speed reference voltage is adjusted automatically.

The measured offset is saved in the SERVOPACK.

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 reference offset.

- The parameters must not be write prohibited.
- The servo must be OFF.
- There must not be a position loop in the host controller.

◆ Applicable Tools

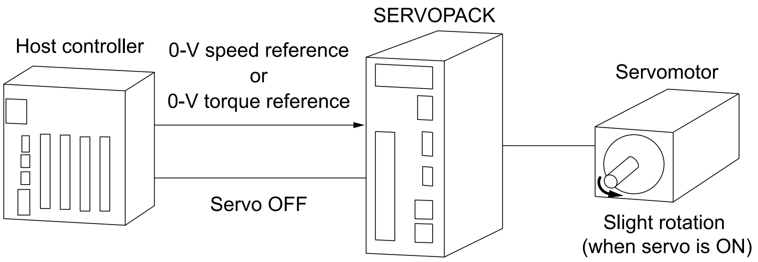
The following table lists the tools that you can use to automatically adjust the speed reference offset.

Tool	Fn No./Function Name	Reference
Panel Operator	Fn009	☞ *14.4.8 Autotune Analog (Speed/Torque) Reference Offset (Fn009) on page 648*
Digital Operator	Fn009	📖 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Others] – [Speed/Torque Reference Offset Adjustment]	☞ *◆ Operating Procedure on page 236*

◆ Operating Procedure

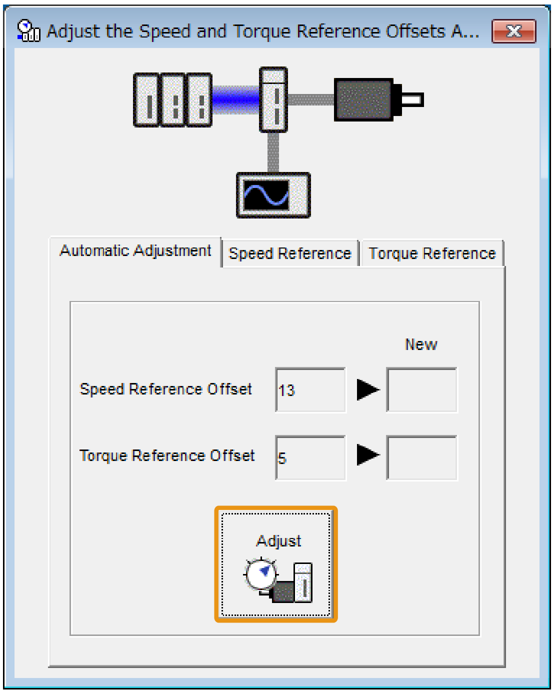
Use the following procedure to automatically adjust the speed reference offset.

1. **Confirm that the servo is OFF in the SERVOPACK.**
2. **Input a 0-V reference voltage from the host controller or an external circuit.**



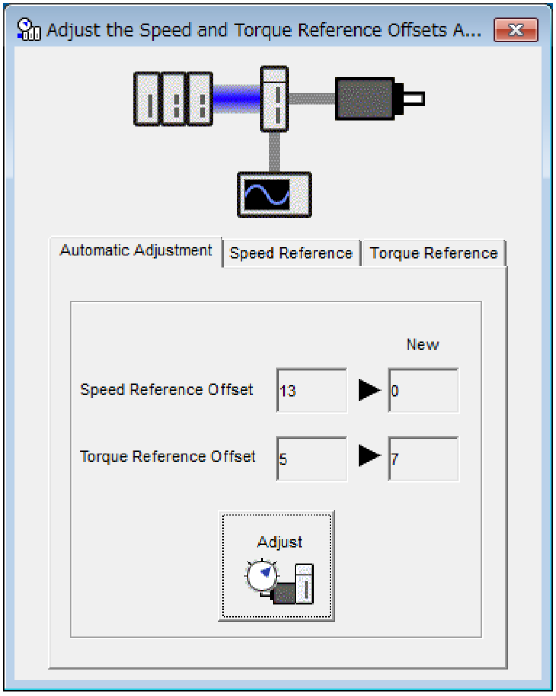
3. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
4. **Click [Adjust the Speed and Torque Reference Offset] in the [Menu] window.**
   The [Adjust the Speed and Torque Reference Offset] window will be displayed.
5. **Click the [Automatic Adjustment] tab.**

6. **Click the [Adjust] button.**



Speed Reference Offset 13 ▶
Torque Reference Offset 5 ▶

The values that result from automatic adjustment will be displayed in the [New] boxes.



Speed Reference Offset 13 ▶ 0
Torque Reference Offset 5 ▶ 7

This concludes the procedure to automatically adjust the speed reference offset.

(b) Manually Adjusting the Speed Reference Offset

You can directly input a speed reference offset to adjust the speed reference. The offset is adjusted manually in the following cases.

- When a position loop is created with the host computer and the position deviation when the servomotor is stopped by a servo lock is to be set to 0
- To intentionally set the offset to a desired value
- To check an offset that was set automatically

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 manually adjust the reference offset.

- The parameters must not be write prohibited.

◆ Applicable Tools

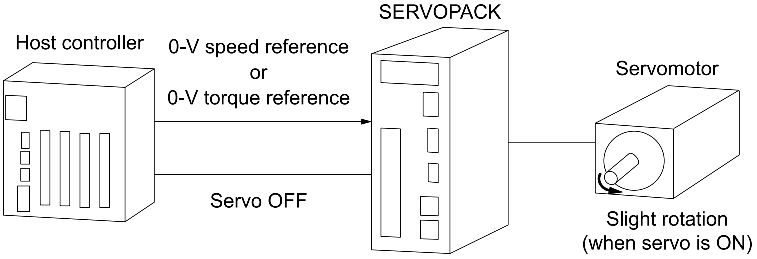
The following table lists the tools that you can use to manually adjust the speed reference offset.

Tool	Fn No./Function Name	Reference
Panel Operator	Fn00A	☞ *14.4.9 Manually Adjust Speed Reference Offset (Fn00A) on page 649*
Digital Operator	Fn00A	📖 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Others] – [Speed/Torque Reference Offset Adjustment]	☞ *◆ Operating Procedure on page 238*

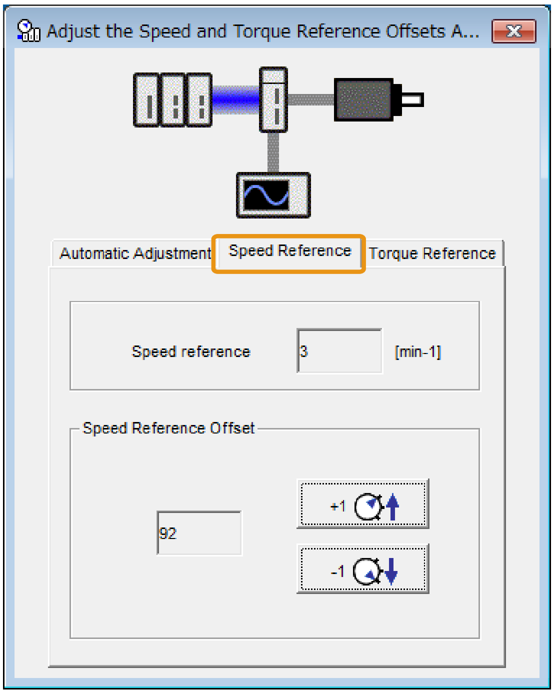
◆ Operating Procedure

Use the following procedure to manually adjust the speed reference offset.

1. **Input a 0-V reference voltage from the host controller or an external circuit.**



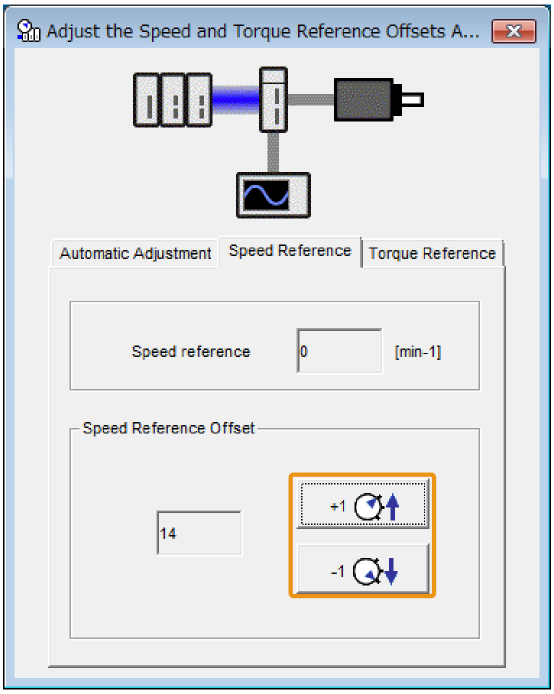
2. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
3. **Click [Adjust the Speed and Torque Reference Offset] in the [Menu] window.**
   The [Adjust the Speed and Torque Reference Offset] window will be displayed.
4. **Click the [Speed Reference] tab.**



Speed reference 3 [min-1]

Speed Reference Offset 92

5. **Use the [+1] and [-1] buttons to adjust the value in the [Speed Reference] box to “0”.**



Speed reference 0 [min-1]

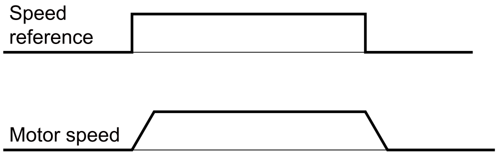
Speed Reference Offset 14

This concludes the procedure to manually adjust the speed reference offset.

6.5.2 Soft Start Settings

The soft start function takes a stepwise speed reference input and applies the specified acceleration/ deceleration rates to convert it to a trapezoidal speed reference.

You specify the acceleration/deceleration rates in Pn305 (Soft Start Acceleration Time) and Pn306 (Soft Start Deceleration Time).



Use this function to perform smoother speed control (including internal set speed control).

Pn305	Soft Start Acceleration Time			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 12000	1 ms	0	Immediately
Pn306	Soft Start Deceleration Time			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 12000	1 ms	0	Immediately

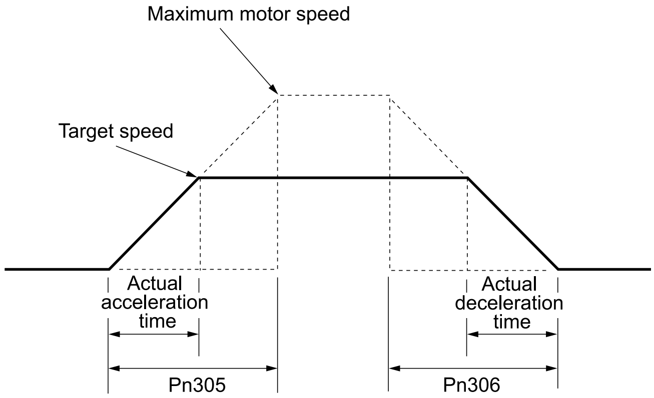
Pn305: The time required for the servomotor to accelerate from a stopped state to the maximum motor speed.

Pn306: The time required for the servomotor to decelerate from the maximum motor speed to a stopped state.

You can calculate the actual acceleration/deceleration times with the following formulas.

- $\text{Actual acceleration time} = \dfrac{\text{Target speed}}{\text{Maximum motor speed}} \times \text{Pn305 (Soft start acceleration time)}$

- $\text{Actual deceleration time} = \dfrac{\text{Target speed}}{\text{Maximum motor speed}} \times \text{Pn306 (Soft start deceleration time)}$



6.5.3 Speed Reference Filter

The speed reference filter is a first order lag filter that is applied to the V-REF (Speed Reference Input) signal.

You set the speed reference filter in Pn307 (Speed Reference Filter Time Constant).

It is normally not necessary to change this parameter. If the setting is too high, the response to the speed reference may be slowed down. Monitor the response to the speed reference as you set this parameter.

Pn307	Speed Reference Filter Time Constant			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.01 ms	40	Immediately

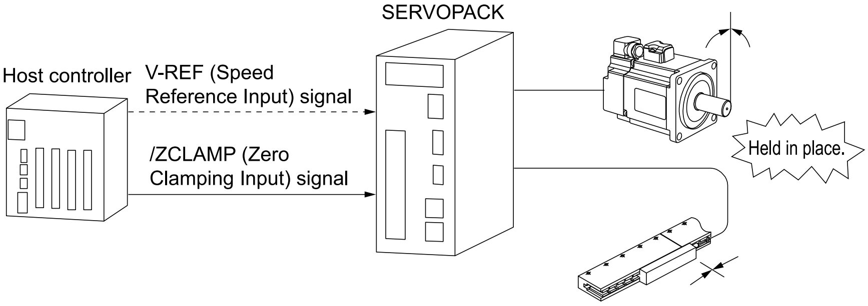
6.5.4 Zero Clamping

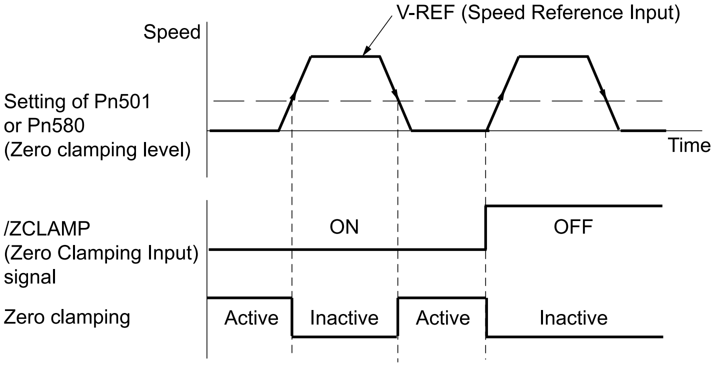
Zero clamping is used to lock the servo when the input voltage of the V-REF (Speed Reference Input) signal is equal to or lower than the speed set for Pn501 or Pn580 (Zero Clamping Level) while the /ZCLAMP (Zero Clamping Input) signal is ON.

The SERVOPACK internally forms a position loop, ignoring the speed reference.

Zero clamping is used for speed control in systems in which the host controller does not form a position loop.

The servomotor is clamped within one pulse of the position where zero clamping was applied, and will return to the zero clamping position even if it is moved by an external force.





Adjust Pn102 (Position Loop Gain) if the servomotor oscillates during zero clamping. If gain selection is used, you must also adjust Pn106 (Second Position Loop Gain).

(1) /ZCLAMP (Zero Clamping Input) Signal

Use the /ZCLAMP signal to enable zero clamping.

(a) Setting Pn50A = n.□□□0 (use input signal terminals with the default allocations)

The /ZCLAMP signal is allocated to pin CN1-41 on the I/O signal connector by default.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/ZCLAMP	CN1-41	ON (closed)	Zero clamping is applied if the input voltage of the V-REF (Speed Reference Input) signal is equal to or lower than the speed set for Pn501 or Pn580 (Zero Clamping Level).
			OFF (open)	Zero clamping is disabled.

(b) Setting Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (SigmaLINK II input signal allocation mode)

You must allocate the /ZCLAMP signal. Allocate the signal with Pn50D = n.□□□X (/ZCLAMP (Zero Clamping Input) Signal Allocation).

Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/ZCLAMP	Must be allocated.	ON (closed)	Zero clamping is applied if the input voltage of the V-REF (Speed Reference Input) signal is equal to or lower than the speed set for Pn501 or Pn580 (Zero Clamping Level).
			OFF (open)	Zero clamping is disabled.

(2) Enabling Zero Clamping

To enable using zero clamping, set Pn000 = n.□□X□ (Control Method Selection) to 0, 3, 4, 5, 6, 7, 9 or A. You can use zero clamping only for operation with speed control.

If Pn000 = n.□□X□ is set to 5, 6, 7, or 9, zero clamping will be disabled when the control method is changed to any method other than speed control.

Information If you set Pn50D to n.□□□7 (zero clamping is always active) for speed control, zero clamping will be applied whenever the speed reference is equal to or lower than the speed set for the zero clamping level. In this case, using the /ZCLAMP signal is not necessary.

Parameter		Control Method	Used Input Signals	When Enabled
Pn000	n.□□0□	Speed control	/ZCLAMP	After restart
	n.□□3□	Internal set speed control	/ZCLAMP, SPD-A, SPD-B, SPD-D	
	n.□□4□	Switching between internal set speed control and speed control with analog references	/ZCLAMP, SPD-A, SPD-B, SPD-D, C-SEL	
	n.□□5□	Switching between internal set speed control and position control	/ZCLAMP, SPD-A, SPD-B, SPD-D, C-SEL	
	n.□□6□	Switching between internal set speed control and torque control	/ZCLAMP, SPD-A, SPD-B, SPD-D, C-SEL	
	n.□□7□	Switching between position control and speed control	/ZCLAMP, C-SEL	
	n.□□9□	Switching between torque control and speed control	/ZCLAMP, C-SEL	
	n.□□A□	Switching between speed control with analog references and speed control with zero clamping	/ZCLAMP	

(a) Related Parameters

You set the speed at which to apply zero clamping with Pn501 or Pn580 (Zero Clamping Level). If you set a value that exceeds the maximum speed of the servomotor, the actual speed will be limited to the maximum speed of the servomotor.

- Rotary Servomotors

Pn501	Zero Clamping Level			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 min^{-1}	10	Immediately

- Linear Servomotors

Pn580	Zero Clamping Level			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 mm/s	10	Immediately

6.5.5 /V-CMP (Speed Coincidence Detection Output) Signal

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

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

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	/V-CMP	CN1-25, -26 (default setting)	ON (closed)	The speed coincides.
			OFF (open)	The speed does not coincide.

Note:

You can use Pn50E = n.□□X□ (/V-CMP (Speed Coincidence Detection Output) Signal Allocation) to allocate the /V-CMP signal to different output connector pins.

Refer to the following section for details.

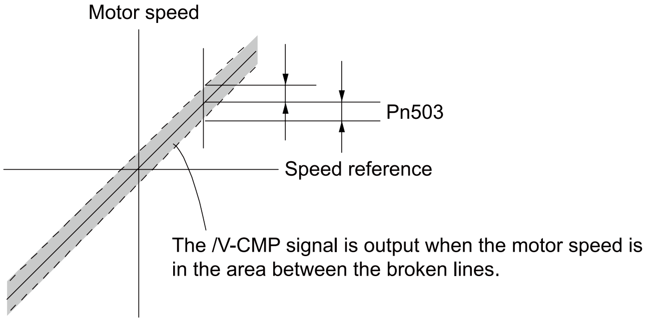
☞ *6.1.4 Output Signal Allocations on page 224*

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

- Rotary Servomotors

Pn503	Speed Coincidence Detection Signal Output Width			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 100	1 min^{-1}	10	Immediately

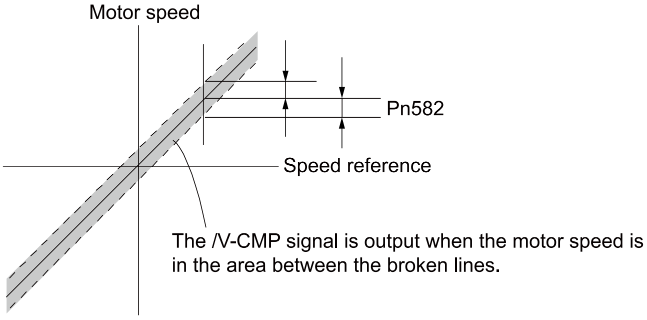
The signal is output when the difference between the reference speed and motor speed is equal or less than the setting.
For example, if Pn503 is set to 100 and the speed reference is 2000 min^{-1}, the signal would be output when the motor speed is between 1900 min^{-1} and 2100 min^{-1}.



- Linear Servomotors

Pn582	Speed Coincidence Detection Signal Output Width			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 100	1 mm/s	10	Immediately

The signal is output when the difference between the reference speed and motor speed is equal or less than the setting.
For example, if Pn582 is set to 100 and the speed reference is 2000 mm/s, the signal would be output when the motor speed is between 1900 mm/s and 2100 mm/s.



6.5.6 Operation Examples for Changing the Motor Direction

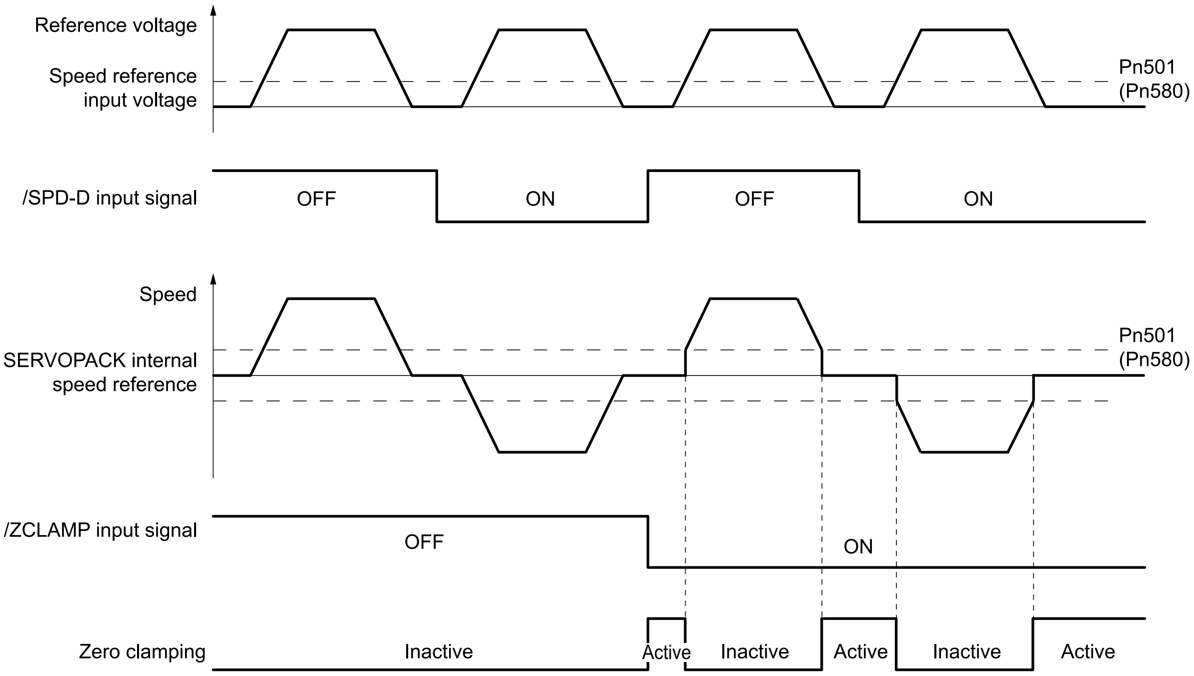
This section describes examples of using the /SPD-D (Motor Direction Input) signal in combination with zero clamping and internal set speed control.

(1) Operation Example for Changing the Motor Direction and Zero Clamping

This section provides an example of changing the motor direction without changing the polarity of the speed reference voltage by using the /SPD-D (Motor Direction Input) signal.

/ZCLAMP	**/SPD-D**	**Polarity of Analog Speed Reference Voltage**		
		Positive	**Zero Clamping Level or Lower (Pn501 (Pn580))** *1	**Negative**
		Rotation Direction	**Operating Status**	**Rotation Direction**
OFF	OFF	CCW	Speed control	CW
OFF	ON	CW	Speed control	CCW
ON	OFF	CCW	Servo lock (Clamped to zero)	CW
ON	ON	CW	Servo lock (Clamped to zero)	CCW

*1 Pn501 (Zero Clamping Level): Used with a rotary servomotor.
Pn580 (Zero Clamping Level): Used with a linear servomotor.



Note:

The soft start function is used for the acceleration/deceleration time of the speed reference.

(2) Operation Example for Changing the Motor Direction and Internal Set Speed Control

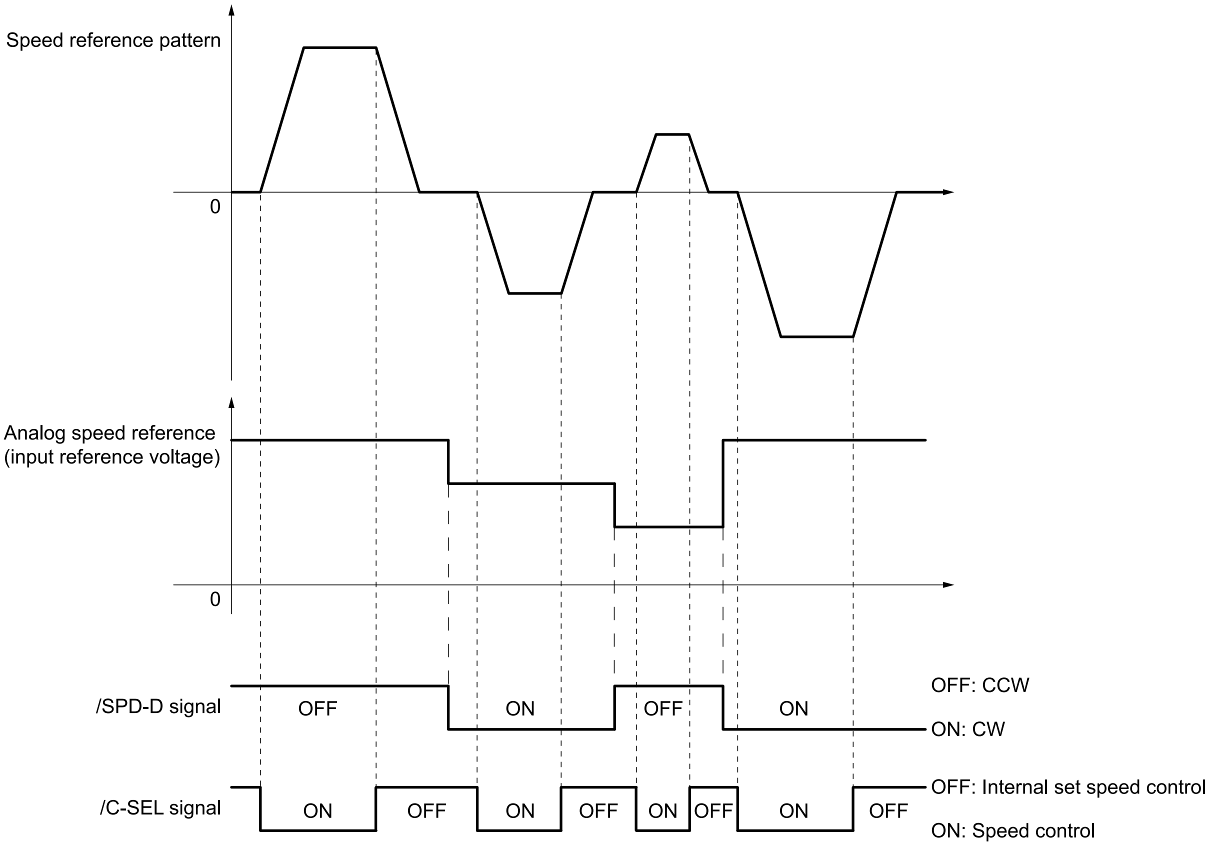
Even with a speed reference with the same polarity, you can change the servomotor direction and stop the servomotor by changing the control mode to internal set speed control and combining the /SPD-D (Motor Direction Input) signal and /C-SEL (Control Selection Input) signal.

The following operation example combines internal set speed control, the /SPD-D signal, and the /C-SEL signal. For this example, the internal set speeds must be set to 0.

(a) Parameter Settings

You must make the following parameter settings to combine internal set speed control, the /SPD-D signal, and the /C-SEL signal.

- Set Pn000 = n.□□X□ (Control Method Selection) to 4 (switching between internal set speed control and speed control).
- Set Pn305 (Soft Start Acceleration Time) to the required acceleration time.
- Set Pn306 (Soft Start Deceleration Time) to the required deceleration time.
- Set Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (SigmaLINK II input signal allocation mode)
- Set Pn50C = n.□□□X (/SPD-D (Motor Direction Input) Signal Allocation) to any setting other than 7 (the signal is always active) or 8 (the signal is always inactive).
- Set Pn50C = n.□□X□ (/SPD-A (Internal Set Speed Gain Switching Input) Signal Allocation) to 8 (the signal is always inactive).
- Set Pn50C = n.□X□□ (/SPD-B (Internal Set Speed Gain Switching Input) Signal Allocation) to 8 (the signal is always inactive).
- Set Pn50C = n.X□□□ (/C-SEL (Control Selection Input) Signal Allocation) to any setting other than 7 (the signal is always active) or 8 (the signal is always inactive).



6.6 Position Control

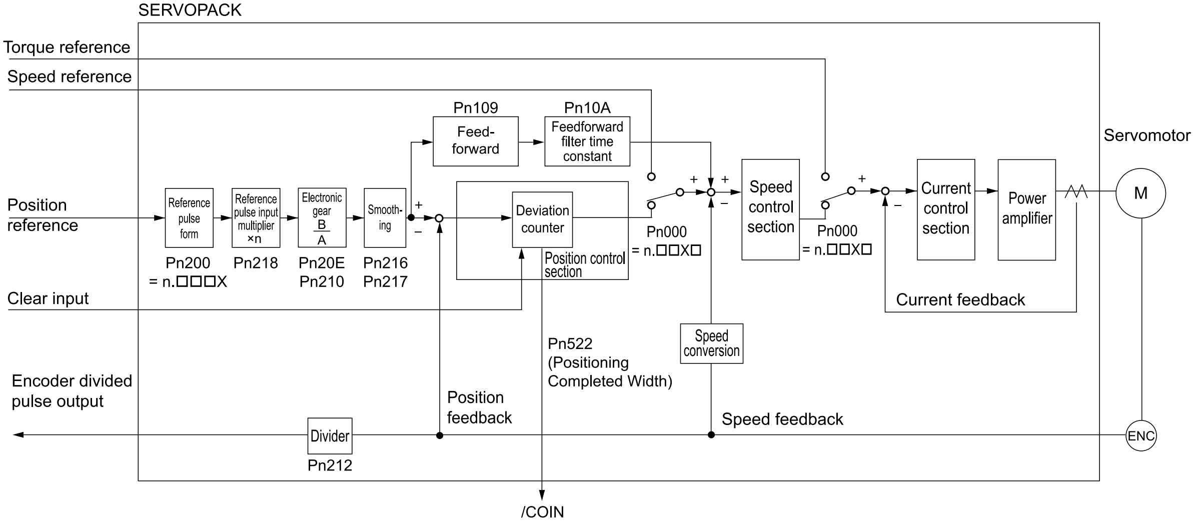
Position control is used to input a pulse train reference from the host controller to the SERVOPACK to move to a target position. The position is controlled with the number of input pulses, and the speed is controlled with the input pulse frequency. Use position control when positioning is required.

Set Pn000 to n.□□1□ to set the control method to position control.

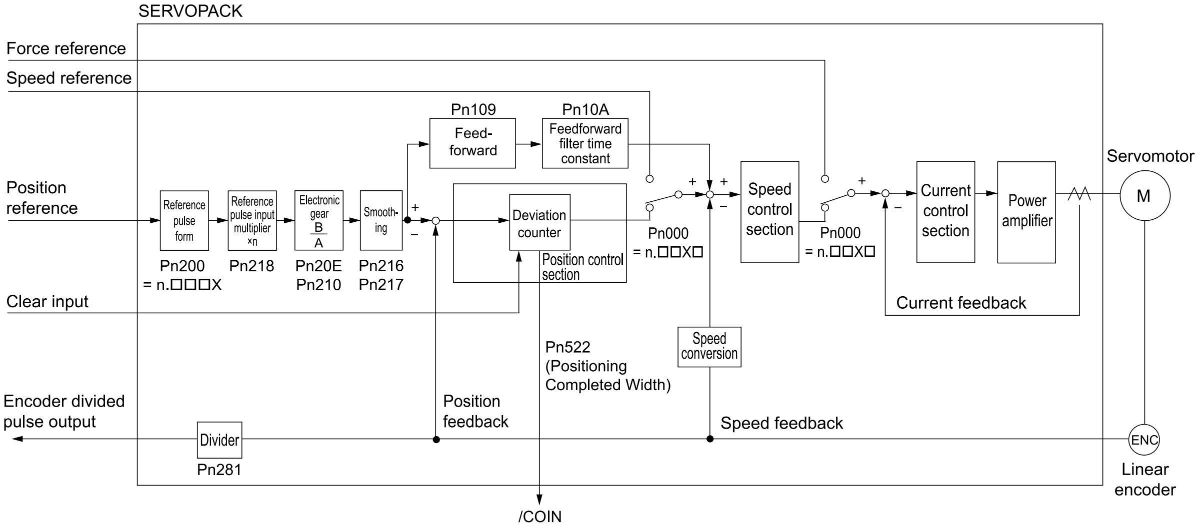
		Control Method Selection **Speed** **Pos** **Trq**		When Enabled
Pn000	n.□□X□	0 Default	Speed control with analog references	After restart
		1	Position control with pulse train references	
		2	Torque control with analog references	
		3	Internal set speed control with contact commands	
		4	Switching between internal set speed control with contact references and speed control with analog references	
		5	Switching between internal set speed control with contact references and position control with pulse train references	
		6	Switching between internal set speed control with contact references and torque control with analog references	
		7	Switching between position control with pulse train references and speed control with analog references	
		8	Switching between position control with pulse train references and torque control with analog references	
		9	Switching between torque control with analog references and speed control with analog references	
		A	Switching between speed control with analog references and speed control with zero clamping	
		B	Switching between position control with pulse train references and position control with reference pulse inhibition	

The control block diagrams for position control are provided below.

- Rotary Servomotors



- Linear Servomotors

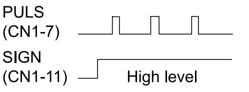
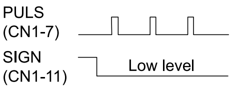
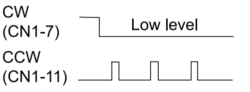
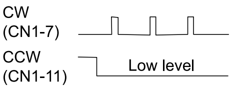
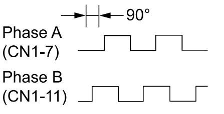
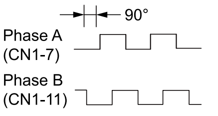
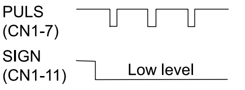
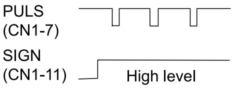
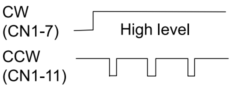
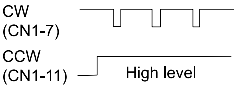


6.6.1 Basic Settings for Position Control

This section describes the reference pulse forms and input filters.

(1) Reference Pulse Form

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

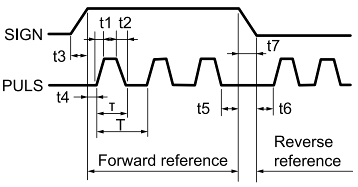
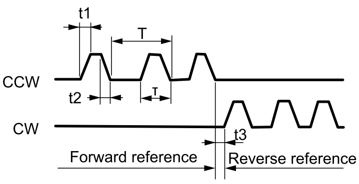
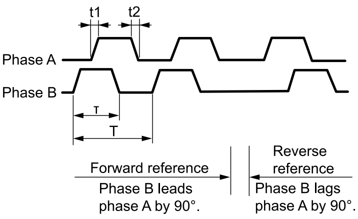
Parameter		Reference Pulse Form	Input Pulse Multi-plier	Forward Reference	Reverse Reference
Pn200	n.□□□0 (default setting)	Sign and pulse train, positive logic	–		
	n.□□□1	CW and CCW pulse trains, positive logic	–		
	n.□□□2	90° phase-differential pulses	×1		
	n.□□□3		×2		
	n.□□□4		×4		
	n.□□□5	Sign and pulse train, negative logic	–		
	n.□□□6	CW and CCW pulse trains, negative logic	–		

(2) Selecting an Input Filter

Pn200	n.X□□□	Filter Selection	Speed Pos Trq	When Enabled
		0 Default	Use the reference input filter 1 for a line-driver signal. (1 Mpps max.)	After restart
		1	Use the reference input filter for an open-collector signal. (200 kpps max.)	
		2	Use the reference input filter 2 for a line-driver signal. (1 to 4 Mpps)	

(3) Electrical Specifications for Pulse Train Reference

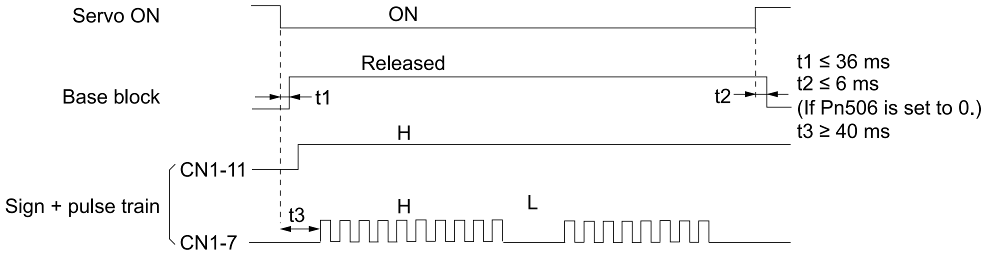
The following table describes the forms for pulse train references.

Pulse Train Reference Form	Electrical Specifications		Remarks
Sign + pulse train (SIGN and PULS signals) Maximum reference frequency: 4 Mpps (maximum reference frequency for open-collector output: 200 kpps)		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 + CCW pulse trains Maximum reference frequency: 4 Mpps (maximum reference frequency for open-collector output: 200 kpps)		t1, t2 ≤ 0.025 µs t3 ≥ 0.5 µs τ ≥ 0.125 µs T – τ ≥ 0.125 µs	–
90° phase-differential pulses (phases A and B) Maximum reference frequency: 1 Mpps *1 (maximum reference frequency for open-collector output: 200 kpps)		t1 ≤ 0.1 µs t2 ≤ 0.1 µs τ ≥ 0.5 µs T – τ ≥ 0.5 µs	–

*1 The maximum reference frequency for the multipliers before multiplication are as follows:
×1 multiplier: 1 Mpps
×2 multiplier: 1 Mpps
×4 multiplier: 1 Mpps

(4) 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.

6.6.2 CLR (Position Deviation Clear Input) Signal Function and Settings

The CLR (Position Deviation Clear Input) 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.

Term

Deviation counter :

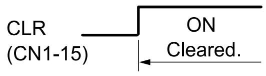
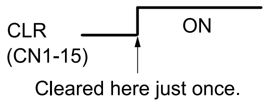
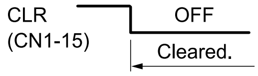
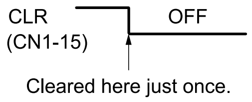
The deviation counter counts the deviation between the reference input pulses and the feedback pulses from the encoder (i. e., the accumulated pulses).

(1) CLR (Position Deviation Clear Input) Signal

Type	Signal	Connector Pin No.	Meaning
Input	CLR	CN1-15	Position deviation clear input
	/CLR	CN1-14	

(2) 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).

Parameter		Reference Form	Clear Timing	When Enabled
Pn200	n.□□0□ (default setting)	Clear position deviation when the signal is at high level.		After restart
	n.□□1□	Clear position deviation on the rising edge of the signal.		
	n.□□2□	Clear position deviation when the signal is at low level.		
	n.□□3□	Clear position deviation on the falling edge of the signal.		

Information

The pulse width of the CLR signal must meet the following condition.

- If Pn200 = n.□□X□ is set to 0 or 2, the width of the CLR signal must be at least 250 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 20 μs to reset the deviation counter.

(3) Setting Pn200 = n.□X□□ (Clear Operation)

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).

		Clear Operation	Speed **Pos** Trq	When Enabled
Pn200	n.□X□□	0 Default	Clear position deviation at a base block (at servo OFF or when alarm occurs).	After restart
		1	Do not clear position error (cleared only with CLR (Clear Position Deviation) signal).	
		2	Clear position deviation when an alarm occurs.	

6.6.3 Reference Pulse Input Multiplication Switching

You can switch the input multiplier for the position reference pulses with the /PSEL (Reference Pulse Input Multiplication Switch Input) signal. The number of reference pulses input to the SERVOPACK is multiplied by the reference pulse input multiplier. You can change the multiplier from 1 to a specified value n (n can be up to 100). You set the multiplier in Pn218 (Reference Pulse Input Multiplier).

You can confirm if the multiplier was changed with the /PSELA (Reference Pulse Input Multiplication Switching Output) signal.

This section describes the /PSEL (Reference Pulse Input Multiplication Gain Switch Input) signal, the reference pulse input multiplier, and restrictions.

(1) /PSEL (Reference Pulse Input Multiplication Switch Input) Signal

Use the /PSEL signal to change to the reference pulse input multiplier that is set in Pn218 (Reference Pulse Input Multiplier).

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/PSEL	Must be allocated.	ON (closed)	Enables the reference pulse input multiplier.
			OFF (open)	Disables the reference pulse input multiplier. The multiplier will be 1.

Note:

You must allocate the /PSEL signal to use it. Use the following parameters to allocate the signal to a terminal.

- Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (SigmaLINK II input signal allocation mode)
- Pn515 = n.□□X□ (/PSEL (Reference Pulse Input Multiplication Gain Switch Input) Signal Allocation)

Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

(2) /PSELA (Reference Pulse Input Multiplication Switching Output) Signal

You can confirm if the reference pulse input multiplier was changed with the /PSELA (Reference Pulse Input Multiplication Switching Output) signal.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	/PSELA	Must be allocated.	ON (closed)	The reference pulse input multiplier was enabled.
			OFF (open)	The reference pulse input multiplier was disabled.

Note:

You must allocate the /PSELA signal to use it. Use Pn510 = n.□X□□ (/PSELA (Reference Pulses Input Multiplication Switching Output) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

☞ *6.1.4 Output Signal Allocations on page 224*

CAUTION

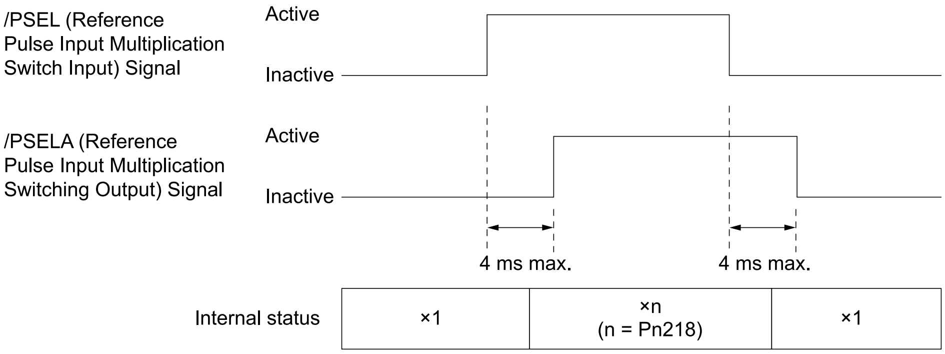
Always use the /PSELA signal to confirm that the reference pulse input multiplier has been switched and make sure that there are no position reference pulses before you input a position reference.

Unexpected operation may occur if position reference pulses are input before the reference pulse input multiplier changes.

(3) Setting Pn218 (Reference Pulse Input Multiplier)

Pn218	Reference Pulse Input Multiplier			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 100	× 1	1	Immediately

A timing chart for switching the reference pulse input multiplier is provided below.



CAUTION

If you change the setting of Pn218 (Reference Pulse Input Multiplier), perform trial operation of the servomotor without the machine coupled to the motor shaft to confirm that no problems will occur in operation before you couple the motor to the machine.

(4) Restrictions

The reference pulse input multiplier will not change during the following operations regardless of the status of the /PSEL signal.

- Program jogging
- Autotuning without a host reference

6.6.4 Smoothing Settings

Smoothing allows you to apply a filter to the position reference to produce smoother servomotor operation. Smoothing is effective in the following cases.

- When the host controller that outputs the references cannot perform acceleration or deceleration
- When the reference pulse frequency is very low

Note:

Smoothing does not affect the travel distance (i.e., the number of reference pulses).

The following parameters are related to smoothing.

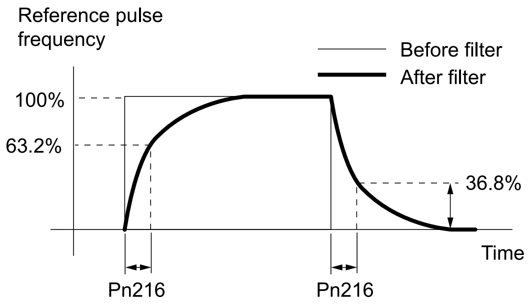
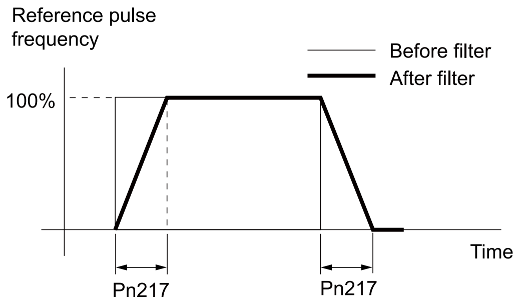
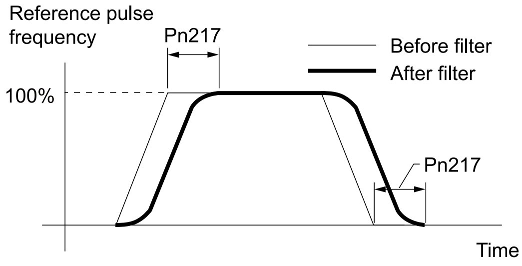
Change the settings while there is no reference pulse input and the servomotor is stopped.

Pn216	Position Reference Acceleration/Deceleration Time Constant Speed **Pos** Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.1 ms	0	Immediately after the motor stops
Pn217	Average Position Reference Movement Time Speed **Pos** Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	0.1 ms	0	Immediately after the motor stops

Information

- The filter is disabled if you set these parameters to 0.
- Changes to the settings in these parameters are not applied while the servomotor is operating. The changes will be enabled the next time the servomotor comes to a stop.

The difference between the settings of Pn216 (Position Reference Acceleration/Deceleration Time Constant) and Pn217 (Average Position Reference Movement Time) is shown below.

Position Reference Acceleration/Deceleration Filter	Average Position Reference Movement Time
	
–	

6.6.5 /COIN (Positioning Completion Output) Signal

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

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

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

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	/COIN	CN1-25, 26 (default setting)	ON (closed)	Positioning has been completed.
			OFF (open)	Positioning has not been completed.

Note:

Use Pn50E = n.□□□X (/COIN (Positioning Completion Output) Signal Allocation) to allocate the /COIN signal to other connector pins. Refer to the following section for details.

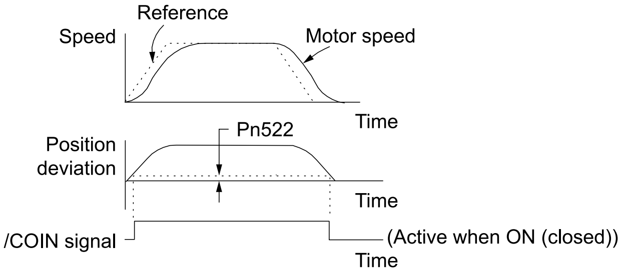
☞ *6.1.4 Output Signal Allocations on page 224*

(1) Setting the Positioning Completed Width

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

Pn522	In-position Range (Speed Pos Trq)			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 1073741824	1 reference unit	7	Immediately

The setting of this parameter has no effect on final positioning accuracy.



Note:

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

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

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

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

Pn207	n.X□□□	/COIN (Positioning Completion Output) Signal Output Timing (Speed Pos Trq)		When Enabled
		0 Default	Output when the absolute value of the position deviation is the same or less than the setting of Pn522 (Positioning Completed Width).	After restart
		1	Output when the absolute value of the position error is the same or less than the setting of Pn522 (Positioning Completed Width) and the reference after the position reference filter is 0.	
		2	Output when the absolute value of the position error is the same or less than the setting of Pn522 (Positioning Completed Width) and the reference input is 0.	

6.6.6 /NEAR (Near Output) Signal

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

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

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

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

Note:

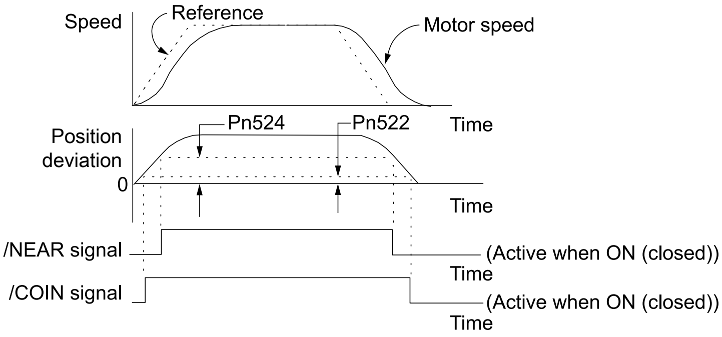
You must allocate the /NEAR signal to use it. Use Pn510 = n.□□□X (/NEAR (Near Output) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

☞ *6.1.4 Output Signal Allocations on page 224*

(1) Setting /NEAR (Near) Signal

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

Pn524	Near Signal Width			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 1073741824	1 reference unit	1073741824	Immediately



Note:

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

6.6.7 Reference Pulse Inhibition Function

You can stop the SERVOPACK from counting the reference input pulses during position control. When this function is enabled, the SERVOPACK will ignore the reference pulse input.

(1) /INHIBIT (Reference Pulse Inhibit Input) Signal

If you set the control method as Pn000 = n.□□B□ (switching between position control with pulse train references and position control with reference pulse inhibition), the /INHIBIT signal is used as the Reference Pulse Inhibit signal (default setting).

(a) Setting Pn50A = n.□□□0 (use input signal terminals with the default allocations)

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/INHIBIT	CN1-41 (default setting)	ON (closed)	Counting the reference pulses is stopped.
			OFF (open)	The reference pulses are counted.

(b) Setting Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) n.□□□2 (SigmaLINK II input signal allocation mode)

If you set Pn000 = n.□□X□ (Control Method Selection) to 1, 5, 7, 8, or B, the /INHIBIT signal is used as the Reference Pulse Inhibit signal for reference pulse inhibition.

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/INHIBIT	Must be allocated.	ON (closed)	Counting the reference pulses is stopped.
			OFF (open)	The reference pulses are counted.

Note:

You must allocate the /INHIBIT signal to use it. Use Pn50D = n.□□X□ (/INHIBIT (Reference Pulse Inhibit Input) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

(c) Reference Pulse Inhibition Settings

To use reference pulse inhibition, set Pn000 = n.□□X□ (Control Method Selection) to 1, 5, 7, 8 or B.

Parameter		Control Method	Used Input Signals	When Enabled
Pn000	n.□□1□	Position control	/INHIBIT	After restart
	n.□□5□	Switching between internal set speed control and position control	/INHIBIT /SPD-A /SPD-B /SPD-D /C-SEL	
	n.□□7□	Switching between position control and speed control	/INHIBIT /C-SEL	
	n.□□8□	Switching between position control and torque control	/INHIBIT /C-SEL	
	n.□□B□	Switching between normal position control and position control with reference pulse inhibition	/INHIBIT	

Information Counting reference pulses can be inhibited only for position control.

6.7 Torque Control

Torque control is performed by inputting a torque reference with an analog voltage reference to the SERVOPACK to control the servomotor with a torque that is proportional to the input voltage.

Set Pn000 to n.□□2□ to set the control method to torque control.

Pn000	n.□□X□	Control Method Selection Speed Pos Trq		When Enabled
		0 Default	Speed control with analog references	After restart
		1	Position control with pulse train references	
		2	Torque control with analog references	
		3	Internal set speed control with contact commands	
		4	Switching between internal set speed control with contact references and speed control with analog references	
		5	Switching between internal set speed control with contact references and position control with pulse train references	
		6	Switching between internal set speed control with contact references and torque control with analog references	
		7	Switching between position control with pulse train references and speed control with analog references	
		8	Switching between position control with pulse train references and torque control with analog references	
		9	Switching between torque control with analog references and speed control with analog references	
		A	Switching between speed control with analog references and speed control with zero clamping	
		B	Switching between position control with pulse train references and position control with reference pulse inhibition	

6.7.1 Basic Settings for Torque Control

This section describes the torque reference input signal and torque reference input gain.

(1) T-REF (Torque Reference Input) Signal

The T-REF signal is described in the following table.

Type	Signal	Connector Pin No.	Name
Input	T-REF	CN1-9	Torque reference input
	SG	CN1-10	Signal ground for torque reference input

Maximum input voltage: ±12 VDC

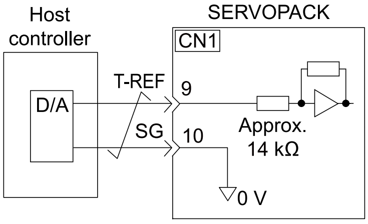
< Input Circuit Example >

Pn400 is 30 (Torque Reference Input Gain = 3 V/rated torque) by default.

Torque Reference Input	Rotation Direction	Torque
+3 V	Forward	Rated torque
+1 V	Forward	1/3 rated torque
-1.5 V	Reverse	1/2 rated torque

If you will use a host controller, such as a programmable controller, for torque control, connect the above output pins to the analog voltage reference output terminals on the host controller .

Always use twisted-pair cables to control noise.

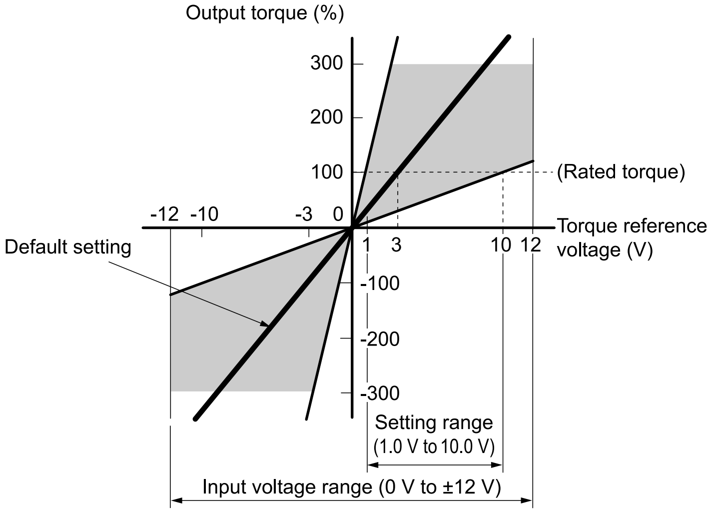


(2) Setting Pn400 (Torque Reference Input Gain)

The torque of the servomotor is controlled in proportion to an analog voltage reference.

The reference voltage for the rated motor torque is set in Pn400 (Torque Reference Input Gain) to define the relationship between the analog voltage reference and the motor output torque.

Pn400	Torque Reference Input Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 100	0.1 V/ rated torque	30	Immediately



Note:

You can input a torque reference that exceeds the rated torque, but A.710 (Instantaneous Overload) or A.720 (Continuous Overload) alarms may occur if the reference is maintained for a long time or the motor outputs a torque that exceeds the rated torque. Refer to the following section for details.

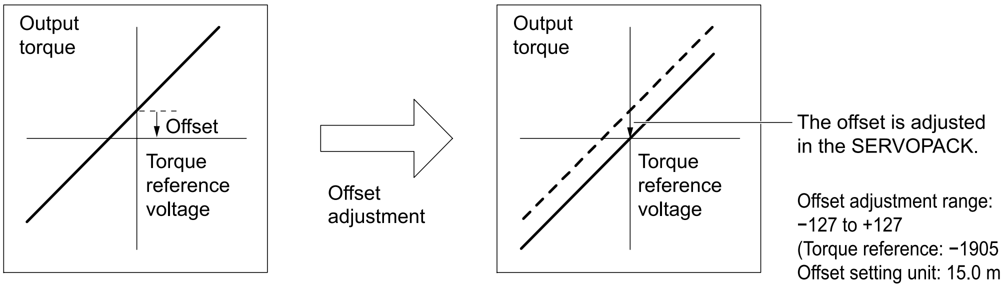
☞ *13.2.2 Troubleshooting Alarms on page 586*

6.7.2 Adjusting the Torque Reference Offset

With torque control, the servomotor may sometimes operate at a very low speed for a torque reference of 0 V. This occurs because the internal reference in the SERVOPACK has a slight offset of a few millivolts.

If the servomotor moves at a very low speed, the offset needs to be eliminated by adjusting the offset.

You can adjust the torque reference offset either automatically or manually.



Offset adjustment range:
−127 to +127
(Torque reference: −1905 mV to 1905 mV,
Offset setting unit: 15.0 mV)

(1) Automatically Adjusting the Torque Reference Offset

To automatically adjust the torque reference offset, the offset is measured and the torque reference voltage is adjusted automatically.

The measured offset is saved in the SERVOPACK.

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

(a) Preparations

The following conditions must be met to automatically adjust the reference offset.

- The parameters must not be write prohibited.
- The servo must be OFF.
- There must not be a position loop or speed loop in the host controller.

(b) Applicable Tools

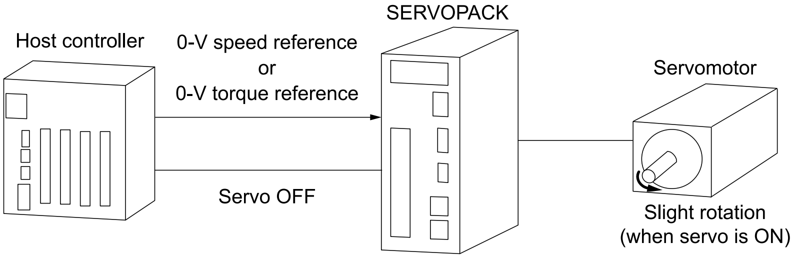
The following table lists the tools that you can use to automatically adjust the torque reference offset.

Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	Fn009	☞ *14.4.8 Autotune Analog (Speed/Torque) Reference Offset (Fn009) on page 648*
Digital Operator	Fn009	🕮 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Others] – [Speed/Torque Reference Offset Adjustment]	☞ *(c) Operating Procedure on page 258*

(c) Operating Procedure

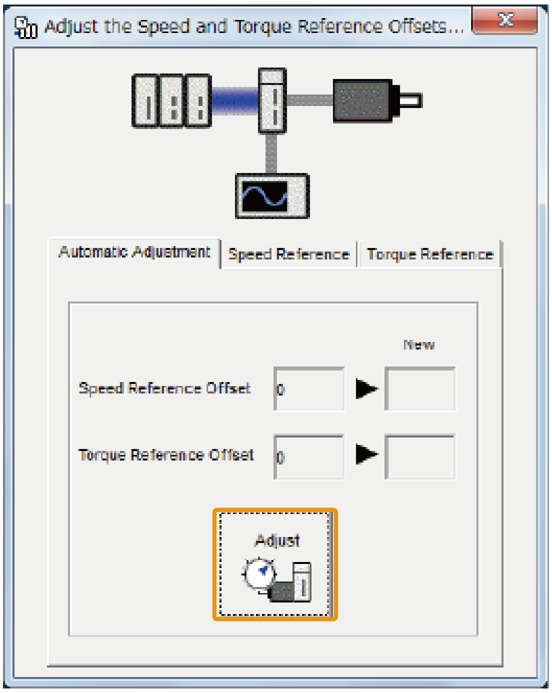
Use the following procedure to automatically adjust the torque reference offset.

1. **Confirm that the servo is OFF in the SERVOPACK.**
2. **Input a 0-V reference voltage from the host controller or an external circuit.**



3. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
4. **Click [Adjust the Speed and Torque Reference Offset] in the [Menu] window.**
   The [Adjust the Speed and Torque Reference Offset] window will be displayed.
5. **Click the [Automatic Adjustment] tab.**

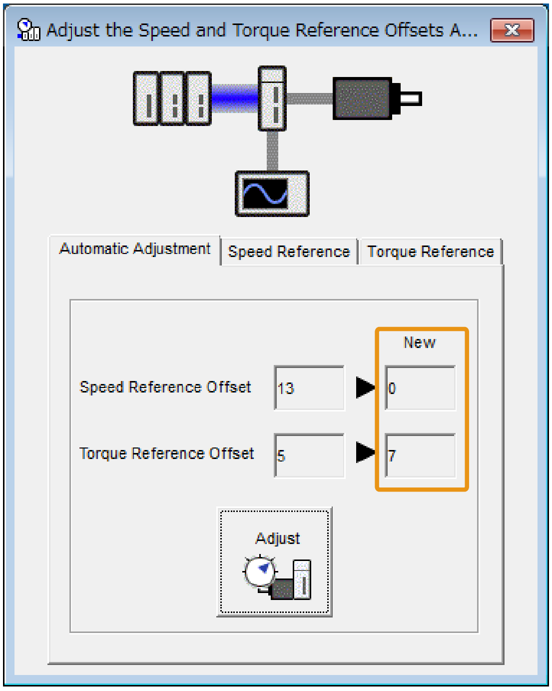
6. **Click the [Adjust] button.**



Speed Reference Offset 0

Torque Reference Offset 0

The values that result from automatic adjustment will be displayed in the [New] boxes.



Speed Reference Offset 13 ▶ 0

Torque Reference Offset 5 ▶ 7

Note:

You cannot automatically adjust the reference offset if a position loop is created with the host controller. Manually adjust the torque reference offset.

This concludes the procedure to automatically adjust the torque reference offset.

(2) Manually Adjusting the Torque Reference Offset

You can directly input a torque reference offset to adjust the torque reference. The offset is adjusted manually in the following cases.

- To intentionally set the offset to a desired value
- To check an offset that was set automatically

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

(a) Preparations

The following conditions must be met to manually adjust the reference offset.

- The parameters must not be write prohibited.

(b) Applicable Tools

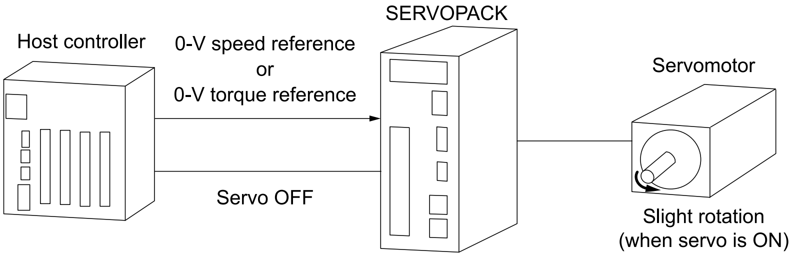
The following table lists the tools that you can use to manually adjust the torque reference offset.

Tool	Fn No./Function Name	Reference
Panel Operator	Fn009	☞ *14.4.8 Autotune Analog (Speed/Torque) Reference Offset (Fn009) on page 648*
Digital Operator	Fn009	🕮 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Others] – [Speed/Torque Reference Offset Adjustment]	☞ *(c) Operating Procedure on page 260*

(c) Operating Procedure

Use the following procedure to manually adjust the torque reference offset.

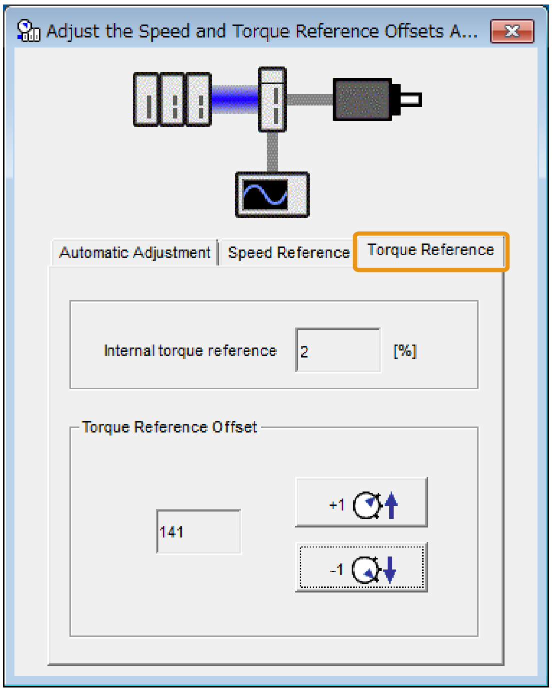
1. **Input a 0-V reference voltage from the host controller or an external circuit.**



2. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

3. **Click [Adjust the Speed and Torque Reference Offset] in the [Menu] window.**
   The [Adjust the Speed and Torque Reference Offset] window will be displayed.

4. **Click the [Torque Reference] tab.**

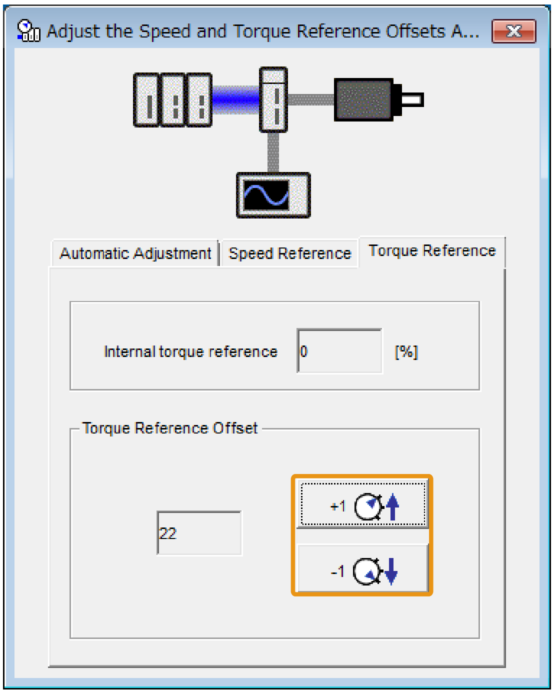


Adjust the Speed and Torque Reference Offsets A...

Internal torque reference 2 [%]

Torque Reference Offset 141

5. **Use the [+1] and [-1] buttons to adjust the value in the [Torque Reference] box to “0”.**



Adjust the Speed and Torque Reference Offsets A...

Automatic Adjustment | Speed Reference | Torque Reference

Internal torque reference: 0 [%]

Torque Reference Offset: 22

This concludes the procedure to manually adjust the torque reference offset.

6.7.3 Torque Reference Filter Settings

The torque reference filter is a first order lag filter that is applied to the T-REF (Torque Reference Input) signal. The torque reference input filter is set in Pn415 (T-REF Filter Time Constant).

If the setting is too high, the response to the torque reference may be slowed down. Monitor the response as you set this parameter.

Pn415	T-REF Filter Time Constant			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.01 ms	0	Immediately

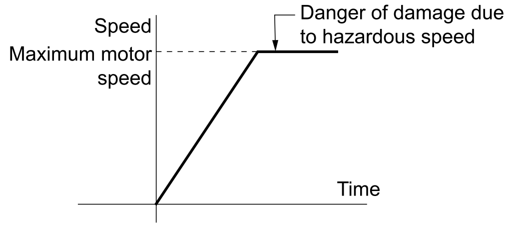
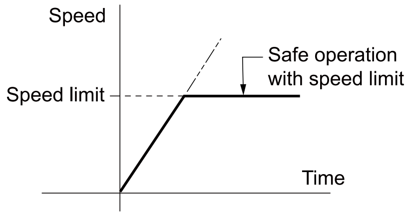
6.7.4 Speed Limit during Torque Control

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

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

Note:

The actual limit of servomotor speed depends on the load conditions on the servomotor.

Without Speed Limit	With a Speed Limit
	

(1) /VLT (Speed Limit Detection Output) Signal

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

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

Note:

You must allocate the /VLT signal to use it. Use Pn50F = n.□□X□ (/VLT (Speed Limit Detection Output) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

☞ *6.1.4 Output Signal Allocations on page 224*

(2) Selecting the Speed Limit

You set the speed limit to use in Pn002 = n.□□X□ (Torque Control Option).

If you set Pn002 to n.□□1□ (use V-REF as an external speed limit input), the smaller of the external speed limit and the internal speed limit will be used.

		Torque Control Option (V-REF Input Allocation) **Speed** **Pos** **Trq**		When Enabled
Pn002	n.□□X□	0 Default	Use Pn407 or Pn480 as the speed limit. (Use internal speed limiting.)	After restart
		1	Use V-REF (CN1-5 and CN1-6) as an external speed limit input signal and limit the speed with the V-REF input voltage and the setting of Pn300. (Use external speed limiting.)	

Note:

If you are using a rotary servomotor, set Pn407 (Speed Limit during Torque Control). If you are using a linear servomotor, set Pn480 (Speed Limit during Force Control).

(a) Internal Speed Limiting

If you select Pn002 = n.□□0□ (do not use V-REF for torque control option), set the speed limit for the motor in Pn407 (Speed Limit during Torque Control) or Pn480 (Speed Limit during Force Control).

Also set Pn408 = n.□□X□ (Speed Limit Selection) to specify using the maximum motor speed or the overspeed alarm detection speed as the speed limit.

Use caution as the definition of maximum motor speed depends on your servomotor.

- Rotary servomotor: The maximum rotation speed listed in the ratings table of the servomotor.
  Refer to the following document for the ratings table of the servomotor.

  📖 Σ-X-Series Catalog (Catalog No.: KAEP C710812 03)
- Linear servomotor: The setting of Pn385 (Maximum Motor Speed).

The overspeed alarm detection speed is appropriately 1.1-times the maximum motor speed.

		Speed Limit Selection **Speed** **Pos** **Trq**		When Enabled
Pn408	n.□□X□	0 Default	Use the smaller of the maximum motor speed and the setting of Pn407 as the speed limit. Use the smaller of the maximum motor speed and the setting of Pn480 as the speed limit.	After restart
		1	Use the smaller of the overspeed alarm detection speed and the setting of Pn407 as the speed limit. Use the smaller of the overspeed alarm detection speed and the setting of Pn480 as the speed limit.	

Note:

If you are using a rotary servomotor, set Pn407 (Speed Limit during Torque Control). If you are using a linear servomotor, set Pn480 (Speed Limit during Force Control).

- Rotary Servomotors

Pn407	Speed Limit during Torque Control			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 min^{-1}	10000	Immediately

- Linear Servomotors

Pn480	Speed Limit during Force Control			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 mm/s	10000	Immediately

Note:

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

(b) External Speed Limiting

If you select external speed limiting with Pn002 = n.□□X□ (Torque Control Option), set the VREF (Speed Reference Input) signal and Pn300 (Speed Reference Input Gain).

Type	Signal	Connector Pin No.	Meaning
Input	V-REF	CN1-5	External speed limit input
	SG	CN1-6	Signal ground for external speed limit input

During torque control, the motor speed limit is controlled by the analog voltage reference.

Information
- If you set Pn002 to n.□□1□, the smaller of the speed limit input with the V-REF signal and the value of Pn407 or Pn480 is used.
- The setting of Pn300 determines the voltage level to be input as the speed limit. The polarity has no effect.
- If you set Pn300 to 6.00 (default setting) and 6 V is input to the V-REF (CN1-5 and CN1-6) signal, the speed is limited to the rated speed of the servomotor.

Pn300	Speed Reference Input Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	150 to 3000	0.01 V/ Rated speed	600	Immediately

6.8 Encoder Divided Pulse Output

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

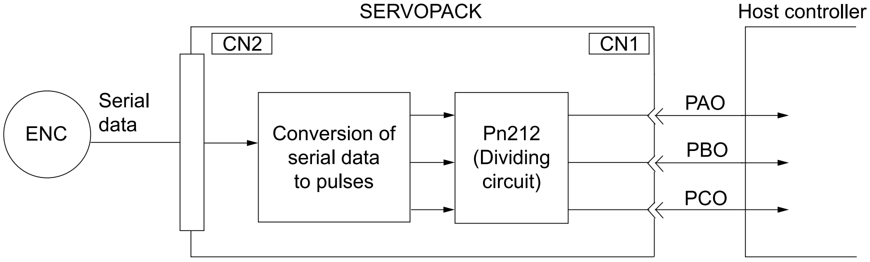
The following table describes the signals and output phase forms.

6.8.1 Encoder Divided Pulse Output Signals

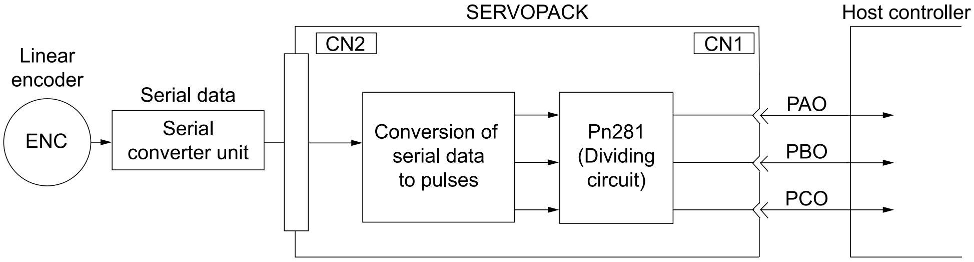
Type	Signal	Connector Pin No.	Name	Meaning
Output	PAO	CN1-33	Encoder Divided Pulse Output, Phase A	• Rotary Servomotors These encoder divided pulse output pins output the number of pulses per servomotor resolution that is set in Pn212 (Number of Encoder Output Pulses). The phase difference between phase A and phase B is an electric angle of 90°. • Linear Servomotors These encoder divided pulse output pins output pulses at the resolution that is set in Pn281 (Encoder Output Resolution). The phase difference between phase A and phase B is an electric angle of 90°.
	/PAO	CN1-34		
	PBO	CN1-35	Encoder Divided Pulse Output, Phase B	
	/PBO	CN1-36		
	PCO	CN1-19	Encoder Divided Pulse Output, Phase C *1	These pins output one pulse every servomotor rotation.
	/PCO	CN1-20		

*1 Refer to the following section for information on the origin within one encoder rotation.
☞ *(a) Relation between Renishaw PLC Incremental Linear Encoders and Encoder Output Pulse Signal from the SERVOPACK When Using a RGS20 Scale and RGH22B Sensor Head on page 265*

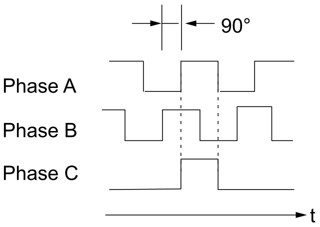
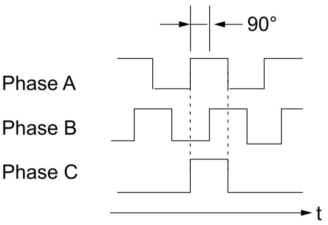
- Rotary Servomotors



- Linear Servomotors



(1) Output Phase Forms

Forward Rotation or Movement (phase B leads by 90°)	Reverse Rotation or Movement (phase A leads by 90°)
	

Note:

The pulse width of the origin within one encoder rotation depends on the setting of Pn212 (Number of Encoder Output Pulses) or Pn281 (Encoder Output Resolution). It is the same as the width of phase A.

Even for Pn000 = n.□□□1 (reverse operation), the output phase form is the same as shown above.

> Important
>
> If you use the SERVOPACK's phase-C pulse output for an origin return, rotate the servomotor two or more rotations before you start an origin return. If the servomotor cannot be rotated two or more times, perform an origin return operation at a motor speed of 600 min^{-1} or lower. If the motor speed is higher than 600 min^{-1}, the phase-C pulse may not be output correctly.

(2) Linear Encoder Application Precautions

The following precautions apply to the encoder output pulses when an external linear encoder is used.

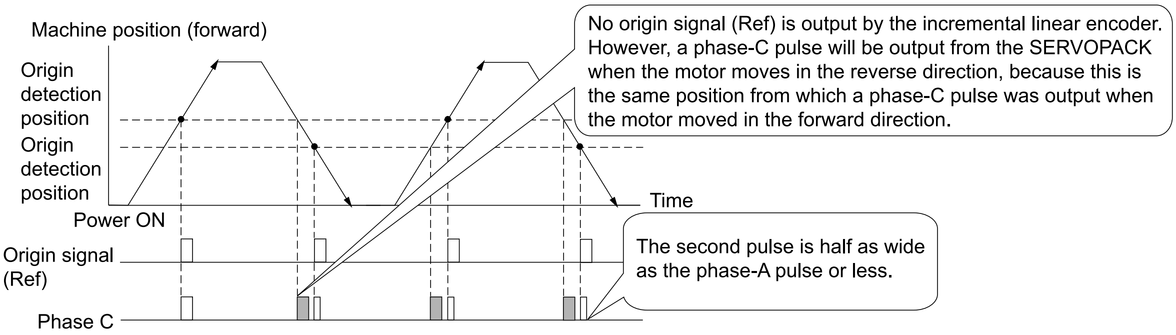
(a) Relation between Renishaw PLC Incremental Linear Encoders and Encoder Output Pulse Signal from the SERVOPACK When Using a RGS20 Scale and RGH22B Sensor Head

The output position of the origin signal (Ref) will depend on the direction of movement for some models of incremental linear encoders from Renishaw PLC.

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

For detailed specifications on the origin signal, refer to the manual for the Renishaw PLC incremental linear encoder.

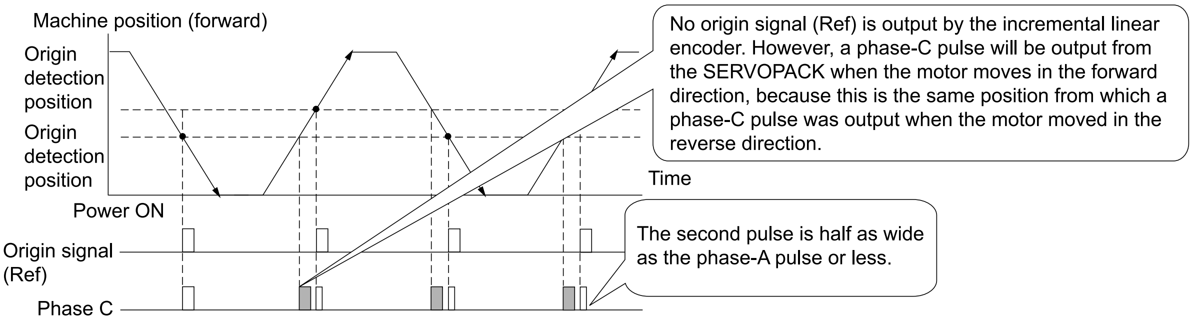
◆ When Passing the First Origin Signal (Ref) in the Forward Direction and Returning after Turning ON the Power



No origin signal (Ref) is output by the incremental linear encoder. However, a phase-C pulse will be output from the SERVOPACK when the motor moves in the reverse direction, because this is the same position from which a phase-C pulse was output when the motor moved in the forward direction.

The second pulse is half as wide as the phase-A pulse or less.

◆ When Passing the First Origin Signal (Ref) in the Reverse Direction and Returning after Turning ON the Power



No origin signal (Ref) is output by the incremental linear encoder. However, a phase-C pulse will be output from the SERVOPACK when the motor moves in the forward direction, because this is the same position from which a phase-C pulse was output when the motor moved in the reverse direction.

The second pulse is half as wide as the phase-A pulse or less.

(b) Precautions When Using a Linear Incremental Encoder from Magnescale Co., Ltd.

◆ Encoder Divided Phase-C Pulse Output Selection

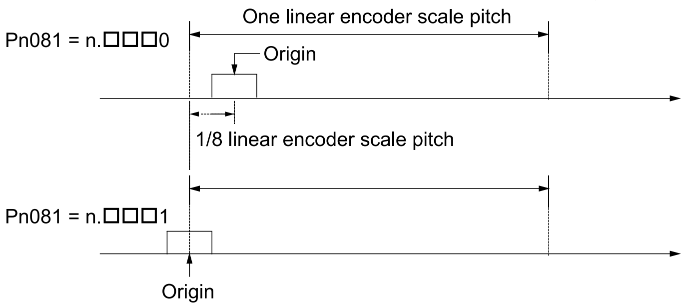
You can also output the encoder's phase-C pulse for reverse movement. To do so, set Pn081 to n.□□□1.

Pn081	n.□□□X	Phase-C Pulse Output Selection Speed Pos Trq		When Enabled
		0 Default	Output phase-C pulses only in the forward direction.	After restart
		1	Output phase-C pulses in both the forward and reverse directions.	

Important

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

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



Observe the following precaution if you set Pn081 to n.□□□0 (output phase-C pulses only in the forward direction).

When a linear incremental encoder from Magnescale Co., Ltd. is used, the count direction of the encoder determines how the phase-C pulse (CN1-19 and CN1-20) is output.

Note:

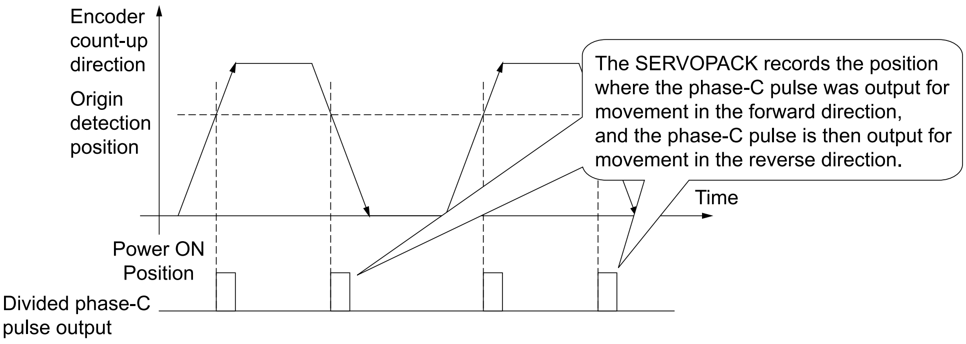
The count direction (up or down) of the linear encoder determines whether a phase-C pulse is output. The output of the pulse does not depend on the setting of Pn000 = n.□□□1 (Reverse Movement Mode).

Encoder Model	Interpolator	Linear Encoder Scale Pitch [μm]
SL710	PL101-RY MJ620-T13	800
SL720		800
SL730		800
SR75		80
SR85		80
SQ10	MQ10-FLA	400
	MQ10-GLA	

◆ When First Passing the Origin Signal in the Forward Direction and Returning after Turning ON the Power

The encoder's phase-C pulse (CN1-19 and CN1-20) is output when the origin detection position is passed for the first time in the forward direction after the power is turned ON.

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

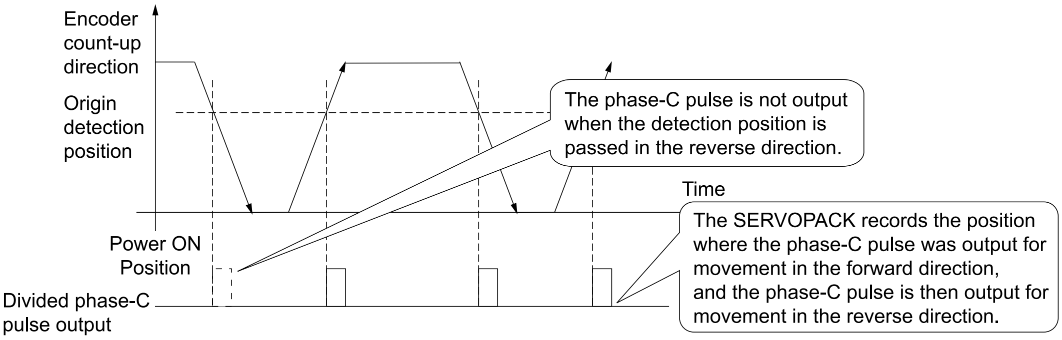


The SERVOPACK records the position where the phase-C pulse was output for movement in the forward direction, and the phase-C pulse is then output for movement in the reverse direction.

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

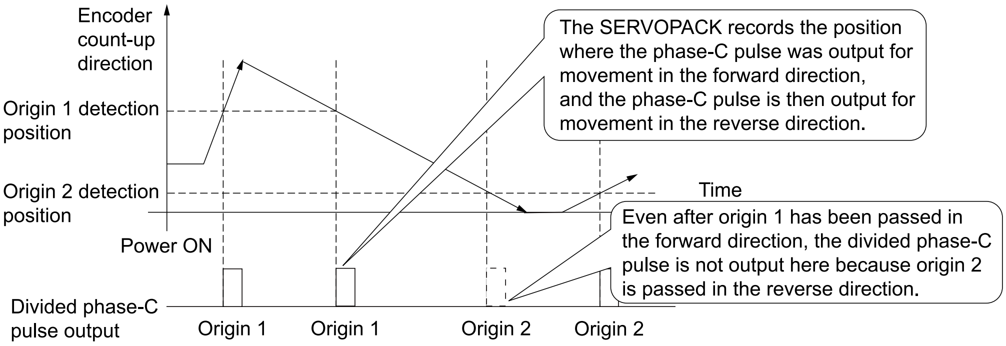
The encoder's phase-C pulse (CN1-19 and CN1-20) is not output when the origin detection position is passed for the first time in the reverse direction after the power is turned ON.

However, after the origin detection position is passed in the forward direction and the encoder's phase-C pulse is output, it will then also be output when the origin detection point is passed in the reverse direction.



◆ **When Using a Linear Encoder with Multiple Origins and First Passing the Origin Position in the Forward Direction and Returning after Turning ON the Power**

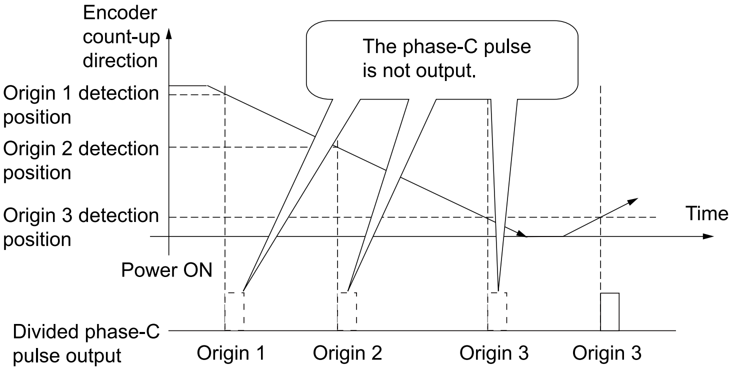
The encoder's phase-C pulse is output when the origin detection position is passed for the first time in the forward direction after the power is turned ON. After that, the phase-C pulse is output whenever the origin detection position is passed in the forward or reverse direction.



◆ **When Using a Linear Encoder with Multiple Origins and First Passing the Origin Position in the Reverse Direction after Turning ON the Power**

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

However, after the origin detection position is passed in the forward direction and the encoder's phase-C pulse is output, it will then also be output when the origin detection point is passed in the reverse direction.



6.8.2 Setting for the Encoder Divided Pulse Output

This section describes the setting for the encoder divided pulse output for a rotary servomotor or linear servomotor.

(1) Encoder Divided Pulse Output When Using a Rotary Servomotor

If you will use a rotary servomotor, set Pn212 (Number of Encoder Output Pulses).

Pn212	Number of Encoder Output Pulses			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	16 to 1073741824	1 P/Rev	2048	After restart

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

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

The setting of the number of encoder output pulses is limited by the resolution of the encoder.

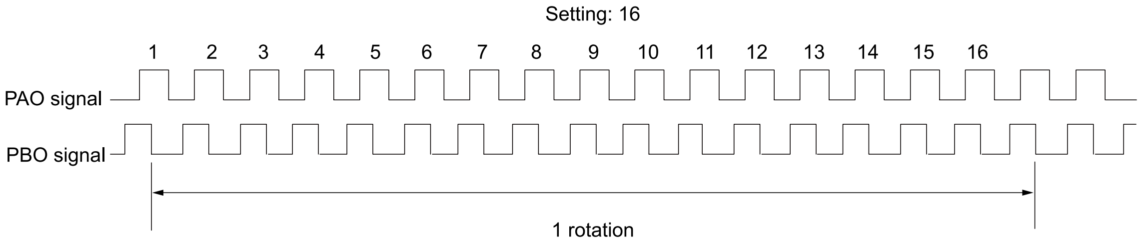
Setting of the Number of Encoder Output Pulses [P/Rev]	Setting Increment	Encoder Resolution				Upper Limit of Servomotor Speed for Set Number of Encoder Output Pulses [min^{-1}]
		20 bits (1048576 pulses)	22 bits (4194304 pulses)	24 bits (16777216 pulses)	26 bits (67108864 pulses)	
16 to 8192	1	○	○	○	○	7000
8193 to 16384	1	○	○	○	○	6000
16386 to 32768	2	○	○	○	○	3000
32772 to 65536	4	○	○	○	○	1500
65544 to 131072	8	○	○	○	○	750
131088 to 262144	16	○	○	○	○	375
262176 to 524288	32	–	○	○	○	187
524352 to 1048576	64	–	○	○	○	93
1048704 to 2097152	128	–	–	○ *1	○	46
2097408 to 4194304	256	–	–	○ *1	○	23

*1 You can use the encoder as an incremental encoder only.

Note:

1. The setting range of Pn212 (Number of Encoder Output Pulses) depends on the resolution of the servomotor encoder. An A.041 alarm (Encoder Output Pulse Setting Error) will occur if the above setting conditions are not met.
   Correct setting example: Pn212 can be set to 25000 [P/Rev].
   Incorrect setting example: Pn212 cannot be set to 25001 (P/Rev) because the setting increment in the above table is not used and A.041 alarm would will occur.
2. The upper limit of the pulse frequency is approximately 1.6 Mpps. The servomotor speed will be limited if the setting of the number of encoder output pulses is too high.
   An A.511 alarm (Encoder Output Pulse Overspeed) will occur if the upper limit of the motor speed is exceeded.

Output example: An output example is given below for the PAO (Encoder Pulse Output Phase A) signal and the PBO (Encoder Pulse Output Phase B) signal when Pn212 is set to 16 (16 pulses output per revolution).



(2) Encoder Divided Pulse Output When Using a Linear Servomotor

If you will use a linear servomotor, set Pn281 (Encoder Output Resolution).

Pn281	Encoder Output Resolution			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 4096	1 edge/pitch	20	After restart

Note:

- The maximum setting for the encoder output resolution is 4096. If the resolution of the external encoder exceeds 4096, pulse output will no longer be possible at the resolution given in the following section.

☞ ◆ *Feedback Resolution of Linear Encoder: Incremental Linear Encoder on page 202*
☞ ◆ *Feedback Resolution of Linear Encoder: Absolute Linear Encoder on page 202*

- If the setting of Pn281 exceeds the number of divisions of the external encoder, A.041 (Encoder Output Pulse Setting Error) will be output.

Set the encoder output resolution for the encoder pulse output signals (PAO, /PAO, PBO, and /PBO) from the SERVOPACK to the host controller.

The number of feedback pulses per linear encoder scale pitch *1 is divided by the setting of Pn281 (after multiplication by 4) inside the SERVOPACK and then the resulting number of pulses is output. Set the parameter according to the system specifications of the machine or host controller.

The setting range depends on Pn385 (Maximum Motor Speed) and Pn282 (Linear Encoder Scale Pitch) *1 of the servomotor. You can calculate the upper limit of the setting of Pn281 with the following formula.

$$\text{Upper limit of Pn281} = \frac{\text{Linear encoder scale pitch}^{*1}/100}{\text{Pn385}} \times 72$$

*1 The value depends on whether a serial converter unit is used.

Using a Serial Converter Unit	Setting of Pn282
Not Using a Serial Converter Unit (when the linear encoder and SERVOPACK are connected directly or when a linear encoder that does not require a serial converter unit is used)	The linear encoder scale pitch is automatically detected by the SERVOPACK, so the setting of Pn282 is ignored.

Information When the linear encoder scale pitch is 4 µm, the maximum motor speed is limited to 1 m/s because of the maximum response frequency of the serial converter unit.

If the setting is out of range or does not satisfy the setting conditions, an A.041 alarm (Encoder Output Pulse Setting Error) will be output. If the motor speed exceeds the upper limit for the set encoder output resolution, an A.511 alarm (Encoder Output Pulse Overspeed) will be output.

The upper limit of the encoder output resolution is restricted by the dividing specifications of the serial converter unit.

<Setting Example>

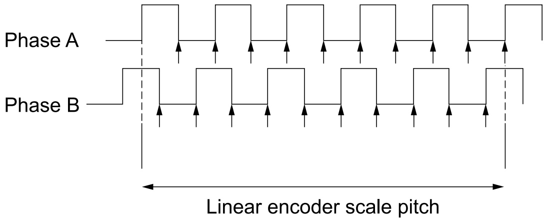
When the linear encoder scale pitch is 20 µm and the maximum motor speed is 5 m/s (Pn385 = 50).

Correct setting: Pn281 = 28 (edges/pitch)

Incorrect setting: Pn281 = 29 (edges/pitch) (An A.041 alarm would will occur.)

<Pulse Output Example>

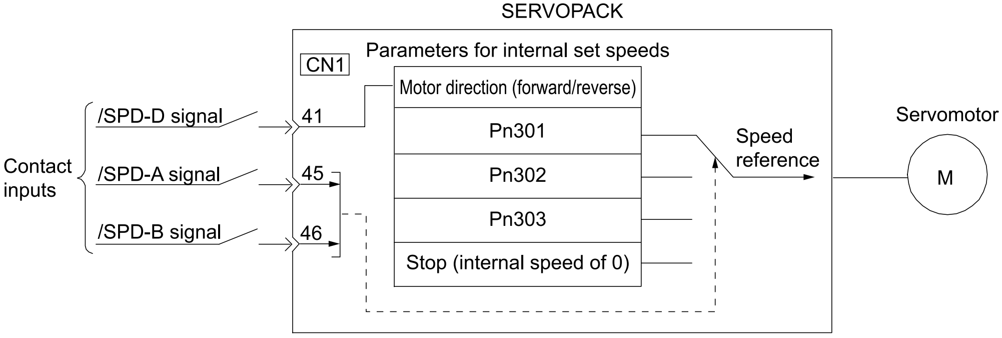
When Pn281 = 20 (20-edge output (5-pulse output) per linear encoder scale pitch)



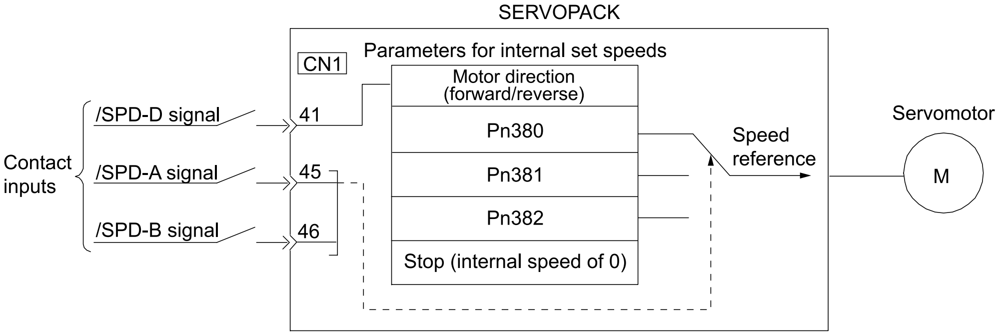
6.9 Internal Set Speed Control

You can set motor speeds in three parameters in the SERVOPACK and then perform speed control by using external input signals to select the motor speed and direction. Because the speed is controlled with parameters in the SERVOPACK, an external pulse generator or a reference generator is not required to control the speed.

- Rotary Servomotors



- Linear Servomotors



6.9.1 Input Signals for Internal Set Speed Control

The following input signals are used to change the speed.

(1) Setting Pn50A = n.□□□0 (use input signal terminals with the default allocations)

Type	Signal	Connector Pin No.	Meaning
Input	/SPD-D	CN1-41	Changes the servomotor direction.
	/SPD-A	CN1-45	Selects the internal set speed.
	/SPD-B	CN1-46	Selects the internal set speed.

(2) Setting Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (SigmaLINK II input signal allocation mode)

Type	Signal	Connector Pin No.	Meaning
Input	/SPD-D	Must be allocated.	Changes the servomotor direction.
	/SPD-A		Selects the internal set speed.
	/SPD-B		Selects the internal set speed.

Note:

You must allocate the /SPD-D, /SPD-A, and /SPD-B signals to use them. Use the following parameters to allocate the signal to a terminal.

- Pn50C = n.□□□X (/SPD-D (Motor Direction) Signal Allocation)
- Pn50C = n.□□X□ (/SPD-A (Internal Set Speed Selection Input) Signal Allocation)
- Pn50C = n.□X□□ (/SPD-B (Internal Set Speed Selection Input) Signal Allocation)

Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

6.9.2 Setting the Control Method to Internal Set Speed Control

Set Pn000 to n.□□3□ to set the control method to internal set speed control.

		Control Method Selection	Speed Pos Trq	When Enabled
Pn000	n.□□X□	0 Default	Speed control with analog references	After restart
		1	Position control with pulse train references	
		2	Torque control with analog references	
		3	Internal set speed control with contact commands	
		4	Switching between internal set speed control with contact references and speed control with analog references	
		5	Switching between internal set speed control with contact references and position control with pulse train references	
		6	Switching between internal set speed control with contact references and torque control with analog references	
		7	Switching between position control with pulse train references and speed control with analog references	
		8	Switching between position control with pulse train references and torque control with analog references	
		9	Switching between torque control with analog references and speed control with analog references	
		A	Switching between speed control with analog references and speed control with zero clamping	
		B	Switching between position control with pulse train references and position control with reference pulse inhibition	

6.9.3 Settings for Internal Set Speed Control

The parameters that you set depend on the type of servomotor.

- Rotary Servomotors

Pn301	Internal Set Speed 1			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	Rotary: 1 min^{-1} Direct Drive: 0.1 min^{-1}	100	Immediately
Pn302	Internal Set Speed 2			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	Rotary: 1 min^{-1} Direct Drive: 0.1 min^{-1}	200	Immediately
Pn303	Internal Set Speed 3			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	Rotary: 1 min^{-1} Direct Drive: 0.1 min^{-1}	300	Immediately

Note:

If you set a value that exceeds the maximum speed of the servomotor, the actual speed will be limited to the maximum speed of the servomotor.

- Linear Servomotors

Pn380	Internal Set Speed 1			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 mm/s	10	Immediately
Pn381	Internal Set Speed 2			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 mm/s	20	Immediately
Pn382	Internal Set Speed 3			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 mm/s	30	Immediately

Note:

If you set a value that exceeds the maximum speed of the servomotor, the actual speed will be limited to the maximum speed of the servomotor.

6.9.4 Changing Internal Set Speeds with Input Signals

You can select the internal set speed and direction with the ON/OFF combinations of the /SPD-D (Motor Direction Input) signal and the /SPD-A and /SPD-B (Internal Set Speed Selection) signals.

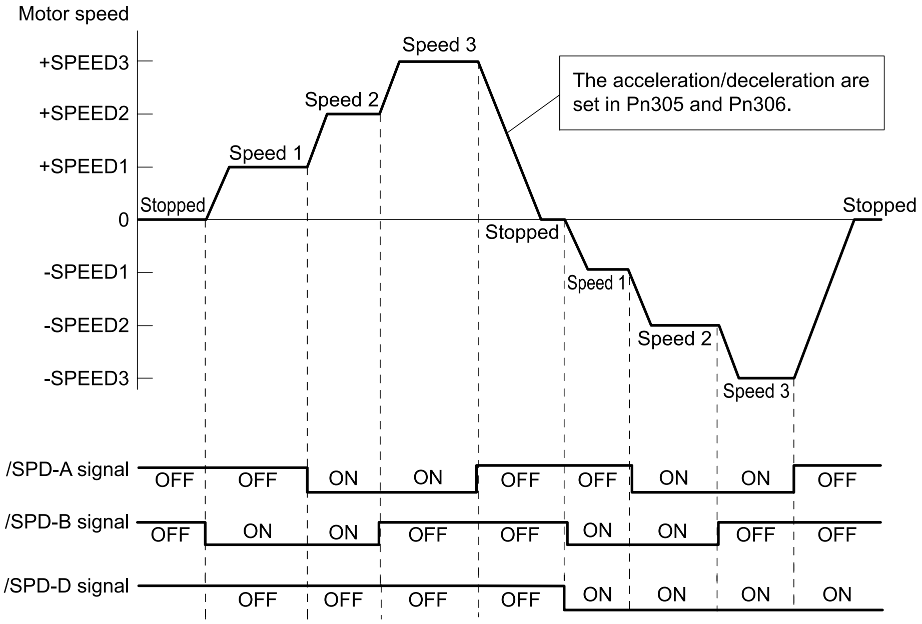
- Rotary Servomotors

Input Signals			Motor Direction	Motor Speed
/SPD-D	/SPD-A	/SPD-B		
OFF	OFF	OFF	Forward	Stops the motor with an internal speed of 0.
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn301.
	ON	ON		Operates the motor with internal set speed 2, which is set in Pn302.
	ON	OFF		Operates the motor with internal set speed 3, which is set in Pn303.
ON	OFF	OFF	Reverse	Stops the motor with an internal speed of 0.
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn301.
	ON	ON		Operates the motor with internal set speed 2, which is set in Pn302.
	ON	OFF		Operates the motor with internal set speed 3, which is set in Pn303.

- Linear Servomotors

Input Signals			Motor Movement Direction	Motor Speed
/SPD-D	/SPD-A	/SPD-B		
OFF	OFF	OFF	Forward	Stops the motor with an internal speed of 0.
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn380.
	ON	ON		Operates the motor with internal set speed 2, which is set in Pn381.
	ON	OFF		Operates the motor with internal set speed 3, which is set in Pn382.
ON	OFF	OFF	Reverse	Stops the motor with an internal speed of 0.
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn380.
	ON	ON		Operates the motor with internal set speed 2, which is set in Pn381.
	ON	OFF		Operates the motor with internal set speed 3, which is set in Pn382.

An operating example of speed control with the internal set speeds is given below. This example combines speed control with the internal set speeds with the soft start function. The shock that results from speed changes is reduced by using the soft start function.


Motor speed
+SPEED3
+SPEED2
+SPEED1
0
-SPEED1
-SPEED2
-SPEED3
Stopped
Speed 1
Speed 2
Speed 3
Stopped
Speed 1
Speed 2
Speed 3
Stopped
The acceleration/deceleration are set in Pn305 and Pn306.
/SPD-A signal
OFF
OFF
ON
ON
OFF
OFF
ON
ON
OFF
/SPD-B signal
OFF
ON
ON
OFF
OFF
ON
ON
OFF
OFF
/SPD-D signal
OFF
OFF
OFF
OFF
ON
ON
ON
ON

6.10 Selecting Combined Control Methods

You can specify switching the SERVOPACK between two control methods. To combine control methods, set Pn000 to n.□□X□ (Control Method Selection) to between 4 and B. This section describes how to switch between the methods and the switching conditions.

Pn000	n.□□X□	Control Method Selection	Speed Pos Trq	When Enabled
		0 Default	Speed control with analog references	After restart
		1	Position control with pulse train references	
		2	Torque control with analog references	
		3	Internal set speed control with contact commands	
		4	Switching between internal set speed control with contact references and speed control with analog references	
		5	Switching between internal set speed control with contact references and position control with pulse train references	
		6	Switching between internal set speed control with contact references and torque control with analog references	
		7	Switching between position control with pulse train references and speed control with analog references	
		8	Switching between position control with pulse train references and torque control with analog references	
		9	Switching between torque control with analog references and speed control with analog references	
		A	Switching between speed control with analog references and speed control with zero clamping	
		B	Switching between position control with pulse train references and position control with reference pulse inhibition	

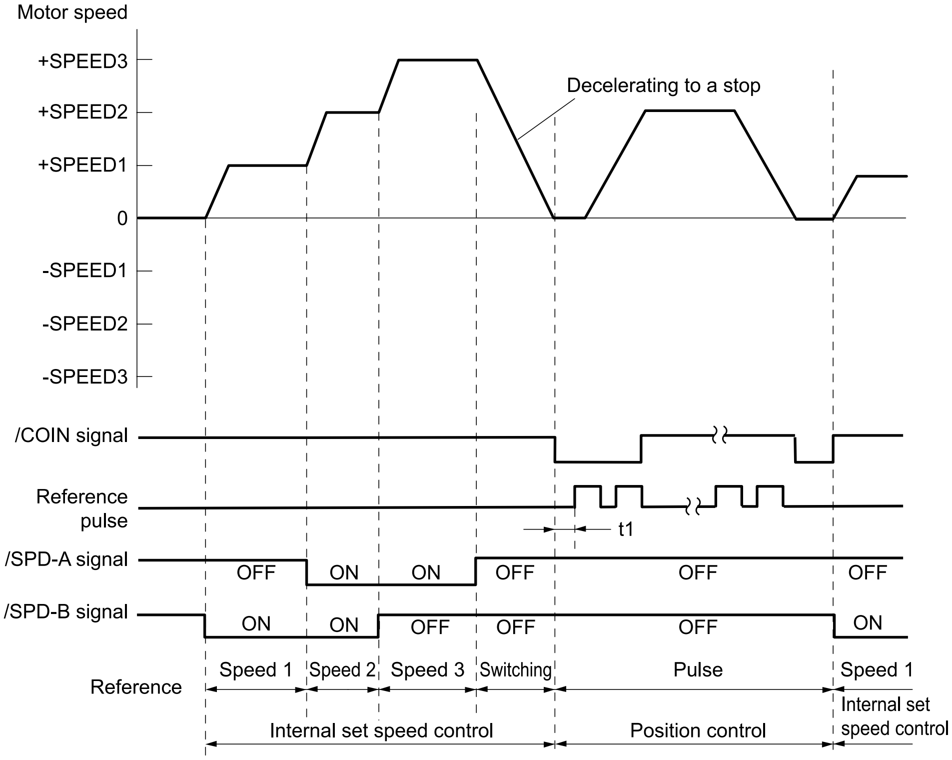
6.10.1 Setting Pn000 = n.□□X□ (Control Method Selection) to 4, 5, or 6

The conditions for switching between internal set speed control and another control method are given below.

(1) Setting Pn50A = n.□□□0 (use input signal terminals with the default allocations)

You can use the /SPD-A and /SPD-B (Internal Set Speed Selection) signals to change the control method and select the internal set speed. You can switch between speed control, position control, or torque control and internal set speed control even while the servomotor is operating.

An example of operation for Pn000 = n.□□5□ (switching between internal set speed control and position control) is given below. This example combines speed control with the internal set speeds with the soft start function. The shock that results from speed changes is reduced by using the soft start function.



Note:

- Set t1 so that it is greater than 2 ms. The value of t1 is not affected by whether the soft start function is used.
- A maximum delay of 2 ms occurs in reading the /SPD-A and /SPD-B signals.
- The speed is decelerated with the deceleration time set in Pn306 (Soft Start Deceleration Time), and internal set speed control is changed to position control after the servomotor comes to a stop.
  The pulse train reference is received after the switch to position control. Always wait until after position control is started before you input the pulse train reference from the host computer. After position control is started, the /COIN (Positioning Completion Output) signal is output. Use the /COIN signal to confirm that the control method has changed.

(a) Rotary Servomotors

Input Pins			Motor Direction	Operation for Setting of Pn000 = n.□□X□		
/SPD-D (CN1-41)	/SPD-A (CN1-45)	/SPD-B (CN1-46)		n.□□4□	n.□□5□	n.□□6□
OFF	OFF	OFF	Forward	Speed control	Position control	Torque control
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn301.		
	ON	ON		Operates the motor with internal set speed 2, which is set in Pn302.		
	ON	OFF		Operates the motor with internal set speed 3, which is set in Pn303.		
ON	OFF	OFF	Reverse	Speed control	Position control	Torque control
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn301.		
	ON	ON		Operates the motor with internal set speed 2, which is set in Pn302.		
	ON	OFF		Operates the motor with internal set speed 3, which is set in Pn303.		

(b) Linear Servomotors

Input Pins			Motor Movement Direction	Operation for Setting of Pn000 = n.□□X□		
/SPD-D (CN1-41)	/SPD-A (CN1-45)	/SPD-B (CN1-46)		n.□□4□	n.□□5□	n.□□6□
OFF	OFF	OFF	Forward	Speed control	Position control	Force control
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn380.		
	ON	ON		Operates the motor with internal set speed 2, which is set in Pn381.		
	ON	OFF		Operates the motor with internal set speed 3, which is set in Pn382.		
ON	OFF	OFF	Reverse	Speed control	Position control	Force control
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn380.		
	ON	ON		Operates the motor with internal set speed 2, which is set in Pn381.		
	ON	OFF		Operates the motor with internal set speed 3, which is set in Pn382.		

(2) Setting Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (SigmaLINK II input signal allocation mode)

The following four signals are assigned to CN1-40 to CN1-46 on the I/O signal connector: /C-SEL (Control Selection Input), /SPD-A and /SPD-B (Internal Set Speed Selection Input) signals, and /SPD-D (Motor Direction Input) signal.

The control method is switched by turning the /C-SEL signal ON and OFF.

Type	Signal	Connector Pin No.	Setting	Control Method for Setting of Pn000 = n.□□X□		
				n.□□4□	n.□□5□	n.□□6□
Input	/C-SEL	Must be allocated.	ON (closed)	Speed control	Position control	Torque control
			OFF (open)	Internal set speed control	Internal set speed control	Internal set speed control

Note:

You must allocate the /C- SEL signal to use it. Use Pn50C = n.X□□□ (/C-SEL (Control Selection Input) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

The operating method for internal set speed control (i.e., the /C-SEL signal is OFF) is given below.

(a) Rotary Servomotors

Input Signals			**Motor Direction**	**Motor Speed**
/SPD-D	**/SPD-A**	**/SPD-B**		
OFF	OFF	OFF	Forward	Stops the motor with an internal speed of 0.
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn301.
	ON	ON		Operates the motor with internal set speed 2, which is set in Pn302.
	ON	OFF		Operates the motor with internal set speed 3, which is set in Pn303.
ON	OFF	OFF	Reverse	Stops the motor with an internal speed of 0.
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn301.
	ON	ON		Operates the motor with internal set speed 2, which is set in Pn302.
	ON	OFF		Operates the motor with internal set speed 3, which is set in Pn303.

Note:

You must allocate the /SPD-D, /SPD-A, and /SPD-B signals to use them. Use the following parameters to allocate the signal to a terminal.

- Pn50C = n.□□□X (/SPD-D (Motor Direction Input) Signal Allocation)
- Pn50C = n.□□X□ (/SPD-A (Set Speed Selection Input) Signal Allocation)
- Pn50C = n.□X□□ (/SPD-B (Set Speed Selection Input) Signal Allocation)

Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

(b) Linear Servomotors

Input Signals			**Motor Movement Direction**	**Motor Speed**
/SPD-D	**/SPD-A**	**/SPD-B**		
OFF	OFF	OFF	Forward	Stops the motor with an internal speed of 0.
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn380.
	ON	ON		Operates the motor with internal set speed 2, which is set in Pn381.
	ON	OFF		Operates the motor with internal set speed 3, which is set in Pn382.
ON	OFF	OFF	Reverse	Stops the motor with an internal speed of 0.
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn380.
	ON	ON		Operates the motor with internal set speed 2, which is set in Pn381.
	ON	OFF		Operates the motor with internal set speed 3, which is set in Pn382.

Note:

You must allocate the /SPD-D, /SPD-A, and /SPD-B signals to use them. Use the following parameters to allocate the signal to a terminal.

- Pn50C = n.□□□X (/SPD-D (Motor Direction Input) Signal Allocation)
- Pn50C = n.□□X□ (/SPD-A (Set Speed Selection Input) Signal Allocation)
- Pn50C = n.□X□□ (/SPD-B (Set Speed Selection Input) Signal Allocation)

Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

6.10.2 Setting Pn000 = n.□□X□ (Control Method Selection) to 7, 8, or 9

You can set Pn000 = n.□□X□ (Control Method Selection) to switch between the following control methods.

- Switching between position control and speed control
- Switching between position control and torque control
- Switching between torque control and speed control

(1) Setting Pn50A = n.□□□0 (use input signal terminals with the default allocations)

Type	Signal	Connector Pin No.	Signal Status	Control Method for Setting of Pn000 = n.□□X□		
				n.□□7□	n.□□8□	n.□□9□
Input	/C-SEL	CN1-41	ON (closed)	Speed control	Torque control	Speed control
			OFF (open)	Position control	Position control	Torque control

(2) Setting Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (SigmaLINK II input signal allocation mode)

Type	Signal	Connector Pin No.	Signal Status	Control Method for Setting of Pn000 = n.□□X□		
				n.□□7□	n.□□8□	n.□□9□
Input	/C-SEL	Must be allocated.	ON (closed)	Speed control	Torque control	Speed control
			OFF (open)	Position control	Position control	Torque control

Note:

You must allocate the /C- SEL signal to use it. Use Pn50C = n.X□□□ (/C-SEL (Control Selection Input) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

6.10.3 Setting Pn000 = n.□□X□ (Control Method Selection) to A or B

You can set Pn000 = n.□□X□ (Control Method Selection) to switch between the following control methods.

- Switching between speed control with analog references and speed control with zero clamping
- Switching between normal position control and position control with reference pulse inhibition

(1) Setting Pn50A = n.□□□0 (use input signal terminals with the default allocations)

Type	Signal	Connector Pin No.	Signal Status	Control Method for Setting of Pn000 = n.□□X□	
				n.□□A□	n.□□B□
Input	/ZCLAMP	CN1-41	ON (closed)	Speed control with zero clamping	–
			OFF (open)	Speed control	–
	/INHIBIT		ON (closed)	–	Position control with reference pulse inhibition
			OFF (open)	–	Position control

(2) Setting Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (SigmaLINK II input signal allocation mode)

Type	Signal	Connector Pin No.	Signal Status	Control Method for Setting of Pn000 = n.□□X□	
				n.□□A□	n.□□B□
Input	/ZCLAMP	Must be allocated.	ON (closed)	Speed control with zero clamping	–
			OFF (open)	Speed control	–
	/INHIBIT		ON (closed)	–	Position control with reference pulse inhibition
			OFF (open)	–	Position control

Note:

You must allocate the /ZCLAMP and /INHIBIT signals to use them. Use the following parameters to allocate the signal to a terminal.

- Pn50D = n.□□□X (/ZCLAMP (Zero Clamping Input) Signal Allocation)
- Pn50D = n.□□X□ (/INHIBIT (Reference Pulse Inhibit Input) Signal Allocation)

Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

6.11 Selecting Torque Limits

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

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

Limit Method	Outline	Control Method	Reference
Internal Torque Limits	The torque is always limited with the setting of a parameter.	Speed control, position control, or torque control	☞ *6.11.1 Internal Torque Limits on page 281*
External Torque Limits	The torque is limited with an input signal from the host computer.		☞ *6.11.2 External Torque Limits on page 282*
Limiting Torque with an Analog Reference	An analog reference is used to set the required torque limits.	Speed control or position control	☞ *6.11.3 Limiting Torque with an Analog Reference on page 285*
Limiting Torque with an External Torque Limit and an Analog Reference	The torque is limited by combining torque limits for an external input signal and torque limits for an analog reference.	Speed control or position control	☞ *6.11.4 Limiting Torque with an External Torque Limit and an Analog Voltage Reference on page 287*

Note:

If you set a value that exceeds the instantaneous maximum torque of the servomotor, the torque will be limited to the instantaneous maximum torque of the servomotor.

6.11.1 Internal Torque Limits

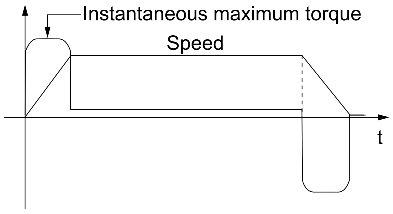
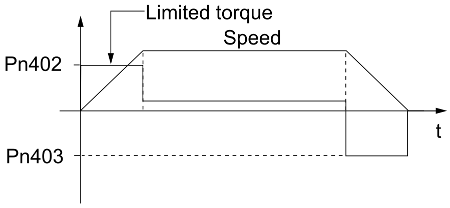
If you use internal torque limits, the maximum output torque will always be limited to the setting of Pn402 (Forward Torque Limit) and Pn403 (Reverse Torque Limit).

(1) Rotary Servomotors

Pn402	Forward Torque Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	800	Immediately
Pn403	Reverse Torque Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	800	Immediately

Note:

- The setting unit is a percentage of the motor rated torque.
- If the setting of Pn402 or Pn403 is too low, the torque may be insufficient for acceleration or deceleration of the servomotor.

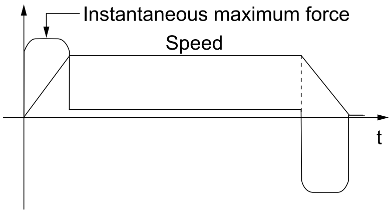
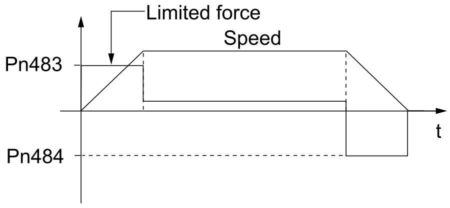
Without Internal Torque Limits (Output to the instantaneous maximum torque is possible.)	**With Internal Torque Limits**
	

(2) Linear Servomotors

Pn483	Forward Force Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	30	Immediately
Pn484	Reverse Force Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	30	Immediately

Note:

- The setting unit is a percentage of the motor rated force.
- If the setting of Pn483 or Pn484 is too low, the force may be insufficient for acceleration or deceleration of the servomotor.

Without Internal Force Limits **(Output to the instantaneous maximum force is possible.)**	**With Internal Force Limits**
	

6.11.2 External Torque Limits

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

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

(1) External Torque Limit Reference Signals

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

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/P-CL	CN1-45 (default setting)	ON (closed)	Applies the forward external torque limit. The torque is limited to the smaller of the settings of Pn402 *1 and Pn404.
			OFF (open)	Cancels the forward external torque limit. The torque is limited to the setting of Pn402 *1.
	/N-CL	CN1-46 (default setting)	ON (closed)	Applies the reverse external torque limit. The torque is limited to the smaller of the settings of Pn403 *1 and Pn405.
			OFF (open)	Cancels the reverse external torque limit. The torque is limited to the setting of Pn403 *1.

*1 Pn483 is used for a linear servomotor.
*2 Pn484 is used for a linear servomotor.

Note:

You can allocate the /P-CL and /N-CL signals to other terminals. The parameters that you use depend on the allocation method.

Allocation Method	Parameter to Use
Σ-7S-compatible I/O Signal Allocations	• Pn50A = n.□□□1 (Σ-7S-compatible I/O Signal Allocations) • Pn50B = n.□X□□ (/P-CL (Forward External Torque Limit Input) Signal Allocation) • Pn50B = n.X□□□ (/N-CL (Reverse External Torque Limit Input) Signal Allocation)
Σ-LINK II Input Signal Allocations	• Pn50A = n.□□□2 (use Σ-LINK II input signal allocations) • Pn598 (/P-CL (Forward External Torque Limit Input) Signal Allocations) • Pn599 (/N-CL (Reverse External Torque Limit Input) Signal Allocations)

Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

(2) Torque Limit Settings

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

(a) Rotary Servomotors

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

Pn402	Forward Torque Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	800	Immediately
Pn403	Reverse Torque Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	800	Immediately
Pn404	Forward External Torque Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	100	Immediately
Pn405	Reverse External Torque Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	100	Immediately

Note:

The setting unit is a percentage of the motor rated torque.

(b) Linear Servomotors

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

Pn483	Forward Force Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	30	Immediately
Pn484	Reverse Force Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	30	Immediately

Continued on next page.

Continued from previous page.

Pn404	Forward External Torque Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	100	Immediately
Pn405	Reverse External Torque Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	100	Immediately

Note:

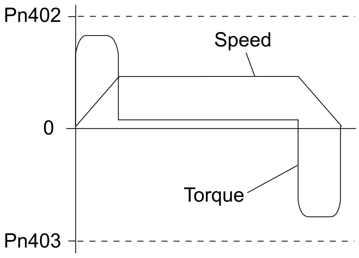
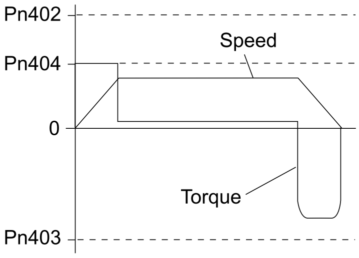
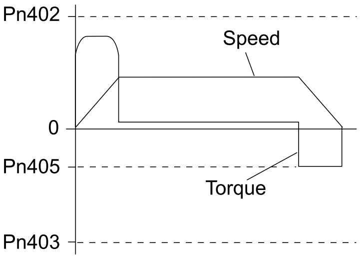
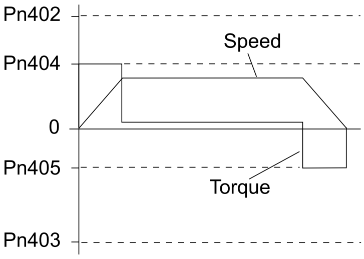
The setting unit is a percentage of the motor rated force.

(3) 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%.

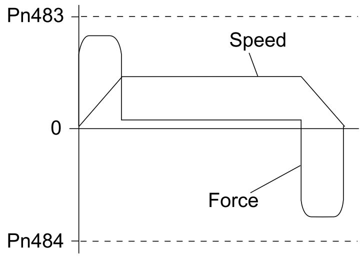
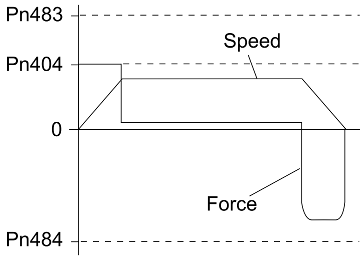
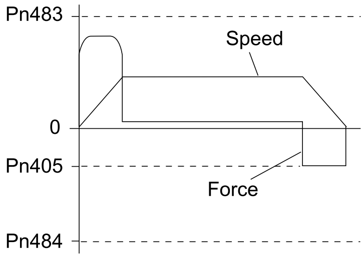
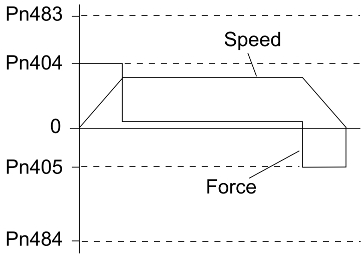
(a) Rotary Servomotors

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

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="2">/P-CL signal</th></tr>
<tr><th>OFF</th><th>ON</th></tr>
<tr><td rowspan="2">/N-CL signal</td><td>OFF</td><td> </td><td> </td></tr>
<tr><td>ON</td><td> </td><td> </td></tr>
</table>

(b) Linear Servomotors

In this example, the servomotor direction is set to Pn000 = n.□□□0 (use the direction in which the linear encoder counts up as the forward direction).

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

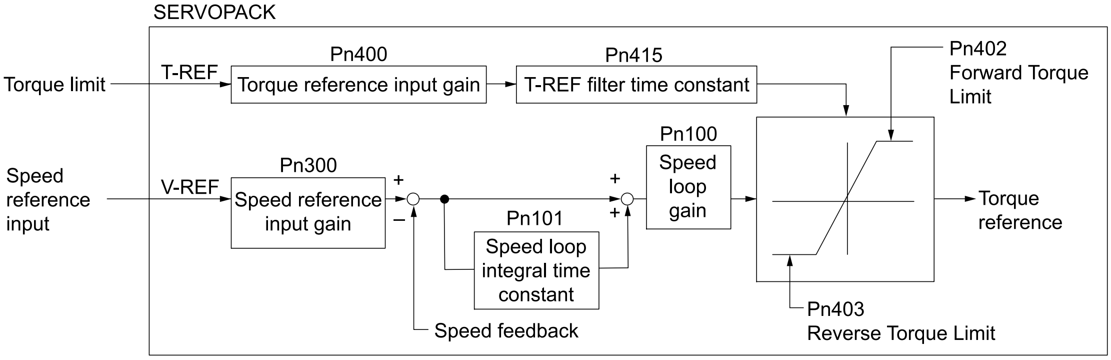
6.11.3 Limiting Torque with an Analog Reference

The analog voltage on the T-REF terminals (CN1-9, -10) is used to limit the torque with an analog reference. The smallest of the analog reference torque reference and the torque limits for Pn402 *1 and Pn403 *2 is used.

*1 Pn483 is used for a linear servomotor.
*2 Pn484 is used for a linear servomotor.

The block diagrams for limiting the torque during speed control are provided below.

(1) Rotary Servomotors

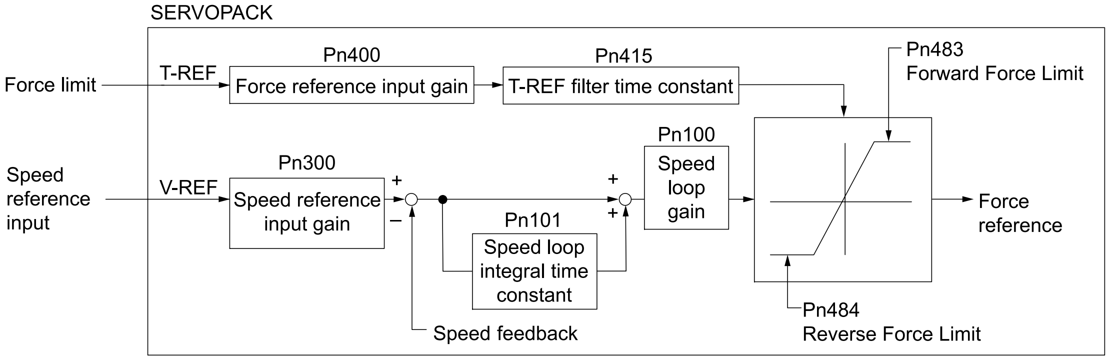


Refer to the following sections for details on the parameters in the figure.

Parameter Number	Reference
Pn300	☞ *6.5.1 Basic Settings for Speed Control on page 233*
Pn400	☞ *6.7.1 Basic Settings for Torque Control on page 256*
Pn402	☞ *6.11.1 Internal Torque Limits on page 281*
Pn403	
Pn415	☞ *6.7.3 Torque Reference Filter Settings on page 261*

Information There is no polarity for the input voltage of the analog voltage reference for the torque limit. The absolute value of voltage is input, and a torque limit that corresponds to that absolute value is applied in the forward and reverse directions.

(2) Linear Servomotors



Refer to the following sections for details on the parameters in the figure.

Parameter Number	Reference
Pn300	☞ *6.5.1 Basic Settings for Speed Control on page 233*
Pn400	☞ *6.7.1 Basic Settings for Torque Control on page 256*
Pn483	☞ *6.11.1 Internal Torque Limits on page 281*
Pn484	
Pn415	☞ *6.7.3 Torque Reference Filter Settings on page 261*

Information There is no polarity for the input voltage of the analog voltage reference for the force limit. The absolute value of voltage is input, and a force limit that corresponds to the absolute value of the input voltage is applied in the forward and reverse directions.

(3) T-REF (Torque Reference Input) Signal

The input signal that is used for torque limits with an analog voltage reference is described below.

Type	Signal	Connector Pin No.	Name
Input	T-REF	CN1-9	Torque reference input
	SG	CN1-10	Signal ground for torque reference input

(4) Setting the External Torque Limit

You must set Pn002 to n.□□□1 (sse T-REF as an external torque limit input) to use T-REF (CN1-9 and CN1-10) as the torque limit input.

Pn002	n.□□□X	Speed/Position Control Option (T-REF Input Allocation) **Speed** **Pos** **Trq**		When Enabled
		0 Default	Do not use T-REF.	After restart
		1	Use T-REF as an external torque limit input.	
		2	Use T-REF as a torque feedforward input.	
		3	Use T-REF as an external torque limit input when /P-CL or /N-CL is enabled.	

(5) Settings Related to Limiting Torque with an Analog Voltage Reference

The parameters that are related to limiting torque with an analog voltage reference include parameters to set the input gain of the analog voltage reference, a reference filter time constant, and the internal torque limits.

(a) Rotary Servomotors

Pn400	Torque Reference Input Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 100	0.1 V/ rated torque	30	Immediately
Pn402	Forward Torque Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	800	Immediately
Pn403	Reverse Torque Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	800	Immediately
Pn415	T-REF Filter Time Constant			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.01 ms	0	Immediately

Note:

The setting unit for Pn402 and Pn403 is a percentage of the motor rated torque.

(b) Linear Servomotors

Pn400	Torque Reference Input Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 100	0.1 V/ rated torque	30	Immediately
Pn483	Forward Force Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	30	Immediately
Pn484	Reverse Force Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	30	Immediately
Pn415	T-REF Filter Time Constant			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.01 ms	0	Immediately

Note:

The setting unit for Pn483 and Pn484 is a percentage of the motor rated force.

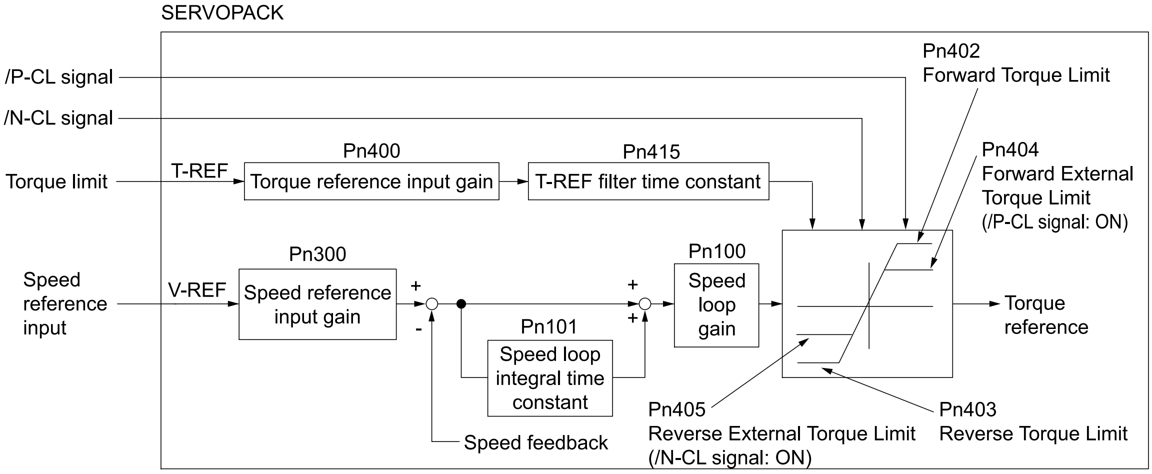
6.11.4 Limiting Torque with an External Torque Limit and an Analog Voltage Reference

The torque is limited by combining torque limits for an external input signal and torque limits for an analog voltage reference.

When the /P-CL (Forward External Torque Limit Input) or /N-CL (Reverse External Torque Limit Input) signal is ON, the torque will be limited by the smaller of the torque limit for the analog voltage reference or the setting of Pn404 or Pn405.

The following block diagram shows limiting the torque with an external torque limit and an analog voltage reference.

(1) Rotary Servomotors

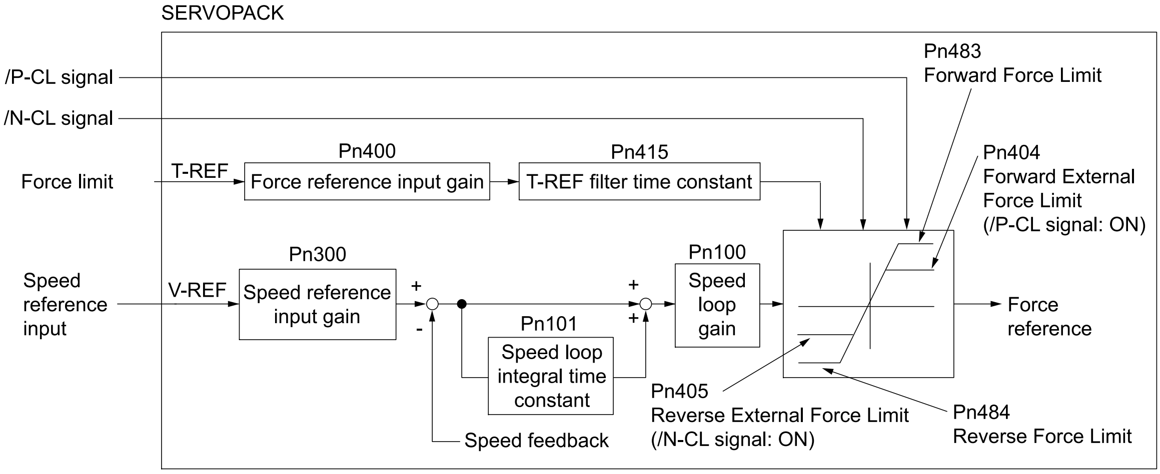


Note:

- You cannot use the torque limit of the analog voltage reference during torque control because the analog voltage is input with the T-REF (Torque Reference Input) signal.
- Refer to the following sections for details on the parameters in the figure.

Parameter Number	Reference
Pn300	☞ *6.5.1 Basic Settings for Speed Control on page 233*
Pn400	☞ *6.7.1 Basic Settings for Torque Control on page 256*
Pn402	☞ *6.11.1 Internal Torque Limits on page 281*
Pn403	
Pn404	
Pn405	
Pn415	☞ *6.7.3 Torque Reference Filter Settings on page 261*

(2) Linear Servomotors



Note:

- You cannot use the force limit of the analog voltage reference during force control because the analog voltage is input with the T-REF (Torque Reference Input) signal.
- Refer to the following sections for details on the parameters in the figure.

Parameter Number	Reference
Pn300	☞ *6.5.1 Basic Settings for Speed Control on page 233*
Pn400	☞ *6.7.1 Basic Settings for Torque Control on page 256*
Pn404	☞ *6.11.1 Internal Torque Limits on page 281*
Pn405	
Pn483	
Pn484	
Pn415	☞ *6.7.3 Torque Reference Filter Settings on page 261*

(3) /P-CL (Forward External Torque Limit) Signal, /N-CL (Reverse External Torque Limit) Signal, and T-REF (Torque Reference Input) Signal

The input signals that are used for torque limits with an external torque limit and an analog voltage reference are described below.

(a) T-REF (Torque Reference Input) Signal

Type	Signal	Connector Pin No.	Name
Input	T-REF	CN1-9	Torque reference input
	SG	CN1-10	Signal ground for torque reference input

(b) /P-CL (Forward External Torque Limit) Signal and /N-CL (Reverse External Torque Limit) Signal

- Rotary Servomotors

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/P-CL	CN1-45 (default setting)	ON (closed)	Applies the forward external torque limit. The torque is limited to the smallest of the analog reference or the setting of Pn402 or Pn404.
			OFF (open)	Cancels the forward external torque limit. The torque is limited to the setting of Pn402.
Input	/N-CL	CN1-46 (default setting)	ON (closed)	Applies the reverse external torque limit. The torque is limited to the smallest of the analog reference or the setting of Pn403 or Pn405.
			OFF (open)	Cancels the reverse external torque limit. The torque is limited to the setting of Pn403.

- Linear Servomotors

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/P-CL	CN1-45 (default setting)	ON (closed)	Applies the forward external force limit. The torque is limited to the smallest of the analog reference or the setting of Pn483 or Pn404.
			OFF (open)	Cancels the forward external force limit. The force is limited to the setting of Pn483.
Input	/N-CL	CN1-46 (default setting)	ON (closed)	Applies the reverse external force limit. The torque is limited to the smallest of the analog reference or the setting of Pn484 or Pn405.
			OFF (open)	Cancels the reverse external force limit. The torque is limited to the setting of Pn484.

(4) Setting the Torque Limit with the External Torque Limit and an Analog Voltage Reference

To limit the torque with an external input signal and an analog voltage reference, you must set Pn002 to n.□□□3 (use T-REF or /N_CL as the torque limit when /P_CL or /N_CL is active).

Pn002	n.□□□X	Speed/Position Control Option (T-REF Input Allocation) Speed Pos Trq		When Enabled
		0 Default	Do not use T-REF.	After restart
		1	Use T-REF as an external torque limit input.	
		2	Use T-REF as a torque feedforward input.	
		3	Use T-REF as an external torque limit input when /P-CL or /N-CL is enabled.	

(5) Related Parameters

The parameters that are related to torque limits with an external torque limit and an analog voltage reference are described below.

With the internal torque limits, the torque is always limited. To disable to internal torque limits, you must set the related parameters (Pn402, Pn403, Pn483, and Pn484) to the maximum values.

(a) Rotary Servomotors

Pn400	Torque Reference Input Gain Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 100	0.1 V/ rated torque	30	Immediately

Pn402	Forward Torque Limit Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	800	Immediately

Pn403	Reverse Torque Limit Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	800	Immediately

Pn404	Forward External Torque Limit Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	100	Immediately

Pn405	Reverse External Torque Limit Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	100	Immediately

Pn415	T-REF Filter Time Constant Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.01 ms	0	Immediately

Note:

The setting unit for Pn402, Pn403, Pn404, and Pn405 is a percentage of the motor rated torque.

(b) Linear Servomotors

Pn400	Torque Reference Input Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 100	0.1 V/ rated torque	30	Immediately
Pn483	Forward Force Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	30	Immediately
Pn484	Reverse Force Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	30	Immediately
Pn404	Forward External Torque Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	100	Immediately
Pn405	Reverse External Torque Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	100	Immediately
Pn415	T-REF Filter Time Constant			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.01 ms	0	Immediately

Note:

The setting unit for Pn483, Pn484, Pn404, and Pn405 is a percentage of the motor rated force.

6.11.5 /CLT (Torque Limit Detection Output) Signal

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

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

Note:

You must allocate the /CLT signal to use it. Use Pn50F = n.□□□X (/CLT (Torque Limit Detection Output) Signal) to allocate the signal to a connector pin. Refer to the following section for details.

☞ *6.1.4 Output Signal Allocations on page 224*

6.12 Absolute Encoders

The absolute encoder records the current position of the stop position even when the power supply is OFF.

With a system that uses an absolute encoder, the host controller can monitor the current position. Therefore, it is not necessary to perform an origin return operation when the power to the system is turned ON.

There are four types of encoders for rotary servomotors. The usage of the encoder is specified in Pn002 = n.□X□□.

Information Σ-X SERVOPACKs can be connected to absolute encoders only. However, an absolute encoder can also be used as an incremental encoder by setting Pn002 to n.□X□□.

Refer to the following section for encoder models.

☞ ◆ *Encoder Resolution on page 201*

- Parameter Settings When Using an Incremental Encoder

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

- Parameter Settings When Using a Single-Turn Absolute Encoder

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

- Parameter Settings When Using a Multiturn Absolute Encoder

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

- Parameter Settings When Using a Batteryless Multiturn Absolute Encoder

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

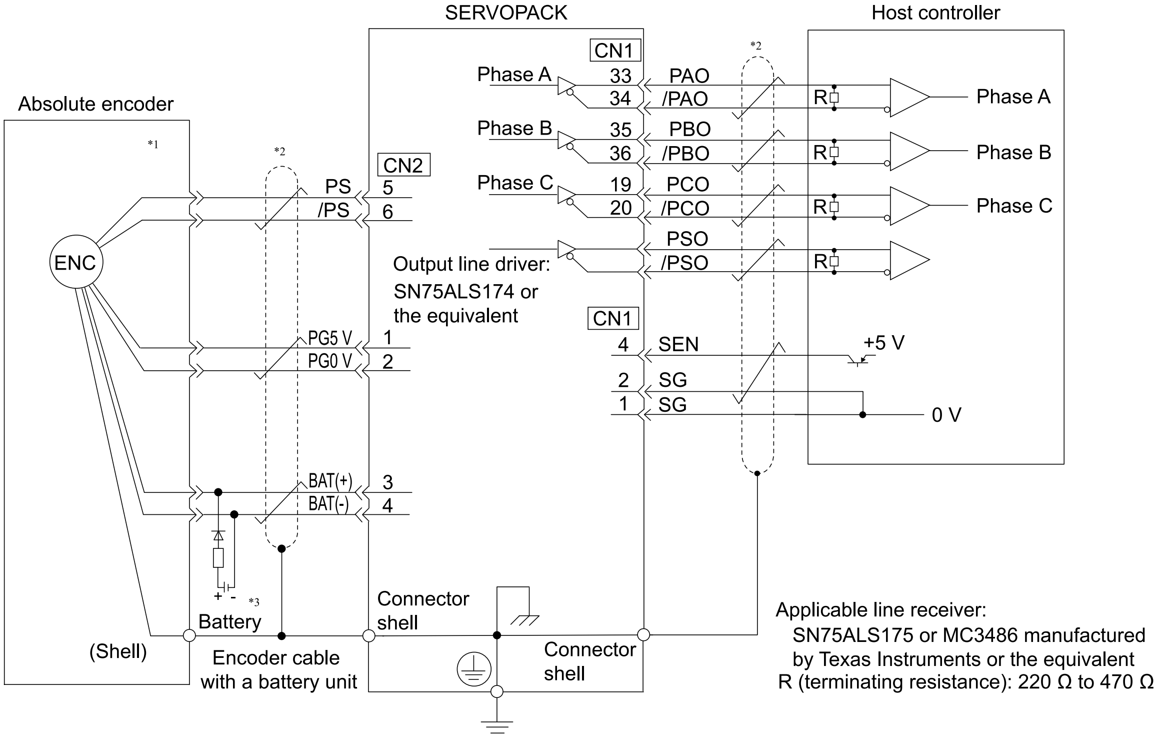
NOTICE

Install a battery at either the host controller or on the encoder cable.

If you install batteries both at the host controller and on the encoder cable at the same time, you will create a loop circuit between the batteries, resulting in a risk of damage or burning.

6.12.1 Connecting an Absolute Encoder

The following diagram shows the typical connections between a servomotor with an absolute encoder, the SERVOPACK, and the host controller.



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

*2 indicates shielded twisted-pair cable.

*3 If you use an encoder cable with a battery unit, do not install a battery at the host controller.

Refer to the following section for details on the typical connections.

☞ *4.4.3 Wiring the SERVOPACK to the Encoder on page 126*

6.12.2 Structure of the Position Data of the Absolute Encoder

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

The position data from the absolute encoder contains the following two items.

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

The position data of the absolute encoder is as follows:

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

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

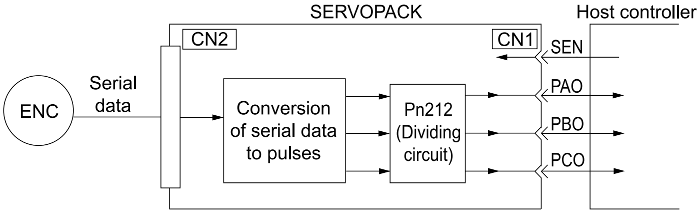
6.12.3 Output Ports for the Position Data from the Absolute Encoder

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

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

(1) Encoder Divided Pulse Output Port

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



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

The PAO (Encoder Divided Pulse Output) signal outputs the position data from the absolute encoder after the control power is turned ON. There are two methods that you can use to output the position data from the absolute encoder: Using the SEN (Absolute Data Request Input) signal and not using the SEN signal.

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

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

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

☞ *4.5.4 I/O Circuits on page 144*

(2) PSO (Absolute Encoder Position Output) Port

The PSO (Absolute Encoder Position Output) signal periodically outputs the position data from the absolute encoder according to the specified protocol after outputting the position data from the absolute encoder with the PAO and PBO signals has been completed. There are two methods that you can use to output the position data from the absolute encoder: Using the SEN (Absolute Data Request Input) signal and not using the SEN signal.

The host controller must have a reception circuit (e.g., UART) for the position data from the absolute encoder.

The output circuit for the PSO signal uses a line driver. Refer to the following section for details on line drivers.

☞ *4.5.4 I/O Circuits on page 144*

6.12.4 Reading the Position Data from the Absolute Encoder

There are two methods that you can use to read the position data from the absolute encoder: Using the SEN (Absolute Data Request Input) signal and not using the SEN signal.

(1) Setting the Parameter to Specify Using or Not Using the SEN (Absolute Data Request Input) Signal

(a) Reading the Position Data from the Absolute Encoder With Using the SEN Signal

- **Setting Pn50A = n.□□□0 (use input signal terminals with the default allocations)**
  The setting of Pn515 = n.□□□X (SEN (Absolute Data Request Input) Signal Allocation) is ignored.
- **Setting Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (Sigma-LINK II input signal allocation mode)**
  Set Pn515 = n.□□□X (SEN (Absolute Data Request Input) Signal Allocation) to 0 to 6 or 9 to F to allocate the SEN signal to one of the pins from CN1-40 to CN1-46.

Refer to the following section for the procedure to allocate input signals.

☞ *6.1.1 Changing Allocations of I/O Signals on page 218*

Information To use the default allocation of the SEN signal and change the default settings of other I/O signals (Pn50A = n.□□□1): Set Pn515 to n.□□□8 (enable when 5 V is input to CN1-4).

(b) Reading the Position Data from the Absolute Encoder Without Using the SEN Signal

Set the parameters as shown below.

- Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (SigmaLINK II input signal allocation mode)
- Pn515 = n.□□□7 (the signal is always active)

Refer to the following sections for details on the parameters.

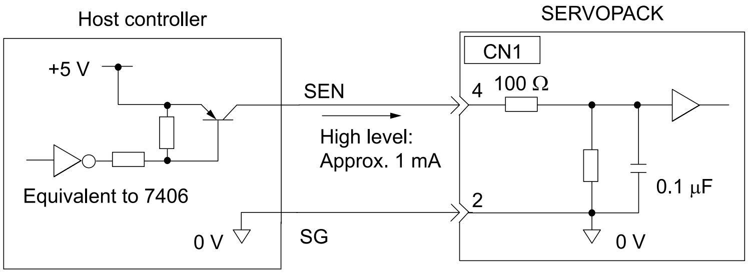
☞ *15 Parameter Lists on page 665*

(2) Connecting the SEN (Absolute Data Request Input) Signal

(a) Allocating the SEN Signal to CN1-4

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	SEN	CN1-4	OFF (open)	Does not request the position data from the absolute encoder. (This is the status after the power is turned ON.)
			ON (closed)	Requests the position data from the absolute encoder.

A circuit example for when the SEN signal is allocated to CN1-4 is provided below.



We recommend a PNP transistor.

(b) Allocating the SEN Signal to a General-Purpose Input

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	SEN	CN1-4 to CN1-46	OFF (open)	Does not request the position data from the absolute encoder. (This is the status after the power is turned ON.)
			ON (closed)	Requests the position data from the absolute encoder.

Refer to the following section for a circuit example for when the SEN signal is allocated to CN1-40 to CN1-46 on the I/O signal connector.

☞ *(2) Sequence Input Circuits on page 145*

Refer to the following section for the procedure to allocate input signals.

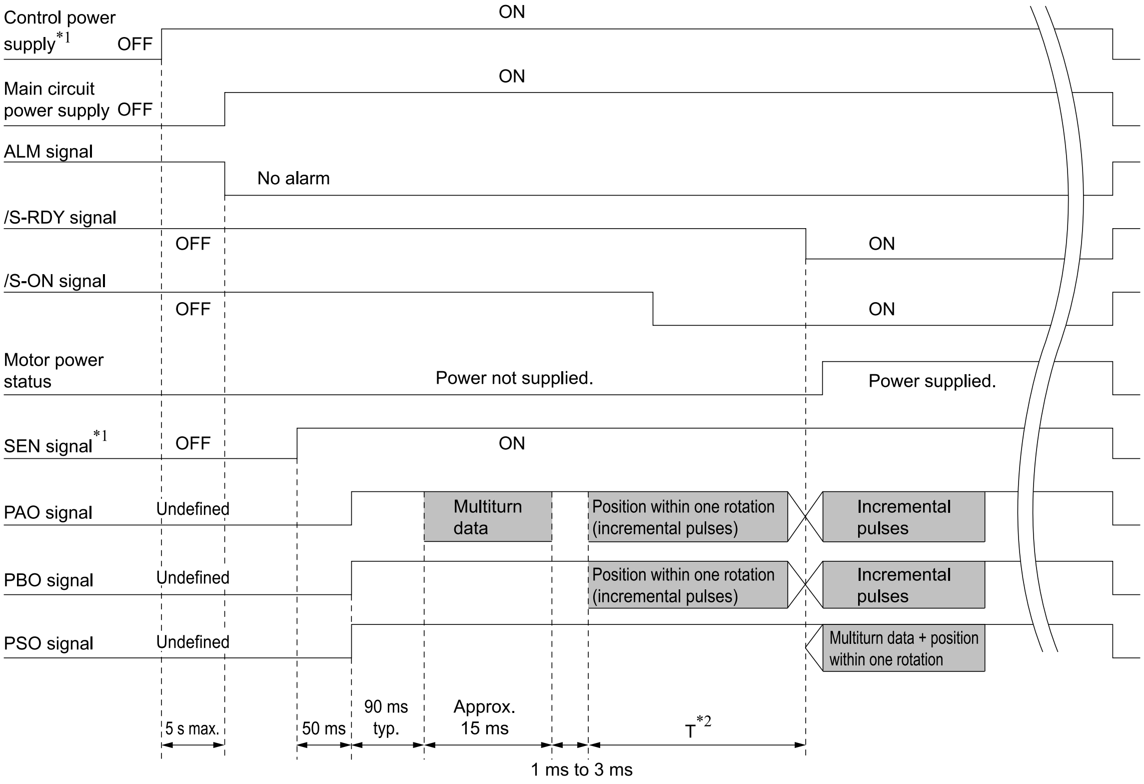
☞ *6.1.3 Input Signal Allocations on page 220*

(3) Sequence for Reading the Position Data from the Absolute Encoder With Using the SEN (Absolute Data Request Input) Signal

The sequence for using the SEN signal to read the position data from the absolute encoder of a rotary servomotor is given below.

The multiturn data is sent according to the transmission specifications.

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



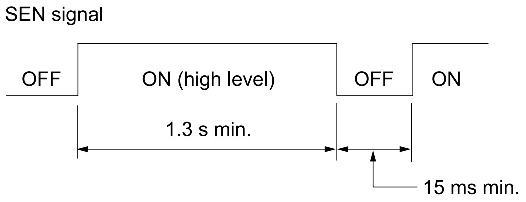
*1 When you turn OFF the control power, turn OFF the SEN signal.

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

Setting of Pn212	Calculation of the Pulse Output Speed for the Position of the Absolute Encoder within One Rotation	Calculation of the Pulse Output Time T for the Position of the Absolute Encoder within One Rotation
16 to 16384	680 × Pn212 / 16384 [kpps]	25 ms max.
16386 to 32768	680 × Pn212 / 32768 [kpps]	50 ms max.
32722 to 65536	680 × Pn212 / 65536 [kpps]	100 ms max.
65544 to 131072	680 × Pn212 / 131072 [kpps]	200 ms max.
131088 to 262144	680 × Pn212 / 262144 [kpps]	400 ms max.
262176 to 524288	680 × Pn212 / 524288 [kpps]	800 ms max.
524352 to 1048576	680 × Pn212 / 1048576 [kpps]	1600 ms max.

Important

- Maintain the SEN signal at the high level for at least 1.3 seconds when you turn it OFF before you turn it ON again, as shown in the following figure.



- The SEN signal is not acknowledged while the servo is ON.

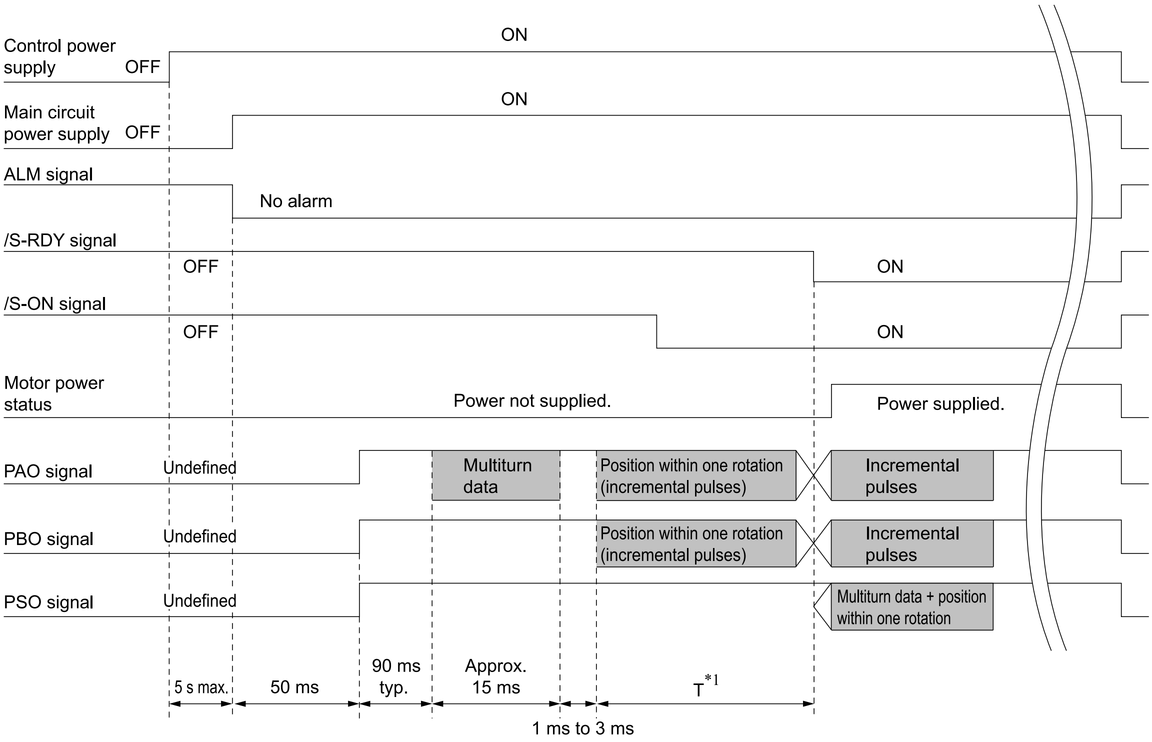
(4) Sequence for Reading the Position Data from the Absolute Encoder Without Using the SEN (Absolute Data Request Input) Signal

The sequence for reading the position data from the absolute encoder of a rotary servomotor without using the SEN signal is given below.

When the specified time has elapsed after the control power to the SERVOPACK is turned ON, the SERVOPACK will automatically read the position data from the absolute encoder.

The position data from the absolute encoder is sent according to the transmission specifications.

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



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

Setting of Pn212	Calculation of the Pulse Output Speed for the Position of the Absolute Encoder within One Rotation	Calculation of the Pulse Output Time T for the Position of the Absolute Encoder within One Rotation
16 to 16384	680 × Pn212 / 16384 [kpps]	25 ms max.
16386 to 32768	680 × Pn212 / 32768 [kpps]	50 ms max.
32722 to 65536	680 × Pn212 / 65536 [kpps]	100 ms max.
65544 to 131072	680 × Pn212 / 131072 [kpps]	200 ms max.
131088 to 262144	680 × Pn212 / 262144 [kpps]	400 ms max.
262176 to 524288	680 × Pn212 / 524288 [kpps]	800 ms max.
524352 to 1048576	680 × Pn212 / 1048576 [kpps]	1600 ms max.

6.12.5 Transmission Specifications

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

The PAO signal sends only the multiturn data. The PSO signal sends the multiturn data plus the position of the absolute encoder within one rotation.

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

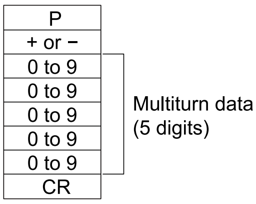
☞ *(3) Sequence for Reading the Position Data from the Absolute Encoder With Using the SEN (Absolute Data Request Input) Signal on page 296*

☞ *(4) Sequence for Reading the Position Data from the Absolute Encoder Without Using the SEN (Absolute Data Request Input) Signal on page 297*

Item	PAO Signal	PSO Signal
Synchronization Method	Start-stop synchronization (ASYNC)	
Transmission Speed	9600 bps	
Start Bits	1 bit	
Stop Bits	1 bit	
Parity	Even	
Character Code	ASCII, 7 bits	
Data Format	☞ *(1) Data Format of PAO Signal on page 298*	☞ *(2) Data Format of PSO Signal on page 298*
Data Output Cycle	• Using the SEN Signal Each time the SEN signal is input after the control power is turned ON • Not Using the SEN Signal Only once after the control power is turned ON	40 ms

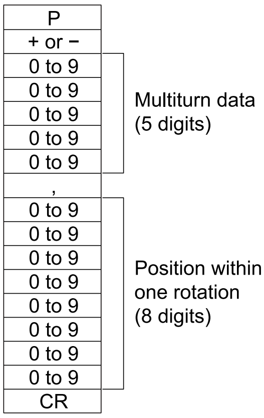
(1) Data Format of PAO Signal

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



(2) Data Format of PSO Signal

As shown below, the message format for a rotary servomotor consists of 17 characters: “P,” the sign, the 5-digit multiturn data, a comma delineator, the 8-digit position within one rotation, and “CR” (which indicates the end of the message).



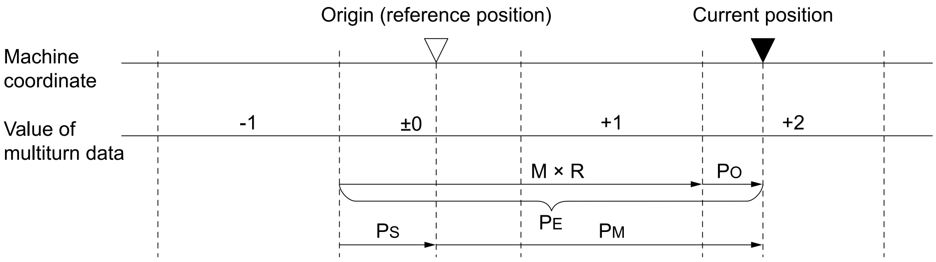
6.12.6 Calculating the Current Position in Machine Coordinates

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

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

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

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



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

$P_M = P_E - P_S$

$P_E = M \times R + P_O$

$P_S = M_S \times R + P_S'$

Symbol	Meaning
P_E	Position data for the current position of the absolute encoder
M	Current position of the multiturn data of the absolute encoder
P_O	Position of the current position within one rotation
P_S	Position data of the absolute encoder when absolute encoder was reset
M_S	Multiturn data of the absolute encoder when absolute encoder was reset
P_S'	Position of the absolute encoder within one rotation when absolute encoder was reset
P_M	Current position in machine coordinate system
R	Pulse output for one encoder rotation

Note:

The calculations for Pn000 = n.□□□1 (reverse rotation mode) are given below.

$P_M = P_E - P_S$

$P_E = -M \times R + P_O$

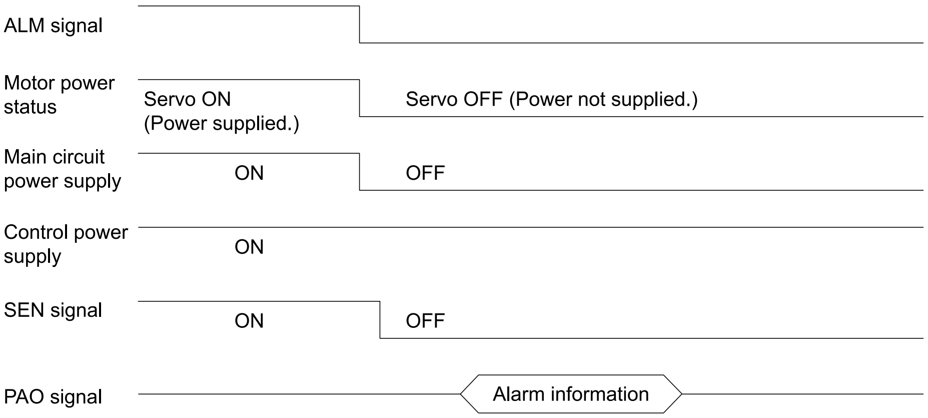
$P_S = M_S \times R + P_S'$

Information If you are using a rotary servomotor, you must reset the absolute encoder. Refer to the following section for information on resetting the absolute encoder.

☞ *5.17 Resetting the Absolute Encoder on page 206*

6.12.7 Alarm Output from Output Ports for the Position Data from the Absolute Encoder

Any alarm detected by the SERVOPACK is transmitted as alarm information to the host controller with the PAO (Encoder Divided Pulse Output) signal when the SEN (Absolute Data Request Input) signal turns OFF.



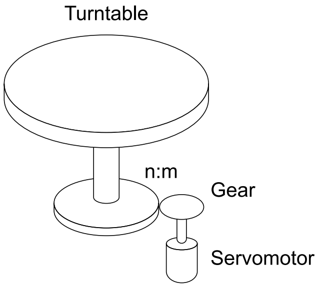
The data format of the alarm information is shown below.

A	
L	
M	
0 to 9	Upper two digits of alarm code
0 to 9	
.	
CR	

6.12.8 Multiturn Limit Setting

The multiturn limit is used in position control for a turntable or other rotating body.

For example, consider a machine that moves the turntable shown in the following diagram in only one direction.



Because the turntable moves in only one direction, the upper limit to the number of rotations that can be counted by an absolute encoder will eventually be exceeded.

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

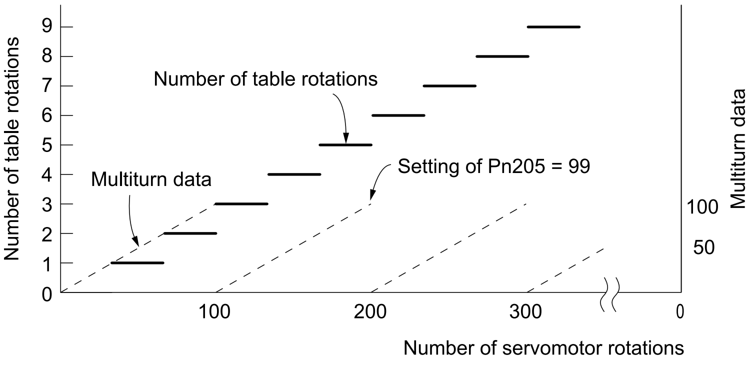
For a machine with a ratio of n:m between the number of servomotor rotations and the number of turntable rotations, as shown above, the value of m minus 1 will be the setting of Pn205 (Multiturn Limit).

Pn205 (Multiturn Limit) = m − 1

If m = 100 and n = 3 (i.e., the turntable rotates three times for each 100 servomotor rotations), the relationship between the number of servomotor rotations and the number of turntable rotations would be as shown below.

Set Pn205 to 99.

Pn205 = 100 – 1 = 99



Pn205	Multiturn Limit			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	1 rev	65535	After restart

Note:

This parameter is enabled when you use an absolute encoder.

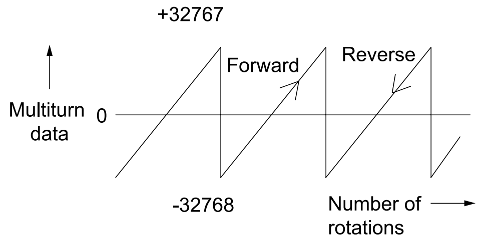
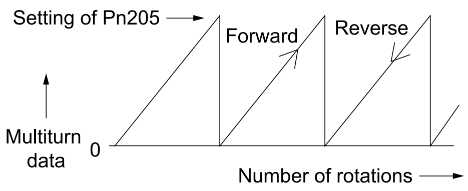
The data will change as shown below when this parameter is set to anything other than the default setting.

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

Set Pn205 to one less than the desired multiturn data.

If you change the setting of Pn205, an A.CC0 alarm (Multiturn Limit Disagreement) will be displayed because the setting disagrees with the value in the encoder. Refer to the following section for the procedure to change the multiturn limit settings in the encoder.

☞ *6.12.9 A.CC0 (Multiturn Limit Disagreement Alarm) on page 301*

Default Setting	Not Default Setting
	

Information The multiturn data will always be zero in the following cases. It is never necessary to reset the absolute encoder in these cases.

- When you use a single-turn absolute encoder
- When Pn002 is set to n.□2□□ (use the encoder as a single-turn absolute encoder)

A.810 and A.820 (alarms related to the absolute encoder) will also not occur.

6.12.9 A.CC0 (Multiturn Limit Disagreement Alarm)

If you change the multiturn limit in Pn205 (Multiturn Limit), an A.CC0 alarm (Multiturn Limit Disagreement) will be displayed because the setting disagrees with the value in the encoder.

Display	Name	Alarm Code Name			Meaning
		ALO1	ALO2	ALO3	
A.CC0	Multiturn Limit Disagreement	ON (low)	OFF (high)	ON (low)	Different multiturn limits are set in the encoder and SERVOPACK.

If this alarm is displayed, use the following procedure to change the multiturn limit in the encoder to the same value as the setting of Pn205.

(1) Applicable Tools

The following table lists the tools that you can use to set the multiturn limit.

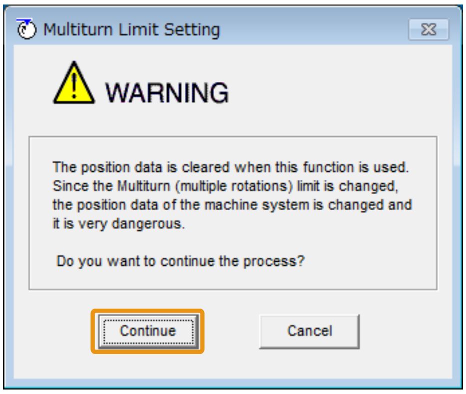
Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	Fn013	☞ *14.4.18 Multiturn Limit Setting after A.CC0 (Multiturn Limit Disagreement) Alarm (Fn013) on page 656*
Digital Operator	Fn013	🕮 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Encoder Setting] – [Multiturn Limit Setup]	☞ *(2) Operating Procedure on page 302*

(2) Operating Procedure

Use the following procedure to adjust the multiturn limit setting.

1. **Click the [▤] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Click [Multi-turn Limit Setup] in the [Menu] window.**

   The [Multiturn Limit Setting] window will be displayed.
3. **Click the [Continue] button.**



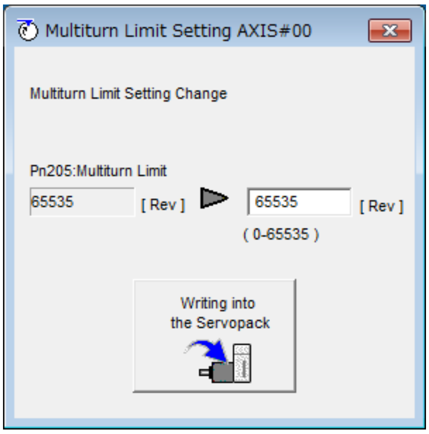
The position data is cleared when this function is used.
Since the Multiturn (multiple rotations) limit is changed,
the position data of the machine system is changed and
it is very dangerous.

Do you want to continue the process?

Click the [Cancel] button to cancel setting the multiturn limit.

The Main Window will return.

4. **Change the setting.**



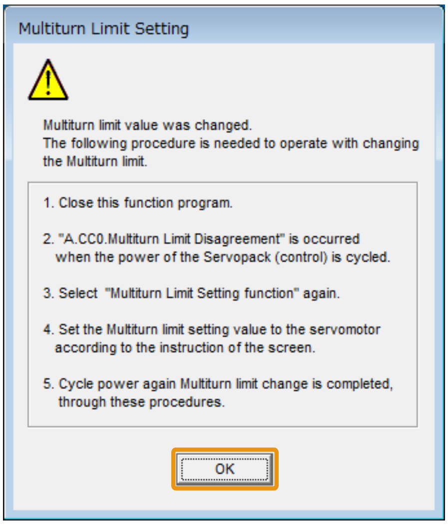
Multiturn Limit Setting Change

Pn205:Multiturn Limit

65535 [Rev] 65535 [Rev]

(0-65535)

5. **Click the [Writing into the Servopack] button.**
6. **Click the [OK] button.**



Multiturn limit value was changed.
The following procedure is needed to operate with changing
the Multiturn limit.

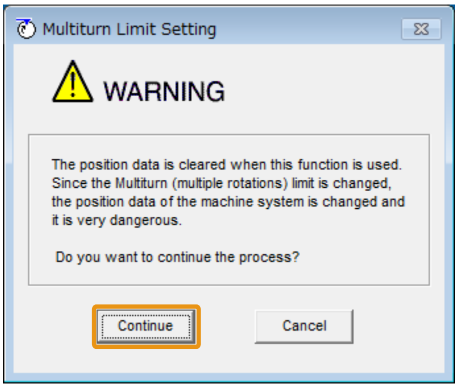
1. Close this function program.
2. "A.CC0.Multiturn Limit Disagreement" is occurred when the power of the Servopack (control) is cycled.
3. Select "Multiturn Limit Setting function" again.
4. Set the Multiturn limit setting value to the servomotor according to the instruction of the screen.
5. Cycle power again Multiturn limit change is completed, through these procedures.

7. **Turn the power to the SERVOPACK OFF and ON again.**

   An A.CC0 alarm (Multiturn Limit Disagreement) will occur because setting the multiturn limit in the servomotor is not yet completed even though the setting has been changed in the SERVOPACK.

8. **Click [Multi-turn Limit Setup] in the [Menu] window.**

9. **Click the [Continue] button.**

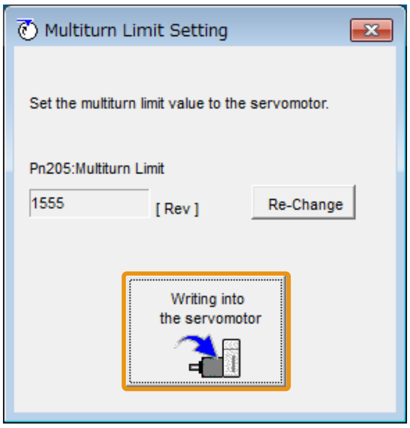


WARNING

The position data is cleared when this function is used. Since the Multiturn (multiple rotations) limit is changed, the position data of the machine system is changed and it is very dangerous.

Do you want to continue the process?

10. **Click the [Writing into the servomotor] button.**

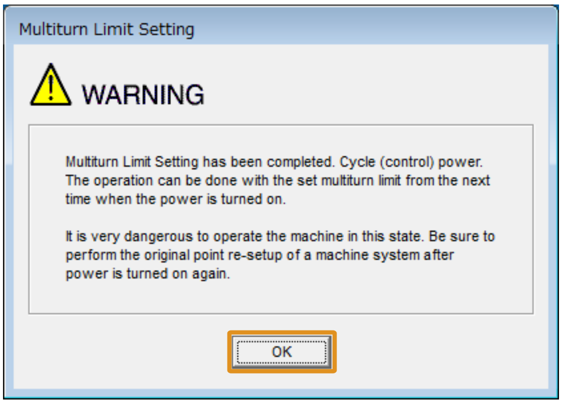


Set the multiturn limit value to the servomotor.

Pn205:Multiturn Limit

1555 [Rev]

11. **Click the [OK] button.**



WARNING

Multiturn Limit Setting has been completed. Cycle (control) power. The operation can be done with the set multiturn limit from the next time when the power is turned on.

It is very dangerous to operate the machine in this state. Be sure to perform the original point re-setup of a machine system after power is turned on again.

This concludes the procedure to set the multiturn limit.

6.13 Absolute Linear Encoders

The absolute linear encoder records the current position of the stop position even when the power is OFF.

With a system that uses an absolute linear encoder, the host controller can monitor the current position. Therefore, it is not necessary to perform an origin return operation when the power to the system is turned ON.

There are two types of linear encoders for linear servomotors. The usage of the linear encoder is specified in Pn002 = n.□X□□.

Refer to the following section for linear encoder models.

☞ ◆ *Feedback Resolution of Linear Encoder: Incremental Linear Encoder on page 202*

☞ ◆ *Feedback Resolution of Linear Encoder: Absolute Linear Encoder on page 202*

- Parameter Settings When Using an Incremental Linear Encoder

Parameter		**Meaning**	**When Enabled**
Pn002	**n.□0□□ (default setting)**	Use the encoder as an incremental linear encoder.	After restart
	n.□1□□	Use the encoder as an incremental linear encoder.	

- Parameter Settings When Using an Absolute Linear Encoder

Parameter		**Meaning**	**When Enabled**
Pn002	**n.□0□□ (default setting)**	Use the encoder as an absolute linear encoder.	After restart
	n.□1□□	Use the encoder as an incremental linear encoder.	

6.13.1 Connecting an Absolute Linear Encoder

Refer to the following sections for information on the connections between an absolute linear encoder, the SERVOPACK, and the host controller.

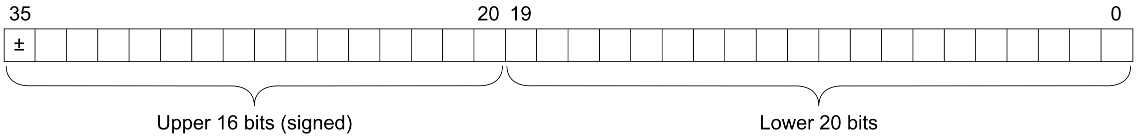
☞ *4.4.3 Wiring the SERVOPACK to the Encoder on page 126*

☞ *4.5.3 I/O Signal Wiring Examples on page 139*

6.13.2 Structure of the Position Data of the Absolute Linear Encoder

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

The position data is signed 36-bit data.



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

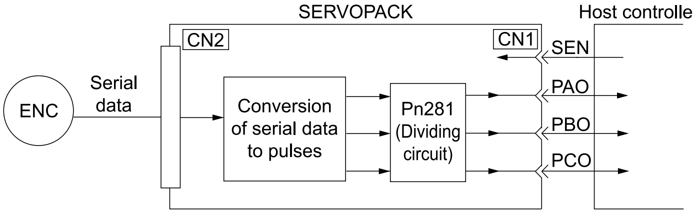
6.13.3 Output Ports for the Position Data from the Absolute Linear Encoder

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

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

(1) PAO, PBO, PCO (Encoder Divided Pulse Output) Ports

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



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

The PAO (Encoder Divided Pulse Output) signal outputs the position data from the absolute linear encoder after the control power is turned ON. There are two methods that you can use to output the position data from the absolute linear encoder: Using the SEN (Absolute Data Request Input) signal and not using the SEN signal.

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

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

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

☞ *4.5.4 I/O Circuits on page 144*

(2) PSO (Absolute Encoder Position Output) Port

The PSO (Absolute Encoder Position Output) signal periodically outputs the position data from the absolute encoder according to the specified protocol after outputting the position data from the absolute encoder with the PAO and PBO signals has been completed. There are two methods that you can use to output the position data from the absolute encoder: Using the SEN (Absolute Data Request Input) signal and not using the SEN signal.

The host controller must have a reception circuit (e.g., UART) for the position data from the absolute encoder.

The output circuit for the PSO signal uses a line driver. Refer to the following section for details on line drivers.

☞ *4.5.4 I/O Circuits on page 144*

6.13.4 Reading the Position Data from the Absolute Linear Encoder

There are two methods that you can use to read the position data from the absolute linear encoder: Using the SEN (Absolute Data Request Input) signal and not using the SEN signal.

(1) Setting the Parameter to Specify Using or Not Using the SEN (Absolute Data Request Input) Signal

(a) Reading the Position Data from the Absolute Linear Encoder With Using the SEN Signal

- **Setting Pn50A = n.□□□0 (use input signal terminals with the default allocations)**
  The setting of Pn515 = n.□□□X (SEN (Absolute Data Request Input) Signal Allocation) is ignored.
- **Setting Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (Sigma-LINK II input signal allocation mode)**
  Set Pn515 = n.□□□X (SEN (Absolute Data Request Input) Signal Allocation) to 0 to 6 or 9 to F to allocate the SEN signal to one of the pins from CN1-40 to CN1-46.

Refer to the following section for the procedure to allocate input signals.

☞ *6.1.1 Changing Allocations of I/O Signals on page 218*

Information To use the default allocation of the SEN signal and change the default settings of other I/O signals (Pn50A = n.□□□1): Set Pn515 to n.□□□8 (enable when 5 V is input to CN1-4).

(b) Reading the Position Data from the Absolute Linear Encoder Without Using the SEN Signal

Set the parameters as shown below.

- Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (SigmaLINK II input signal allocation mode)
- Pn515 = n.□□□7 (the signal is always active)

Refer to the following sections for details on the parameters.

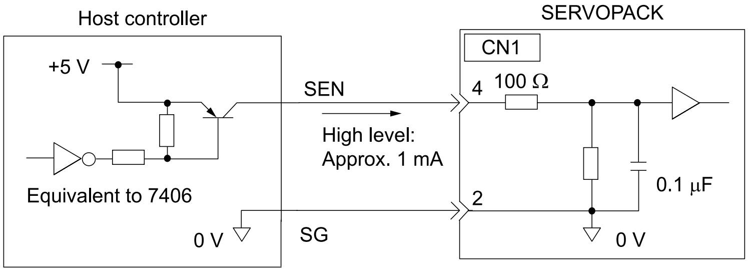
☞ *15 Parameter Lists on page 665*

(2) Connecting the SEN (Absolute Data Request Input) Signal

(a) Allocating the SEN Signal to CN1-4

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	SEN	CN1-4	OFF (open)	Does not request the position data from the absolute linear encoder. (This is the status after the power is turned ON.)
			ON (closed)	Requests the position data from the absolute linear encoder.

A circuit example for when the SEN signal is allocated to CN1-4 is provided below.



We recommend a PNP transistor.

(b) Allocating the SEN Signal to a General-Purpose Input

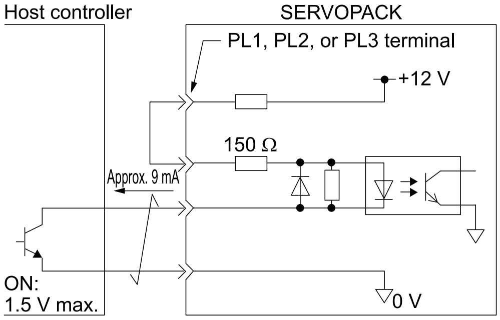
Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	SEN	CN1-40 to CN1-46	OFF (open)	Does not request the position data from the absolute linear encoder. (This is the status after the power is turned ON.)
			ON (closed)	Requests the position data from the absolute linear encoder.

A circuit example for when the SEN signal is allocated to CN1-40 to CN1-46 on the I/O signal connector is provided below.

Refer to the following section for the procedure to allocate input signals.

☞ *6.1.3 Input Signal Allocations on page 220*

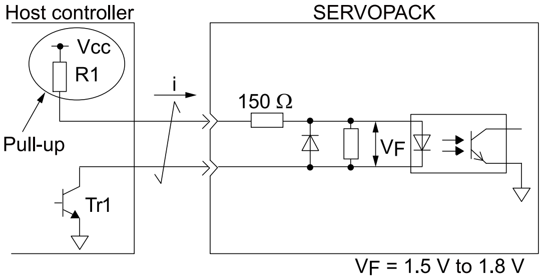
◆ Using the Pull-Up Power Supply in the SERVOPACK



◆ Using an External Pull-Up Power Supply

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

- Circuit Example for Open-Collector Outputs

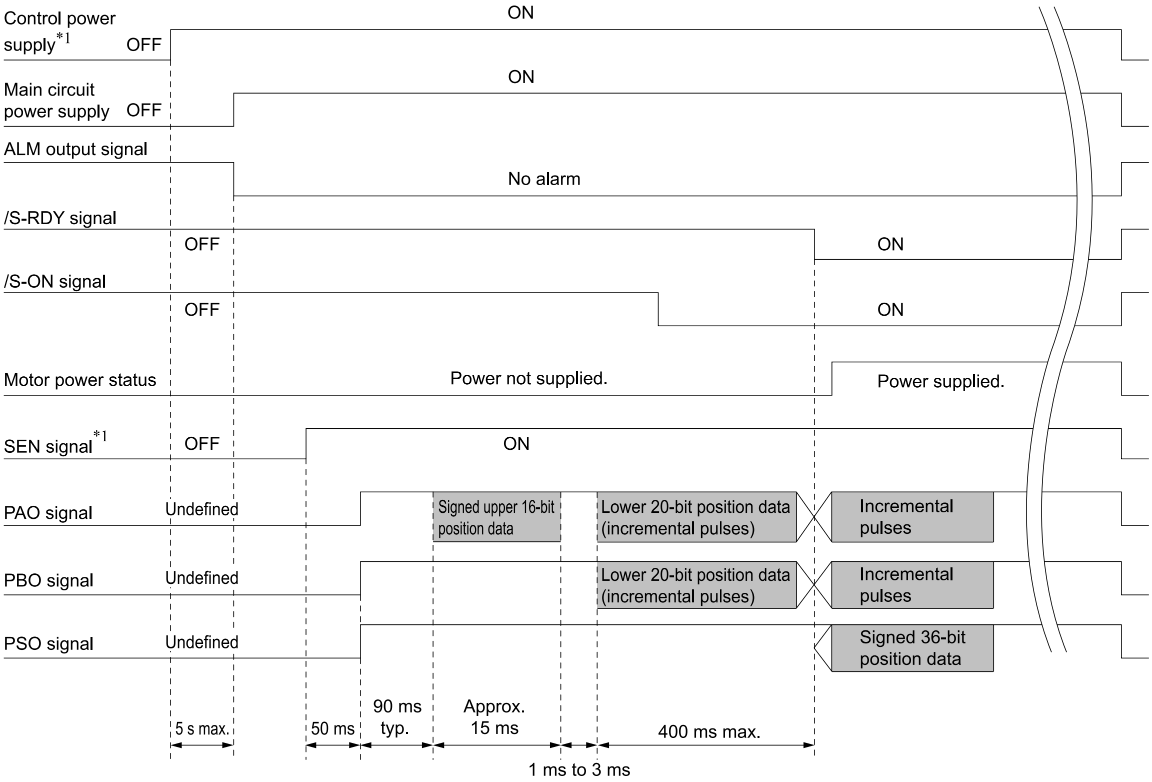


(3) Sequence for Reading the Position Data from the Absolute Linear Encoder With Using the SEN (Absolute Data Request Input) Signal

The sequence for using the SEN signal to read the position data from the absolute linear encoder of a linear servomotor is given below.

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

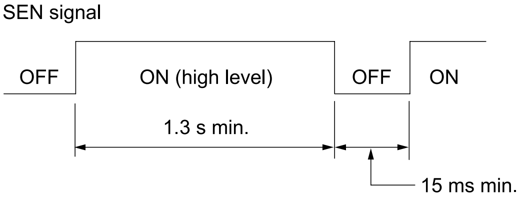
The lower 20-bit data is output as a pulse train.



*1 When you turn OFF the control power, turn OFF the SEN signal.

Important

- Maintain the SEN signal at the high level for at least 1.3 seconds when you turn it OFF before you turn it ON again, as shown in the following figure.



- The SEN signal is not acknowledged while the servo is ON.

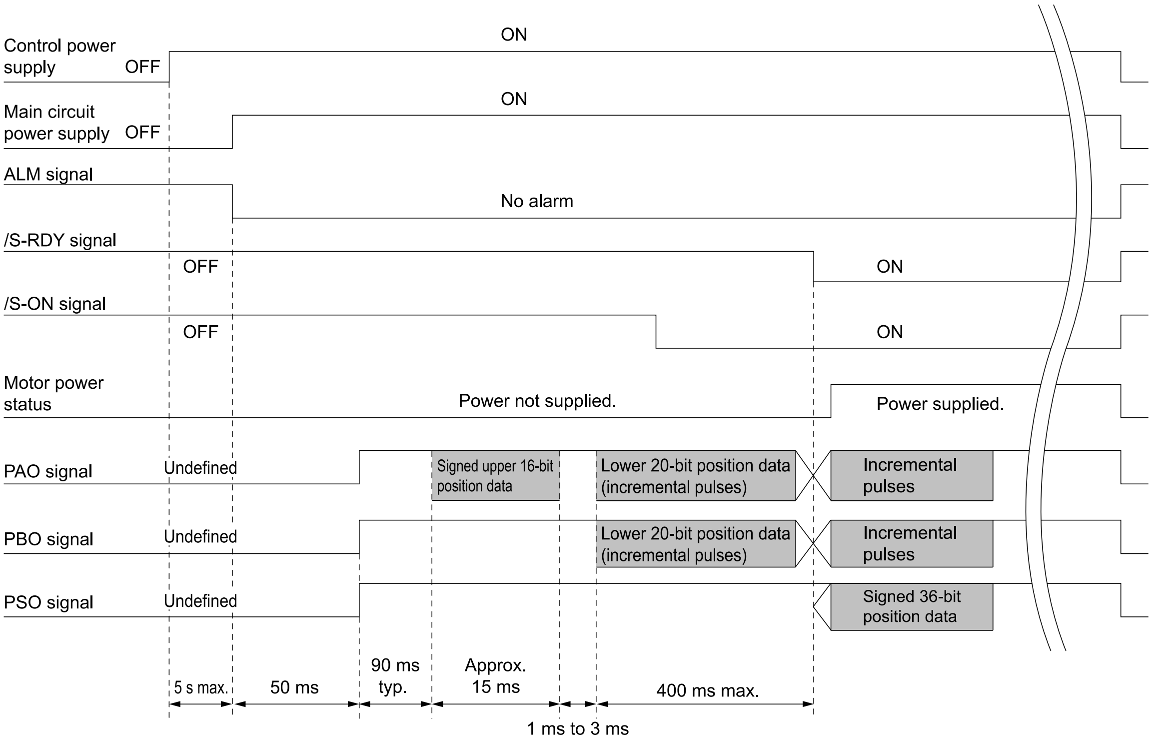
(4) Sequence for Reading the Position Data from the Absolute Linear Encoder Without Using the SEN (Absolute Data Request Input) Signal

The sequence for reading the position data from the absolute linear encoder of a linear servomotor without using the SEN signal is given below.

When the specified time has elapsed after the control power to the SERVOPACK is turned ON, the SERVOPACK will automatically read the position data from the absolute linear encoder.

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

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



6.13.5 Transmission Specifications

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

The PAO signal sends only the 16-bit data (with sign). The PSO signal sends the signed 36-bit data.

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

☞ *(3) Sequence for Reading the Position Data from the Absolute Linear Encoder With Using the SEN (Absolute Data Request Input) Signal on page 307*

☞ *(4) Sequence for Reading the Position Data from the Absolute Linear Encoder Without Using the SEN (Absolute Data Request Input) Signal on page 308*

Item	PAO Signal	PSO Signal
Synchronization Method	Start-stop synchronization (ASYNC)	
Transmission Speed	9600 bps	
Start Bits	1 bit	
Stop Bits	1 bit	
Parity	Even	
Character Code	ASCII, 7 bits	
Data Format	☞ *(1) Data Format of PAO Signal on page 309*	☞ *(2) Data Format of PSO Signal on page 310*
Data Output Cycle	• Using the SEN Signal Each time the SEN signal is input after the control power is turned ON • Not Using the SEN Signal Only once after the control power is turned ON	40 ms

(1) Data Format of PAO Signal

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

P	
+ or −	
0 to 9	Upper 15 bits of position data
0 to 9	
0 to 9	
0 to 9	
0 to 9	
CR	

(2) Data Format of PSO Signal

The data format for a linear servomotor consists of 17 characters: “P,” the sign, the 11-digit 35-bit data, and “CR” (which indicates the end of the message).

P	
+ or −	
0 to 9	Position data: 35 bits (11 digits)
0 to 9	
0 to 9	
0 to 9	
0 to 9	
0 to 9	
0 to 9	
0 to 9	
0 to 9	
0 to 9	
0 to 9	
CR	

6.13.6 Calculating the Current Position in Machine Coordinates

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

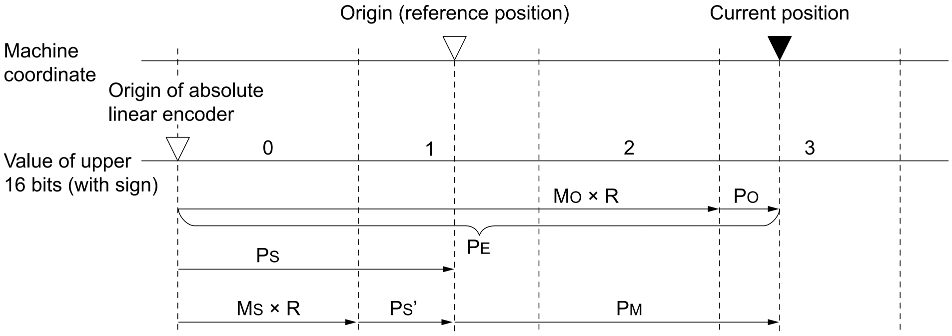
The host controller reads the coordinate from the origin of the encoder coordinate system. The host controller must record the value of this coordinate.

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

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

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

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



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

$P_M = P_E - P_S$

$P_E = M_O \times R + P_O$

$P_S = M_S \times R + P_S'$

Symbol	Meaning
P_E	Position data for the current position of the absolute linear encoder
M_O	Upper 16 bits (with sign) of the position data for the current position of the absolute linear encoder
P_O	Lower 20 bits of the position data for the current position of the absolute linear encoder
P_S	Position data of the origin
M_S	Upper 16 bits (with sign) of the position data of the origin
P_S'	Lower 20 bits of the position data of the origin
P_M	Current position in machine coordinate system
R	1048576 (= 2^{20})

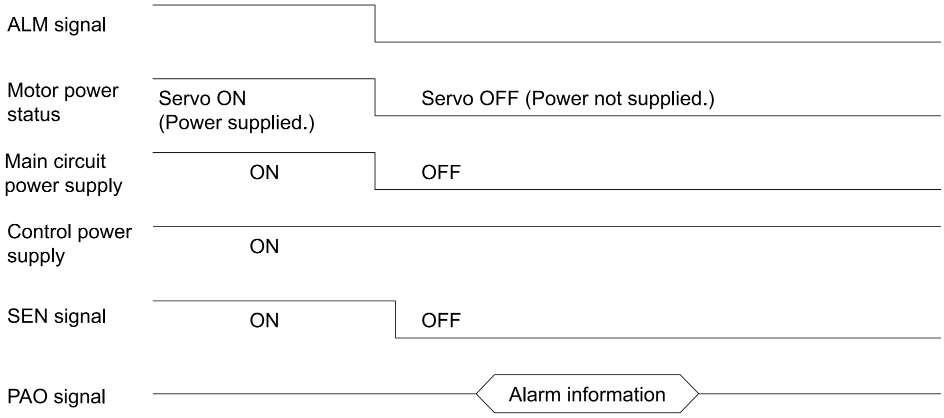
Note:

The above calculations are also used for Pn000 = n.□□□1 (reverse movement mode).

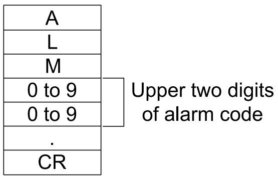
Information If you are using a linear servomotor, you do not need to reset the absolute linear encoder to define the origin. (Some absolute linear encoders also allow you to set any position as the origin.)

6.13.7 Alarm Output from the Output Ports for the Position Data from the Absolute Linear Encoder

Any alarm detected by the SERVOPACK is transmitted as alarm information to the host controller with the PAO (Encoder Divided Pulse Output) signal when the SEN (Absolute Data Request Input) signal turns OFF.



The data format of the alarm information is shown below.



6.14 Software Reset

You can reset the SERVOPACK internally with the software. Reset the SERVOPACK in the following cases:

- For a parameter in which the setting is applied after restart, to change the setting of that parameter without turning OFF the power to the SERVOPACK.
- To reset an alarm without turning OFF the power to the SERVOPACK.

Information

- Always confirm that the servo is OFF and servomotor is stopped before you start a software reset.
- This function resets the SERVOPACK independently of the host controller. The SERVOPACK carries out the same processing as when the power is turned ON and outputs the ALM (Servo Alarm Output) signal. The status of other output signals may be forcibly changed.
- When you execute a software reset, the SERVOPACK will not respond for approximately five seconds.
  Before you execute a software reset, check the status of the SERVOPACK and servomotor and make sure that no problems will occur.

6.14.1 Preparations

Always check the following before you perform a software reset.

- The servo must be OFF.
- The motor must be stopped.

6.14.2 Applicable Tools

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

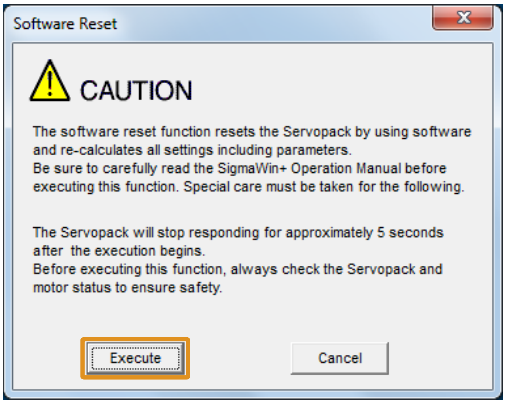
Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	Fn030	☞ *14.4.25 Software Reset (Fn030) on page 659*
Digital Operator	Fn030	🕮 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Basic Functions] – [Software Reset]	☞ *6.14.3 Operating Procedure on page 312*

6.14.3 Operating Procedure

Use the following procedure to perform a software reset.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Select [Software Reset] in the [Menu] window.**

   The [Software Reset] window will be displayed.
3. **Read the precaution and then click the [Execute] button.**

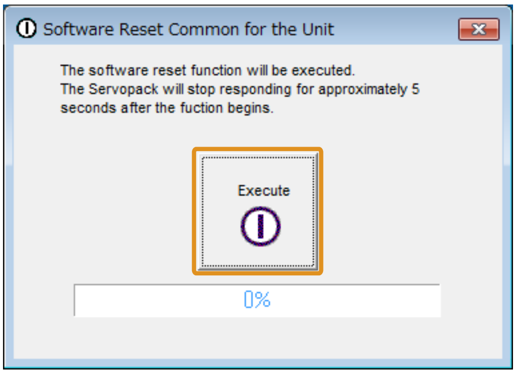


The software reset function resets the Servopack by using software and re-calculates all settings including parameters.
Be sure to carefully read the SigmaWin+ Operation Manual before executing this function. Special care must be taken for the following.

The Servopack will stop responding for approximately 5 seconds after the execution begins.
Before executing this function, always check the Servopack and motor status to ensure safety.

Click the [Cancel] button to cancel the software reset. The Main Window will return.

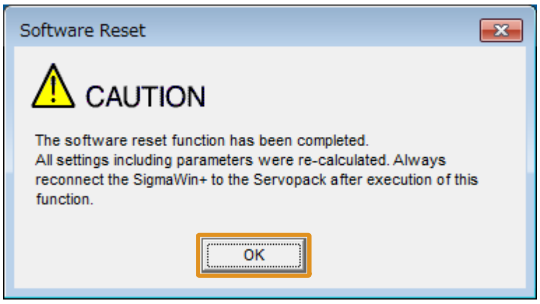
4. **Click the [Execute] button.**



The software reset function will be executed.
The Servopack will stop responding for approximately 5 seconds after the fuction begins.

5. **Read the precaution and then click the [OK] button to end the software reset.**

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.



The software reset function has been completed.
All settings including parameters were re-calculated. Always reconnect the SigmaWin+ to the Servopack after execution of this function.

This concludes the procedure to reset the software.

6.15 Vibration Detection Level Initialization

You can detect machine vibration during operation to automatically adjust the settings of Pn312 or Pn384 (Vibration Detection Level) to detect A.520 alarms (Vibration Alarm) and A.911 warnings (Vibration) more precisely.

This function detects specific vibration components in the servomotor speed.

Pn310	n.□□□X	Vibration Detection Selection Speed Pos Trq		When Enabled
		0 Default	Do not detect vibration.	Immediately
		1	Output a warning (A.911) if vibration is detected.	
		2	Output an alarm (A.520) if vibration is detected.	

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

- Rotary Servomotors

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

- Linear Servomotors

$$\text{Detection level} = \frac{\text{Pn384 [mm/s] (Vibration detection level)} \times \text{Pn311 [\%] (Vibration detection sensitivity)}}{100}$$

Use this function only if A.520 or A.911 alarms are not output at the correct timing when vibration is detected with the default setting of Pn312 or Pn384 (Vibration Detection Level).

There will be discrepancies in the detection sensitivity for vibration alarms and warnings depending on the condition of your machine. If there is a discrepancy, use the above formula to adjust the setting of Pn311 (Vibration Detection Sensitivity).

Pn311	Vibration Detection Sensitivity Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	50 to 500	1%	100	Immediately

Information

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

6.15.1 Preparations

Always check the following before you initialize the vibration detection level.

- The parameters must not be write prohibited.
- Pn00C must be set to n.□□□0 (Function Selection for Test without a Motor is disabled).

6.15.2 Applicable Tools

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

Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	Fn01B	☞ *14.4.20 Initialize Vibration Detection Level (Fn01B) on page 657*
Digital Operator	Fn01B	🕮 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Others] – [Initialize Vibration Detection Level]	☞ *6.15.3 Operating Procedure on page 315*

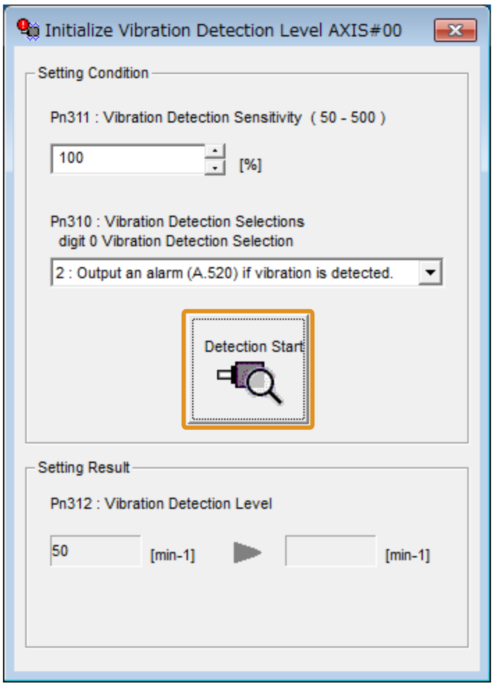
6.15.3 Operating Procedure

Use the following procedure to initialize the vibration detection level.

1. **Click the [▤] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Select [Initialize Vibration Detection Level] in the [Menu] window.**

   The [Initialize Vibration Detection Level] window will be displayed.
3. **Select [Pn311: Vibration Detection Sensitivity] and [Pn310: Vibration Detection Selections] and then click the [Detection Start] button.**

   A setting execution standby mode will be entered.

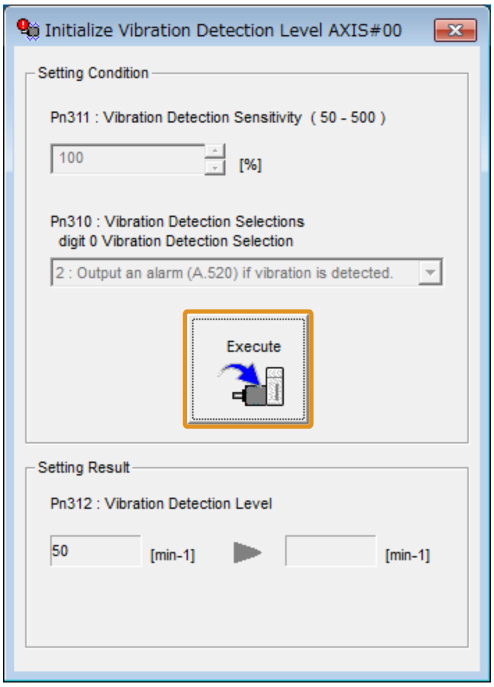


Pn311 : Vibration Detection Sensitivity (50 - 500): 100 [%]

Pn310 : Vibration Detection Selections digit 0 Vibration Detection Selection: 2 : Output an alarm (A.520) if vibration is detected.

Pn312 : Vibration Detection Level: 50 [min-1] ▶ [min-1]

4. **Click the [Execute] button.**

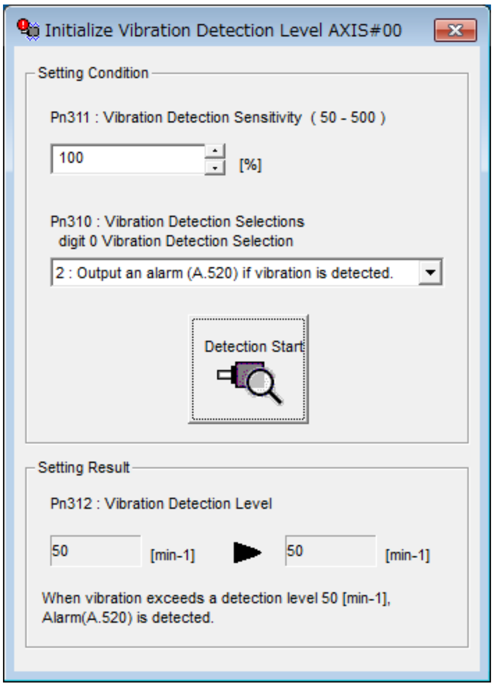


Pn311 : Vibration Detection Sensitivity (50 - 500): 100 [%]

Pn310 : Vibration Detection Selections digit 0 Vibration Detection Selection: 2 : Output an alarm (A.520) if vibration is detected.

Pn312 : Vibration Detection Level: 50 [min-1] ▶ [min-1]

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



Pn311 : Vibration Detection Sensitivity (50 - 500)

100 [%]

Pn310 : Vibration Detection Selections
digit 0 Vibration Detection Selection

2 : Output an alarm (A.520) if vibration is detected.

Pn312 : Vibration Detection Level

50 [min-1] ▶ 50 [min-1]

When vibration exceeds a detection level 50 [min-1], Alarm(A.520) is detected.

This concludes the procedure to initialize the vibration detection level.

6.15.4 Related Parameters

The following three items are given in the following table.

- Parameters Related to this Function
  These are the parameters that are used or referenced when this function is executed.
- Changes during Function Execution
  Not allowed: The parameter cannot be changed using the SigmaWin+ or other tool while this function is being executed.
  Allowed: The parameter can be changed using the SigmaWin+ or other tool while this function is being executed.
- Automatic Changes after Function Execution
  Yes: The parameter is automatically set or adjusted after execution of this function.
  No: The parameter is not automatically set or adjusted after execution of this function.

Parameter	Name	Setting Changes	Automatic Changes
Pn311	Vibration Detection Sensitivity	Allowed	No
Pn312	Vibration Detection Level	Not allowed	Yes
Pn384	Vibration Detection Level	Not allowed	Yes

6.16 Adjusting the Motor Current Detection Signal Offset

The motor current detection signal offset is used to reduce ripple in the torque. You can adjust the motor current detection signal offset either automatically or manually.

6.16.1 Automatic Adjustment

Perform this adjustment only if highly accurate adjustment is required to reduce torque ripple.

It is normally not necessary to adjust this offset.

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

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

(1) Preparations

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

- The main circuit power must be ON.
- The servo must be OFF.
- The servomotor must be stopped.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.

(2) Applicable Tools

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

Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	Fn00E	☞ *14.4.13 Autotune Motor Current Detection Signal Offset (Fn00E) on page 652*
Digital Operator	Fn00E	📖 Σ-7/Σ-X-series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Others] –[Adjust the Motor Current Detection Signal Offsets]	☞ *(3) Operating Procedure on page 317*

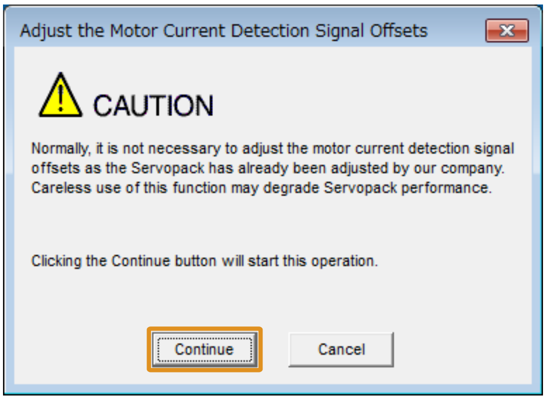
(3) Operating Procedure

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

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Click [Adjust the Motor Current Detection Signal Offsets] in the [Menu] window.**

   The [Adjust the Motor Current Detection Signal Offsets] window will be displayed.

3. **Click the [Continue] button.**



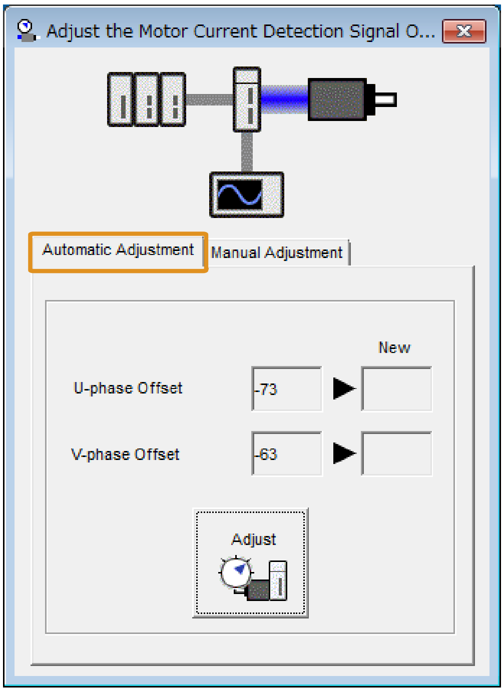
Adjust the Motor Current Detection Signal Offsets

CAUTION

Normally, it is not necessary to adjust the motor current detection signal offsets as the Servopack has already been adjusted by our company. Careless use of this function may degrade Servopack performance.

Clicking the Continue button will start this operation.

4. **Click the [Automatic Adjustment] tab in the [Adjust the Motor Current Detection Signal Offsets] window.**



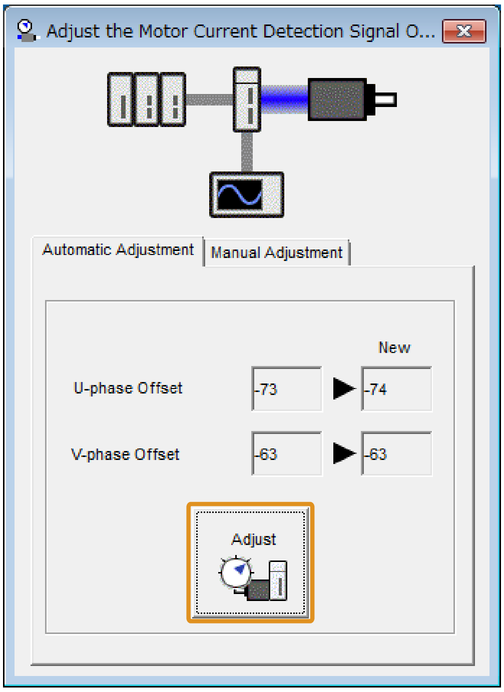
Adjust the Motor Current Detection Signal O...

U-phase Offset -73 ▶

V-phase Offset -63 ▶

5. **Click the [Adjust] button.**

The values that result from automatic adjustment will be displayed in the [New] boxes.



New

U-phase Offset -73 ▶ -74

V-phase Offset -63 ▶ -63

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

6.16.2 Manual Adjustment

You can use this function if you automatically adjust the motor current detection signal offset and the torque ripple is still too large.

Important

If the offset is incorrectly adjusted with this function, the servomotor characteristics may be adversely affected.

Observe the following precautions when you manually adjust the offset.

- Operate the servomotor at a speed of approximately 100 min^{-1}.
- Adjust the offset while monitoring the torque reference with the analog monitor until the ripple is minimized.
- Adjust the offsets for the phase-U current and phase-V current of the servomotor so that they are balanced. Alternately adjust both offsets several times.

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

(1) Preparations

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

- The parameters must not be write prohibited.

(2) Applicable Tools

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

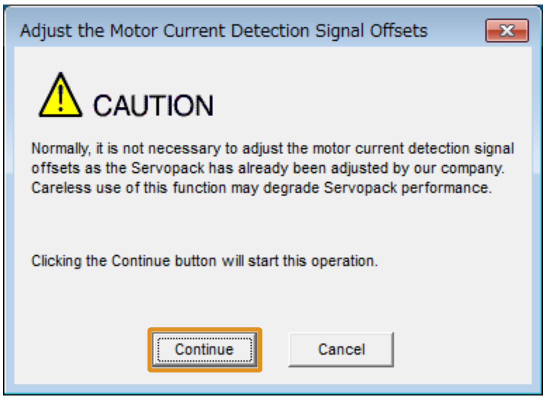
Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	Fn00F	☞ *14.4.14 Manually Adjust Motor Current Detection Signal Offset (Fn00F) on page 652*
Digital Operator	Fn00F	📖 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Others] –[Adjust the Motor Current Detection Signal Offsets]	☞ *(3) Operating Procedure on page 320*

(3) Operating Procedure

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

1. **Operate the servomotor at approximately 100 min^{-1}.**
2. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
3. **Click [Adjust the Motor Current Detection Signal Offsets] in the [Menu] window.**

   The [Adjust the Motor Current Detection Signal Offsets] window will be displayed.
4. **Click the [Continue] button.**



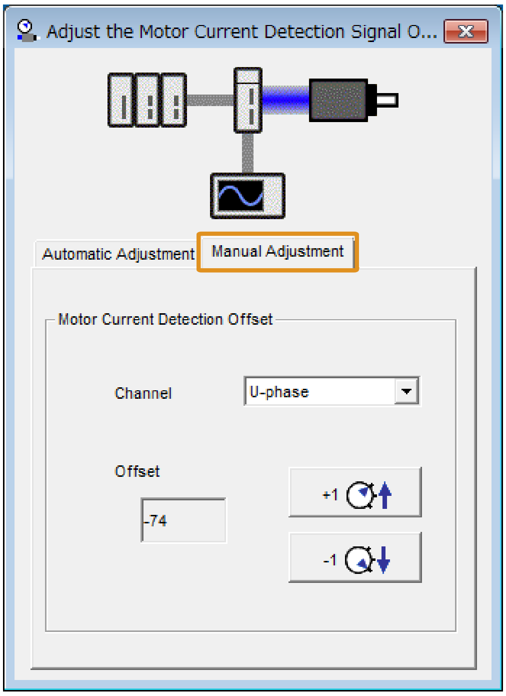
Adjust the Motor Current Detection Signal Offsets

CAUTION

Normally, it is not necessary to adjust the motor current detection signal offsets as the Servopack has already been adjusted by our company. Careless use of this function may degrade Servopack performance.

Clicking the Continue button will start this operation.

5. **Click the [Manual Adjustment] tab in the [Adjust the Motor Current Detection Signal Offsets] window.**



Adjust the Motor Current Detection Signal O...

Motor Current Detection Offset

Channel: U-phase

Offset: -74

6. **Set the [Channel] in the [Motor Current Detection Offset] to [U-phase].**
7. **Use the [+1] and [-1] buttons to adjust the offset for phase U.**

   Change the offset by about 10 in the direction that reduces the torque ripple.

   Adjustment range: -512 to +511
8. **Set the [Channel] in the [Motor Current Detection Offset] to [V-phase].**
9. **Use the [+1] and [-1] buttons to adjust the offset for phase V.**

   Change the offset by about 10 in the direction that reduces the torque ripple.
10. **Repeat steps 6 to 9 until the torque ripple cannot be decreased any further regardless of whether you increase or decrease the offsets.**

11. **Reduce the amount by which you change the offsets each time and repeat steps 6 to 9.**

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

6.17 Forcing the Motor to Stop

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

To force the motor to stop, you must set Pn516 to n.□□□X (FSTP (Forced Stop Input) Signal Allocation). You can specify one of the following stopping methods: dynamic brake (DB), coasting to a stop, or decelerating to a stop.

Note:

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

Information **Panel Display and Digital Operator Display**

When a forced stop is performed, the panel display will display “FST” and the digital operator will display “FSTP.”

⚠ CAUTION

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

6.17.1 FSTP (Forced Stop Input) Signal

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

Note:

You must allocate the FSTP signal to use it. Use the following parameters to allocate the signal to a terminal.

- Pn50A = n.□□□1 (Sigma-7S-compatible I/O signal allocation mode) or n.□□□2 (SigmaLINK II input signal allocation mode)
- Pn516 = n.□□□X (FSTP (Forced Stop Input) Signal Allocation)

Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

6.17.2 Stopping Method Selection for Forced Stops

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

		Stopping Method for Forced Stops	Speed Pos Trq	When Enabled
Pn00A	n.□□X□	0 Default	Apply the dynamic brake or coast the motor to a stop (use the stopping method set in Pn001 = n.□□□X).	After restart
		1	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque. Use the setting of Pn001 = n.□□□X for the status after stopping.	
		2	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then let the motor coast.	
		3	Decelerate the motor to a stop using the deceleration time set in Pn30A. Use the setting of Pn001 = n.□□□X for the status after stopping.	
		4	Decelerate the motor to a stop using the deceleration time set in Pn30A and then let the motor coast.	

Note:

You cannot decelerate a servomotor to a stop during torque control. The servomotor will be stopped with the dynamic braking or coast to a stop according to the setting of Pn001 = n.□□□X (Motor Stopping Method for Servo OFF and Group 1 Alarms).

(1) Stopping the Servomotor by Setting Pn406 (Emergency Stop Torque)

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

If Pn00A = n.□□X□ is set to 1 or 2, the servomotor will be decelerated to a stop using the torque set in Pn406 as the maximum torque.

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

Pn406	Emergency Stop Torque			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	800	Immediately

Note:

The setting unit is a percentage of the motor rated torque.

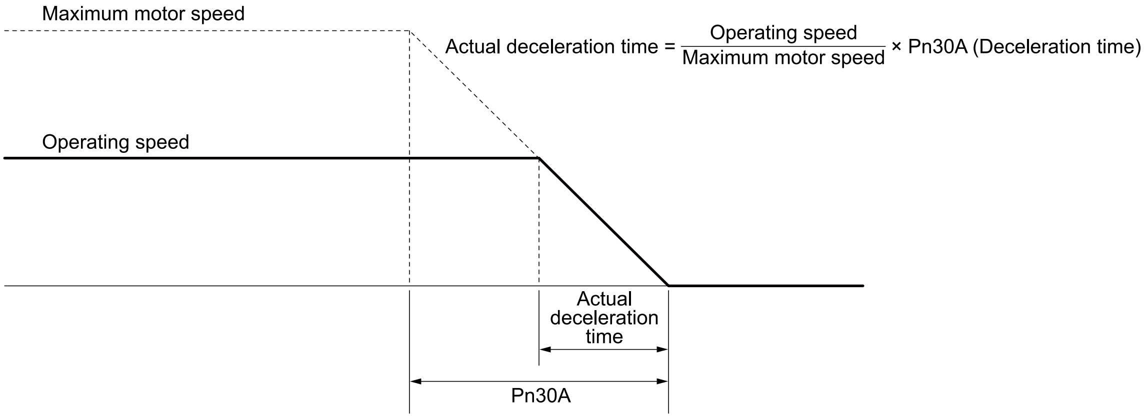
(2) Stopping the Servomotor by Setting Pn30A (Deceleration Time for Servo OFF and Forced Stops)

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

Pn30A	Deceleration Time for Servo OFF and Forced Stops			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 12000	1 ms	0	Immediately

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

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

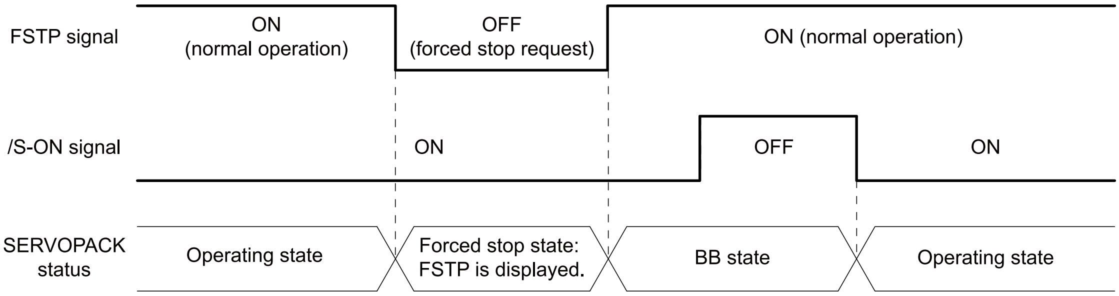


6.17.3 Resetting Method for Forced Stops

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

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

Turn OFF the /S-ON signal to place the SERVOPACK in the base block (BB) state and then turn ON the /S-ON signal again.



6.18 Overheat Protection

Overheat protection detects an A.93B warning (Overheat Warning) and an A.862 alarm (Overheat Alarm) by monitoring the overheat protection input signal from a Yaskawa SGLFW2 linear servomotor or from a sensor attached to the machine.

When you use overheat protection, you must wire the TH (Overheat Protection Input) signal and set Pn61A to n.□□□X (Overheat Protection Selection).

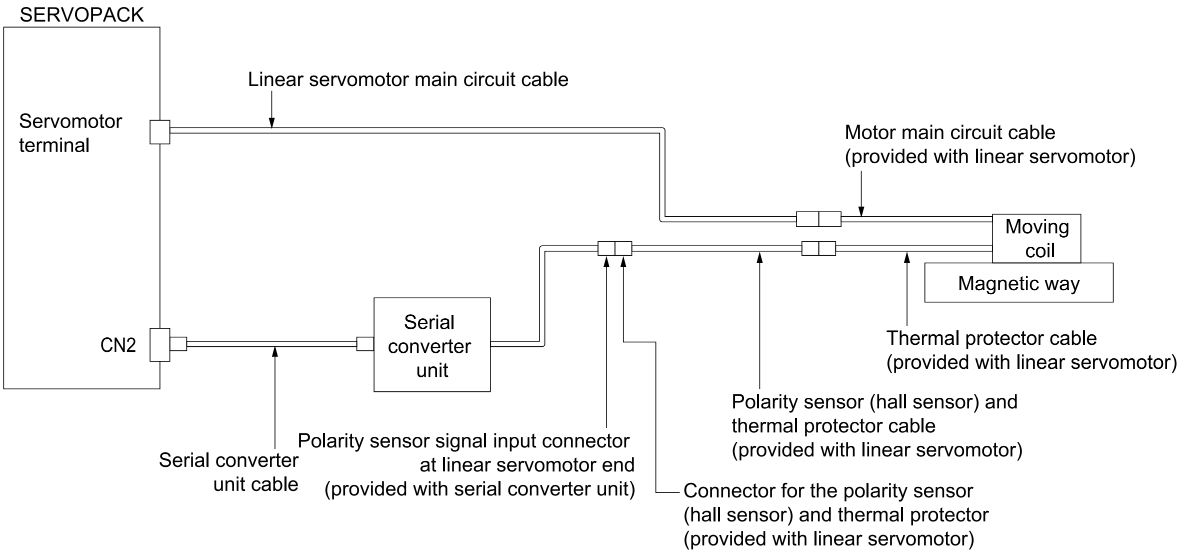
6.18.1 Connecting the Overheat Protection Input (TH) Signal

To use overheat protection, you must connect an overheat protection input (TH) signal to the SERVOPACK. This section describes the connection methods for the overheat protection input (TH) signal.

(1) Using Overheat Protection in the Linear Servomotor

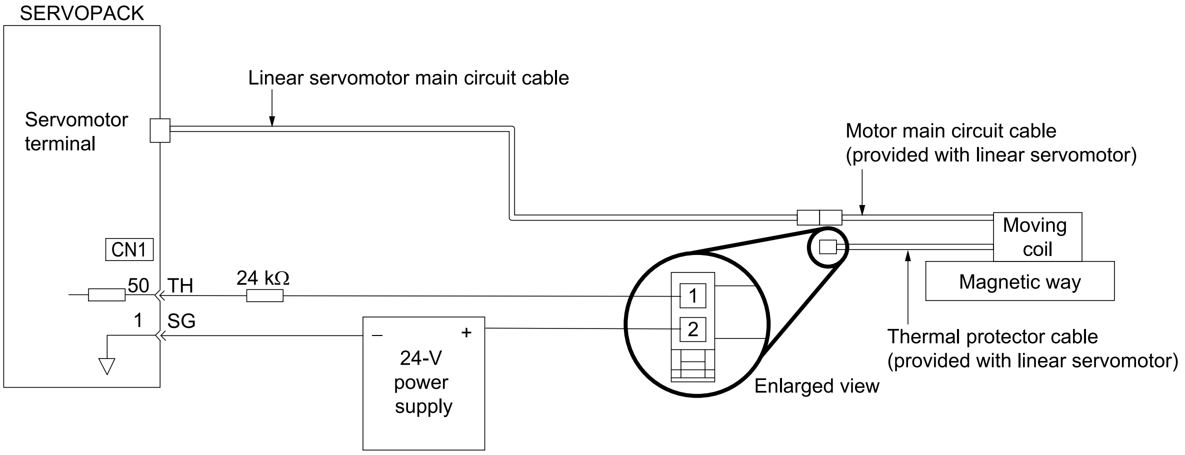
(a) When Using a Serial Converter Unit

Connect the connector for the polarity sensor (hall sensor) and thermal protector of the linear servomotor to the serial converter unit.



(b) When Not Using a Serial Converter Unit

Connect the thermal protector cable of the linear servomotor to CN1-50 on the SERVOPACK. The following figure shows a wiring example.

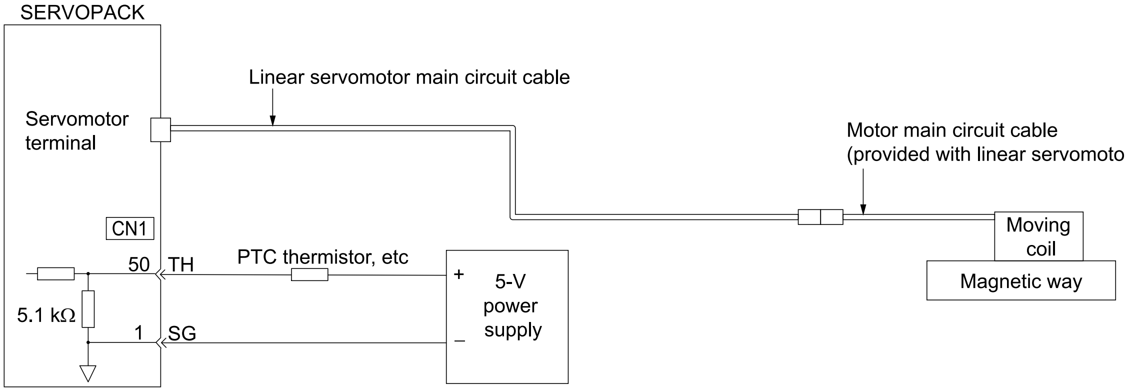


Important

- The thermal protector signal from the linear servomotor must be input to the host controller.
  This example shows the connection to the SERVOPACK.
  The thermal protector signal is closed when the temperature is normal and open when the thermal protector is activated.
  Do not exceed 3 A or 30 V.
- The recommended length of the thermal protector cable is 15 m maximum.
- The 24-V power supply and 24-kΩ resistor are not provided by Yaskawa. Use a 0.3 W or greater 24-V power supply, and use a 0.2 W or greater 24-kΩ resistor.
- Be sure to connect the positive and negative sides of the power supply correctly. Otherwise there is a risk of SERVOPACK failure.

(2) Using Overheat Protection for the Machine

To use overheat protection for the machine, connect the overheat protection input (an analog voltage input) from the sensor mounted to the machine to the CN1-50 on the SERVOPACK. The following figure shows a wiring example.



The equation when wired as shown in the above wiring example is as follows:

Input voltage = 5 V × 5.1 kΩ/(5.1 kΩ + thermistor resistance)

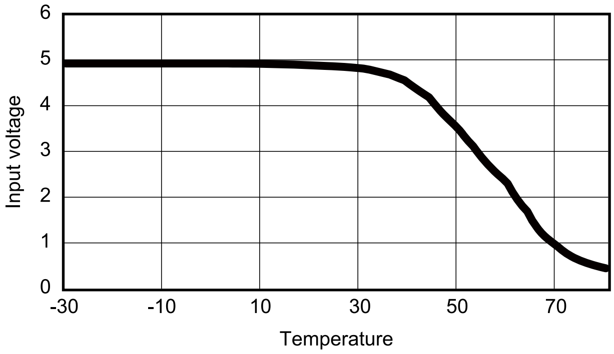
When an NTC thermistor is used, the input voltage increases because the thermistor resistance decreases when the temperature increases. The voltage input when an NTC thermistor is being used is called "positive voltage input" in this manual.

When a PTC thermistor is used, the input voltage decreases because the thermistor resistance increases when the temperature increases. The voltage input when a PTC thermistor is being used is called "negative voltage input" in this manual.

You must consider the following three elements for the detection error of overheat protection.

- SERVOPACK detection accuracy: ±5% (= 4.5 V maximum)
- Variations in the external 5-V power supply
- Variations in thermistor resistance

The following graph shows an example of the relationship between PTC thermistor input voltage and temperature.



Important

- The 5-V power supply is not provided by Yaskawa.
- The customer is responsible for adjusting the detection level.
- Be sure to connect the positive and negative sides of the power supply correctly. Otherwise there is a risk of SERVOPACK failure.

6.18.2 Overheat Protection Selections

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

		Overheat Protection Selections Speed Pos Trq		When Enabled
Pn61A	n.□□□X	0 Default	Disable overheat protection.	After restart
		1	Use overheat protection in the Yaskawa linear servomotor.	
		2	Monitor a negative voltage input from a sensor attached to the machine and use overheat protection.	
		3	Monitor a positive voltage input from a sensor attached to the machine and use overheat protection.	

Important

The SGLFW2 is the only Yaskawa linear servomotor that supports this function.

(1) Using Overheat Protection in the Yaskawa Linear Servomotor

To use the overheat protection in the Yaskawa linear servomotor (SGLFW2), set Pn61A to n.□□□1.

An A.93B warning (Overheat Warning) will be detected if the TH (Overheat Protection Input) signal from the Yaskawa SGLFW2 linear servomotor exceeds the warning temperature.

An A.862 alarm (Overheat Alarm) will be detected if the TH (Overheat Protection Input) signal from the Yaskawa SGLFW2 linear servomotor exceeds the alarm temperature.

Important

1. If the overheat protection input signal line is disconnected or short-circuited, an A.862 alarm (Overheat Alarm) will occur.
2. If you set Pn61A to n.□□□1 (use overheat protection in the Yaskawa linear servomotor), the parameters in the servomotor are enabled and the following parameters are disabled.
   - Pn61B (Overheat Alarm Level)
   - Pn61C (Overheat Warning Level)
   - Pn61D (Overheat Alarm Filter Time)

(2) Monitoring the Machine’s Temperature and Using Overheat Protection

Set Pn61A = n.□□□X to 2 or 3 to use overheat protection for the machine.

Set the following parameters as required.

Pn61B	Overheat Alarm Level Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 500	0.01 V	250	Immediately
Pn61C	Overheat Warning Level Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 100	1%	100	Immediately
Pn61D	Overheat Alarm Filter Time Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	1 s	0	Immediately

Important

1. When Pn61A is set to n.□□□2, an A.862 alarm (Overheat Alarm) will occur if the overheat protection input signal line is disconnected or short-circuited.
2. When Pn61A is set to n.□□□3, an A862 alarm will not occur if the overheat protection input signal line is disconnected or short-circuited. To ensure safety, we recommend that you connect the external circuits so that you can use a negative voltage input for the overheat protection input (an analog voltage input).
3. Set Pn61B to a value that matches the actually measured level of the connected sensor.
   Additionally, when Pn61B is set to a value of 450 (= 4.5 V) or higher, the detection error of the overheat alarm/warning will increase. For this reason, we recommend setting a value less than 450 (= 4.5 V).

7

Trial Operation and Actual Operation

Provides information on the flow and procedures for trial operation and convenient functions to use during trial operation.

7.1 Flow of Trial Operation

7.1.1 Flow of Trial Operation for Rotary Servomotors

The procedure for trial operation is given below.

(1) Preparations for Trial Operation

1. **Installation**

   Install the servomotor and SERVOPACK according to the conditions.

   First, operation is checked with no load. Do not connect the servomotor to the machine.

   ☞ *3 SERVOPACK Installation on page 93*

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.

   ☞ *4 Wiring and Connecting SERVOPACKs on page 103*

3. **Confirmations before Trial Operation**

   ☞ *7.2 Inspections and Confirmations before Trial Operation on page 332*

4. **Power ON**

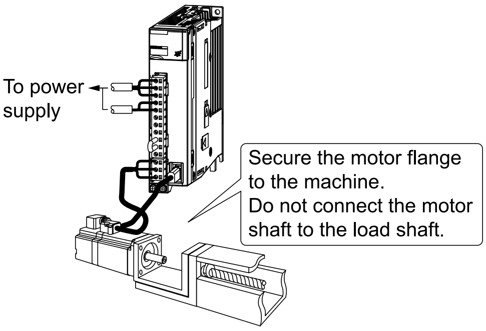
5. **Resetting the Absolute Encoder**

   This step is necessary only for a servomotor with an absolute encoder.

   ☞ *5.17 Resetting the Absolute Encoder on page 206*

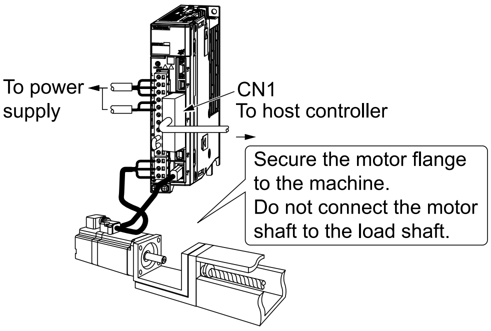
(2) Trial Operation

1. **Trial Operation for the Servomotor without a Load**



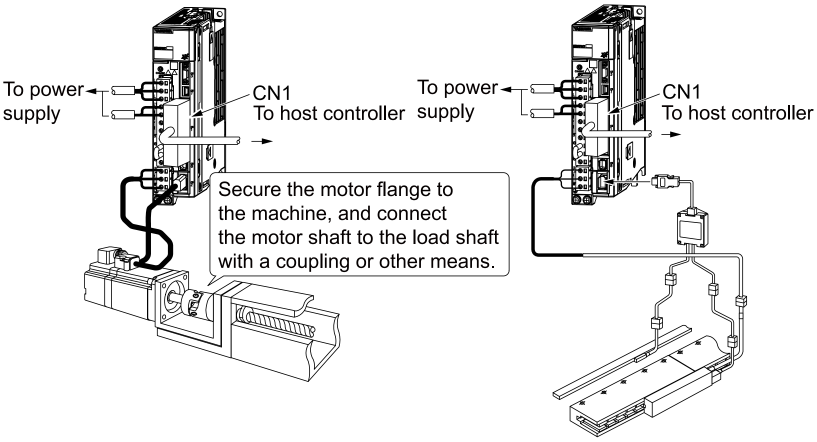
   ☞ *7.3 Trial Operation for the Servomotor without a Load on page 333*

2. **Trial Operation from the Host Controller for the Servomotor without a Load**



   ☞ *7.4 Trial Operation from the Host Controller for the Servomotor without a Load on page 336*

3. **Trial Operation with the Servomotor Connected to the Machine**



☞ *7.5 Trial Operation with the Servomotor Connected to the Machine on page 342*

7.1.2 Flow of Trial Operation for Linear Servomotors

The procedure for trial operation is given below.

(1) Preparations for Trial Operation

1. **Installation**

   Install the servomotor and SERVOPACK according to the conditions.

   First, operation is checked with no load. Do not connect the servomotor to the machine.

   ☞ *3 SERVOPACK Installation on page 93*

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.

   ☞ *4 Wiring and Connecting SERVOPACKs on page 103*

3. **Confirmations before Trial Operation**

   ☞ *7.2 Inspections and Confirmations before Trial Operation on page 332*

4. **Power ON**

5. **Setting Parameters in the SERVOPACK**

Step	No. of Parameter to Set	Description	Remarks	Reference
5-1	Pn282	Linear Encoder Scale Pitch	Set this parameter only if you are using a serial converter unit.	☞ *5.7 Setting the Linear Encoder Pitch on page 174*
5-2	–	Writing Parameters to the Linear Servomotor	Set this parameter only if you are not using a serial converter unit.	☞ *5.8 Writing Linear Servomotor Parameters on page 175*
5-3	Pn080 = n.□□X□.	Motor Phase Sequence Selection	–	☞ *5.9 Selecting the Phase Sequence for a Linear Servomotor on page 179*

Continued on next page.

Continued from previous page.

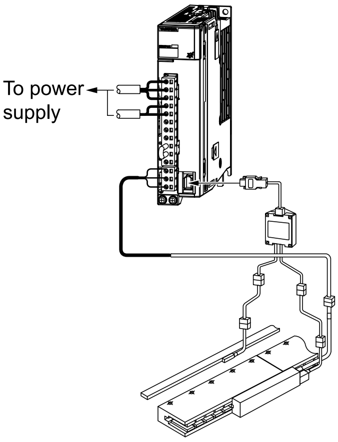
Step	No. of Parameter to Set	Description	Remarks	Reference
5-4	Pn080 = n.□□□X	Polarity Sensor Selection	–	☞ *5.10 Polarity Sensor Setting on page 181*
5-5	–	Polarity Detection	This step is necessary only for a linear servomotor with a polarity sensor.	☞ *5.11 Polarity Detection on page 182*
5-6	Pn50A = n.X□□□ and Pn50B = n.□□□X	Overtravel Signal Allocations	–	☞ *5.1-2 Overtravel Function and Settings on page 186*
5-7	Pn483, Pn484	Force Control	–	☞ *6.11.-1 Internal Torque Limits on page 281*

6. Setting the Origin of the Absolute Linear Encoder

☞ *5.18.1 Setting the Origin of the Absolute Linear Encoder on page 209*

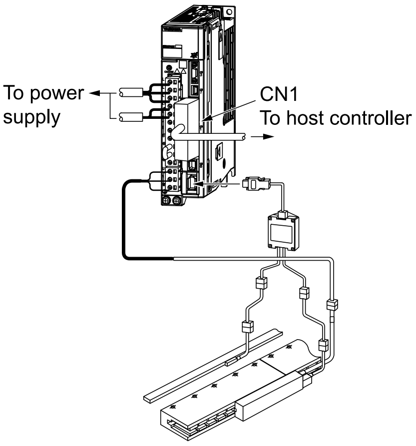
(2) Trial Operation

1. Trial Operation for the Servomotor without a Load



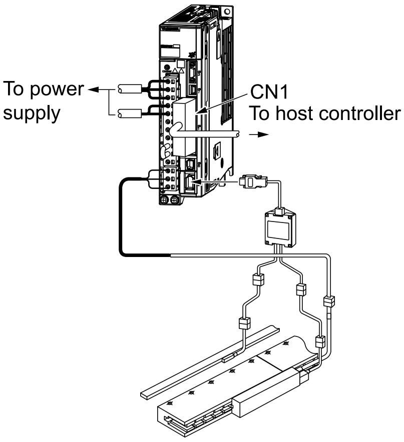
☞ *7.3 Trial Operation for the Servomotor without a Load on page 333*

2. Trial Operation from the Host Controller for the Servomotor without a Load



☞ *7.4 Trial Operation from the Host Controller for the Servomotor without a Load on page 336*

3. Trial Operation with the Servomotor Connected to the Machine

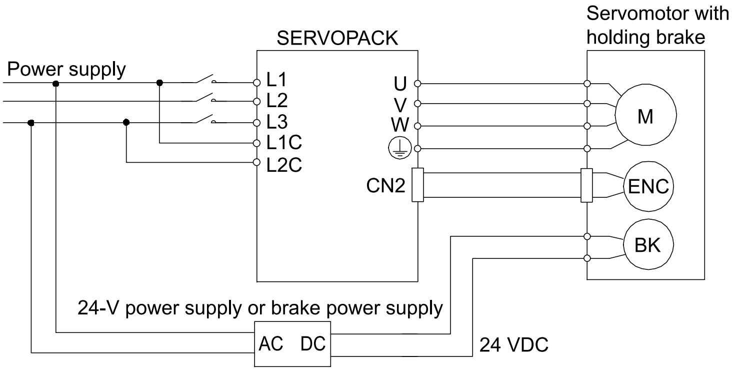


☞ *7.5 Trial Operation with the Servomotor Connected to the Machine on page 342*

7.2 Inspections and Confirmations before Trial Operation

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

- Make sure that the SERVOPACK and servomotor are installed, wired, and connected correctly.
- Make sure that the correct power supply voltage is supplied to the SERVOPACK.
- Make sure that there are no loose parts in the servomotor mounting.
- If you are using a servomotor with an oil seal, make sure that the oil seal is not damaged. Also make sure that oil has been applied.
- If you are performing trial operation on a servomotor that has been stored for a long period of time, make sure that all servomotor inspection and maintenance procedures have been completed.
  Refer to the manual for your servomotor for servomotor maintenance and inspection information.
- If you are using a servomotor with a holding brake, make sure that the brake is released in advance. To release the brake, you must apply the specified voltage of 24 VDC to the brake.
  A circuit example for trial operation is provided below.



7.3 Trial Operation for the Servomotor without a Load

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

Jogging operation is used to check the operation of the servomotor without connecting the SERVOPACK to the host controller. The servomotor is moved at the preset jogging speed.

⚠ CAUTION

During jogging operation, the overtravel function is disabled. Consider the range of motion of your machine when you jog the servomotor.

Important

The tuning-less function is enabled as the default setting. When the tuning-less function is enabled, gain will increase and vibration may occur if the servomotor is operated with no load. If vibration occurs, set Pn170 = n.□□□0 (disable the tuning-less function).

7.3.1 Preparations

Always check the following before you execute jogging.

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

Pn304	Jogging Speed			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	Rotary: 1 min^{-1} Direct Drive: 0.1 min^{-1}	500	Immediately
Pn305	Soft Start Acceleration Time			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 12000	1 ms	0	Immediately
Pn306	Soft Start Deceleration Time			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 12000	1 ms	0	Immediately

  - Linear Servomotors

Pn383	Jogging Speed			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 mm/s	50	Immediately
Pn305	Soft Start Acceleration Time			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 12000	1 ms	0	Immediately
Pn306	Soft Start Deceleration Time			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 12000	1 ms	0	Immediately

Information When an absolute encoder is used, you do not need to input the SEN signal. It is always active.

7.3.2 Applicable Tools

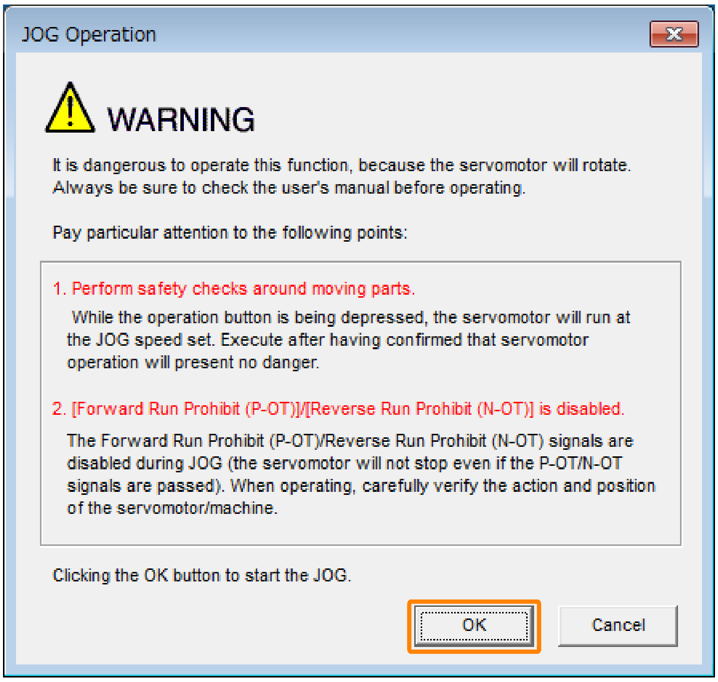
The following table lists the tools that you can use to perform jogging.

Tool	Fn No./Function Name	Reference
Panel Operator	Fn002	☞ *14.4.2 Jog (Fn002) on page 645*
Digital Operator	Fn002	🕮 Σ-7/Σ-X series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Operation] - [Jog]	☞ *7.3.3 Operating Procedure on page 334*

7.3.3 Operating Procedure

Use the following procedure to jog the motor.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Click [Jog] in the [Menu] window.**
   The [Jog Operation] window will be displayed.
3. **Read the warnings and then click the [OK] button.**



It is dangerous to operate this function, because the servomotor will rotate.
Always be sure to check the user's manual before operating.

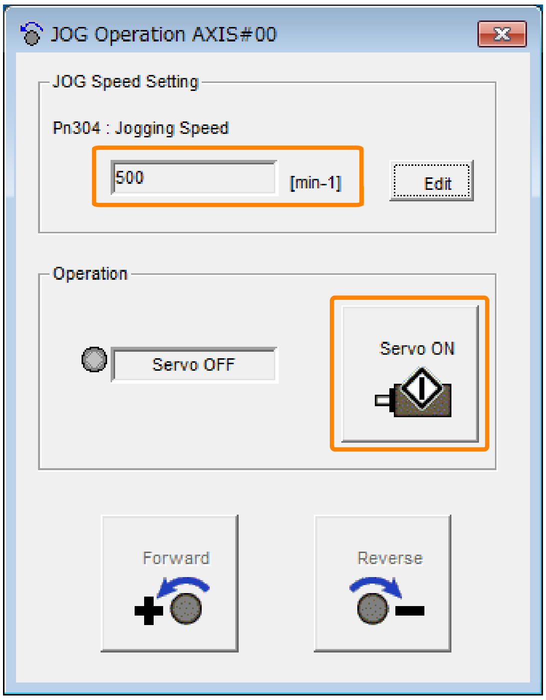
Pay particular attention to the following points:

1. Perform safety checks around moving parts.
   While the operation button is being depressed, the servomotor will run at the JOG speed set. Execute after having confirmed that servomotor operation will present no danger.

2. [Forward Run Prohibit (P-OT)]/[Reverse Run Prohibit (N-OT)] is disabled.
   The Forward Run Prohibit (P-OT)/Reverse Run Prohibit (N-OT) signals are disabled during JOG (the servomotor will not stop even if the P-OT/N-OT signals are passed). When operating, carefully verify the action and position of the servomotor/machine.

Clicking the OK button to start the JOG.

4. **Check the jogging speed and then click the [Servo ON] button.**

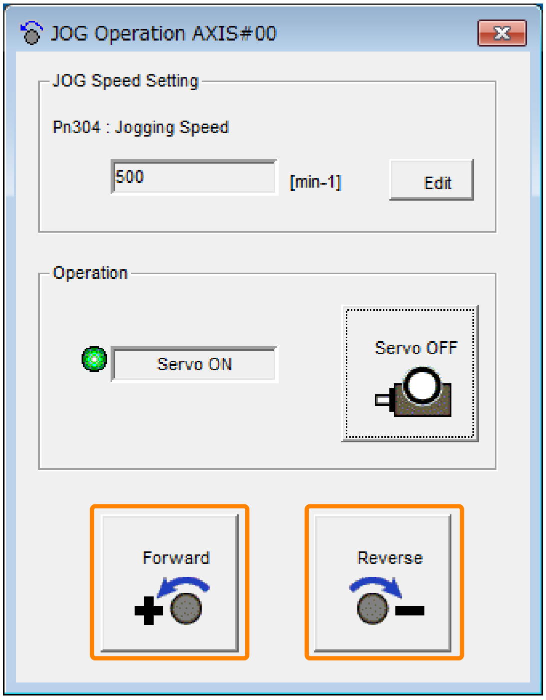


The display in the [Operation] area will change to [Servo ON].

Information To change the speed, click the [Edit] button and enter the new speed.

5. **Click the [Forward] button or the [Reverse] button.**

Jogging will be performed only while you hold down the mouse button.



6. **Turn the power to the SERVOPACK OFF and ON again after you finish jogging.**

This concludes the jogging procedure.

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

Conform the following items before you start trial operation from the host controller for the servomotor without a load.

- Make sure that the servomotor travel command 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.

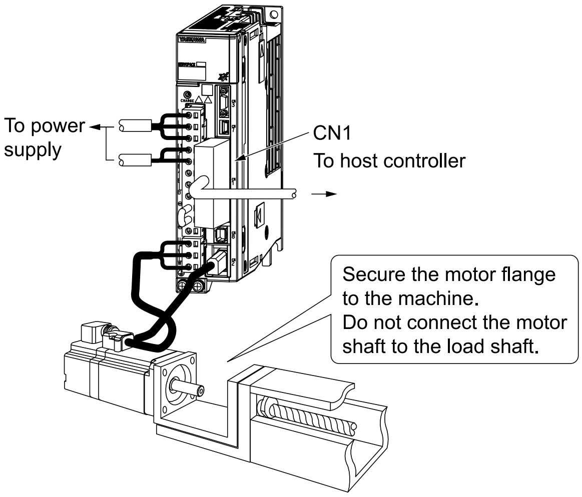
The operation sequence for trial operation from the host controller for the servomotor without a load is given below.

1. Check the connections and status of the input signal circuits.
   Refer to the following section for details.
   ☞ *7.4.1 Preparing the Servomotor for Trial Operation on page 336*
2. Perform the trial operation with speed control or position control.
   Refer to the following sections for details.
   ☞ *7.4.2 Trial Operation for Speed Control on page 338*
   ☞ *7.4.4 Trial Operation for Position Control on page 340*
3. To also perform position control when the control method is speed control, perform position control with the host controller.
   Refer to the following section for details.
   ☞ *7.4.3 Trial Operation for Position Control from the Host Controller with the SERVOPACK Used for Speed Control on page 339*
4. Perform the trial operation for both the machine and SERVOPACK
   Refer to the following section for details.
   ☞ *7.5 Trial Operation with the Servomotor Connected to the Machine on page 342*

⚠ CAUTION

Before you perform trial operation of the servomotor without a load for references from the host controller, make sure that there is no load connected to the servomotor.

There is a risk of machine damage or personal injury due to unexpected machine movement.



7.4.1 Preparing the Servomotor for Trial Operation

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

(1) Preparations

Always confirm the following before you perform the procedure to prepare the servomotor for trial operation.

- Make sure that the preparations given in the following have been completed.
  ☞ *7.1 Flow of Trial Operation on page 328*
- Make sure that the procedure described in the following has been completed.
  ☞ *7.3 Trial Operation for the Servomotor without a Load on page 333*

(2) 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 111*

1. **Wire the I/O signals from the host controller.**

   Refer to the following section for details.

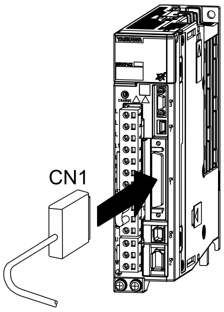
   ☞ *4.2 Basic Wiring Diagrams on page 111*

2. **Check the following items.**

   1. Make sure that the /S-ON (Servo ON Input) signal can be input.
   2. Make sure that the P-OT (Forward Drive Prohibit input) and N-OT (Reverse Drive Prohibit Input) signals are ON (closed).
      Setting Procedure
      - Input the signal to turn ON CN1-42 and CN1-43 (closed).
      - Set Pn50A to n.8□□□ (set the signal to always enable forward drive) and Pn50B to n.□□□8 (set the signal to always enable reverse drive).
   3. Make sure that a reference is not being input.
   4. If you are using a Safety Function, make sure that the Safety Function device is connected to CN8. Refer to the following section for the Safety Function device connection method.
      ☞ *4.6 Connecting Safety Function Signals on page 148*

   Information You can set Pn002 to n.□1□□ (use the encoder as an incremental encoder) to temporarily use an absolute encoder as an incremental encoder. This makes it possible to perform trial operation without setting up the absolute encoder or setting the SEN signal.

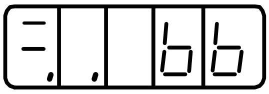
3. **Connect the I/O signal cable to the I/O signal connector (CN1).**



4. **Turn ON the power to the SERVOPACK.**

   The control power and main circuit power will be supplied.

5. **Confirm that the panel operator display is as shown below.**



6. **If you are using an absolute encoder, turn ON the SEN signal.**

   The current position will be read from the absolute encoder.

   Note:
   This step is not necessary if you are setting Pn002 to n.□1□□ (use the encoder as an incremental encoder).

7. **Check the status of the I/O signals.**

   - Using the SigmaWin+: [Monitor] - [Wiring Check]
   - Using the panel operator or digital operator: Un005 (Input Signal Monitor)

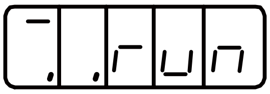
   The correct states of the input signals are given in the following table. If the actual states do not agree with those given in the following table, correct the I/O signals.

Signal	Correct State
/S-ON (Servo ON Input) signal	OFF
/P-CON (Proportional Control Input) signal	OFF
P-OT (Forward Drive Prohibit Input) signal	ON
N-OT (Reverse Drive Prohibit Input) signal	ON
/ALM-RST (Alarm Reset Input) signal	OFF
/P-CL (Forward External Torque Limit) signal	OFF
/N-CL (Reverse External Torque Limit) signal	OFF
SEN (Absolute Data Request Input) signal	• When using an absolute encoder: ON • When not using an absolute encoder: OFF

8. **Input the /S-ON (Servo ON Input) signal.**

   The servo will turn ON.

9. **Confirm that the panel operator display 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.

   ☞ *13.2.3 Alarm Reset on page 610*

10. **If you changed the settings of Pn50A or Pn50B in step 2, return the settings to their original values.**

This concludes the procedure to prepare the servomotor for trial operation.

Proceed to one of the following sections according to the control method.

☞ *7.4.2 Trial Operation for Speed Control on page 338*

☞ *7.4.4 Trial Operation for Position Control on page 340*

7.4.2 Trial Operation for Speed Control

This section describes trial operation with speed control.

(1) Preparations

Always confirm the following before you perform the procedure for trial operation with speed control.

- Make sure that the procedure described in the following has been completed.
  ☞ *7.4.1 Preparing the Servomotor for Trial Operation on page 336*

(2) Operating Procedure

1. **Adjust Pn300 (Speed Reference Input Gain).**

   The default setting of Pn300 is for the rated speed at 6 V. If you want to use this setting, do not adjust Pn300 and proceed to the next step.

   To change the setting of Pn300, refer to the following section.

☞ *6.5 Speed Control on page 233*

2. **Set the speed reference (V-REF, SG voltage) to 0 V from the host controller and check the rotation of the servomotor shaft.**

   If the servomotor is rotating slightly, refer to the following section and adjust the reference offset so that the servomotor does not rotate.

   ☞ *(5) Adjusting the Speed Reference Offset on page 235*

3. **Input a low-speed, constant-speed reference from the host controller to operate the servomotor and visually check the motor speed.**
   - Rotary servomotor example: For a speed reference of 60 min^{-1}, the shaft should rotate at 1 rotation per second.
   - Linear servomotor example: For a speed reference of 60 mm/s, the moving coil should move at 60 mm/s.
4. **Gradually increase the speed reference input from the host controller starting from 0 V.**
5. **Confirm that the motor speed agrees with the speed reference value.**
   - Using the SigmaWin+: [Monitor] - [Monitor] - [Status Monitor] and [Monitor] - [Monitor] - [Motion Monitor]
   - Using the panel operator or digital operator: Un001 (Speed Reference Monitor) and Un000 (Motor Speed Monitor)
6. **Confirm that the servomotor is rotating in the correct direction.**

   If the servomotor rotation direction is not correct, refer to the following section and change the servomotor rotation direction.

   ☞ *5.6 Motor Direction Setting on page 172*

7. **Reduce the speed reference input from the host controller back to 0 V.**
8. **Turn OFF the power to the SERVOPACK.**

This concludes the procedure for trial operation with speed control.

Proceed to the following section if you will perform position control on the host controller.

☞ *7.4.3 Trial Operation for Position Control from the Host Controller with the SERVOPACK Used for Speed Control on page 339*

Proceed to the following section if you will not perform position control on the host controller.

☞ *7.5 Trial Operation with the Servomotor Connected to the Machine on page 342*

7.4.3 Trial Operation for Position Control from the Host Controller with the SERVOPACK Used for Speed Control

This section describes the trial operation procedure to use the SERVOPACK for speed control and perform position control at the host controller.

(1) Preparations

Always confirm the following before you perform the procedure to use the SERVOPACK for speed control and perform position control at the host controller.

- Make sure that the procedure described in the following has been completed.
  ☞ *7.4.2 Trial Operation for Speed Control on page 338*

(2) Operating Procedure

1. **Turn ON the power to the SERVOPACK.**
2. **Set Pn212 (Number of Encoder Output Pulses) or Pn281 (Encoder Output Resolution).**

   Refer to the following section for details.

   ☞ *6.8.2 Setting for the Encoder Divided Pulse Output on page 267*

3. **Execute the following type of simple positioning from the host controller and confirm the motion of the servomotor.**

    - Rotary servomotors: Input a reference to move the servomotor one rotation and confirm that the motor shaft moves one rotation.
    - Linear servomotors: Input a reference to move the servomotor 100 mm and confirm that the servomotor moves 100 mm.

    Confirm the operation visually or with a monitor function. To use a monitor function, perform one of the following.

    - Using the SigmaWin+: [Monitor] - [Monitor] - [Motion Monitor]
    - Using the panel operator or digital operator: Un003 (Rotational Angle 1 [unit: encoder pulses])

    If the amount of servomotor rotation (pulses) is not correct, check the setting of Pn212 or Pn281.

4. **Reduce the speed reference input from the host controller back to 0 V.**
5. **Turn OFF the power to the SERVOPACK.**

This concludes the trial operation procedure for position control from the host controller with the SERVOPACK used for speed control. Proceed to the following section.

☞ *7.5 Trial Operation with the Servomotor Connected to the Machine on page 342*

7.4.4 Trial Operation for Position Control

This section describes the procedure for trial operation for position control.

(1) Preparations

Always confirm the following before you perform the procedure for trial operation with position control.

- Make sure that the procedure described in the following has been completed.
  ☞ *7.4.1 Preparing the Servomotor for Trial Operation on page 336*

(2) 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 Input) 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 Pn20E and Pn210 (Numerator and Denominator of Electronic Gear Ratio) according to the host controller.**
4. **Turn the power to the SERVOPACK OFF and ON again.**

    The new parameter settings will be enabled.

5. **Input the /S-ON (Servo ON Input) signal from the host controller.**

    The servo will turn ON.

6. **Input a low-speed pulse reference from the host controller.**

    Use a travel amount (number of reference pulses) that is easy to check (for example, the number of pulses for one rotation).

    For safety, set the number of reference pulses for approximately the following motor speeds.

    - Rotary Servomotors: 100 min^{-1}
    - Linear Servomotors: 100 mm/s

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.**

    - Using the SigmaWin+: [Monitor] - [Monitor] - [Motion Monitor], [Reference Pulse Counter]
    - Using the panel operator or digital operator: Un00C (Input Reference Pulse Counter Monitor)

8. **Check the actual amount of motor rotations from the changes in the feedback pulse counter before and after the reference.**
   - Using the SigmaWin+: [Monitor] - [Monitor] - [Motion Monitor], [Feedback Pulse Counter]
   - Using the panel operator or digital operator: Un00D (Feedback Pulse Counter Monitor)

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 feedback pulse counter = Change in input reference 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.

    ☞ *5.6 Motor Direction Setting on page 172*

11. **Input a pulse reference for a comparatively large amount 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.**
    - Using the SigmaWin+: [Monitor] - [Monitor] - [Motion Monitor], [Input Reference Pulse Speed]
    - Using the panel operator or digital operator: Un007 (Input Reference Pulse Speed Monitor)

    The input reference pulse speed monitor uses the following formula.
    - Rotary Servomotor with a 20-bit Encoder

$$\text{Input reference pulse speed monitor} = \underbrace{\text{Input reference pulse speed [pulses/s]} \times 60}_{\text{Reference input pulse speed/min}} \times \underbrace{\frac{\text{Pn20E}}{\text{Pn210}}}_{\text{Electronic gear ratio}} \times \underbrace{\frac{1}{2^{20}\,(=1048576)}}_{\text{Encoder pulse}}$$

    - Linear Servomotor

$$\text{Input reference pulse speed monitor} = \text{Input reference pulse speed [pulses/s]} \times \underbrace{\frac{\text{Pn20E}}{\text{Pn210}}}_{\text{Electronic gear ratio}} \times \underbrace{\frac{\text{Linear encoder scale pitch [μm]}}{\text{Number of divisions}}}_{\text{Linear encoder resolution}} \times \frac{1}{1000}$$

13. **Check the motor speed monitor.**
    - Using the SigmaWin+: [Monitor] - [Monitor] - [Motion Monitor], [Motor Speed]
    - Using the panel operator or digital operator: Un000 (Motor Speed Monitor)

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 Input) signal from the host controller.**

    The servo will turn OFF.

This concludes the procedure for trial operation with position control. Proceed to the following section.

☞ *7.5 Trial Operation with the Servomotor Connected to the Machine on page 342*

7.5 Trial Operation with the Servomotor Connected to the Machine

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

7.5.1 Precautions

⚠ **WARNING**

Perform the correct operation with the servomotor connected to the machine.

There is a risk of machine damage or personal injury.

Important

If you disabled the overtravel function for trial operation of the servomotor without a load, enable the overtravel function (P-OT and N-OT signal) before you preform trial operation with the servomotor connected to the machine in order to provide protection.

If you will use a holding brake, observe the following precautions during trial operation.

- Before you check the operation of the brake, implement measures to prevent the machine from falling due to gravity and to prevent vibration from being caused by an external force.
- First check the servomotor operation and brake operation with the servomotor uncoupled from the machine. If no problems are found, connect the servomotor to the machine and perform trial operation again.

Control the operation of the brake with the /BK (Brake Output) signal from the SERVOPACK.

Refer to the following sections for information on wiring and the related parameter settings.

☞ *4.4.4 Wiring the SERVOPACK to the Holding Brake on page 134*

☞ *5.13 Holding Brake on page 191*

Important

Failures caused by incorrect wiring or incorrect voltage application in the brake circuit may cause the SERVOPACK to fail, damage the SERVOPACK, damage the equipment, or cause an accident resulting in death or injury.

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

7.5.2 Preparations

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

- Make sure that the procedure described in the following has been completed.
  ☞ *7.4 Trial Operation from the Host Controller for the Servomotor without a Load on page 336*
- Make sure that the SERVOPACK is connected correctly to both the host controller and the peripheral devices.
  - Safety Function wiring
    If you are not using the Safety Function, leave the safety jumper connector (provided as an accessory with the SERVOPACK) connected to CN8.
    If you are using the Safety Function, remove the safety jumper connector from CN8 and connect the Safety Function device.
  - Overtravel wiring
  - Brake wiring
  - Allocation of the /BK (Brake) signal to a pin on the I/O signal connector (CN1)
  - Emergency stop circuit wiring
  - Host controller wiring
    Refer to the following section and change the wiring to match the system configuration
    ☞ *16.1 Examples of Connections to Host Controllers on page 736*

7.5.3 Operating Procedure

1. **Enable the overtravel signals.**

   ☞ *5.12.1 Overtravel Signals on page 186*

2. **Make the settings for the protective functions, such as the Safety Function, overtravel, and the brake.**

   ☞ *4.6 Connecting Safety Function Signals on page 148*

   ☞ *5.12 Overtravel Function and Settings on page 186*

   ☞ *5.13 Holding Brake on page 191*

3. **Set the parameters that are required for the control method you will use.**

   ☞ *6.5 Speed Control on page 233*

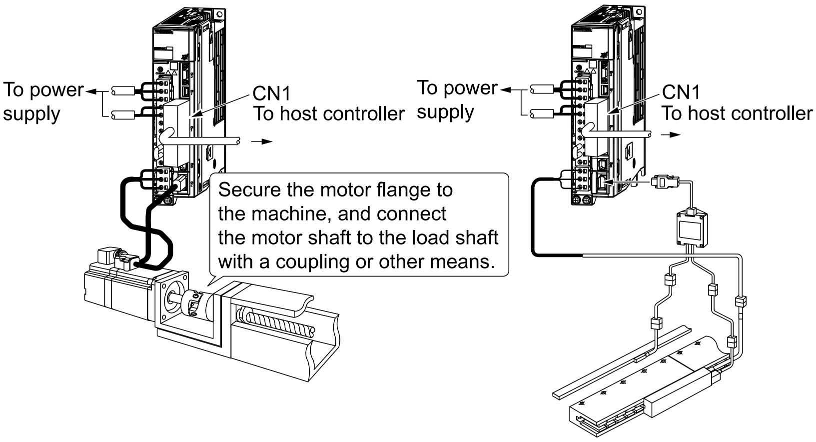
   ☞ *6.6 Position Control on page 246*

   ☞ *6.7 Torque Control on page 256*

4. **Turn OFF the power to the SERVOPACK.**

   The control power and main circuit power will turn OFF.

5. **Couple the servomotor to the machine.**



6. **Turn ON the power to the machine and host controller and turn ON the control power and main circuit power to the SERVOPACK.**

7. **Check the protective functions, such as overtravel and the brake, to confirm that they operate correctly.**

   Note:

   Enable activating an emergency stop so that the servomotor can be stopped safely should an error occur during the remainder of the procedure.

8. **Perform trial operation according to the following and confirm that the same results are obtained as when trial operation was performed on the servomotor without a load.**

   ☞ *7.4 Trial Operation from the Host Controller for the Servomotor without a Load on page 336*

9. **Check the settings of the parameters for the control method and confirm that the servomotor operates according to machine operating specifications.**

10. **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.

11. **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.

7.6 Convenient Function to Use during Trial Operation

This section describes some convenient operations that you can use during trial operation.

Use them as required.

7.6.1 Program Jogging

You can use program jogging to perform continuous operation with a preset operation pattern, travel distance, movement speed, acceleration/deceleration time, waiting time, and number of movements.

You can use this operation when you set up the system in the same way as for normal jogging to move the servomotor without connecting it to the host controller in order to check servomotor operation and execute simple positioning operations.

(1) Preparations

Always check the following before you execute program jogging.

- The parameters must not be write prohibited.
- The main circuit power must be ON.
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- The servo must be OFF.
- The range of machine motion and the safe travel speed of your machine must be considered when you set the travel distance and travel speed.
- There must be no overtravel.
- The settings of the electronic gear ratio (Pn20E/Pn210), Pn533 or Pn585 (Program Jogging Movement Speed), and Pn385 (Maximum Motor Speed) must not satisfy either of the conditional expressions shown below.
  If either of these conditional expressions is satisfied, an A.042 (Parameter Combination Error) will occur.
  - Rotary Servomotors
    - $\text{Pn533 [min}^{-1}\text{]} \times \frac{\text{Encoder resolution}}{6 \times 10^5} \leq \frac{\text{Pn20E}}{\text{Pn210}}$
    - $\text{Maximum motor speed [min}^{-1}\text{]} \times \frac{\text{Encoder resolution}}{\text{Approx. } 3.66 \times 10^{12}} \geq \frac{\text{Pn20E}}{\text{Pn210}}$

Information Refer to the following section for details on the encoder resolution.

☞ ◆ *Encoder Resolution on page 201*

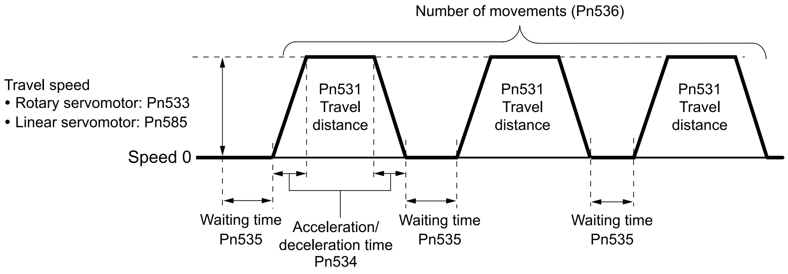
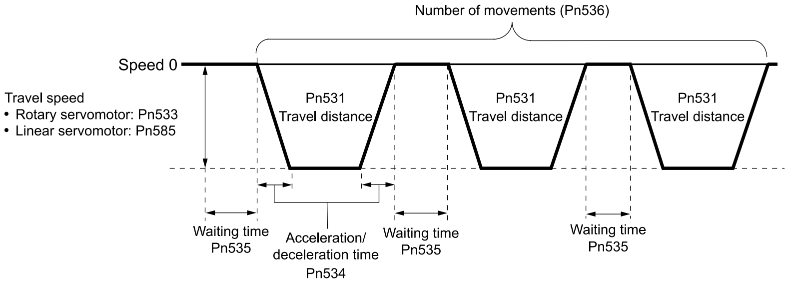
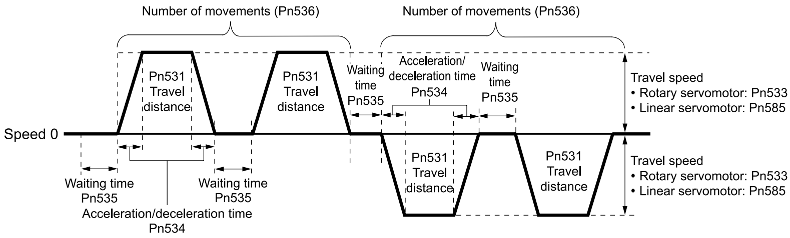
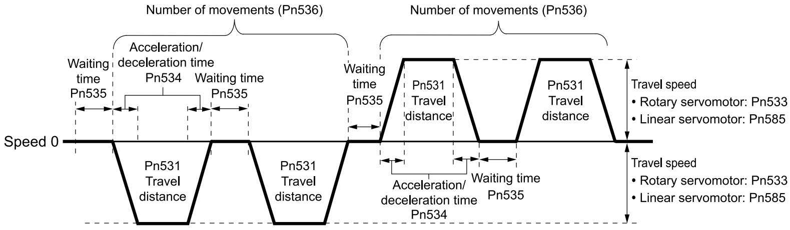
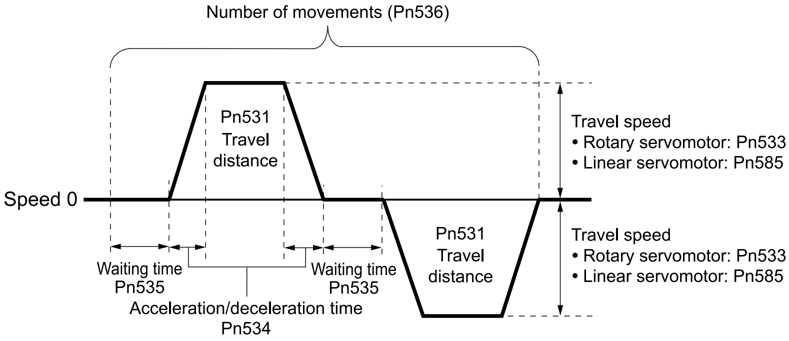
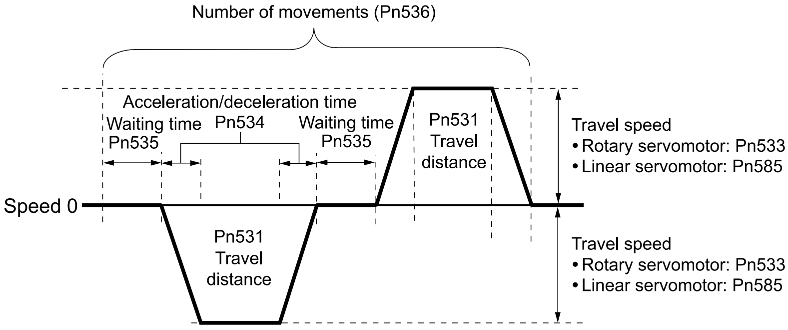
  - Linear Servomotors
    - $\frac{\text{Pn585 [mm/s]}}{\text{Linear encoder scale pitch [}\mu\text{m]}} \times \frac{\text{Number of divisions of the serial converter unit}}{10} \leq \frac{\text{Pn20E}}{\text{Pn210}}$
    - $\frac{\text{Pn385 [100 mm/s]}}{\text{Linear encoder scale pitch [}\mu\text{m]}} \times \frac{\text{Number of divisions of the serial converter unit}}{\text{Approx. } 6.10 \times 10^5} \geq \frac{\text{Pn20E}}{\text{Pn210}}$

(2) Additional Information

- The program jogging operation is performed with position control, but a pulse reference is not input to the SERVOPACK.
- You can use the functions that are applicable to position control.
- The overtravel function is enabled.
- When an absolute encoder is used, you do not need to input the SEN signal. It is always active.
- You cannot use reference pulse input multiplication switching.

(3) Program Jogging Operation Pattern

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

Setting of Pn530	Setting	Operation Pattern
n.□□□0	(Waiting time → Forward by travel distance) × Number of movements	
n.□□□1	(Waiting time → Reverse by travel distance) × Number of movements	
n.□□□2	(Waiting time → Forward by travel distance) × Number of movements → (Waiting time → Reverse by travel distance) × Number of movements	
n.□□□3	(Waiting time → Reverse by travel distance) × Number of movements → (Waiting time → Forward by travel distance) × Number of movements	
n.□□□4	(Waiting time → Forward by travel distance → Waiting time → Reverse by travel distance) × Number of movements	
n.□□□5	(Waiting time → Reverse by travel distance → Waiting time → Forward by travel distance) × Number of movements	

Information If Pn530 is set to n.□□□0, n.□□□1, n.□□□4, or n.□□□5, you can set Pn536 (Program Jogging Number of Movements) to 0 to perform infinite time operation.

You cannot use infinite time operation if Pn530 is set n.□□□2 or n.□□□3.

If you perform infinite time operation from the panel operator or digital operator, press the [MODE/SET] key or [JOG/SVON] key to turn OFF the servo to end infinite time operation.

(4) Related Parameters

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

(a) Rotary Servomotors

		Program Jogging Operation Pattern	Speed Pos Trq	When Enabled
Pn530	n.□□□X	0 Default	(Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536	Immediately
		1	(Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536	
		2	(Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536 (Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536	
		3	(Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536 (Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536	
		4	(Waiting time in Pn535 → Forward by travel distance in Pn531 → Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536	
		5	(Waiting time in Pn535 → Reverse by travel distance in Pn531 → Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536	

Pn531	Program Jogging Travel Distance			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 1073741824	1 reference unit	32768	Immediately
Pn533	Program Jogging Movement Speed			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 10000	Rotary: 1 min^{-1} Direct Drive: 0.1 min^{-1}	500	Immediately
Pn534	Program Jogging Acceleration/Deceleration Time			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	2 to 10000	1 ms	100	Immediately
Pn535	Program Jogging Waiting Time			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 ms	100	Immediately
Pn536	Program Jogging Number of Movements			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 1000	1 time	1	Immediately

(b) Linear Servomotors

		Program Jogging Operation Pattern **Speed** **Pos** **Trq**		When Enabled
Pn530	n.□□□X	0 Default	(Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536	Immediately
		1	(Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536	
		2	(Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536 (Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536	
		3	(Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536 (Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536	
		4	(Waiting time in Pn535 → Forward by travel distance in Pn531 → Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536	
		5	(Waiting time in Pn535 → Reverse by travel distance in Pn531 → Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536	

	Program Jogging Travel Distance			**Speed** **Pos** **Trq**
Pn531	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 1073741824	1 reference unit	32768	Immediately
	Program Jogging Movement Speed			**Speed** **Pos** **Trq**
Pn585	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 10000	1 mm/s	50	Immediately
	Program Jogging Acceleration/Deceleration Time			**Speed** **Pos** **Trq**
Pn534	Setting Range	Setting Unit	Default Setting	When Enabled
	2 to 10000	1 ms	100	Immediately
	Program Jogging Waiting Time			**Speed** **Pos** **Trq**
Pn535	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 ms	100	Immediately
	Program Jogging Number of Movements			**Speed** **Pos** **Trq**
Pn536	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 1000	1 time	1	Immediately

(5) Applicable Tools

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

Tool	Fn No./Function Name	Reference
Panel Operator	Fn004	☞ *14.4.4 Jog Program (Fn004) on page 646*
Digital Operator	Fn004	🕮 Σ-7/Σ-X series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Operation] - [Program JOG Operation]	☞ *(6) Operating Procedure on page 347*

(6) Operating Procedure

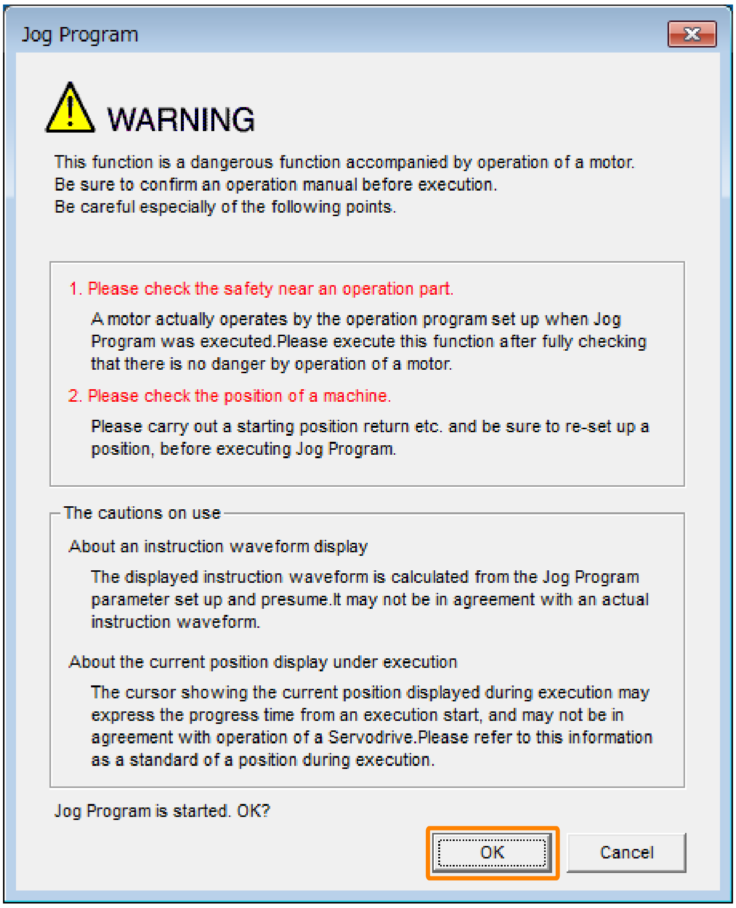
Use the following procedure for program jogging.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

2. **Click [Jog Program] in the [Menu] window.**

   The [Jog Program] window will be displayed.

3. **Read the warnings and then click the [OK] button.**



Jog Program

WARNING

This function is a dangerous function accompanied by operation of a motor.
Be sure to confirm an operation manual before execution.
Be careful especially of the following points.

1. Please check the safety near an operation part.

   A motor actually operates by the operation program set up when Jog Program was executed.Please execute this function after fully checking that there is no danger by operation of a motor.

2. Please check the position of a machine.

   Please carry out a starting position return etc. and be sure to re-set up a position, before executing Jog Program.

The cautions on use

About an instruction waveform display

The displayed instruction waveform is calculated from the Jog Program parameter set up and presume.It may not be in agreement with an actual instruction waveform.

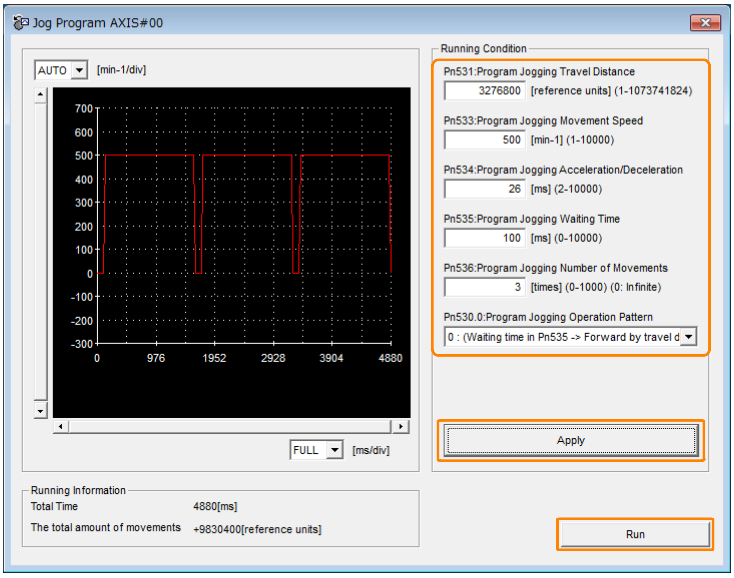
About the current position display under execution

The cursor showing the current position displayed during execution may express the progress time from an execution start, and may not be in agreement with operation of a Servodrive.Please refer to this information as a standard of a position during execution.

Jog Program is started. OK?

4. **Set the operating conditions, click the [Apply] button, and then click the [Run] button.**

   A graph of the operation pattern will be displayed.



Jog Program AXIS#00

Running Condition

Pn531:Program Jogging Travel Distance
3276800 [reference units] (1-1073741824)

Pn533:Program Jogging Movement Speed
500 [min-1] (1-10000)

Pn534:Program Jogging Acceleration/Deceleration
26 [ms] (2-10000)

Pn535:Program Jogging Waiting Time
100 [ms] (0-10000)

Pn536:Program Jogging Number of Movements
3 [times] (0-1000) (0: Infinite)

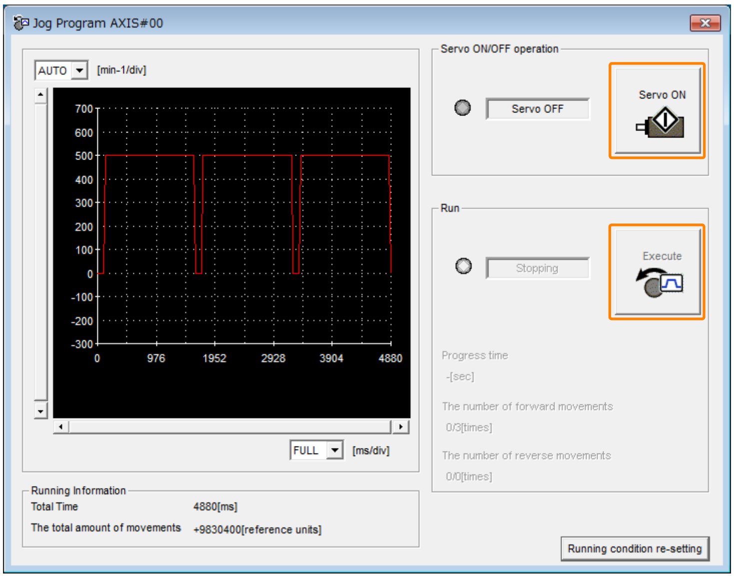
Pn530.0:Program Jogging Operation Pattern
0 : (Waiting time in Pn535 -> Forward by travel d

Running Information

Total Time 4880[ms]

The total amount of movements +9830400[reference units]

5. **Click the [Servo ON] button and then the [Execute] button. The program jogging operation will be executed.**



Running Information
Total Time 4880[ms]
The total amount of movements +9830400[reference units]

Progress time
-[sec]
The number of forward movements
0/3[times]
The number of reverse movements
0/0[times]

Important

The stopping method if you cancel the program jogging operation while the servomotor is operating is given below.

- If you cancel operation with the [Servo OFF] button, the servomotor will stop according to the setting of Pn001 = n.□□□X (Motor Stopping Method for Servo OFF).
- If you cancel operation with the [Cancel] button, the servomotor will decelerate to a stop and then enter a zero-clamped state.

This concludes the program jogging procedure.

7.6.2 Origin Search

The origin search operation positions the motor to the origin within one rotation and then clamps it there.

The overtravel function is disabled during an origin search.

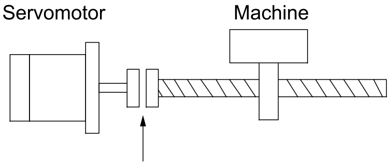
⚠ CAUTION

Make sure that the load is not coupled when you execute an origin search.

Since the P-OT (Forward Drive Prohibit Input) signal and N-OT (Reverse Drive Prohibit Input) signal are disabled during an origin search, the machine may be damaged by exceeding its movement limits.

Use an origin search when it is necessary to align the origin within one rotation with the machine origin. The following speeds are used for origin searches.

- Rotary servomotors: 60 min^{-1}
- Direct drive servomotors: 6 min^{-1}
- Linear servomotors: 15 mm/s



To align the origin within one encoder rotation with the machine origin

(1) Preparations

Always check the following before you execute an origin search.

- The load must not be coupled.
- The parameters must not be write prohibited.
- The main circuit power must be ON.
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- The servo must be OFF.

(2) Applicable Tools

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

Tool	Fn No./Function Name	Reference
Panel Operator	Fn003	☞ *14.4.3 Origin Search (Fn003) on page 645*
Digital Operator	Fn003	🕮 Σ-7/Σ-X series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+ **1*	[Encoder Setting] - [Origin Search]	☞ *(3) Operating Procedure on page 350*

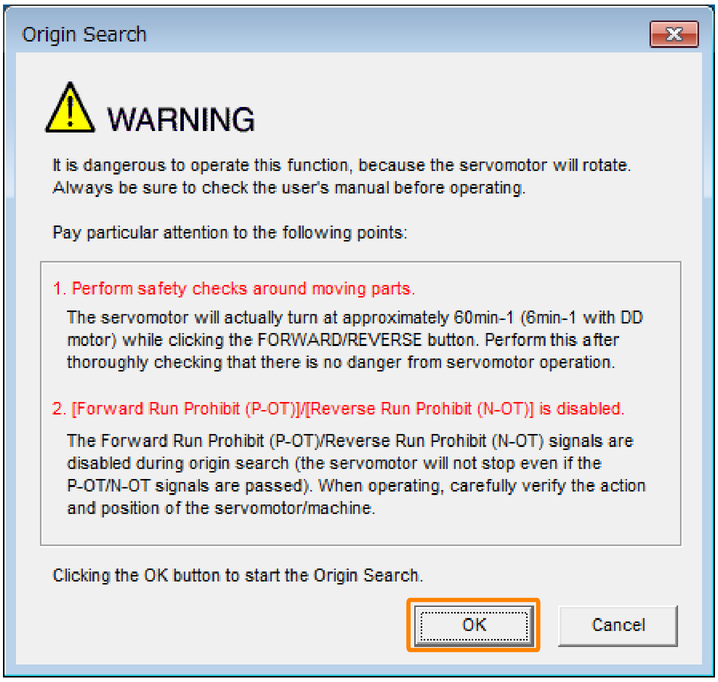
*1 Cannot be used when connecting a linear servomotor.

(3) Operating Procedure

Use the following procedure to perform an origin search.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Click [Origin Search] in the [Menu] window.**

   The [Origin Search] window will be displayed.
3. **Read the warnings and then click the [OK] button.**



WARNING

It is dangerous to operate this function, because the servomotor will rotate.
Always be sure to check the user's manual before operating.

Pay particular attention to the following points:

1. Perform safety checks around moving parts.

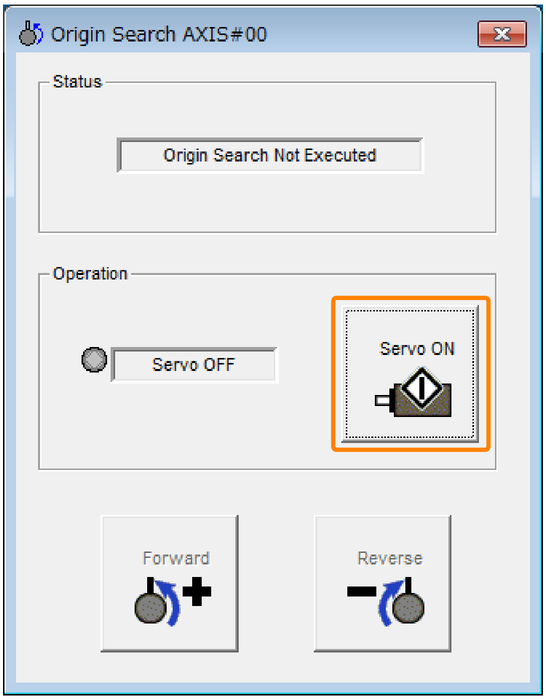
The servomotor will actually turn at approximately 60min-1 (6min-1 with DD motor) while clicking the FORWARD/REVERSE button. Perform this after thoroughly checking that there is no danger from servomotor operation.

2. [Forward Run Prohibit (P-OT)]/[Reverse Run Prohibit (N-OT)] is disabled.

The Forward Run Prohibit (P-OT)/Reverse Run Prohibit (N-OT) signals are disabled during origin search (the servomotor will not stop even if the P-OT/N-OT signals are passed). When operating, carefully verify the action and position of the servomotor/machine.

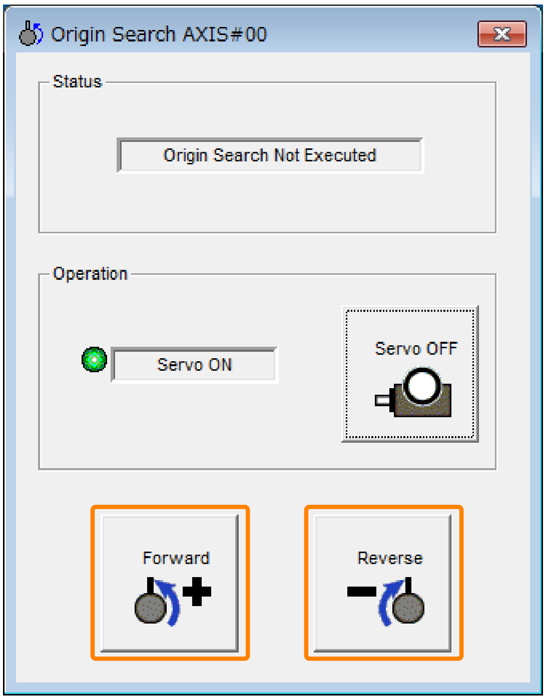
Clicking the OK button to start the Origin Search.

4. **Click the [Servo ON] button.**



5. **Click the [Forward] button or the [Reverse] button.**

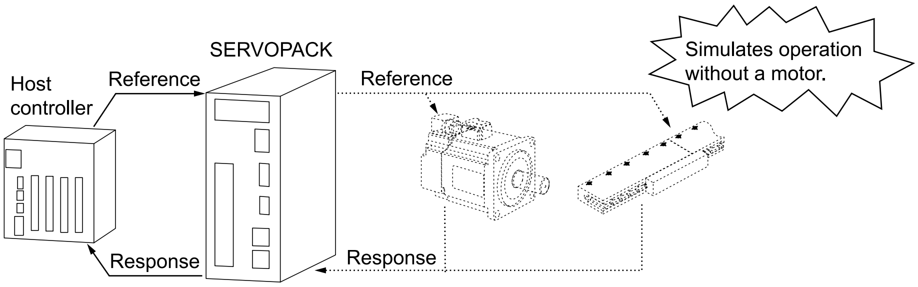
An origin search will be performed only while you hold down the mouse button. The motor will stop when the origin search has been completed.



This concludes the origin search procedure.

7.6.3 Test without a Motor

A test without a motor is used to check the operation of the host controller and peripheral devices by simulating the operation of the servomotor in the SERVOPACK, i.e., without actually operating a servomotor. This test allows you to check wiring, debug the system, and verify parameters to shorten the time required for setup work and to prevent damage to the machine that may result from possible malfunctions. The operation of the servomotor can be checked with this test regardless of whether the servomotor is actually connected or not.



Use Pn00C = n.□□□X to enable or disable the test without a motor.

Pn00C	n.□□□X	Function Selection for Test without a Motor **Speed** **Pos** **Trq**		When Enabled
		0 Default	Disable tests without a motor.	After restart
		1	Enable tests without a motor.	

Information

- While the test without a motor is being executed, the display on the panel operator will alternate between "tSt" and the status of the SERVOPACK.
  Refer to the following section for information on SERVOPACK status displays.
  ☞ *14.1.3 Status Display on page 636*
- An asterisk is displayed on the status display of the digital operator while a test without a motor is being executed.

(1) Motor Information and Encoder Information

The motor and encoder information is used during tests without a motor. The source of the information depends on the connection status.

(a) Rotary Servomotors

Motor Connection Status	Information That Is Used	Source of Information
Connected	Motor information • Motor rated speed • Maximum motor speed	Information in the servomotor that is connected
	Encoder information • Encoder resolution • Encoder type	
Not connected	Motor information • Motor rated speed • Maximum motor speed	• Setting of Pn000 = n.X□□□ (Rotary/Linear Servomotor Startup Selection When Encoder Is Not Connected) • Motor rated speed and maximum motor speed The values previously saved in the SERVOPACK will be used for the motor rated speed and maximum motor speed. Use the motor displays (Un020: Motor Rated Speed and Un021: Maximum Motor Speed) to check the values.
	Encoder information • Encoder resolution • Encoder type	• Encoder resolution: Setting of Pn00C = n.□□X□ (Encoder Resolution for Tests without a Motor) • Encoder type: Setting of Pn00C = n.□X□□ (Encoder Type Selection for Tests without a Motor)

If you use fully-closed loop control, the external encoder information is also used.

External Encoder Connection Status	Information That Is Used	Source of Information
Connected	• External encoder number of divisions • External encoder type	Information in the external encoder that is connected
Not connected		Because you do not connect an external encoder to the SERVPOACK, the following values will always be displayed. • Number of divisions: 256 • Encoder type: Incremental encoder

(b) Linear Servomotor

Motor Connection Status	Information That Is Used	Source of Information
Connected	Motor information	Information in the motor that is connected
	Linear encoder information • Number of divisions • Encoder scale pitch • Encoder type	Information in the linear encoder that is connected
Not connected	Motor information	Setting of Pn000 = n.X□□□ (Rotary/Linear Servomotor Startup Selection When Encoder Is Not Connected)
	Encoder information • Number of divisions • Encoder scale pitch • Encoder type	• Number of divisions: 256 • Encoder scale pitch: Setting of Pn282 (Linear Encoder Scale Pitch) • Encoder type: Setting of Pn00C = n.□X□□ (Encoder Type Selection for Tests without a Motor)

(c) Related Parameters

Pn000	n.X□□□	Rotary/Linear Servomotor Startup Selection When Encoder Is Not Connected Speed Pos Trq		When Enabled
		0 Default	When an encoder is not connected, start as SERVOPACK for rotary servomotor.	After restart
		1	When an encoder is not connected, start as SERVOPACK for linear servomotor.	

Pn282	Linear Encoder Scale Pitch Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 6553600	0.01 μm	0	After restart

Pn00C	n.□□X□	Encoder Resolution for Tests without a Motor Speed Pos Trq		When Enabled
		0	Use 13 bits.	After restart
		1	Use 20 bits.	
		2	Use 22 bits.	
		3	Use 24 bits.	
		4 Default	Use 26 bits.	
Pn00C	n.□X□□	Encoder Type Selection for Tests without a Motor Speed Pos Trq		When Enabled
		0 Default	Use an incremental encoder.	After restart
		1	Use an absolute encoder.	

(2) Motor Position and Speed Responses

For a test without a motor, the following responses are simulated for references from the host controller according to the gain settings for position or speed control.

- Motor position
- Motor speed
- External encoder position

The load model will be for a rigid system with the moment of inertia ratio that is set in Pn103.

(3) Restrictions

The following functions cannot be used during the test without a motor.

- Regeneration and dynamic brake operation
- Brake output signal
- Items marked with “×” in the following utility function table

SigmaWin+		**Panel Operator or Digital Operator**		**Executable?**		**Reference**
Button in Menu Window	**SigmaWin+ Function Name**	**Fn No.**	**Utility Function Name**	**Motor Not Connected**	**Motor Connected**	
Basic Functions	Initialize *1	**Fn005**	Initialize Parameters	○	○	☞ *5.1.5 Initialize Parameters on page 164*
	Software Reset	**Fn030**	Software Reset	○	○	☞ *6.14 Software Reset on page 312*
	Product Information	**Fn011**	Display Servomotor Model	○	○	☞ *9.1 Monitoring Product Information on page 502*
		Fn012	Display Software Version	○	○	
		Fn01E	Display SERVOPACK and Servomotor IDs	○	○	
		Fn01F	Display Servomotor ID from Feedback Option Module	○	○	
Encoder Setting	Reset Absolute Encoder	**Fn008**	Reset Absolute Encoder	×	○	☞ *5.17 Resetting the Absolute Encoder on page 206*
	Multiturn Limit Setting	**Fn013**	Multiturn Limit Setting after Multiturn Limit Disagreement Alarm	×	○	☞ *6.12.9 A.CC0 (Multiturn Limit Disagreement Alarm) on page 301*
	Origin Search	**Fn003**	Origin Search	○	○	☞ *7.6.2 Origin Search on page 349*
	Set Origin	**Fn020**	Set Absolute Linear Encoder Origin	×	○	☞ *5.18 Setting the Origin of the Absolute Encoder on page 209*
	Polarity Detection	**Fn080**	Polarity Detection	×	×	☞ *5.11 Polarity Detection on page 182*
Trouble-shooting	Display Alarm	**Fn000**	Display Alarm History	○	○	☞ *13.2.4 Displaying the Alarm History on page 612*
		Fn006	Clear Alarm History	○	○	☞ *13.2.5 Clearing the Alarm History on page 613*
		Fn014	Reset Option Module Configuration Error	○	○	☞ *13.2.6 Resetting Option Module Configuration Error on page 614*
	Reset Motor Type Alarm	**Fn021**	Reset Motor Type Alarm	○	○	☞ *13.2.7 Resetting Motor Type Alarms on page 616*
Operation	Jog	**Fn002**	Jog	○	○	☞ *7.3 Trial Operation for the Servomotor without a Load on page 333*
	Program JOG Operation	**Fn004**	Jog Program	○	○	☞ *7.6.1 Program Jogging on page 344*

Continued on next page.

Continued from previous page.

SigmaWin+		Panel Operator or Digital Operator		Executable?		Reference
Button in Menu Window	**SigmaWin+ Function Name**	**Fn No.**	**Utility Function Name**	**Motor Not Connected**	**Motor Connected**	
Tuning	Tuning - Autotuning without Host Reference	**Fn201**	Advanced Autotuning without Reference	×	×	☞ *8.7 Autotuning without a Host Reference on page 394*
	Tuning - Autotuning with Host Reference	**Fn202**	Advanced Autotuning with Reference	×	×	☞ *8.8 Autotuning with a Host Reference on page 407*
	Tuning - Custom Tuning	**Fn203**	One-Parameter Tuning	×	×	☞ *8.9 Custom Tuning on page 422*
	Tuning - Custom Tuning - Adjust Anti-resonance Control	**Fn204**	Adjust Anti-resonance Control	×	×	☞ *8.10 Anti-Resonance Control Adjustment on page 431*
	Tuning - Custom Tuning - Vibration Suppression	**Fn205**	Vibration Suppression	×	×	☞ *8.11 Vibration Suppression on page 438*
	Response Level Setting	**Fn200**	Tuning-less Level Setting	×	×	☞ *8.4 Tuning-less Function on page 368*
Diagnostic	Easy FFT	**Fn206**	Easy FFT	×	×	☞ *8.16.2 Easy FFT on page 495*
Others	Adjust the Speed and Torque Reference Offset	**Fn009**	Autotune Analog (Speed/ Torque) Reference Offset	○	○	☞ *(a) Automatically Adjusting the Speed Reference Offset on page 236* , ☞ *(1) Automatically Adjusting the Torque Reference Offset on page 258*
		Fn00A	Manually Adjust Speed Reference Offset	○	○	☞ *(b) Manually Adjusting the Speed Reference Offset on page 237*
		Fn00B	Manually Adjust Torque Reference Offset	○	○	☞ *(2) Manually Adjusting the Torque Reference Offset on page 259*
	Adjust the Analog Monitor Output	**Fn00C**	Adjust Analog Monitor Output Offset	○	○	☞ *9.3.3 Using the Analog Monitors on page 513*
		Fn00D	Adjust Analog Monitor Output Gain	○	○	
	Adjust the Motor Current Detection Offsets	**Fn00E**	Autotune Motor Current Detection Signal Offset	×	○	☞ *6.16 Adjusting the Motor Current Detection Signal Offset on page 317*
		Fn00F	Manually Adjust Motor Current Detection Signal Offset	×	○	
	Initialize Vibration Detection Level	**Fn01B**	Initialize Vibration Detection Level	×	×	☞ *6.15 Vibration Detection Level Initialization on page 314*
	Write Prohibited Setting	**Fn010**	Write Prohibition Setting	○	○	☞ *5.1.4 Write Prohibition Setting on page 161*

[*1] An [Initialize] button will be displayed in the [Edit Parameters] window.

8

Tuning

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

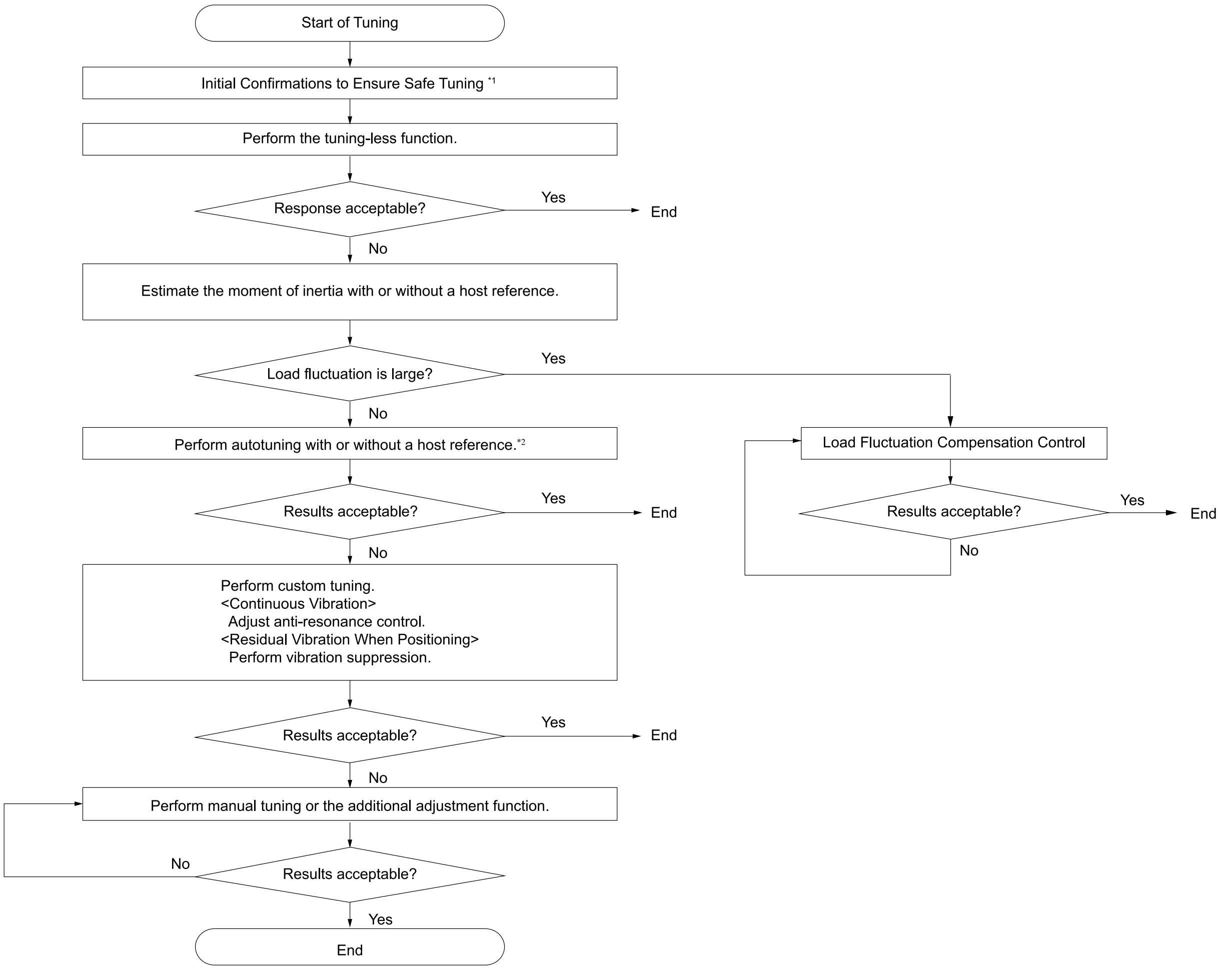
8.1 Overview and Flow of Tuning

Tuning is performed to optimize response by adjusting the servo gains in the SERVOPACK.

The servo gains are set using a combination of parameters, such as parameters for the speed loop gain, position loop gain, filters, friction compensation, and moment of inertia ratio. These parameters influence each other, so you must consider the balance between them.

The servo gains are set to stable settings by default. Use the various tuning functions to increase the response even further for the conditions of your machine.

The basic tuning procedure is shown in the following flowchart. Make suitable adjustments considering the conditions and operating requirements of your machine.



*1 Refer to the following section for details.
☞ *8.3 Precautions to Ensure Safe Tuning on page 364*

*2 If possible, perform autotuning with a host reference.
If a host controller is not available, set an operation pattern that is as close as possible to the host reference and perform autotuning without a host reference.
If an operation pattern that is close to the host reference is not possible, perform autotuning with a host reference while performing program jogging.

8.1.1 Tuning Functions

The following table provides an overview of the tuning functions.

Tuning Function	Outline	Applicable Control Methods	Reference
Tuning-less Function	This automatic adjustment function is designed to enable stable operation without servo tuning. This function can be used to obtain a stable response regardless of the type of machine or changes in the load. You can use it with the default settings.	Speed control or position control	☞ *8.4 Tuning-less Function on page 368*
Moment of Inertia Estimation without a Host Reference	The moment of inertia during operation is automatically calculated by the SERVOPACK for round-trip operation. A reference from the host controller is not used. The moment of inertia ratio that is calculated here is used in other tuning functions.	Speed control, position control, or torque control	☞ *8.5 Moment of Inertia Estimation without a Host Reference on page 373*
Moment of Inertia Estimation with a Host Reference	The load moment of inertia is estimated from operation by reference (position control) from the host controller. The moment of inertia ratio that is calculated here is used in other tuning functions.	Speed control, position control, or torque control	☞ *8.6 Moment of Inertia Estimation with a Host Reference on page 391*
Autotuning without a Host Reference	The following parameters are automatically adjusted in the internal references in the SERVOPACK during automatic operation. • Gains (e.g., position loop gain and speed loop gain) • Filters (torque reference filter and notch filters) • Friction compensation • Anti-resonance control • Vibration suppression	Speed control or position control	☞ *8.7 Autotuning without a Host Reference on page 394*
Autotuning with a Host Reference	The following parameters are automatically adjusted with the position reference input from the host controller while the machine is in operation. You can use this function for fine-tuning after you perform autotuning without a host reference. • Gains (e.g., position loop gain and speed loop gain) • Filters (torque reference filter and notch filters) • Friction compensation • Anti-resonance control • Vibration suppression	Position control	☞ *8.8 Autotuning with a Host Reference on page 407*
Custom Tuning	The following parameters are adjusted with the position reference or speed reference input from the host controller while the machine is in operation. • Gains (e.g., position loop gain and speed loop gain) • Filters (torque reference filter and notch filters) • Friction compensation • Anti-resonance control	Speed control or position control	☞ *8.9 Custom Tuning on page 422*
Anti-Resonance Control Adjustment	This function effectively suppresses continuous vibration.	Speed control or position control	☞ *8.10 Anti-Resonance Control Adjustment on page 431*
Vibration Suppression	This function effectively suppresses residual vibration if it occurs when positioning.	Position control	☞ *8.11 Vibration Suppression on page 438*
Load Fluctuation Compensation Control	This function is used to control fluctuations in response for applications where the load (moment of inertia) fluctuates greatly.	Position control, speed control, or torque control	☞ *8.13 Load Fluctuation Compensation Control on page 465*
Additional Adjustment Function	This function combines autotuning with custom tuning. You can use it to improve adjustment results.	Depends on the functions that you use.	☞ *8.14 Additional Adjustment Functions on page 468*
Manual Tuning	You can manually adjust the servo gains to adjust the response.	Speed control, position control, or torque control	☞ *8.15 Manual Tuning on page 478*

8.1.2 Diagnostic Tool

You can use the following tools to measure the frequency characteristics of the machine and set notch filters.

Diagnostic Tool	Outline	Applicable Control Methods	Reference
Mechanical Analysis	The machine is subjected to vibration to detect resonance frequencies. The measurement results are displayed as waveforms or numeric data.	Speed control, position control, or torque control	☞ *8.16.1 Mechanical Analysis on page 494*
Easy FFT	The machine is subjected to vibration to detect resonance frequencies. The measurement results are displayed only as numeric data.	Speed control, position control, or torque control	☞ *8.16.2 Easy FFT on page 495*

8.2 Monitoring Methods

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

Check the adjustment results with the following response waveforms.

- Position Control

Item	**Unit**	
	Rotary Servomotor	**Linear Servomotor**
Torque reference	%	
Feedback speed	min^{-1}	mm/s
Position reference speed	min^{-1}	mm/s
Position deviation	Reference units	

- Speed Control

Item	**Unit**	
	Rotary Servomotor	**Linear Servomotor**
Torque reference	%	
Feedback speed	min^{-1}	mm/s
Reference speed	min^{-1}	mm/s

- Torque Control

Item	**Unit**	
	Rotary Servomotor	**Linear Servomotor**
Torque reference	%	
Feedback speed	min^{-1}	mm/s

8.3 Precautions to Ensure Safe Tuning

⚠ CAUTION

Observe the following precautions when you perform tuning.

- **Do not touch the rotating parts of the motor when the servo is ON.**
- **Before starting the 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.**

There is a risk of machine damage or injury.

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

8.3.1 Overtravel Settings

Overtravel settings are made to force the servomotor to stop for a signal input from a limit switch when a moving part of the machine exceeds the safe movement range.

Refer to the following section for details.

☞ *5.12 Overtravel Function and Settings on page 186*

8.3.2 Torque Limit Settings

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

Refer to the following section for details.

☞ *6.11 Selecting Torque Limits on page 281*

8.3.3 Setting the Position Deviation Overflow Alarm Level

The position deviation overflow alarm is a protective function that is enabled when the SERVOPACK is used in position control.

If the alarm level is set to a suitable value, the SERVOPACK will detect excessive position deviation and will stop the 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 setting of Pn102 (Position Loop Gain) and the motor speed with the following formula.

- Rotary Servomotors

$$\begin{array}{l}\text{Position deviation}\\ \text{[reference units]}\end{array} = \frac{\text{Motor speed [min}^{-1}\text{]}}{60} \times \frac{\text{Encoder resolution}^{*1}}{\text{Pn102 [0.1/s]}/10^{*2,\,*3}} \times \frac{\text{Pn210}}{\text{Pn20E}}$$

- Linear Servomotors

$$\begin{array}{l}\text{Position deviation}\\ \text{[reference units]}\end{array} = \frac{\text{Motor speed [mm/s]}}{\text{Pn102 [0.1/s]}/10^{*2,\,*3}} \times \frac{\text{Number of divisions}}{\text{Linear encoder scale pitch [}\mu\text{m]}/1000} \times \frac{\text{Pn210}}{\text{Pn20E}}$$

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

- Rotary Servomotors

$$\text{Pn520} > \frac{\text{Maximum motor speed [min}^{-1}]}{60} \times \frac{\text{Encoder resolution}^{*1}}{\text{Pn102 [0.1/s]/10}^{*2,\,*3}} \times \frac{\text{Pn210}}{\text{Pn20E}} \times \underline{\underline{(1.2\text{ to }2)}}^{*4}$$

- Linear Servomotors

$$\text{Pn520} > \frac{\text{Maximum motor speed [mm/s]}}{\text{Pn102 [0.1/s]/10}^{*2,\,*3}} \times \frac{\text{Number of divisions}}{\text{Linear encoder pitch [}\mu\text{m] /1000}} \times \frac{\text{Pn210}}{\text{Pn20E}} \times \underline{\underline{(1.2\text{ to }2)}}^{*4}$$

*1 Refer to the following section for details.

☞ *5.16 Electronic Gear Settings on page 200*

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

*3 To check the setting of Pn102 on the digital operator, set Pn00B to n.□□□1 (display all parameters).

*4 The underlined coefficient “× (1.2 to 2)” adds a margin to prevent an A.d00 alarm (Position Deviation Overflow) from occurring too frequently.

If you set a value that satisfies the formula, an A.d00 alarm (Position Deviation Overflow) should not occur during normal operation.

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

The following calculation example uses a rotary servomotor with a maximum motor speed of 7000 and an encoder resolution of 67108864 (26 bits). Pn102 is set to 400. $\frac{\text{Pn210}}{\text{Pn20E}} = \frac{1}{64}$

$$\text{Pn520} = \frac{7000}{60} \times \frac{67108864}{400/10} \times \frac{1}{64} \times 2$$

$$= 3058347 \times 2$$

$$= 6116694$$

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.

(1) Related Parameters

Pn520	Position Deviation Overflow Alarm Level			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 1073741823	1 reference unit	6116694	Immediately
Pn51E	Position Deviation Overflow Warning Level			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 100	1%	100	Immediately

(2) Related Alarms

Alarm Number	Alarm Name	Alarm Meaning
A.d00	Position Deviation Overflow	The setting of Pn520 (Position Deviation Overflow Alarm Level) was exceeded by the position deviation while the servo was ON.

(3) Related Warnings

Warning Number	Warning Name	Warning Meaning
A.900	Position Deviation Overflow	The position deviation exceeded the percentage set with the following formula: (Pn520 × Pn51E/100)

8.3.4 Vibration Detection Level Setting

You can set Pn312 (Vibration Detection Level) to more accurately detect A.520 alarms (Vibration Alarm) and A.911 warnings (Vibration) when vibration is detected during machine operation.

Set the initial vibration detection level to an appropriate value. Refer to the following section for details.

☞ *6.15 Vibration Detection Level Initialization on page 314*

8.3.5 Setting the Position Deviation Overflow Alarm Level at Servo ON

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

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

(1) Related Parameters

Pn526	Position Deviation Overflow Alarm Level at Servo ON			Speed **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 1073741823	1 reference unit	6116694	Immediately
Pn528	Position Deviation Overflow Warning Level at Servo ON			Speed **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 100	1%	100	Immediately

- Rotary Servomotors

Pn529	Speed Limit Level at Servo ON			Speed **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 min^{-1}	10000	Immediately

- Linear Servomotors

Pn584	Speed Limit Level at Servo ON			Speed **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 mm/s	10000	Immediately

(2) Related Alarms

Alarm Number	Alarm Name	Alarm Meaning
A.d01	Position Deviation Overflow Alarm at Servo ON	The servo was turned ON after the position deviation exceeded the setting of Pn526 (Position Deviation Overflow Alarm Level at Servo ON) while the servo was OFF.
A.d02	Position Deviation Overflow Alarm for Speed Limit at Servo ON	If position deviation remains in the deviation counter, the setting of Pn529 or Pn584 (Speed Limit Level at Servo ON) limits the speed when the servo is turned ON. This alarm occurs if reference pulses are input and the setting of Pn520 (Position Deviation Overflow Alarm Level) is exceeded before the limit is cleared.

Refer to the following section for information on troubleshooting alarms.

☞ *13.2.3 Alarm Reset on page 610*

(3) Related Warnings

Warning Number	Warning Name	Warning Meaning
A.901	Position Deviation Overflow Alarm at Servo ON	The position deviation when the servo was turned ON exceeded the percentage set with the following formula: (Pn526 × Pn528/100)

8.4 Tuning-less Function

The tuning-less function performs autotuning to obtain a stable response regardless of the type of machine or changes in the load. Autotuning is started when the servo is turned ON.

⚠ CAUTION

To ensure safety, make sure that you can perform an emergency stop at any time when you change the tuning-less level and change the tuning-less type.

Important

The servomotor may vibrate if it exceeds the allowable load moment of inertia. If that occurs, set Pn170 to n.2□□□ (set the load level for the tuning-less function to 2) or reduce the setting of Pn170 = n.□X□□ (Rigidity Level).

Information

- The tuning-less function is disabled during torque control.
- The servomotor may momentarily emit a sound or vibrate the first time the servo is turned ON after the servomotor is connected to the machine. This sound is caused by setting the automatic notch filter. It does not indicate a problem. Depending on the mechanism, the automatic notch filter may not be set to an appropriate frequency. If this sound or vibration continues, set Pn460 to n.□0□□ (do not adjust automatically) and manually set a function to suppress vibration (e.g., a notch filter). Refer to the following section for the settings of functions that are automatically adjusted.
  ☞ *8.4.5 Automatically Adjusted Function Setting on page 371*

8.4.1 Application Restrictions

The following application restrictions apply to the tuning-less function.

Function	Executable? [1]	Remarks
Vibration Detection Level Initialization	○	–
Moment of Inertia Estimation	×	Set Pn170 to n.□□□0 (disable the tuning-less function) before you execute moment of inertia estimation.
Autotuning without a Host Reference	×	Set Pn170 to n.□□□0 (disable the tuning-less function) before you execute autotuning without a host reference. [2]
Autotuning with a Host Reference	×	–
Custom Tuning	×	–
Anti-Resonance Control Adjustment	×	–
Vibration Suppression	×	–
Load Fluctuation Compensation	×	Set Pn170 to n.□□□0 (disable the tuning-less function), turn the power OFF and then ON again, and then set Pn173 to n.□□□1 (enable load fluctuation compensation).
EasyFFT	○	The tuning-less function is disabled while you execute Easy FFT and then it is enabled when Easy FFT has been completed.
Friction Compensation	×	–
Gain Switching	×	–
Mechanical Analysis	○	The tuning-less function is disabled while you execute mechanical analysis and then it is enabled when mechanical analysis has been completed.

[1] ○: Yes ×: No

[2] To execute this function from the digital operator, set Jcalc = ON (estimate moment of inertia) [default setting] on the Fn201 (Advanced Autotuning without Reference) setting display of the digital operator when Pn170 = n.□□□1 (enable the tuning-less function) [default setting], and then autotuning without a host reference can be executed.
Refer to the following manual for the operating procedures for the digital operator.

🕮 Σ-7/Σ-X-series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)

8.4.2 Operating Procedure

The tuning-less function is enabled in the default settings. No specific procedure is required. You can use the following parameter to enable or disable the tuning-less function.

Pn170	n.□□□X	Tuning-less Selection	Speed Pos Trq	When Enabled
		0	Disable tuning-less function.	After restart
		1 Default	Enable tuning-less function.	
Pn170	n.□□X□	Speed Control Method	Speed Pos Trq	When Enabled
		0 Default	Use for speed control.	After restart
		1	Use for speed control and use host controller for position control.	

When you enable the tuning-less function, you can select the tuning-less type.

Normally, set Pn14F to n.□□3□ (use tuning-less type 4) (default setting). If you set Pn14F to n.□□3□, load level correction will be switched automatically.

If you require compatibility with previous products, use one of the following settings.

- Pn14F= n.□□0□ (use tuning-less type 1)
- Pn14F= n.□□1□ (use tuning-less type 2)
- Pn14F= n.□□2□ (use tuning-less type 3)

If you set the parameter to one of the above settings, load level correction will not be switched automatically.

Information Automatic switching of load level correction is used to automatically switch Pn170 = n.X□□□ (Tuning-less Load Level) according to the load. Automatic switching of load level correction is used to execute tuning automatically so that the SERVOPACK can handle a load up to 100-times that of the normal load.

Pn14F	n.□□X□	Tuning-less Type Selection	Speed Pos Trq	When Enabled
		0	Use tuning-less type 1.	After restart
		1	Use tuning-less type 2.	
		2	Use tuning-less type 3.	
		3 Default	Use tuning-less type 4.	

(1) Tuning-less Level Settings

If vibration or other problems occur, change the tuning-less levels. To change the tuning-less levels, use the SigmaWin+.

(a) Preparations

Always check the following before you set the tuning-less levels.

- Pn170 must be set to n.□□□1 (Tuning-less Selection is enabled).
- Pn00C must be set to n.□□□0 (Function Selection for Test without a Motor is disabled).
- The servomotor must be connected to the machine.

(b) Procedure

Use the following procedure to set the tuning-less levels.

Information This section gives the procedure using the SigmaWin+, but the tuning-less levels can also be set with parameters. Refer to the following sections for details on the parameters to set.

☞ *(c) Related Parameters on page 370*

1. **Click the [▤] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Select [Response Level Setting] in the [Menu] window.**

   The [Turning-less Level Setting-Adj] window will be displayed.

3. **Click the [▲] or [▼] button to adjust the turning-less level setting. Increase the turning-less level setting to increase the response. Decrease the turning-less level setting to suppress vibration.**

   The default response level setting is 4.

Tuning-less Rigidity Level	Description	Remarks
7	Response level: High	These levels cannot be selected if Pn14F is set to n.□□0□ or n.□□1□ (use tuning-less type 1 or 2).
6	↓	
5		
4 (default setting)		–
3		
2		
1		
0	Response level: Low	

4. **Click the [Completed] button.**

   The adjustment results will be saved in the SERVOPACK.

Important If the servomotor will be removed from the machine, always reset the tuning-less levels back to the default settings. If you turn ON the servo when the servomotor has been removed from the machine without resetting the default settings, there is a risk of servomotor vibration.

(c) Related Parameters

◆ Tuning-less Rigidity Level

If Pn14F is set to n.□□0□ or n.□□1□ (use tuning-less type 1 or 2), set Pn170 to n.□0□□ to n.□4□□ (tuning-less level 0 to 4). Do not set Pn170 to n.□5□□ to n.□7□□ (tuning-less level 5 to 7).

Information Tuning-less level 0 is the lowest response level, and then levels increase up to the largest response level at tuning-less level 7.

Pn170	n.□X□□	Tuning-less Level	Speed Pos Trq	When Enabled
		0	Set the tuning-less level to 0.	Immediately
		1	Set the tuning-less level to 1.	
		2	Set the tuning-less level to 2.	
		3	Set the tuning-less level to 3.	
		4 Default	Set the tuning-less level to 4.	
		5	Set the tuning-less level to 5.	
		6	Set the tuning-less level to 6.	
		7	Set the tuning-less level to 7.	

◆ Tuning-less Load Level

Pn170	n.X□□□	Tuning-less Load Level	Speed Pos Trq	When Enabled
		0	Set the tuning-less load level to 0.	Immediately
		1 Default	Set the tuning-less load level to 1.	
		2	Set the tuning-less load level to 2.	

8.4.3 Troubleshooting Alarms

An A.521 alarm (Autotuning Alarm) will occur if a resonant sound occurs or if excessive vibration occurs during position control. If an alarm occurs, implement the following measures.

- Resonant Sound
  Decrease the setting of Pn170 = n.X□□□ or Pn170 = n.□X□□.
- Excessive Vibration during Position Control
  Increase the setting of Pn170 = n.X□□□ or decrease the setting of Pn170 = n.□X□□.

8.4.4 Parameters Disabled by Tuning-less Function

When Pn170 is set to n.□□□1 (the tuning-less function is enabled) (default setting), the parameters in the following table are disabled.

Parameter Name	Parameter Number
Speed Loop Gain Second Speed Loop Gain	Pn100 Pn104
Speed Loop Integral Time Constant Second Speed Loop Integral Time Constant	Pn101 Pn105
Position Loop Gain Second Position Loop Gain	Pn102 Pn106
Moment of Inertia Ratio	Pn103
Friction Compensation Function Selection	Pn408 = n.X□□□
Anti-Resonance Control Selection	Pn160 = n.□□□X
Gain Switching Selection	Pn139 = n.□□□X

The tuning-less function is disabled during torque control, Easy FFT, and mechanical analysis for a vertical axis. In addition, Pn100, Pn104, Pn101, Pn105, Pn102, Pn106, and Pn103 in the above table are enabled for torque control, Easy FFT, and mechanical analysis for a vertical axis. Of these, only Pn100, Pn103, and Pn104 are enabled for torque control.

8.4.5 Automatically Adjusted Function Setting

You can also automatically adjust notch filters.

Normally, set Pn460 to n.□1□□ (adjust automatically) (default setting). Vibration is automatically detected and a notch filter is set.

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

Pn460	n.□X□□	Notch Filter Adjustment Selection 2 Speed Pos Trq		When Enabled
		0	Do not adjust the second stage notch filter automatically when the tuning-less function is enabled or during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately
		1 Default	Adjust the second stage notch filter automatically when the tuning-less function is enabled or during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	

8.4.6 Related Parameters

The following parameters are automatically adjusted when you execute the tuning-less function.

Do not manually change the settings of these parameters after you have enabled the tuning-less function.

Parameter	Name
Pn401	First Stage First Torque Reference Filter Time Constant
Pn40A	First Stage Notch Filter Q Value
Pn40C	Second Stage Notch Filter Frequency
Pn40D	Second Stage Notch Filter Q Value

8.5 Moment of Inertia Estimation without a Host Reference

This section describes how the moment of inertia without a host reference is calculated.

The moment of inertia ratio that is calculated here is used in other tuning functions. You can also estimate the moment of inertia during autotuning without a host reference. Refer to the following section for the procedure.

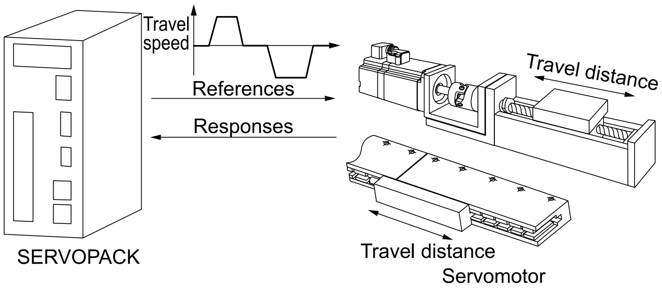
☞ *8.7.4 Operating Procedure on page 396*

8.5.1 Outline

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

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

Although the load moment of inertia can be calculated from the weight and structure of the mechanisms, doing so is very troublesome and calculating it accurately can be very difficult with the complex mechanical structures that are used these days. With this function, you can estimate load moment of inertia with good accuracy.



Note:

Execute this function after jogging to a position that ensures a suitable range of motion.

8.5.2 Restrictions

The following restrictions apply to estimating the moment of inertia without a host reference.

(1) Systems for which Execution Cannot Be Performed

- When the machine system can move only in one direction
- When the range of motion is greater than 0.25 rotations and less than or equal to 0.5 rotations

(2) 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 P control is used

  Note:

  If you specify calculating the moment of inertia, an error will occur if the /P-CON (Proportional Control Input) signal changes to specify the proportional action during moment of inertia estimation.
- When mode switching is used

  Note:

  If you specify moment of inertia estimation, mode switching will be disabled and PI control will be used while the moment of inertia is being calculated. Mode switching will be enabled after moment of inertia estimation has been completed.
- When speed feedforward or torque feedforward is input

(3) Preparations

Always check the following before you execute moment of inertia estimation without a host reference.

- The main circuit power must be ON.
- There must be no overtravel.
- The servo must be OFF.
- The control method must not be set to torque control.
- The gain switching selection must be Pn139 = n.□□□0 (automatic gain switching is disabled).
- The gain 1 must be selected.
- Pn00C must be set to n.□□□0 (Function Selection for Test without a Motor is disabled).
- Pn170 must be set to n.□□□0 (tuning-less function is disabled).
- Pn173 must be set to n.□□□0 (a load fluctuation compensation control is disabled).
- There must be no alarms or warnings.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.

8.5.3 Applicable Tools

The following table lists the tools that you can use to estimate the moment of inertia without a host reference.

Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	You cannot estimate the moment of inertia without a host reference from the panel operator.	
Digital Operator	You cannot estimate the moment of inertia without a host reference from the digital operator.	
SigmaWin+	[Tuning] - [Tuning]	☞ *8.5.4 Operating Procedure on page 375*

8.5.4 Operating Procedure

⚠ WARNING

Moment of inertia estimation is a measurement function that actually drives the machine and therefore presents hazards. Observe the following precautions.

- **Confirm safety around moving parts.**
- **This function involves automatic reciprocating operation. Make sure that you can perform an emergency stop (to turn OFF the power supply) at any time.**
- **There will be movement in both directions within the set range of movement. Check the range of movement and the directions and implement protective measures for safety, such as the overtravel functions.**

Important

The stopping method if you cancel the moment of inertia estimation without a host reference is given below.

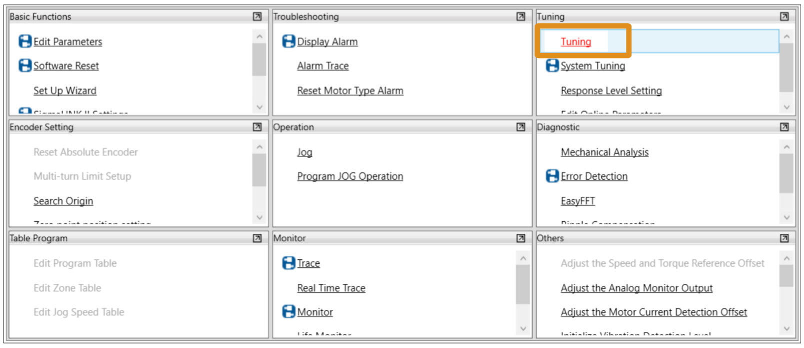
- If you cancel operation with the [Servo OFF] button, the servomotor will stop according to the setting of Pn001 = n.□□□X (Motor Stopping Method for Servo OFF).
- If you cancel operation with the [Cancel] button, the servomotor will decelerate to a stop and then enter a zero-clamped state.

Use the following procedure to estimate the moment of inertia without a host reference.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

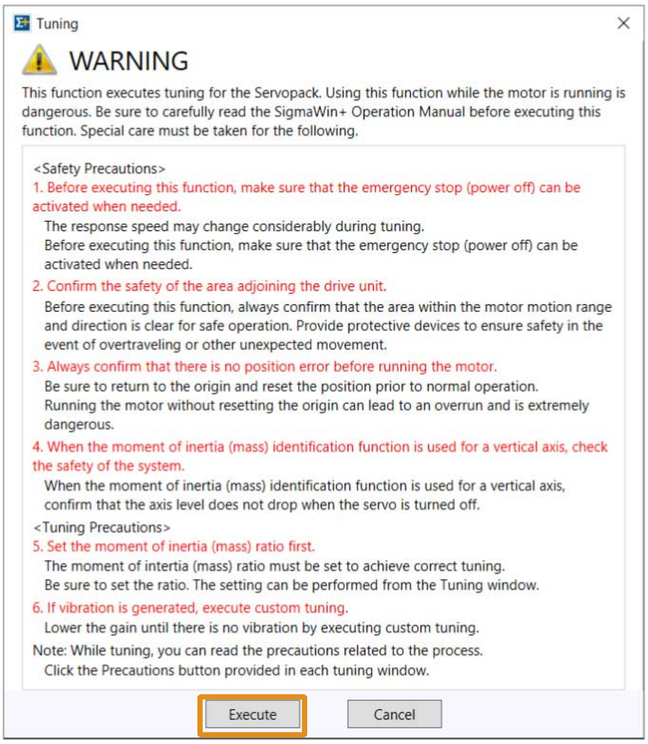
   The [Menu] window will be displayed.

2. **Click [Tuning] in the [Tuning] area.**



   The [Tuning] window will be displayed.

3. **Read the warnings and then click the [Execute] button.**



Tuning

WARNING

This function executes tuning for the Servopack. Using this function while the motor is running is dangerous. Be sure to carefully read the SigmaWin+ Operation Manual before executing this function. Special care must be taken for the following.

<Safety Precautions>

1. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
   The response speed may change considerably during tuning.
   Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
2. Confirm the safety of the area adjoining the drive unit.
   Before executing this function, always confirm that the area within the motor motion range and direction is clear for safe operation. Provide protective devices to ensure safety in the event of overtraveling or other unexpected movement.
3. Always confirm that there is no position error before running the motor.
   Be sure to return to the origin and reset the position prior to normal operation.
   Running the motor without resetting the origin can lead to an overrun and is extremely dangerous.
4. When the moment of inertia (mass) identification function is used for a vertical axis, check the safety of the system.
   When the moment of inertia (mass) identification function is used for a vertical axis, confirm that the axis level does not drop when the servo is turned off.

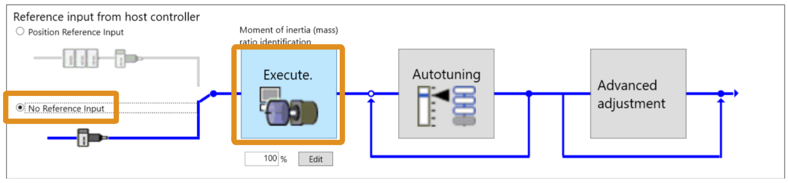
<Tuning Precautions>

5. Set the moment of inertia (mass) ratio first.
   The moment of intertia (mass) ratio must be set to achieve correct tuning.
   Be sure to set the ratio. The setting can be performed from the Tuning window.
6. If vibration is generated, execute custom tuning.
   Lower the gain until there is no vibration by executing custom tuning.

Note: While tuning, you can read the precautions related to the process.
Click the Precautions button provided in each tuning window.

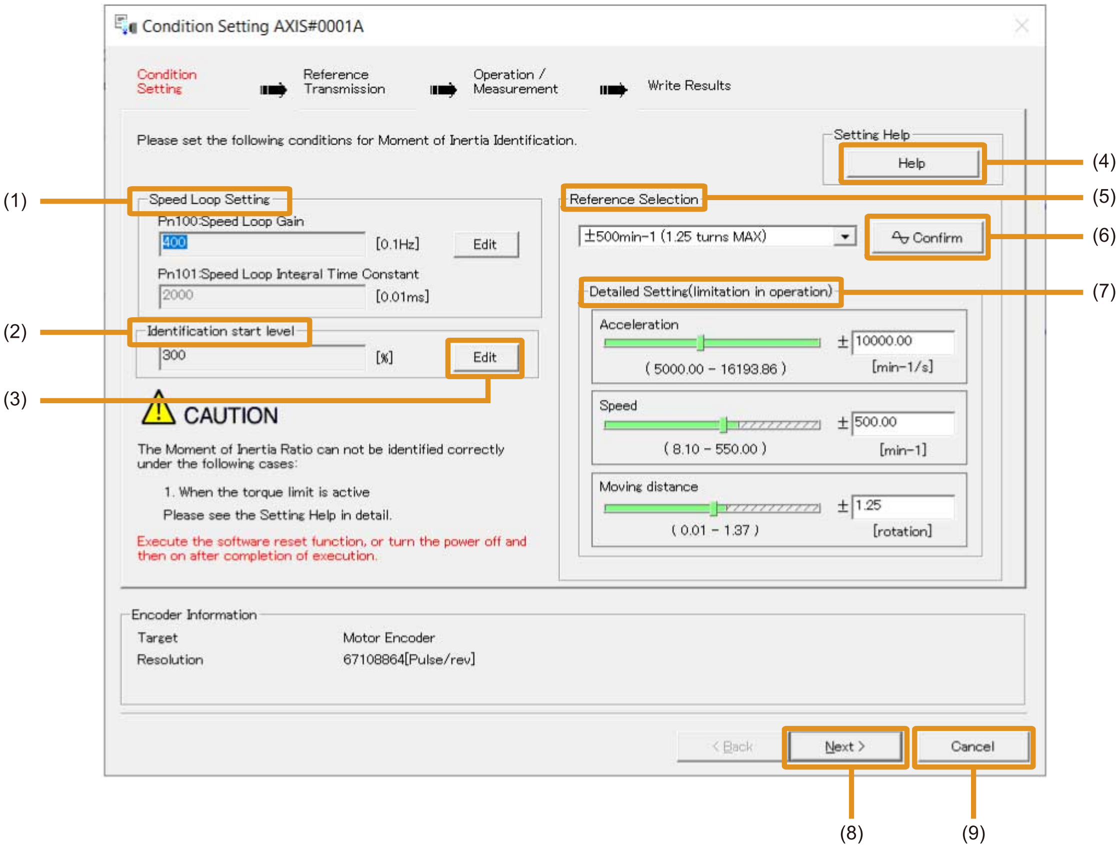
The [Tuning] window will be displayed.

4. **Under [Reference input from host controller], select [No Reference Input], and then click the [Execute] button.**



The [Condition Setting] window will be displayed.

5. **Set the conditions as required.**



Condition Setting AXIS#0001A

Please set the following conditions for Moment of Inertia Identification.

Setting Help

Speed Loop Setting

Pn100:Speed Loop Gain 400 [0.1Hz]

Pn101:Speed Loop Integral Time Constant 2000 [0.01ms]

Identification start level 300 [%]

CAUTION

The Moment of Inertia Ratio can not be identified correctly under the following cases:

1. When the torque limit is active

Please see the Setting Help in detail.

Execute the software reset function, or turn the power off and then on after completion of execution.

Reference Selection

±500min-1 (1.25 turns MAX)

Detailed Setting(limitation in operation)

Acceleration ±10000.00 (5000.00 - 16193.86) [min-1/s]

Speed ±500.00 (8.10 - 550.00) [min-1]

Moving distance ±1.25 (0.01 - 1.37) [rotation]

Encoder Information

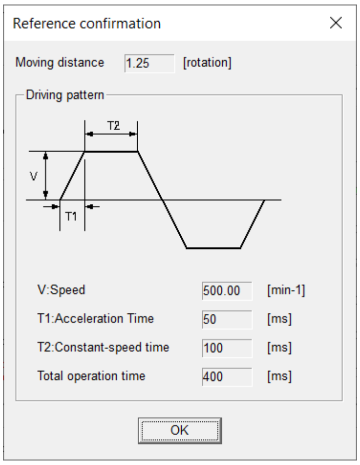
Target Motor Encoder

Resolution 67108864[Pulse/rev]

No.	Item	Meaning
(1)	[Speed Loop Setting]	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. A suitable value is set to perform the moment of inertia estimation. 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]	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] button	Click the button to display a window to change the settings related to the speed loop or estimation start level.
(4)	[Help] button	Click this button to display guidelines for setting the reference conditions. Make the following settings as required. • Operate the servomotor to measure the load moment of inertia of the machine in comparison with the rotor moment of inertia. • Set the operation mode, reference pattern (maximum acceleration rate, maximum speed, and maximum travel distance), and speed loop-related parameters. • Correct measurement of the moment of inertia ratio may not be possible depending on the settings. Set suitable settings using the measurement results as reference.
(5)	[Reference Selection]	Either select the reference pattern for estimation processing from the box, or set the values in the [Detailed Setting]. 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.

Continued on next page.

Continued from previous page.

No.	Item	Meaning
(6)	[Confirm] button	Click this button to display the [Reference Confirmation] window.  Reference confirmation Moving distance 1.25 [rotation] Driving pattern V:Speed 500.00 [min-1] T1:Acceleration Time 50 [ms] T2:Constant-speed time 100 [ms] Total operation time 400 [ms]
(7)	[Detailed Setting]	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] window.
(9)	[Cancel] button	Click this button to return to the [Tuning] window.

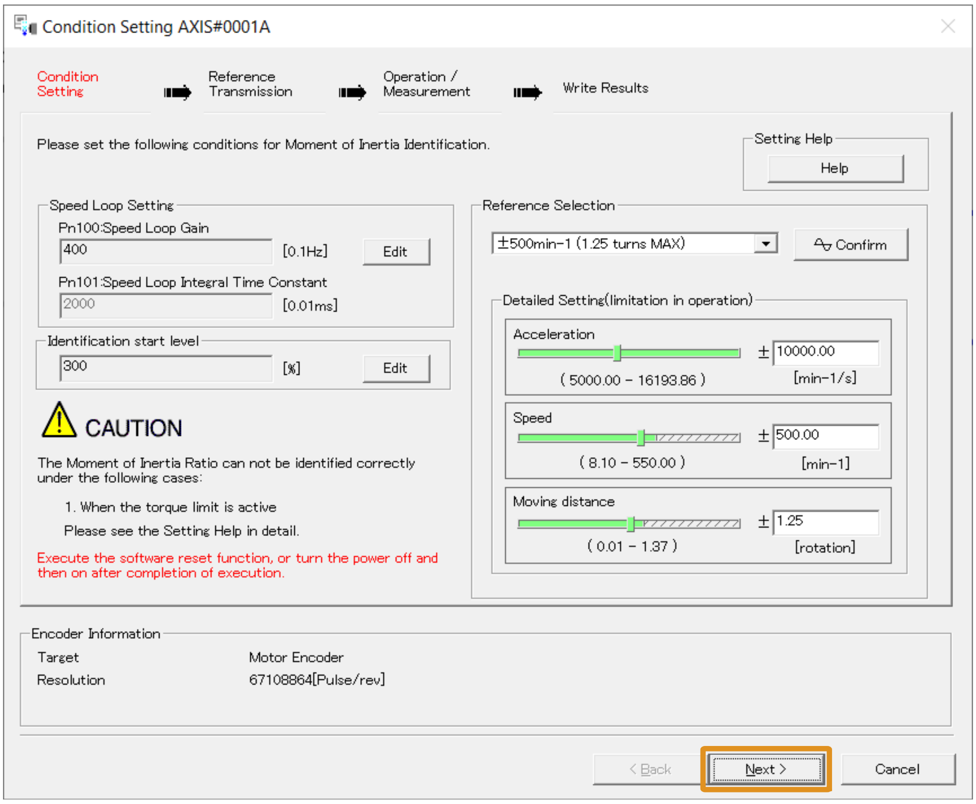
Important

- The travel distance is the distance for one operation in the forward or reverse direction. During multiple operations, the operation starting position may move in one direction or the other. Confirm the possible operating range for each measurement or operation.
- Depending on the parameter settings and the moment of inertia of the machine, overshooting may occur and may cause the maximum speed setting to be exceeded temporarily. Allow sufficient leeway in the settings.

Information **When Measurement Is Not Correct**

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

6. Click the [Next] button.



Condition Setting AXIS#0001A

Please set the following conditions for Moment of Inertia Identification.

Speed Loop Setting

Pn100:Speed Loop Gain 400 [0.1Hz] Edit

Pn101:Speed Loop Integral Time Constant 2000 [0.01ms]

Identification start level 300 [%] Edit

CAUTION

The Moment of Inertia Ratio can not be identified correctly under the following cases:

1. When the torque limit is active

Please see the Setting Help in detail.

Execute the software reset function, or turn the power off and then on after completion of execution.

Reference Selection

±500min−1 (1.25 turns MAX)

Detailed Setting(limitation in operation)

Acceleration ± 10000.00 (5000.00 – 16193.86) [min−1/s]

Speed ± 500.00 (8.10 – 550.00) [min−1]

Moving distance ± 1.25 (0.01 – 1.37) [rotation]

Encoder Information

Target Motor Encoder

Resolution 67108864[Pulse/rev]

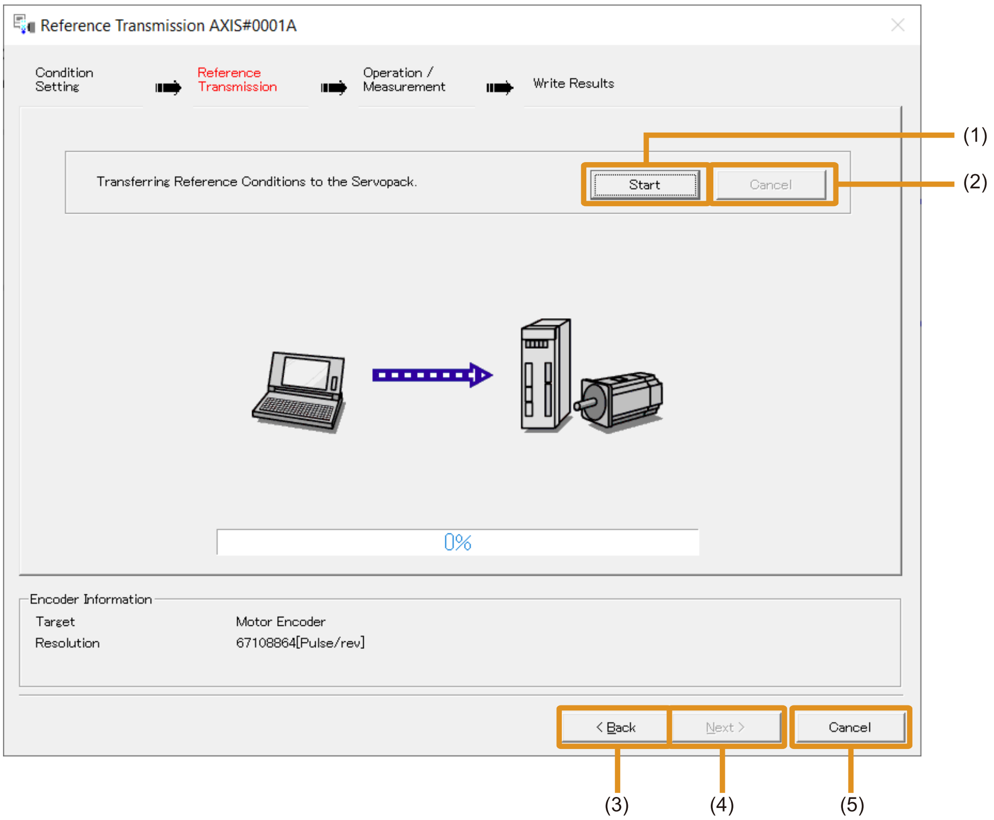
The procedure after this step depends on the travel distance. If any of the following apply, proceed to the next step.

- The travel distance of a rotary servomotor is 0.25 rotations or more.
- The travel distance of a direct drive servomotors is 0.04 rotations or more.
- The travel distance of a linear servomotor is 2.5 mm or more.

If none of the above apply, refer to the following section.

☞ *(1) Moment of Inertia Estimation without a Host Reference When Travel Distance Is Short on page 385*

7. **Click the [Start] button.**



Reference Transmission AXIS#0001A

Transferring Reference Conditions to the Servopack.

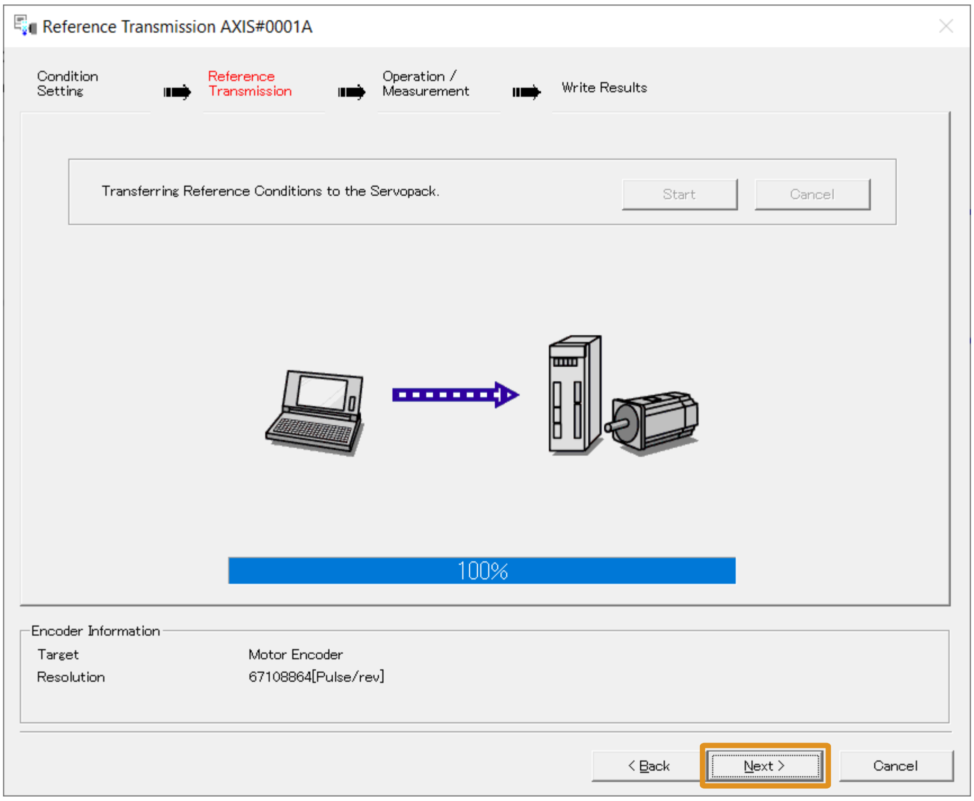
Encoder Information

Target Motor Encoder

Resolution 67108864[Pulse/rev]

No.	Item	Meaning
(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] window. 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] window.
(5)	[Cancel] button	This button cancels processing and returns you to the [Tuning] window.

8. **Click the [Next] button.**



Reference Transmission AXIS#0001A

Transferring Reference Conditions to the Servopack.

100%

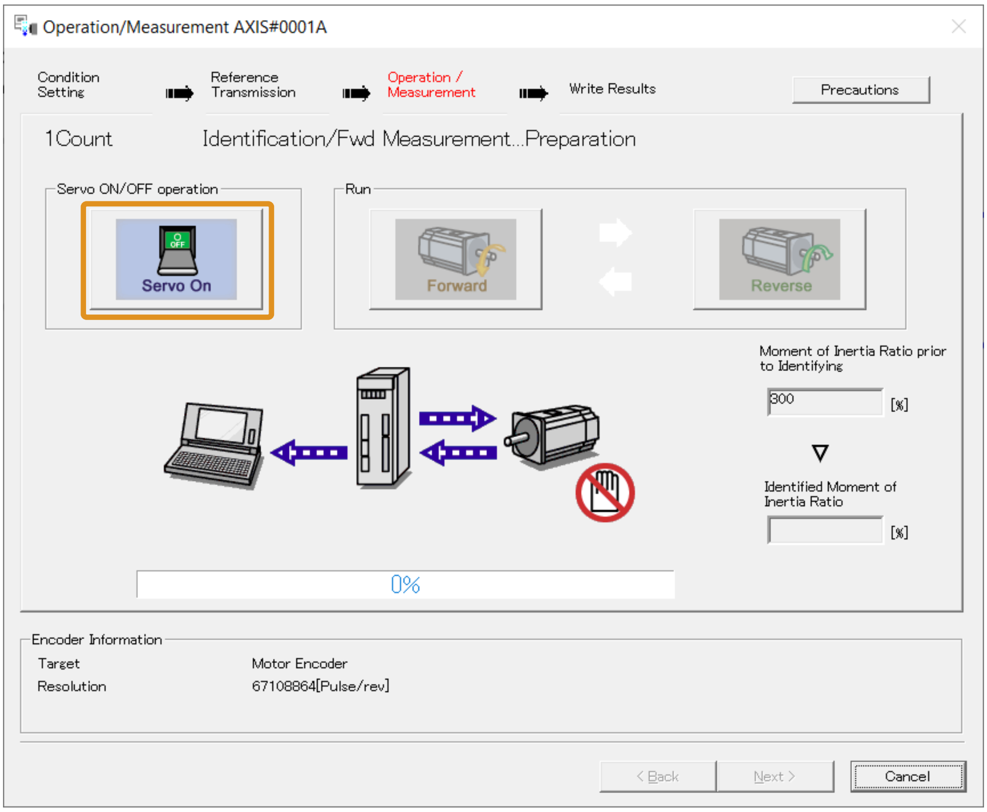
Encoder Information

Target Motor Encoder

Resolution 67108864[Pulse/rev]

The [Operation/Measurement] window will be displayed.

9. **Click the [Servo On] button.**



Operation/Measurement AXIS#0001A

1Count Identification/Fwd Measurement...Preparation

Moment of Inertia Ratio prior to Identifying 300 [%]

Identified Moment of Inertia Ratio [%]

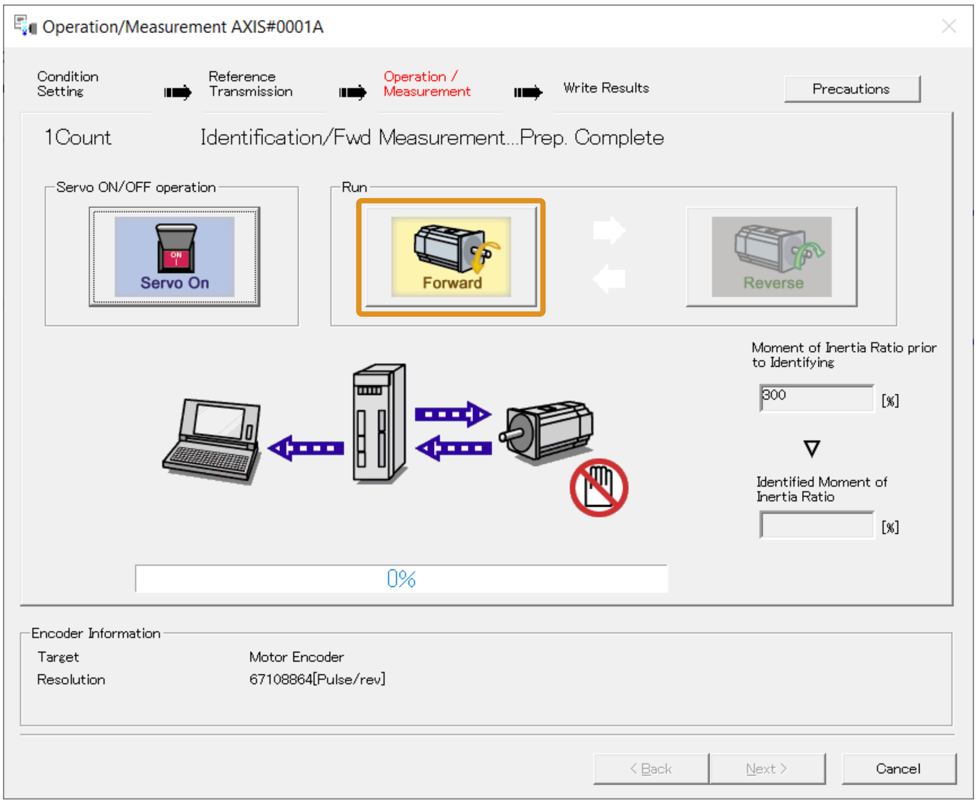
0%

Encoder Information

Target Motor Encoder

Resolution 67108864[Pulse/rev]

10. **Click the [Forward] button.**



Operation/Measurement AXIS#0001A

1Count Identification/Fwd Measurement...Prep. Complete

Moment of Inertia Ratio prior to Identifying: 300 [%]

Identified Moment of Inertia Ratio: [%]

0%

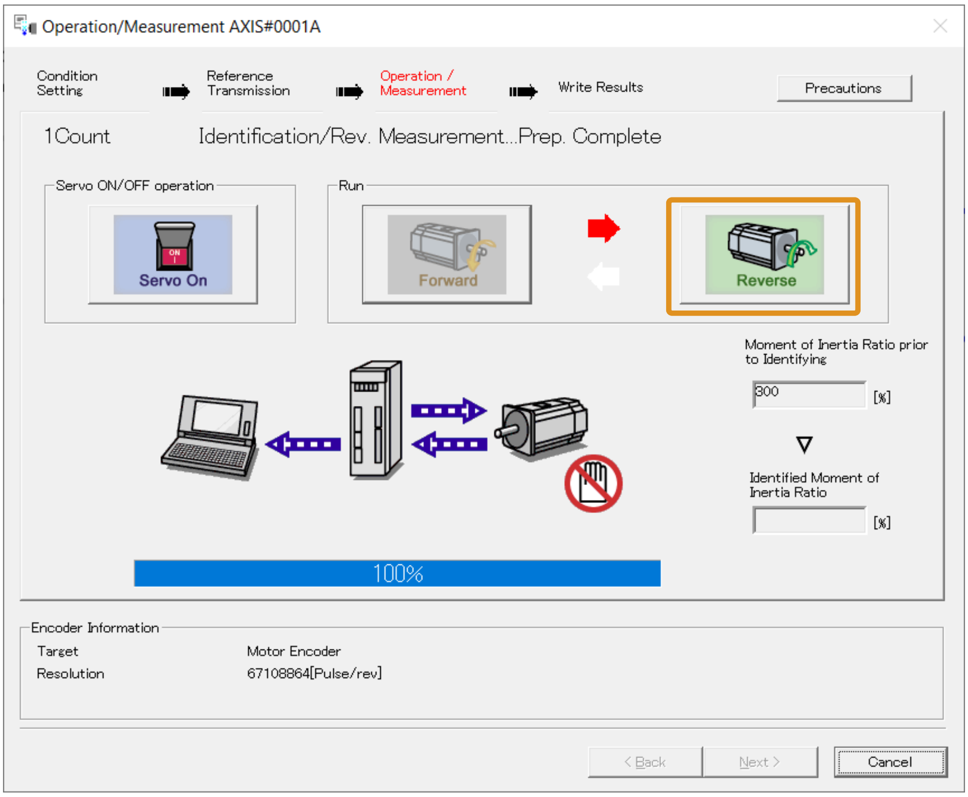
Encoder Information

Target: Motor Encoder

Resolution: 67108864[Pulse/rev]

The servomotor shaft will rotate in the forward direction and the measurement will start. After the measurement and data transfer have been completed, the [Reverse] button will be displayed in color.

11. **Click the [Reverse] button.**



Operation/Measurement AXIS#0001A

1Count Identification/Rev. Measurement...Prep. Complete

Moment of Inertia Ratio prior to Identifying: 300 [%]

Identified Moment of Inertia Ratio: [%]

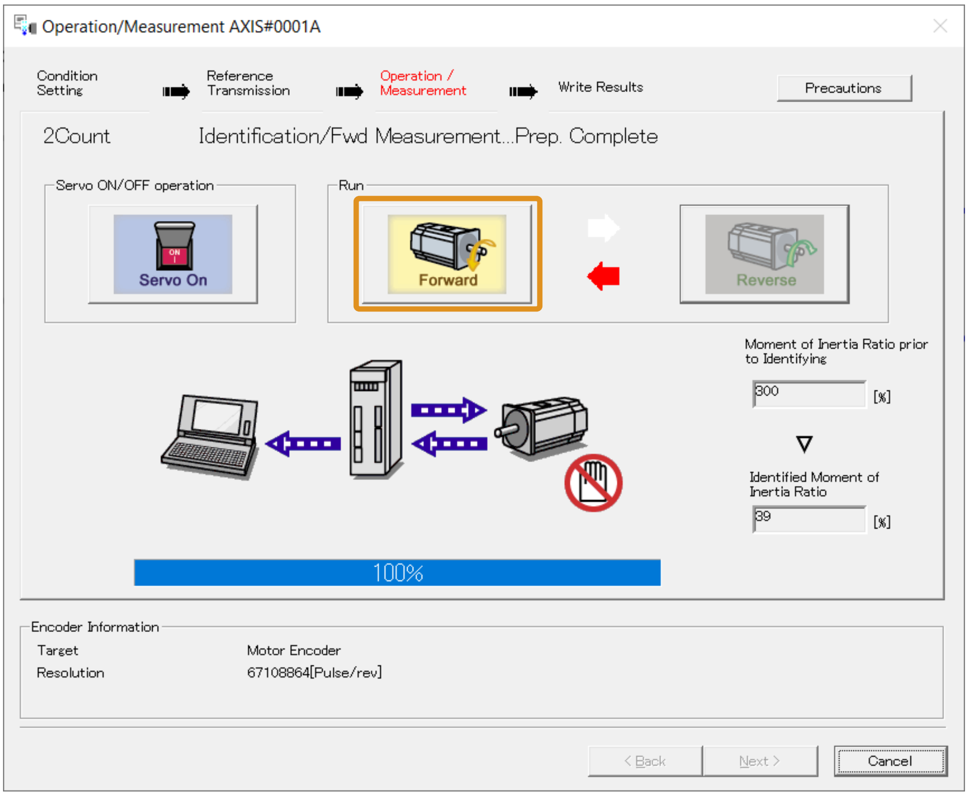
100%

Encoder Information

Target: Motor Encoder

Resolution: 67108864[Pulse/rev]

The servomotor shaft will rotate in the reverse direction and the measurement will start. After the measurement and data transfer have been completed, the [Forward] button will be displayed in color.



2Count Identification/Fwd Measurement...Prep. Complete

Moment of Inertia Ratio prior to Identifying: 300 [%]

Identified Moment of Inertia Ratio: 39 [%]

Encoder Information

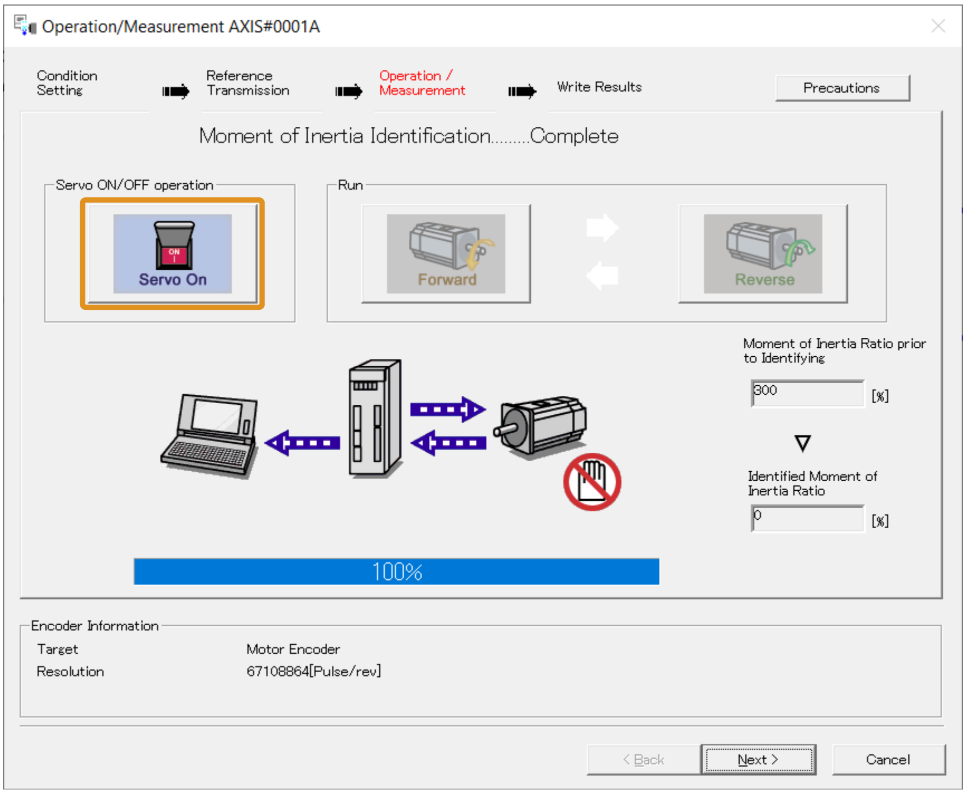
Target: Motor Encoder

Resolution: 67108864[Pulse/rev]

12. **Repeat steps 10 to 11 until the [Next] button is enabled.**

    Measurements are performed from 2 to 7 times and then verified. The number of measurements is displayed in upper left corner of the window. A progress bar at the bottom of the window will show the progress of the transfer each time.

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



Moment of Inertia Identification.........Complete

Moment of Inertia Ratio prior to Identifying: 300 [%]

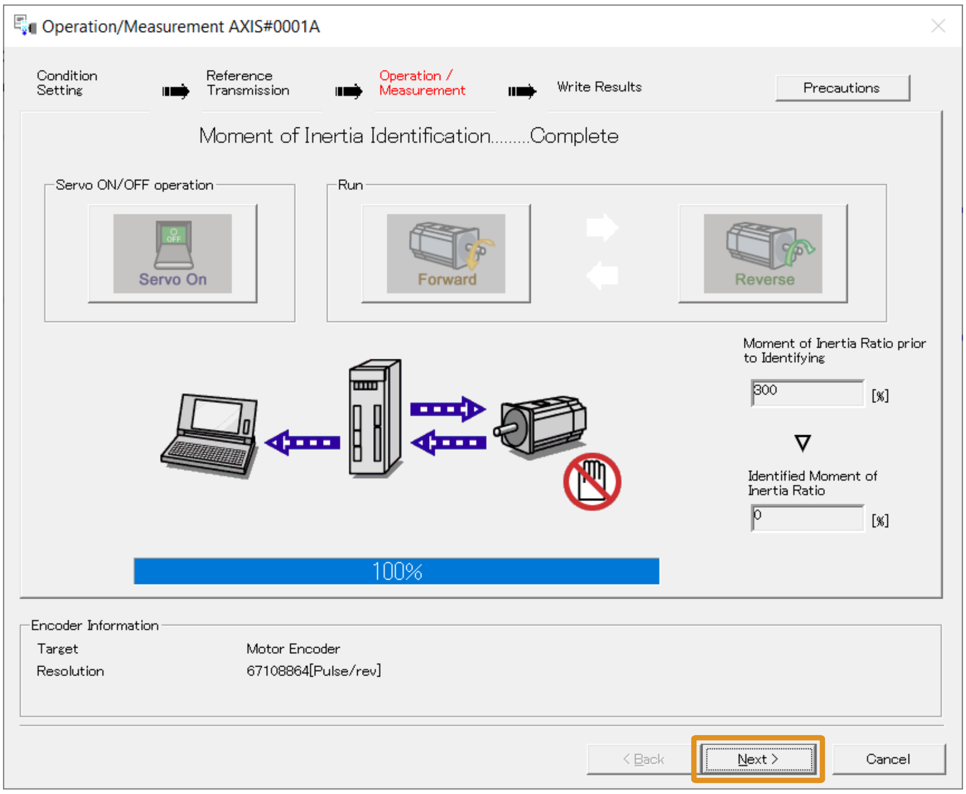
Identified Moment of Inertia Ratio: 0 [%]

Encoder Information

Target: Motor Encoder

Resolution: 67108864[Pulse/rev]

14. **Click the [Next] button.**



Moment of Inertia Identification.........Complete

Moment of Inertia Ratio prior to Identifying: 300 [%]

Identified Moment of Inertia Ratio: 0 [%]

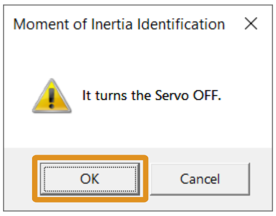
Encoder Information

Target: Motor Encoder

Resolution: 67108864[Pulse/rev]

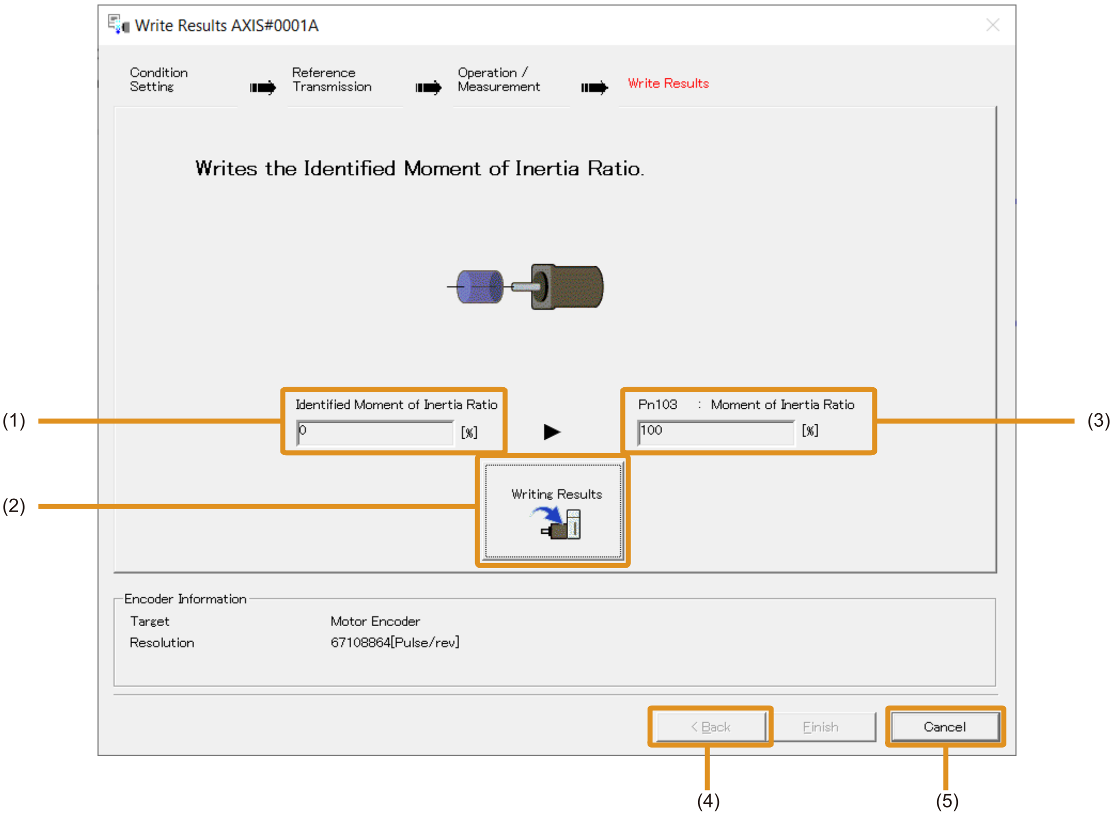
The [Write Results] window will be displayed.

Information If you click the [Next] button before you turn OFF the servo, the following message dialog box will be displayed. Click the [OK] button to turn OFF the servo.



It turns the Servo OFF.

15. **Click the [Writing Results] button.**



Writes the Identified Moment of Inertia Ratio.

Identified Moment of Inertia Ratio: 0 [%]

Pn103 : Moment of Inertia Ratio: 100 [%]

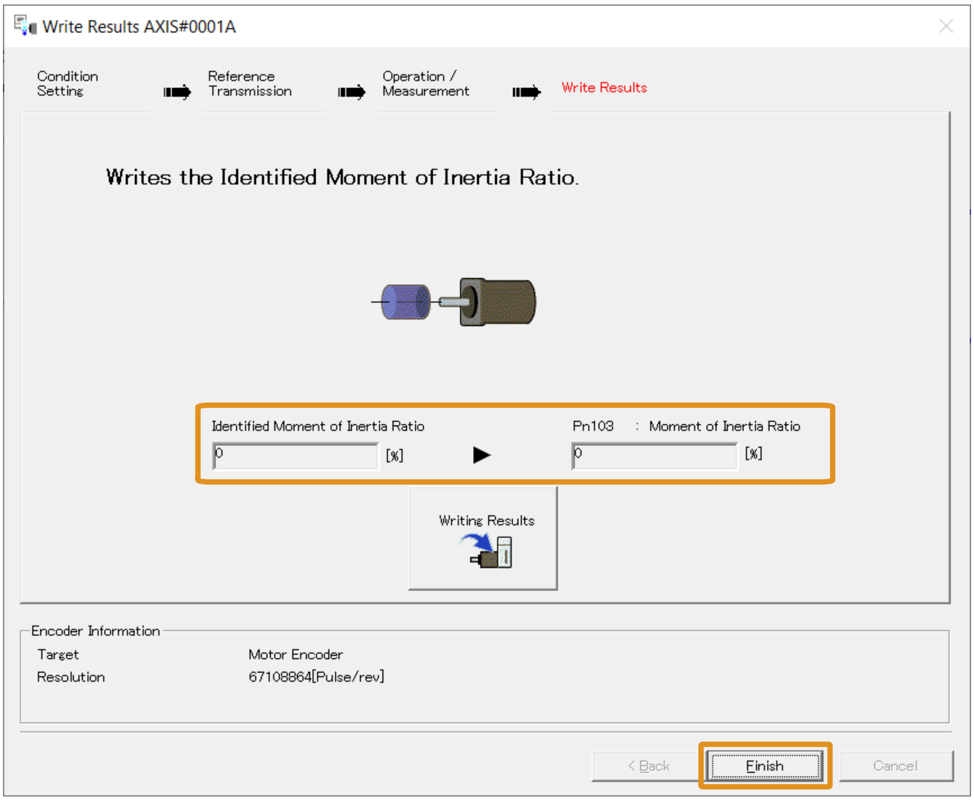
Encoder Information

Target: Motor Encoder

Resolution: 67108864[Pulse/rev]

No.	Item	Meaning
(1)	[Identified Moment of Inertia Ratio]	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]	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	You will return to the [Tuning] window.

16. **Confirm that the [Identified Moment of Inertia Ratio] and the [Pn103: Moment of Inertia Ratio] show the same value and then click the [Finish] button.**



Writes the Identified Moment of Inertia Ratio.

Identified Moment of Inertia Ratio: 0 [%]

Pn103 : Moment of Inertia Ratio: 0 [%]

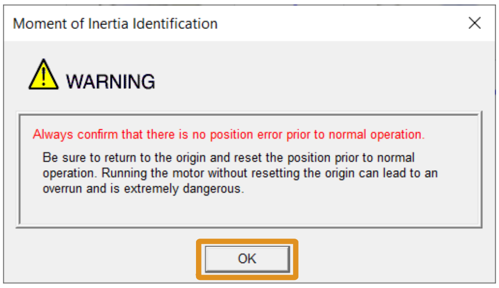
Encoder Information

Target: Motor Encoder

Resolution: 67108864[Pulse/rev]

The message dialog box will be displayed.

17. **Click the [OK] button.**



Always confirm that there is no position error prior to normal operation.

Be sure to return to the origin and reset the position prior to normal operation. Running the motor without resetting the origin can lead to an overrun and is extremely dangerous.

If the setting of Pn103 (Moment of Inertia Ratio) was changed, the new value will be saved and the [Tuning] window will be displayed again.

This concludes the procedure to estimate the moment of inertia ratio without a host reference.

(1) Moment of Inertia Estimation without a Host Reference When Travel Distance Is Short

Use the following procedure to estimate the moment of inertia without a host reference when any of the following apply to the travel distance.

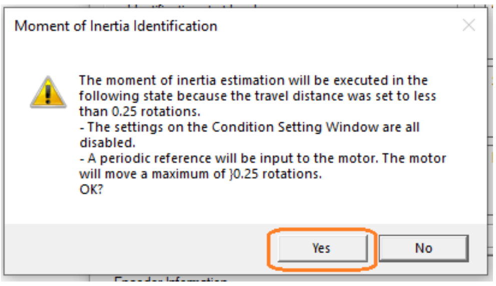
- The travel distance of a rotary servomotor is less than 0.25 rotations.
- The travel distance of a direct drive servomotors is less than 0.04 rotations.
- The travel distance of a linear servomotor is less than 2.5 mm.

Note:

This section does not contain the complete procedure to estimate moment of inertia without a host reference. Refer to the following section before using this procedure.

☞ *8.5.4 Operating Procedure on page 375*

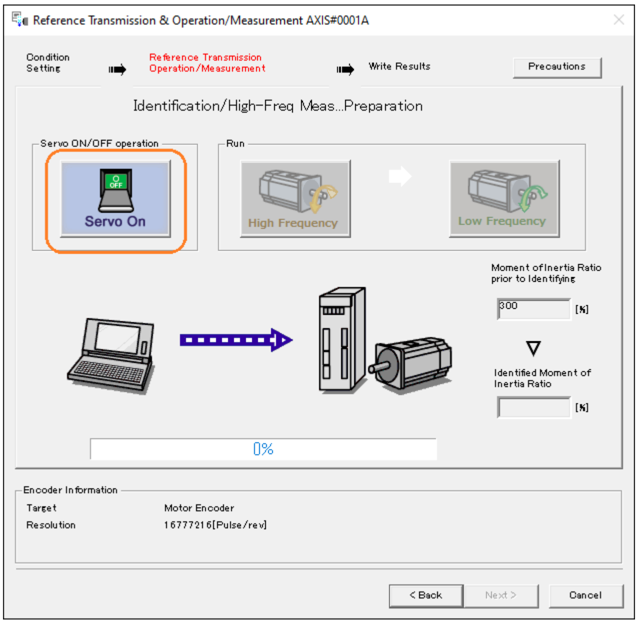
1. **Click the [Yes] button.**



Moment of Inertia Identification

The moment of inertia estimation will be executed in the following state because the travel distance was set to less than 0.25 rotations.
- The settings on the Condition Setting Window are all disabled.
- A periodic reference will be input to the motor. The motor will move a maximum of }0.25 rotations.
OK?

2. **Click the [Servo On] button.**



Reference Transmission & Operation/Measurement AXIS#0001A

Identification/High-Freq Meas...Preparation

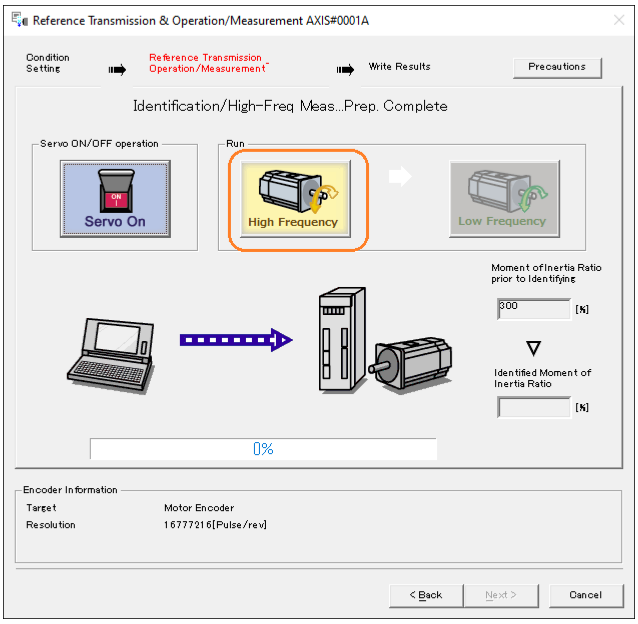
Moment of Inertia Ratio prior to Identifying: 300 [%]

Identified Moment of Inertia Ratio: [%]

0%

Encoder Information
Target: Motor Encoder
Resolution: 16777216[Pulse/rev]

3. **Click the [High Frequency] button.**



Reference Transmission & Operation/Measurement AXIS#0001A

Identification/High-Freq Meas...Prep. Complete

Moment of Inertia Ratio prior to Identifying: 300 [%]

Identified Moment of Inertia Ratio: [%]

0%

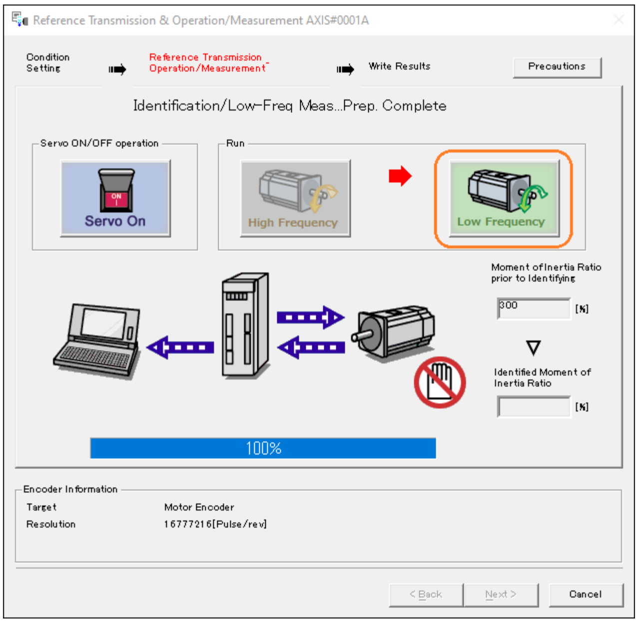
Encoder Information
Target: Motor Encoder
Resolution: 16777216[Pulse/rev]

The servomotor shaft will rotate and measurements will start. After the measurement and data transfer have been completed, the [Low Frequency] button will be displayed in color.

Information

- The servomotor shaft will rotate only a maximum of 0.25 rotations (0.04 rotations for a direct drive servomotor) at one time.
- The servomotor may not operate as configured because it will operate at a constant frequency.
- Noise may occur during operation.

4. **Click the [Low Frequency] button.**



Identification/Low-Freq Meas...Prep. Complete

Moment of Inertia Ratio prior to Identifying: 300 [%]

Identified Moment of Inertia Ratio: [%]

100%

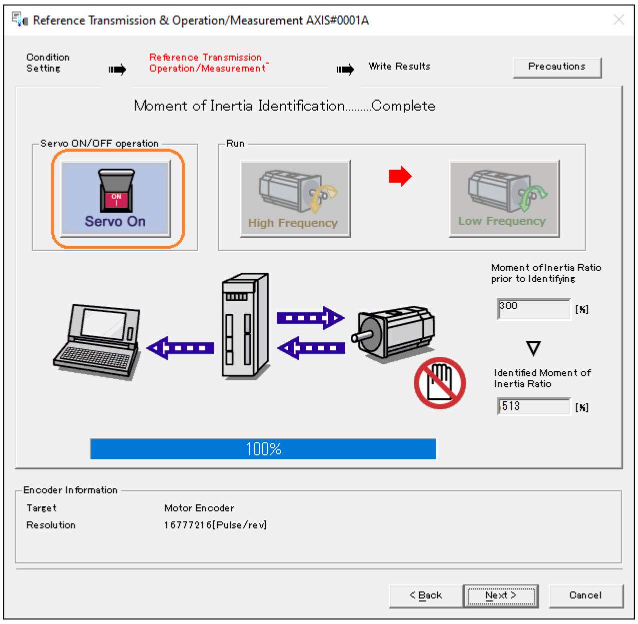
Target: Motor Encoder

Resolution: 16777216[Pulse/rev]

The servomotor shaft will rotate and measurements will start. After the measurement and data transfer have been completed, the [Next] button will be enabled.

Information
- The servomotor shaft will rotate only a maximum of 0.25 rotations (0.04 rotations for a direct drive servomotor) at one time.
- The servomotor may not operate as configured because it will operate at a constant frequency.
- Noise may occur during operation.

5. **When the measurements have been completed, click the [Servo On] button to turn OFF the servo.**



Moment of Inertia Identification.........Complete

Moment of Inertia Ratio prior to Identifying: 300 [%]

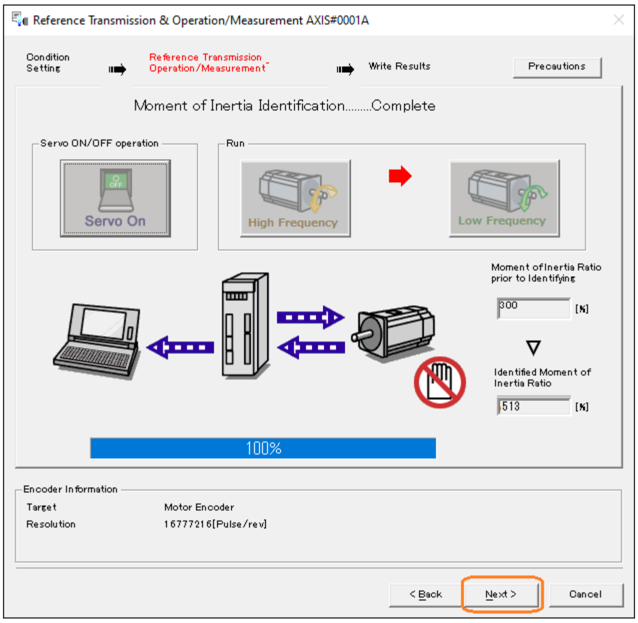
Identified Moment of Inertia Ratio: 513 [%]

100%

Target: Motor Encoder

Resolution: 16777216[Pulse/rev]

6. **Click the [Next] button.**



Moment of Inertia Identification........Complete

Moment of Inertia Ratio prior to Identifying: 300 [%]

Identified Moment of Inertia Ratio: 513 [%]

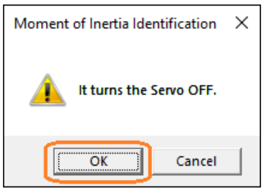
100%

Target: Motor Encoder

Resolution: 16777216[Pulse/rev]

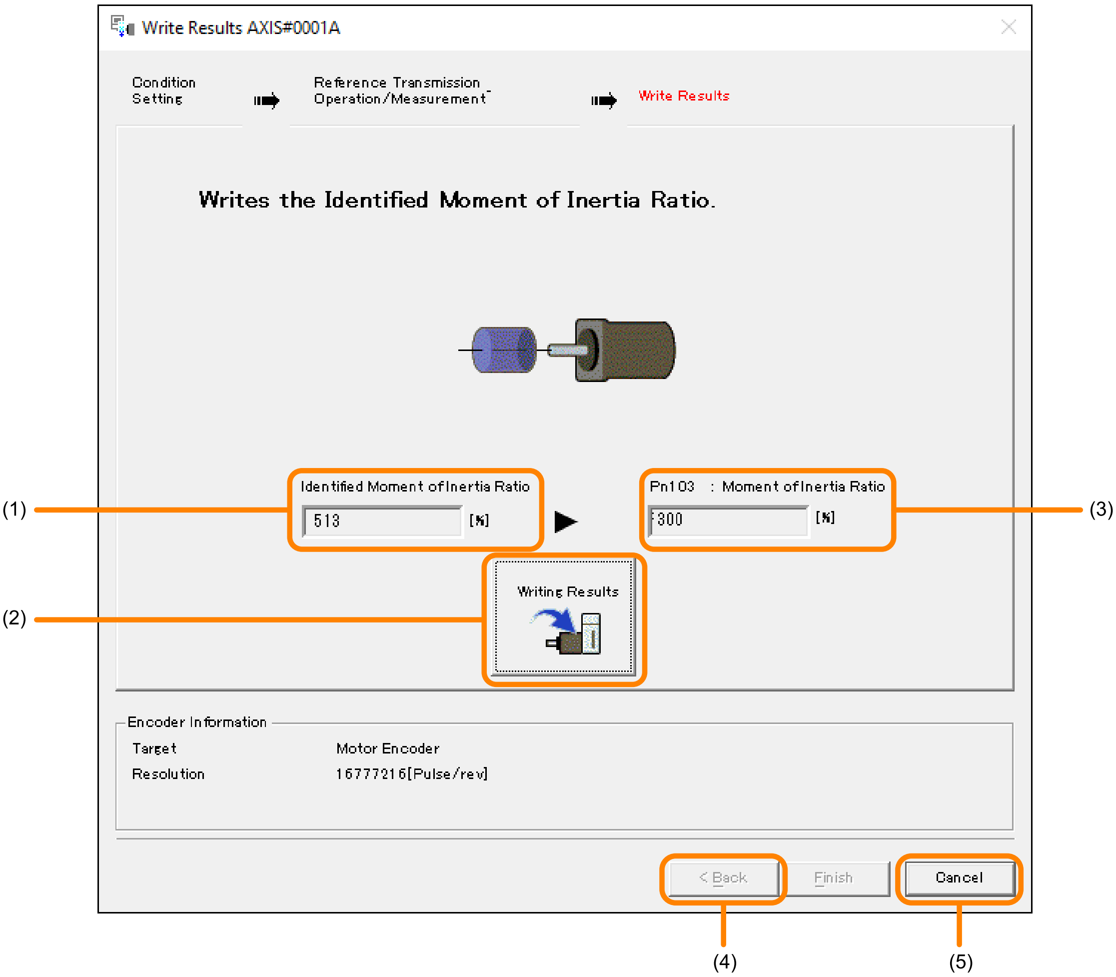
The [Write Results] window will be displayed.

Information If you click the [Next] button before you turn OFF the servo, the following message dialog box will be displayed. Click the [OK] button to turn OFF the servo.



It turns the Servo OFF.

7. **Click the [Writing Results] button.**



Write Results AXIS#0001A

Writes the Identified Moment of Inertia Ratio.

Identified Moment of Inertia Ratio: 513 [%]

Pn103 : Moment of Inertia Ratio: 300 [%]

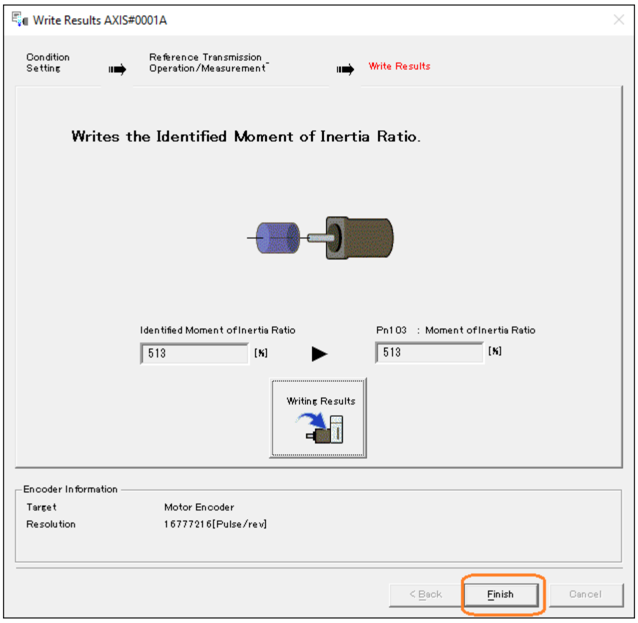
Encoder Information

Target: Motor Encoder

Resolution: 16777216[Pulse/rev]

No.	Item	Meaning
(1)	[Identified Moment of Inertia Ratio]	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]	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	You will return to the [Tuning] window.

8. **Confirm that the [Identified Moment of Inertia Ratio] and the [Pn103: Moment of Inertia Ratio] show the same value and then click the [Finish] button.**



Writes the Identified Moment of Inertia Ratio.

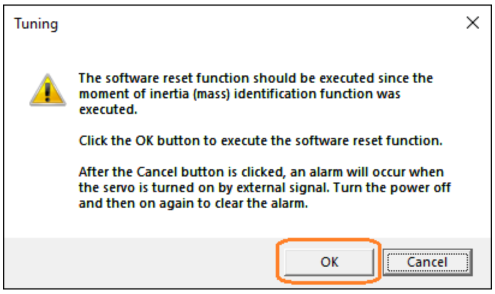
Identified Moment of Inertia Ratio: 513 [%]

Pn103 : Moment of Inertia Ratio: 513 [%]

Encoder Information
Target: Motor Encoder
Resolution: 16777216[Pulse/rev]

The message dialog box will be displayed.

9. **Click the [OK] button.**

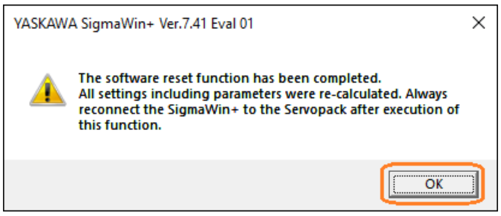


The software reset function should be executed since the moment of inertia (mass) identification function was executed.

Click the OK button to execute the software reset function.

After the Cancel button is clicked, an alarm will occur when the servo is turned on by external signal. Turn the power off and then on again to clear the alarm.

10. **Click the [OK] button.**



The software reset function has been completed.
All settings including parameters were re-calculated. Always reconnect the SigmaWin+ to the Servopack after execution of this function.

This concludes the procedure to estimate the moment of inertia ratio without a host reference when the travel distance is short.

8.6 Moment of Inertia Estimation with a Host Reference

This section describes how the moment of inertia with a host reference is calculated.

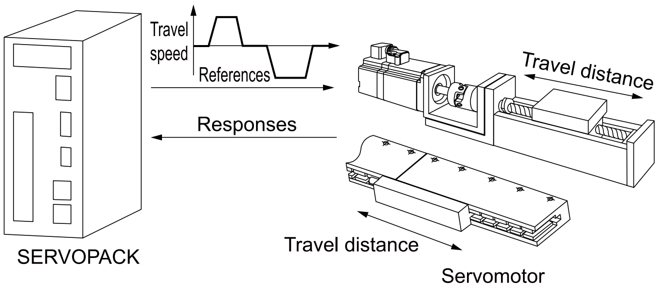
The moment of inertia ratio that is calculated here is used in other tuning functions.

8.6.1 Outline

The load moment of inertia is estimated from operation by reference (position control) from the host controller. This function is called real-time moment of inertia estimation.

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, calculating it accurately can be very difficult with the complex mechanical structures that are used these days. With this function, you can estimate load moment of inertia with good accuracy.



Note:

Execute this function after jogging to a position that ensures a suitable range of motion.

8.6.2 Restrictions

The following restrictions apply to estimating the moment of inertia with a host reference.

(1) Systems for which Execution Cannot Be Performed

- When the operating time is shorter than 200 ms
- For low speed operations

(2) Systems for Which Adjustments Cannot Be Made Accurately

- When a suitable range of motion is not possible
- When the machine has high dynamic friction

(3) Preparations

Always check the following before you execute moment of inertia estimation with a host reference.

- The main circuit power must be ON.
- There must be no overtravel.
- The servo must be OFF.
- The control method must not be set to torque control.
- Pn00C must be set to n.□□□0 (Function Selection for Test without a Motor is disabled).
- There must be no alarms or warnings.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.

8.6.3 Applicable Tools

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

Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	You cannot estimate the moment of inertia with a host reference from the panel operator.	
Digital Operator	You cannot estimate the moment of inertia with a host reference from the digital operator.	
SigmaWin+	[Tuning] - [Tuning]	☞ *8.6.4 Operating Procedure on page 392*

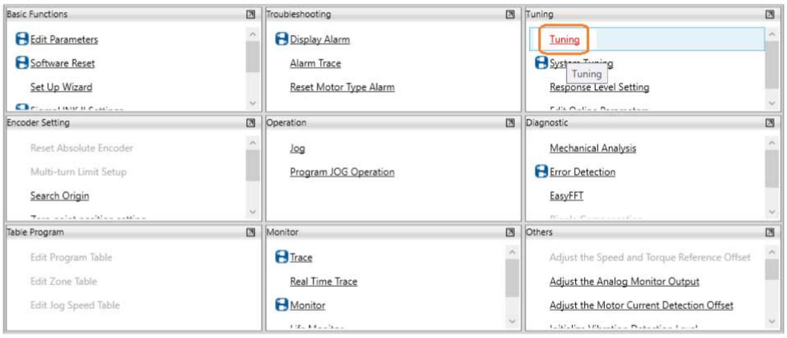
8.6.4 Operating Procedure

Use the following procedure to estimate the moment of inertia with a host reference.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

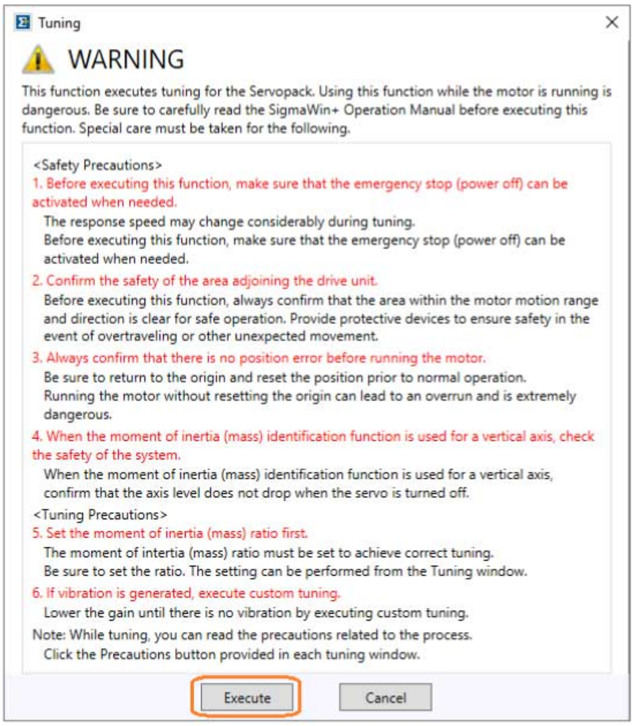
   The [Menu] window will be displayed.

2. **Click [Tuning] in the [Tuning] area.**



   The [Tuning] window will be displayed.

3. **Read the warnings and then click the [Execute] button.**



WARNING

This function executes tuning for the Servopack. Using this function while the motor is running is dangerous. Be sure to carefully read the SigmaWin+ Operation Manual before executing this function. Special care must be taken for the following.

<Safety Precautions>

1. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
   The response speed may change considerably during tuning.
   Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
2. Confirm the safety of the area adjoining the drive unit.
   Before executing this function, always confirm that the area within the motor motion range and direction is clear for safe operation. Provide protective devices to ensure safety in the event of overtraveling or other unexpected movement.
3. Always confirm that there is no position error before running the motor.
   Be sure to return to the origin and reset the position prior to normal operation.
   Running the motor without resetting the origin can lead to an overrun and is extremely dangerous.
4. When the moment of inertia (mass) identification function is used for a vertical axis, check the safety of the system.
   When the moment of inertia (mass) identification function is used for a vertical axis, confirm that the axis level does not drop when the servo is turned off.

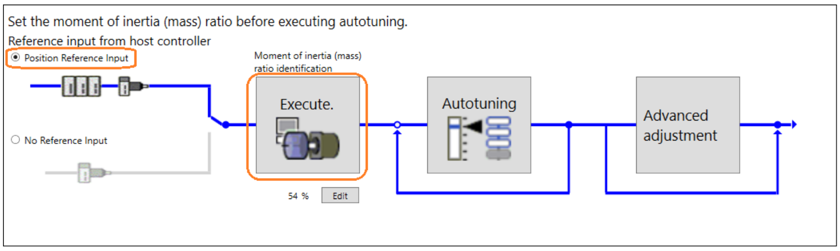
<Tuning Precautions>

5. Set the moment of inertia (mass) ratio first.
   The moment of interia (mass) ratio must be set to achieve correct tuning.
   Be sure to set the ratio. The setting can be performed from the Tuning window.
6. If vibration is generated, execute custom tuning.
   Lower the gain until there is no vibration by executing custom tuning.

Note: While tuning, you can read the precautions related to the process.
Click the Precautions button provided in each tuning window.

   The [Tuning] window will be displayed.

4. **Under [Reference input from host controller], select [Position Reference Input], and then click the [Execute] button.**



Set the moment of inertia (mass) ratio before executing autotuning.

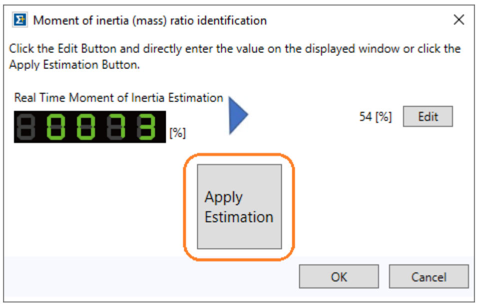
Reference input from host controller

● Position Reference Input

○ No Reference Input

The [Moment of inertia (mass) ratio identification] window will be displayed.

5. **If you click the [Apply Estimation] button, the estimated value of the real-time moment of inertia will be applied to the settings area.**

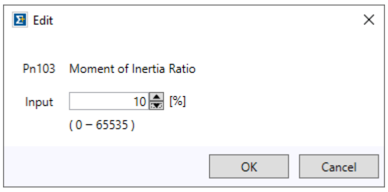


Moment of inertia (mass) ratio identification

Click the Edit Button and directly enter the value on the displayed window or click the Apply Estimation Button.

Real Time Moment of Inertia Estimation

Information Click the [Edit] button to display the [Edit] window on which you can manually enter the value. Set the value and click the [OK] button.



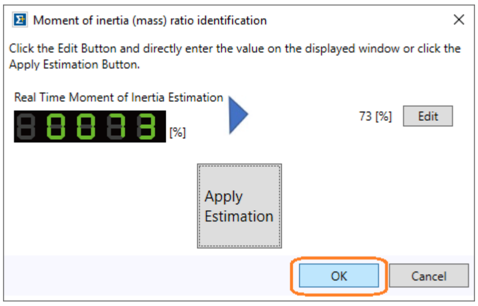
Edit

Pn103 Moment of Inertia Ratio

Input 10 [%]

(0 – 65535)

6. **Click the [OK] button.**



Moment of inertia (mass) ratio identification

Click the Edit Button and directly enter the value on the displayed window or click the Apply Estimation Button.

Real Time Moment of Inertia Estimation

This concludes the procedure to estimate the moment of inertia ratio with a host reference.

8.7 Autotuning without a Host Reference

This section describes autotuning without a host reference.

Important

- Autotuning without a host reference performs adjustments based on the setting of Pn100 (Speed Loop Gain). Therefore, precise adjustments cannot be made if there is vibration when adjustments are started. Make adjustments after lowering the setting of Pn100 (Speed Loop Gain) until vibration is eliminated.
- You cannot execute autotuning without a host reference if Pn170 is set to n.□□□1 (enable tuning-less function)(default setting). Set Pn170 to n.□□□0 (disable the tuning-less function) before you execute autotuning without a host reference.
- You cannot execute autotuning without a host reference if Pn173 is set to n.□□□1 (enable load fluctuation compensation control). Set Pn173 to n.□□□0 (disable load fluctuation compensation control) before you execute autotuning without a host reference.
- If you change the machine load conditions or drive system after you execute autotuning without a host reference and then you execute autotuning without a host reference with moment of inertia estimation specified, use the following parameter settings. If you execute autotuning without a host reference for any other conditions, the machine may vibrate and may be damaged.
  Pn140 = n.□□□0 (do not use model following control)
  Pn160 = n.□□□0 (do not use anti-resonance control)
  Pn408 = n.00□0 (disable friction compensation, first stage notch filter, and second stage notch filter)

  Note:

  If you are using the digital operator and the above parameters are not displayed, set Pn00B to n.□□□1 (display all parameters) and then turn the power OFF and ON again.

8.7.1 Outline

For autotuning without a host reference, operation is automatically performed by the SERVOPACK for round-trip (forward and reverse) operation to adjust for machine characteristics during operation. A reference from the host controller is not used.

The following items are adjusted automatically.

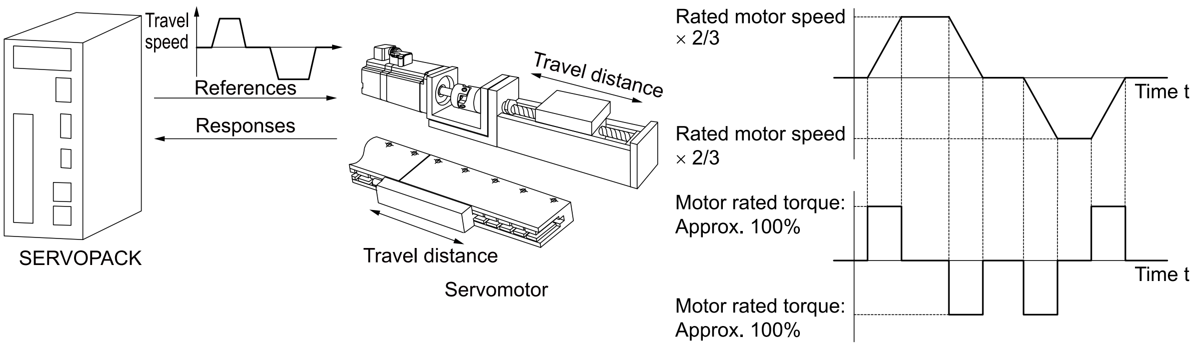
- Moment of inertia ratio
- Gains (e.g., speed loop gain and position loop gain)
- Filters (torque reference filter and notch filters)
- Friction compensation
- Anti-resonance control
- Vibration suppression (only for mode 2 or 3)

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

☞ *8.7.7 Related Parameters on page 405*

The servomotor is operated with the following specifications.

Maximum Motor Speed	Rated motor speed × 2/3	
Acceleration Torque	Rated motor torque: Approx. 100% **Note:** The acceleration torque depends on the setting of Pn103 (Moment of Inertia Ratio), and the influences of machine friction and external disturbance.	
Travel Distance	Rotary Servomotors	You can set the desired travel distance. The default setting is for a value equivalent to 3 servomotor shaft rotations.
	Direct Drive Servomotors	You can set the desired travel distance. The default setting is for a value equivalent to 0.3 rotations.
	Linear Servomotors	You can set the desired travel distance in increments of 1000 reference units. The default setting is for 90 mm.



Example of Automatic Operation Pattern

Note:

Execute this function after jogging to a position that ensures a suitable range of motion.

⚠ WARNING

Autotuning without a host reference is a measurement function that actually drives the machine and therefore presents hazards. Observe the following precautions.

- **Confirm safety around moving parts.**
- **This function involves automatic reciprocating operation. Make sure that you can perform an emergency stop (to turn OFF the power supply) at any time.**
- **There will be movement in both directions within the set range of movement. Check the range of movement and the directions and implement protective measures for safety, such as the overtravel functions.**

8.7.2 Restrictions

The following restrictions apply to autotuning without a host reference.

If you cannot use autotuning without a host reference because of these restrictions, use autotuning with a host reference or custom tuning. Refer to the following section for details.

☞ *8.8 Autotuning with a Host Reference on page 407*

☞ *8.9 Custom Tuning on page 422*

(1) 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

(2) 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 P control is used

  Note:

  If you specify calculating the moment of inertia, an error will occur if the /P-CON (Proportional Control Input) signal changes to specify the proportional action during moment of inertia estimation.
- When mode switching is used

  Note:

  If you specify moment of inertia estimation, mode switching will be disabled and PI control will be used while the moment of inertia is being calculated. Mode switching will be enabled after moment of inertia estimation has been completed.
- When speed feedforward or torque feedforward is input
- When the setting of Pn522 (Positioning Completed Width) is too small

(3) Preparations

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

- The main circuit power must be ON.
- There must be no overtravel.
- The servo must be OFF.
- The control method must not be set to torque control.
- The gain switching selection must be Pn139 = n.□□□0 (automatic gain switching is disabled).
- The gain 1 must be selected.
- Pn00C must be set to n.□□□0 (Function Selection for Test without a Motor is disabled).
- Pn173 must be set to n.□□□0 (a load fluctuation compensation control is disabled).
- There must be no alarms or warnings.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.
- Moment of inertia estimation must be specified when Pn170 is set to n.□□□0 (tuning-less function is disabled) or Pn170 is set to n.□□□1 (tuning-less function is enabled) (default setting).
- If you execute autotuning without a host reference during speed control, set the mode to 1.

Information
- If you start autotuning without a host reference while the SERVOPACK is in speed control for mode 2 or 3, the SERVOPACK will change to position control automatically to perform autotuning without a host reference. The SERVOPACK will return to speed control after autotuning has been completed.
- Reference pulse input multiplication switching is disabled during autotuning without a host reference.

- The settings of the electronic gear ratio (Pn20E/Pn210), Pn533 or Pn585 (Program Jogging Movement Speed), and Pn385 (Maximum Motor Speed) must not satisfy either of the conditional expressions shown below.
  If either of these conditional expressions is satisfied, an A.042 (Parameter Combination Error) will occur.

– Rotary Servomotors

$$\cdot\ \text{Pn533 [min}^{-1}\text{]} \times \frac{\text{Encoder resolution}}{6 \times 10^5} \leq \frac{\text{Pn20E}}{\text{Pn210}}$$

$$\cdot\ \text{Maximum motor speed [min}^{-1}\text{]} \times \frac{\text{Encoder resolution}}{\text{Approx. } 3.66 \times 10^{12}} \geq \frac{\text{Pn20E}}{\text{Pn210}}$$

Information Refer to the following section for details on the encoder resolution.

☞ ◆ *Encoder Resolution on page 201*

– Linear Servomotors

$$\cdot\ \frac{\text{Pn585 [mm/s]}}{\text{Linear encoder scale pitch [}\mu\text{m]}} \times \frac{\text{Number of divisions of the serial converter unit}}{10} \leq \frac{\text{Pn20E}}{\text{Pn210}}$$

$$\cdot\ \frac{\text{Pn385 [100 mm/s]}}{\text{Linear encoder scale pitch [}\mu\text{m]}} \times \frac{\text{Number of divisions of the serial converter unit}}{\text{Approx. } 6.10 \times 10^5} \geq \frac{\text{Pn20E}}{\text{Pn210}}$$

8.7.3 Applicable Tools

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

Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	You cannot perform autotuning without a host reference from the panel operator.	
Digital Operator	Fn201	📖 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Tuning] - [Tuning]	☞ *8.7.4 Operating Procedure on page 396*

8.7.4 Operating Procedure

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

⚠ CAUTION

If you specify not estimating the moment of inertia, set Pn103 (Moment of Inertia Ratio) correctly.

If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.

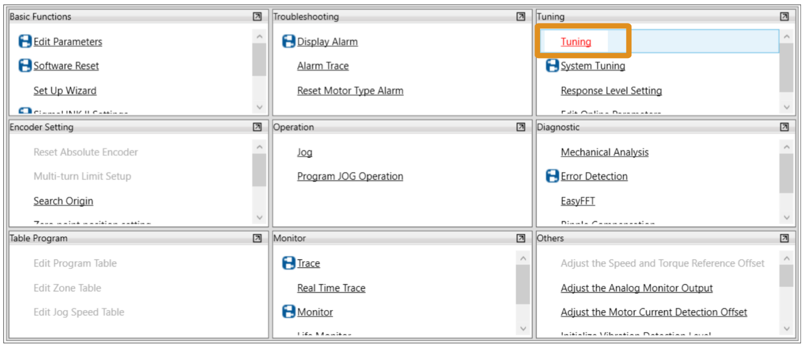
NOTICE

If you are using an MP3000-Series Controller for phase control, set the mode selection to 1.

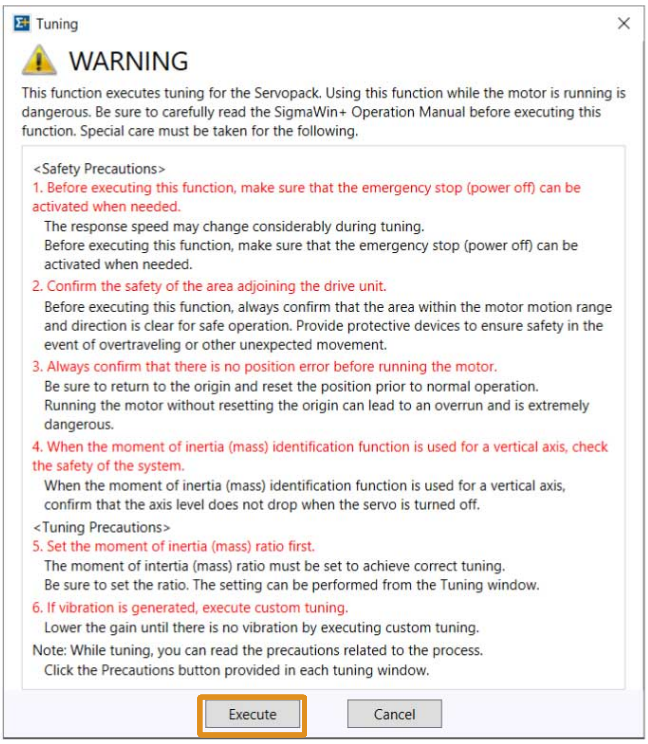
If 2 or 3 is selected for the mode, correct phase control may not be possible.

1. **Confirm that the value of Pn103 (Moment of Inertia Ratio) is set correctly.**
2. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

   The [Menu] window will be displayed.
3. **Click [Tuning] in the [Tuning] area.**



   The [Tuning] window will be displayed.
4. **Read the warnings and then click the [Execute] button.**



WARNING

This function executes tuning for the Servopack. Using this function while the motor is running is dangerous. Be sure to carefully read the SigmaWin+ Operation Manual before executing this function. Special care must be taken for the following.

<Safety Precautions>

1. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.

   The response speed may change considerably during tuning.
   Before executing this function, make sure that the emergency stop (power off) can be activated when needed.

2. Confirm the safety of the area adjoining the drive unit.

   Before executing this function, always confirm that the area within the motor motion range and direction is clear for safe operation. Provide protective devices to ensure safety in the event of overtraveling or other unexpected movement.

3. Always confirm that there is no position error before running the motor.

   Be sure to return to the origin and reset the position prior to normal operation.
   Running the motor without resetting the origin can lead to an overrun and is extremely dangerous.

4. When the moment of inertia (mass) identification function is used for a vertical axis, check the safety of the system.

   When the moment of inertia (mass) identification function is used for a vertical axis, confirm that the axis level does not drop when the servo is turned off.

<Tuning Precautions>

5. Set the moment of inertia (mass) ratio first.

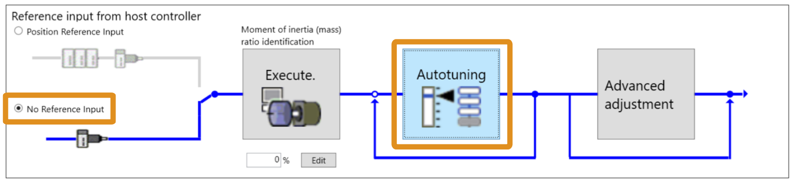
   The moment of intertia (mass) ratio must be set to achieve correct tuning.
   Be sure to set the ratio. The setting can be performed from the Tuning window.

6. If vibration is generated, execute custom tuning.

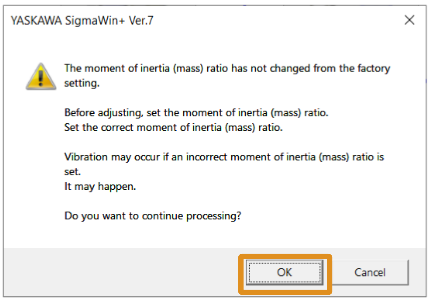
   Lower the gain until there is no vibration by executing custom tuning.

Note: While tuning, you can read the precautions related to the process.
Click the Precautions button provided in each tuning window.

5. **Click [No Reference Input] in [Reference input from host controller] and then click the [Autotuning] button.**



Information When the following message dialog box is displayed, click the [OK] button and then confirm that Pn103 (Moment of Inertia Ratio) is set correctly.



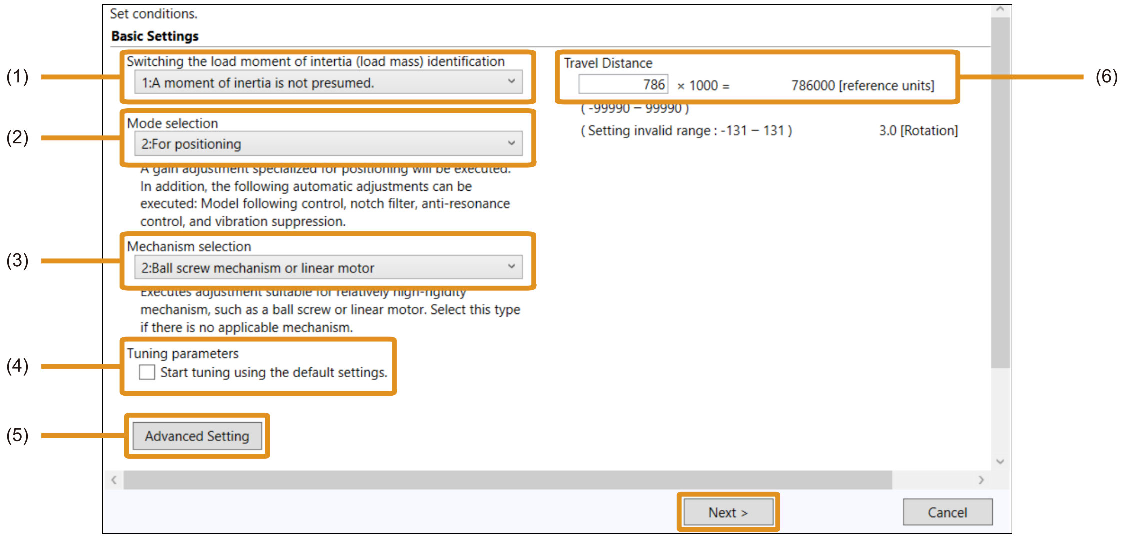
The moment of inertia (mass) ratio has not changed from the factory setting.

Before adjusting, set the moment of inertia (mass) ratio.
Set the correct moment of inertia (mass) ratio.

Vibration may occur if an incorrect moment of inertia (mass) ratio is set.
It may happen.

Do you want to continue processing?

6. **Set the conditions, and then click the [Next] button.**



Set conditions.

Basic Settings

Switching the load moment of interia (load mass) identification: 1:A moment of inertia is not presumed.

Mode selection: 2:For positioning

A gain adjustment specialized for positioning will be executed. In addition, the following automatic adjustments can be executed: Model following control, notch filter, anti-resonance control, and vibration suppression.

Mechanism selection: 2:Ball screw mechanism or linear motor

Executes adjustment suitable for relatively high-rigidity mechanism, such as a ball screw or linear motor. Select this type if there is no applicable mechanism.

Tuning parameters
☐ Start tuning using the default settings.

Travel Distance
786 × 1000 = 786000 [reference units]
(-99990 – 99990)
(Setting invalid range : -131 – 131) 3.0 [Rotation]

No.	Item	Meaning
(1)	[Switching the load moment of inertia (load mass) identification]	Specify whether to estimate the moment of inertia.
(2)	[Mode selection]	Set the mode. For details on the options, refer to the explanations on the window.
(3)	[Mechanism selection]	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. For details on the options, refer to the explanations on the window.
(4)	[Tuning parameters]	Specify the parameters to use for tuning. If you select [Start tuning using the default settings], the tuning parameters will be returned to the default settings before tuning is started.

Continued on next page.

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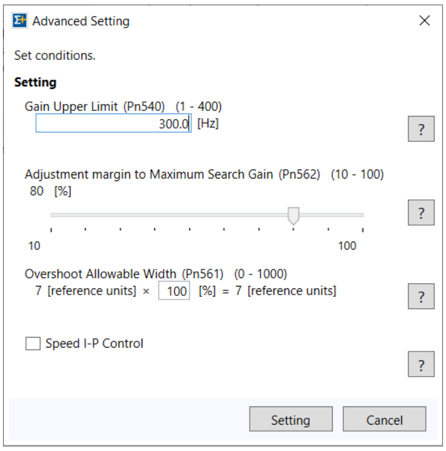
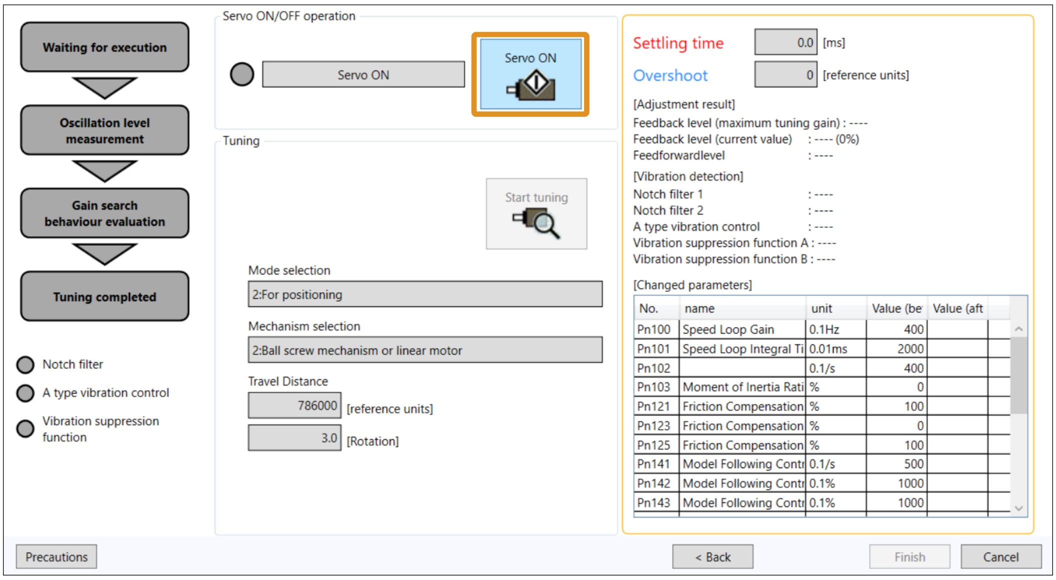
No.	Item	Meaning
(5)	[Advanced Setting] button	Click this button to display the [Advanced Setting] window on which you can set the details of tuning conditions. Configure detailed tuning conditions in the following cases: • To tune a higher response than the tuning results • When tuning fails with a large amount of overshoot • To tune with speed I-P control  Advanced Setting Set conditions. **Setting** Gain Upper Limit (Pn540) (1 - 400) 300.0 [Hz] Adjustment margin to Maximum Search Gain (Pn562) (10 - 100) 80 [%] 10 100 Overshoot Allowable Width (Pn561) (0 - 1000) 7 [reference units] × 100 [%] = 7 [reference units] ☐ Speed I-P Control Setting Cancel
(6)	[Travel Distance]	Set the travel distance. Movement range: -99990000 to +99990000 [reference units] Minimum setting increment for travel distance: 1000 [reference units] Negative values are for reverse operation and positive values are for forward operation from the current position. Default settings: Rotary servomotors: Approx. 3 rotations Direct drive servomotors: Approx. 0.3 rotations Linear servomotors: Approx. 90 mm Set the distance to the following values or higher. To ensure tuning precision, we recommend that you use approximately the default distance setting. Rotary servomotors: 0.5 rotations Direct drive servomotors: 0.05 rotations Linear servomotors: 5 mm

7. Click the [Servo ON] button.



Servo ON/OFF operation

● Servo ON

Tuning

Mode selection: 2:For positioning

Mechanism selection: 2:Ball screw mechanism or linear motor

Travel Distance: 786000 [reference units] 3.0 [Rotation]

● Notch filter
● A type vibration control
● Vibration suppression function

Settling time 0.0 [ms]
Overshoot 0 [reference units]

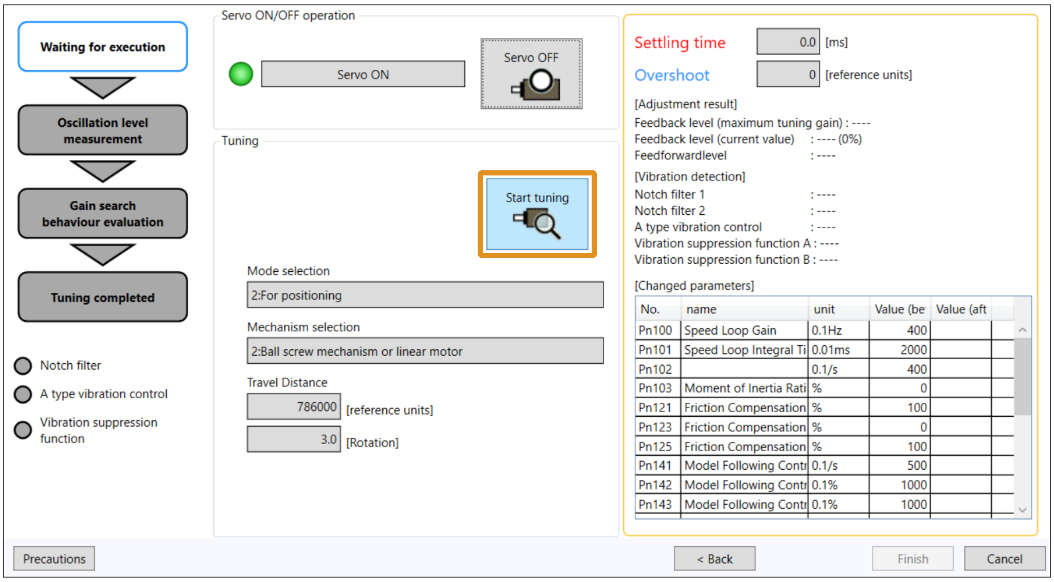
[Adjustment result]
Feedback level (maximum tuning gain) : ----
Feedback level (current value) : ---- (0%)
Feedforwardlevel : ----

[Vibration detection]
Notch filter 1 : ----
Notch filter 2 : ----
A type vibration control : ----
Vibration suppression function A : ----
Vibration suppression function B : ----

[Changed parameters]

No.	name	unit	Value (be	Value (aft
Pn100	Speed Loop Gain	0.1Hz	400	
Pn101	Speed Loop Integral Ti	0.01ms	2000	
Pn102		0.1/s	400	
Pn103	Moment of Inertia Rati	%	0	
Pn121	Friction Compensation	%	100	
Pn123	Friction Compensation	%	0	
Pn125	Friction Compensation	%	100	
Pn141	Model Following Contr	0.1/s	500	
Pn142	Model Following Contr	0.1%	1000	
Pn143	Model Following Contr	0.1%	1000	

8. **Click the [Start tuning] button.**



Mode selection: 2:For positioning

Mechanism selection: 2:Ball screw mechanism or linear motor

Travel Distance: 786000 [reference units]

3.0 [Rotation]

Settling time 0.0 [ms]

Overshoot 0 [reference units]

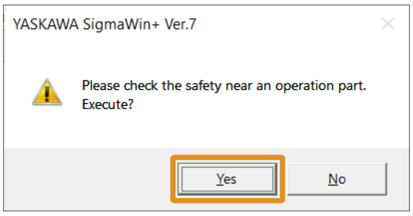
[Adjustment result]
Feedback level (maximum tuning gain) : ----
Feedback level (current value) : ---- (0%)
Feedforwardlevel : ----

[Vibration detection]
Notch filter 1 : ----
Notch filter 2 : ----
A type vibration control : ----
Vibration suppression function A : ----
Vibration suppression function B : ----

[Changed parameters]

No.	name	unit	Value (be	Value (aft
Pn100	Speed Loop Gain	0.1Hz	400	
Pn101	Speed Loop Integral Ti	0.01ms	2000	
Pn102		0.1/s	400	
Pn103	Moment of Inertia Rati	%	0	
Pn121	Friction Compensation	%	100	
Pn123	Friction Compensation	%	0	
Pn125	Friction Compensation	%	100	
Pn141	Model Following Contr	0.1/s	500	
Pn142	Model Following Contr	0.1%	1000	
Pn143	Model Following Contr	0.1%	1000	

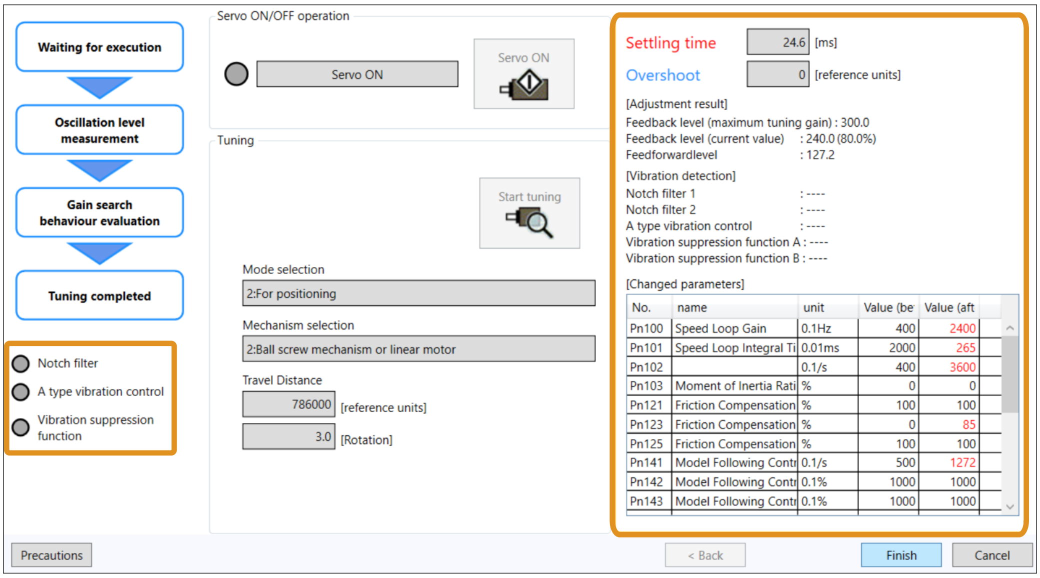
9. **Confirm safety around moving parts and click the [Yes] button.**



Please check the safety near an operation part.
Execute?

The servomotor will start operating and tuning will be executed.

Vibration that occurs during tuning will be detected automatically and suitable settings will be made for that vibration. The content to set will be displayed on the right side of the window. When the settings have been completed, the indicators for the functions that were used will light at the lower left of the window.



Mode selection: 2:For positioning

Mechanism selection: 2:Ball screw mechanism or linear motor

Travel Distance: 786000 [reference units]

3.0 [Rotation]

Settling time 24.6 [ms]

Overshoot 0 [reference units]

[Adjustment result]
Feedback level (maximum tuning gain) : 300.0
Feedback level (current value) : 240.0 (80.0%)
Feedforwardlevel : 127.2

[Vibration detection]
Notch filter 1 : ----
Notch filter 2 : ----
A type vibration control : ----
Vibration suppression function A : ----
Vibration suppression function B : ----

[Changed parameters]

No.	name	unit	Value (be	Value (aft
Pn100	Speed Loop Gain	0.1Hz	400	2400
Pn101	Speed Loop Integral Ti	0.01ms	2000	265
Pn102		0.1/s	400	3600
Pn103	Moment of Inertia Rati	%	0	0
Pn121	Friction Compensation	%	100	100
Pn123	Friction Compensation	%	0	85
Pn125	Friction Compensation	%	100	100
Pn141	Model Following Contr	0.1/s	500	1272
Pn142	Model Following Contr	0.1%	1000	1000
Pn143	Model Following Contr	0.1%	1000	1000

Details on the content to set are shown below.

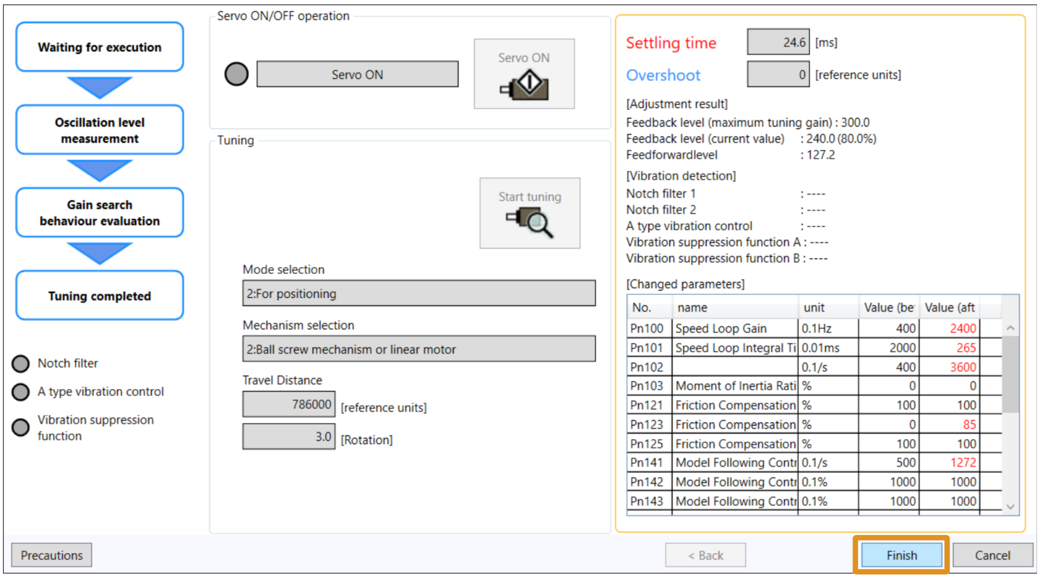
Item	Meaning
[Settling time]	Displays the settling time by the tuning results.
[Overshoot]	Displays the maximum overshoot by the tuning results.

Continued on next page.

Continued from previous page.

Item	Meaning
[Feedback level (maximum tuning gain)]	Displays the maximum value of Pn100 (Speed Loop Gain) during tuning.
[Feedback level (current value)]	Displays the value of Pn100 (Speed Loop Gain) after tuning. The number in parentheses is the percentage of adjusting maximum gain.
[Feedforward level]	Displays the value of Pn141 (Model Following Control Gain) after tuning.
[Notch filter 1] [Notch filter 2]	Displays the frequencies set by the notch filters. "——" is displayed if not set.
[A type vibration control]	Displays the frequency set by anti-resonance control. "——" is displayed if not set.
[Vibration suppression function A] [Vibration suppression function B]	Displays the frequencies set by vibration suppression. "——" is displayed if not set.

10. **When tuning has been completed, click the [Finish] button.**



Mode selection: 2:For positioning

Mechanism selection: 2:Ball screw mechanism or linear motor

Travel Distance: 786000 [reference units]; 3.0 [Rotation]

Settling time 24.6 [ms]

Overshoot 0 [reference units]

[Adjustment result]
Feedback level (maximum tuning gain) : 300.0
Feedback level (current value) : 240.0 (80.0%)
Feedforwardlevel : 127.2

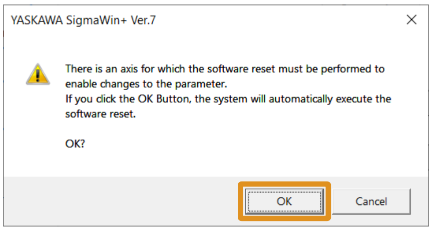
[Vibration detection]
Notch filter 1 : ----
Notch filter 2 : ----
A type vibration control : ----
Vibration suppression function A : ----
Vibration suppression function B : ----

[Changed parameters]

No.	name	unit	Value (be	Value (aft
Pn100	Speed Loop Gain	0.1Hz	400	2400
Pn101	Speed Loop Integral Ti	0.01ms	2000	265
Pn102		0.1/s	400	3600
Pn103	Moment of Inertia Rati	%	0	0
Pn121	Friction Compensation	%	100	100
Pn123	Friction Compensation	%	0	85
Pn125	Friction Compensation	%	100	100
Pn141	Model Following Contr	0.1/s	500	1272
Pn142	Model Following Contr	0.1%	1000	1000
Pn143	Model Following Contr	0.1%	1000	1000

The message dialog box will be displayed.

11. **Click the [OK] button.**



There is an axis for which the software reset must be performed to enable changes to the parameter.
If you click the OK Button, the system will automatically execute the software reset.

OK?

The software will be reset, the results of tuning will be set in the parameters, and you will return to the [Tuning] window.

This concludes the procedure to perform autotuning without a host reference.

8.7.5 Troubleshooting Problems in Autotuning without a Host Reference

The following tables give the causes of and corrections for problems that may occur in autotuning without a host reference.

(1) Autotuning without a Host Reference Was Not Performed

Possible Cause	Corrective Action
Main circuit power is OFF.	Turn ON the main circuit power.
An alarm or warning occurred.	Remove the cause of the alarm or warning.
Overtraveling occurred.	Remove the cause of overtraveling.
The gain 2 was selected with the gain selection.	Disable automatic gain switching.
The HWBB was activated.	Release the HWBB.
The setting of the travel distance is too small.	Set the travel distance again in step 6 of the procedure.
The settings for the tuning-less function are not correct.	• Set Pn170 to n.□□□0 (disable the tuning-less function). • Set Pn170 to n.□□□1 (enable the tuning-less function) and specify moment of inertia estimation.

(2) When an Error Occurs during Execution of Autotuning without a Host Reference

Error	Possible Cause	Corrective Action
The gain adjustments were not successfully completed.	Machine vibration occurs or the positioning completion signal is not stable when the servomotor stops.	• On the [Detailed Setting] window, increase the setting of Pn561 (Overshoot Detection Level). • Increase the setting of Pn522 (Positioning Completed Width). • On the [Detailed Setting] window, decrease the setting of Pn562 (Setting Gain Ratio). • Change the mode from 2 to 3. • If machine vibration occurs, suppress the vibration with the anti-resonance control adjustment and the vibration suppression function.
An error occurred during calculation of the moment of inertia.	Refer to the following section for troubleshooting information. ☞ *(3) When an Error Occurs during Calculation of Moment of Inertia on page 402*	
Positioning was not completed within approximately 10 seconds after position adjustment was completed.	The positioning completed width is too narrow or proportional control is being used.	• Increase the setting of Pn522 (Positioning Completed Width). • Turn OFF the /P-CON (Proportional Control Input) signal.

(3) When an Error Occurs during Calculation of Moment of Inertia

Possible Cause	Corrective Action
The SERVOPACK started calculating the moment of inertia but the calculation was not completed.	• Increase the setting of Pn100 (Speed Loop Gain). • Increase the stroke (travel distance).
The moment of inertia fluctuated greatly and did not converge within 10 tries.	Set Pn103 (Moment of Inertia Ratio) from the machine specifications and specify not estimating the moment of inertia.
Low-frequency vibration was detected.	Double the setting of Pn324 (Moment of Inertia Calculation Starting Level).
The torque limit was reached.	• If you are using the torque limit, increase the torque limit. • Double the setting of Pn324 (Moment of Inertia Calculation Starting Level).
The speed control section changed to proportional control during calculation of the moment of inertia, e.g., the /P-CON (Proportional Control Input) signal was input.	Use PI control when calculating the moment of inertia.

(4) Adjustment Results Are Not Satisfactory for Position Control

Configuring parameters as shown below may improve the adjustment results.

- Change Pn522 (Positioning Completed Width) and Pn20E/Pn210 (Electronic Gear Ratio).

- Adjust Pn561 (Overshoot Detection Level).
  You can change these parameters on the [Adjustment Settings] window. Details on the settings of Pn561 are shown below.

Setting of Pn561	Meaning
0% to 99%	This will allow tuning to be performed without overshooting within the positioning completed width, but the positioning completed width may be extended.
100% (default setting)	This will allow tuning with overshooting that is equivalent to the positioning completed width.
101% to 1000%	The settings that allow overshooting to exceed the positioning completed width. Adjust Pn561 (Overshoot Detection Level) without changing the positioning completed width. Increase this setting when high responsiveness is required even if overshooting increases.

- Increase the upper limits for tuning.
  However, the changes in these settings are valid only when the tuning results are Pn100 = 2400 [0.1 Hz] (speed loop gain = 240 Hz) and Pn141 = 6000 [0.1/s] (model following control gain = 600/s). If you increase the upper limits of tuning at this time, you may be able to further decrease the settling time.
  You can change the upper limits of tuning on the [Detailed Setting] window. Set the parameters as shown below.
  - Pn540 = 3000 [0.1 Hz] or higher (maximum search gain = 300 Hz [default setting] or higher)
  - Pn562 = 80 [%] or higher (setting gain ratio = 80% [default setting] or higher)

8.7.6 Automatically Adjusted Function Setting

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

(1) Automatic Notch Filters

Normally, set Pn460 to n.□1□□ (adjust automatically) (default setting).

Vibration will be detected during autotuning without a host reference and a notch filter will be adjusted.

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

Pn460	n.□□□X	Notch Filter Adjustment Selection 1 **Speed** **Pos** **Trq**		When Enabled
		0	Do not adjust the first stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately
		1 Default	Adjust the first stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	
Pn460	n.□X□□	Notch Filter Adjustment Selection 2 **Speed** **Pos** **Trq**		When Enabled
		0	Do not adjust the second stage notch filter automatically when the tuning-less function is enabled or during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately
		1 Default	Adjust the second stage notch filter automatically when the tuning-less function is enabled or during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	

(2) Anti-Resonance Control Adjustment

This function reduces low vibration frequencies, for which the notch filters cannot be used.

Normally, set Pn160 to n.□□1□ (adjust automatically) (default setting).

Vibration will be detected during autotuning without a host reference and anti-resonance control will be automatically adjusted.

Pn160	n.□□X□	Anti-Resonance Control Adjustment Selection	Speed Pos Trq	When Enabled
		0	Do not adjust anti-resonance control automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately
		1 Default	Adjust anti-resonance control automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	

(3) Vibration Suppression

You can use vibration suppression to suppress transitional vibration at a low frequency from 1 Hz to 100 Hz, which is generated mainly when the machine vibrates during positioning.

Normally, set Pn140 to n.□1□□ (adjust automatically) (default setting).

Vibration will be detected during autotuning without a host reference and vibration suppression control will be automatically set.

Set Pn140 = n.□0□□ (do not adjust automatically) only if you do not change the settings for vibration suppression before you execute this function.

Note:

This function uses model following control. Therefore, it can be executed only if the mode is set to 2 or 3.

Pn140	n.□X□□	Vibration Suppression Adjustment Selection	Speed Pos Trq	When Enabled
		0	Do not adjust vibration suppression automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately
		1 Default	Adjust vibration suppression automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	

(4) Friction Compensation

Friction compensation compensates for changes in the following conditions.

- Changes in the viscous resistance of the lubricant, such as grease, on the sliding parts of the machine
- Changes in the friction resistance resulting from variations in the machine assembly
- Changes in the friction resistance due to aging

The conditions for applying friction compensation depend on the mode selection.

Mode Selection Settings	Friction Compensation
1: Standard	Based on the setting of Pn408 = n.X□□□ (Friction Compensation Function Selection) *1
2. Priority to settling time	Adjusted with friction compensation.
3: Priority to overshoot control	

Pn408	n.X□□□	Friction Compensation Function Selection	Speed Pos Trq	When Enabled
		0 Default	Disable friction compensation.	Immediately
		1	Enable friction compensation.	

*1 Refer to the following section for details.
☞ *(1) Required Parameter Settings on page 472*

(5) Feedforward

If Pn140 is set to n.0□□□ (do not use model following control and speed/torque feedforward together (default setting)) and tuning is performed with the mode selection set to 2 or 3, the setting of Pn109 (Feedforward), the speed feedforward input, and the torque feedforward input will be disabled.

To use the speed feedforward input, the torque feedforward input, and model following control from the host controller in the system, set Pn140 to n.1□□□ (use model following control and speed/torque feedforward together).

Pn140	n.X□□□	Speed Feedforward (VFF)/Torque Feedforward (TFF) Selection	Speed Pos Trq	When Enabled
		0 Default	Do not use model following control and speed/torque feedforward together.	Immediately
		1	Use model following control and speed/torque feedforward together.	

Refer to the following section for information on the torque feedforward input and the speed feedforward input.

☞ *(2) Torque Feedforward and Speed Feedforward on page 488*

☞ ◆ *Speed Feedforward on page 490*

> **Important**
>
> When model following control is used with this function, it is used to make optimum feedforward settings in the SERVOPACK. Therefore, model following control is not normally used together with either the speed feedforward input or torque feedforward input from the host controller. However, model following control can be used with the speed feedforward input or torque feedforward input if required. An unsuitable feedforward input may result in overshooting.

8.7.7 Related Parameters

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

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

Parameter	Name	Automatic Changes
Pn100	Speed Loop Gain	Yes
Pn101	Speed Loop Integral Time Constant	Yes
Pn102	Position Loop Gain	Yes
Pn103	Moment of Inertia Ratio	Yes
Pn121	Friction Compensation Gain	Yes
Pn123	Friction Compensation Coefficient	Yes
Pn124	Friction Compensation Frequency Correction	No
Pn125	Friction Compensation Gain Correction	Yes
Pn401	First Stage First Torque Reference Filter Time Constant	Yes
Pn408	Torque-Related Function Selections	Yes
Pn409	First Stage Notch Filter Frequency	Yes
Pn40A	First Stage Notch Filter Q Value	Yes
Pn40C	Second Stage Notch Filter Frequency	Yes
Pn40D	Second Stage Notch Filter Q Value	Yes
Pn140	Model Following Control-Related Selections	Yes
Pn141	Model Following Control Gain	Yes
Pn142	Model Following Control Gain Correction	Yes
Pn143	Model Following Control Bias in the Forward Direction	Yes
Pn144	Model Following Control Bias in the Reverse Direction	Yes
Pn145	Vibration Suppression 1 Frequency A	Yes
Pn146	Vibration Suppression 1 Frequency B	Yes
Pn147	Model Following Control Speed Feedforward Compensation	Yes
Pn14F = n.□□□X	Model Following Control Type Selection	Yes
Pn160	Anti-Resonance Control-Related Selections	Yes

Continued on next page.

Continued from previous page.

Parameter	Name	Automatic Changes
Pn161	Anti-Resonance Frequency	Yes
Pn163	Anti-Resonance Damping Gain	Yes
Pn531	Program Jogging Travel Distance	No
Pn533	Program Jogging Movement Speed for Rotary Servomotor	No
Pn585	Program Jogging Movement Speed for Linear Servomotor	No
Pn534	Program Jogging Acceleration/Deceleration Time	No
Pn535	Program Jogging Waiting Time	No
Pn536	Program Jogging Number of Movements	No

Yes: The parameter is automatically set.

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

8.8 Autotuning with a Host Reference

This section describes autotuning with a host reference.

Important Autotuning with a host reference makes adjustments based on the setting of Pn100 (Speed Loop Gain). Therefore, precise adjustments cannot be made if there is vibration when adjustments are started. Make adjustments after lowering the setting of Pn100 (Speed Loop Gain) until vibration is eliminated.

8.8.1 Outline

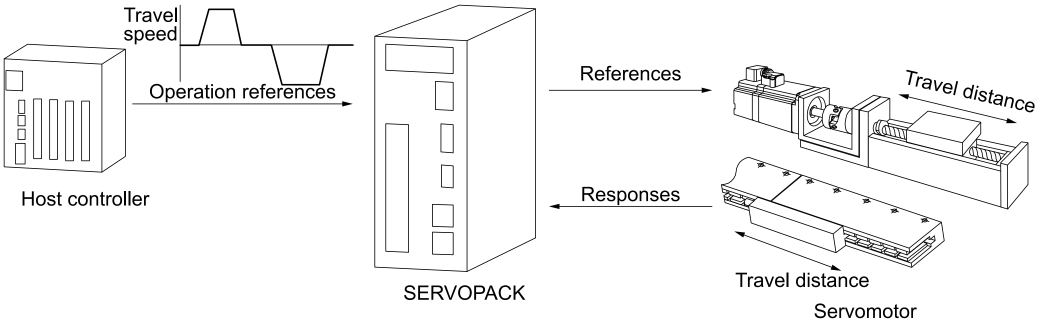
Autotuning with a host reference automatically makes optimum adjustments for operation references from the host controller.

The following items are adjusted automatically.

- Gains (e.g., speed loop gain and position loop gain)
- Filters (torque reference filter and notch filters)
- Friction compensation
- Anti-resonance control
- Vibration suppression

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

☞ *8.8.8 Related Parameters on page 420*



⚠ CAUTION

Because autotuning with a host reference adjusts the SERVOPACK during automatic operation, vibration or overshooting may occur. To ensure safety, make sure that you can perform an emergency stop at any time when you execute this function.

8.8.2 Restrictions

(1) Systems for Which Adjustments Cannot Be Made Accurately

Adjustments will not be made correctly for autotuning with a host reference in the following cases. Use custom tuning.

- When the travel distance for the reference from the host controller is equal to or lower than the setting of Pn522 (Positioning Completed Width).
- Rotary Servomotors: When the movement speed for the reference from the host controller is equal to or lower than the setting of Pn502 (Rotation Detection Level)
- Linear Servomotors: When the movement speed for the reference from the host controller is equal to or lower than the setting of Pn581 (Zero Speed Level)
- When the time required to stop is 10 ms or less
- When the rigidity of the machine is low and vibration occurs when positioning is performed
- When the position integration function is used
- When P control is used
- When mode switching is used
- When the setting of Pn522 (Positioning Completed Width) is too small

Refer to the following sections for details on custom tuning.

☞ *8.9 Custom Tuning on page 422*

(2) Preparations

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

- The servo must be in ready status.
- There must be no overtravel.
- The servo must be OFF.
- Position control must be selected if power is supplied to the motor (i.e., when the servo is ON).
- The gain switching selection must be Pn139 = n.□□□0 (automatic gain switching is disabled).
- The gain 1 must be selected.
- Pn00C must be set to n.□□□0 (Function Selection for Test without a Motor is disabled).
- Pn170 must be set to n.□□□0 (Tuning-less Selection is disabled).
- Pn173 must be set to n.□□□0 (a load fluctuation compensation control is disabled).
- There must be no warnings.
- The parameters must not be write prohibited.

8.8.3 Applicable Tools

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

Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	You cannot perform autotuning with a host reference from the panel operator.	
Digital Operator	Fn202	🕮 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Tuning] - [Tuning]	☞ *8.8.4 Operating Procedure on page 408*

Note:

Multi-axis simultaneous tuning can be executed in the SigmaWin+ only.

8.8.4 Operating Procedure

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

NOTICE

If you are using an MP3000-Series Controller for phase control, set the mode selection to 1.

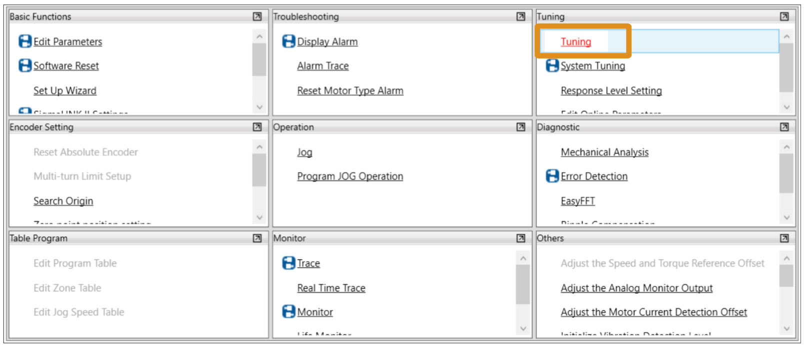
If 2 or 3 is selected for the mode, correct phase control may not be possible.

1. **Confirm that the value of Pn103 (Moment of Inertia Ratio) is set correctly.**

2. **Click the [] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

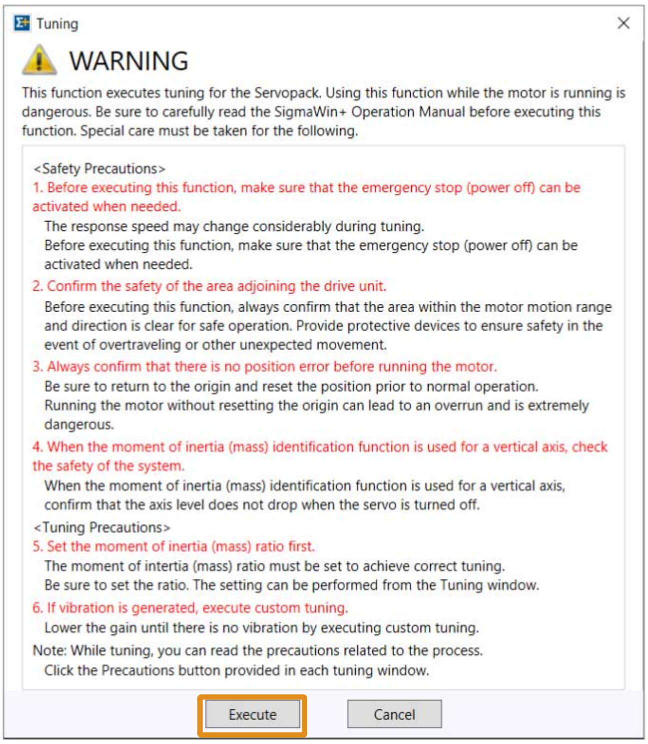
   The [Menu] window will be displayed.

3. **Click [Tuning] in the [Tuning] area.**



   The [Tuning] window will be displayed.

4. **Read the warnings and then click the [Execute] button.**



This function executes tuning for the Servopack. Using this function while the motor is running is dangerous. Be sure to carefully read the SigmaWin+ Operation Manual before executing this function. Special care must be taken for the following.

<Safety Precautions>

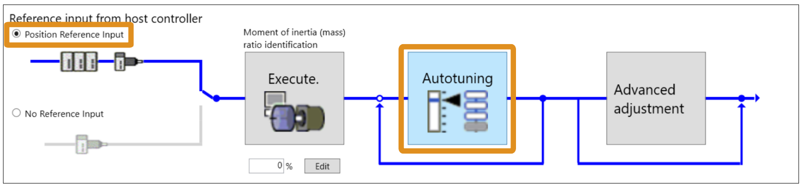
1. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
   The response speed may change considerably during tuning.
   Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
2. Confirm the safety of the area adjoining the drive unit.
   Before executing this function, always confirm that the area within the motor motion range and direction is clear for safe operation. Provide protective devices to ensure safety in the event of overtraveling or other unexpected movement.
3. Always confirm that there is no position error before running the motor.
   Be sure to return to the origin and reset the position prior to normal operation.
   Running the motor without resetting the origin can lead to an overrun and is extremely dangerous.
4. When the moment of inertia (mass) identification function is used for a vertical axis, check the safety of the system.
   When the moment of inertia (mass) identification function is used for a vertical axis, confirm that the axis level does not drop when the servo is turned off.

<Tuning Precautions>

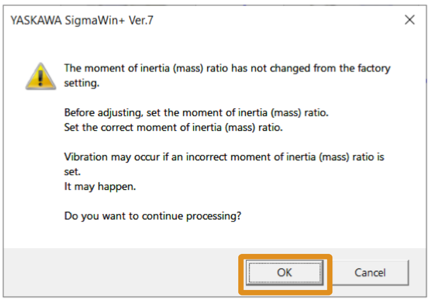
5. Set the moment of inertia (mass) ratio first.
   The moment of intertia (mass) ratio must be set to achieve correct tuning.
   Be sure to set the ratio. The setting can be performed from the Tuning window.
6. If vibration is generated, execute custom tuning.
   Lower the gain until there is no vibration by executing custom tuning.

Note: While tuning, you can read the precautions related to the process.
Click the Precautions button provided in each tuning window.

5. **Click [Position Reference Input] in [Reference input from host controller] and then click the [Autotuning] button.**



Information When the following message dialog box is displayed, click the [OK] button and then confirm that Pn103 (Moment of Inertia Ratio) is set correctly.



YASKAWA SigmaWin+ Ver.7

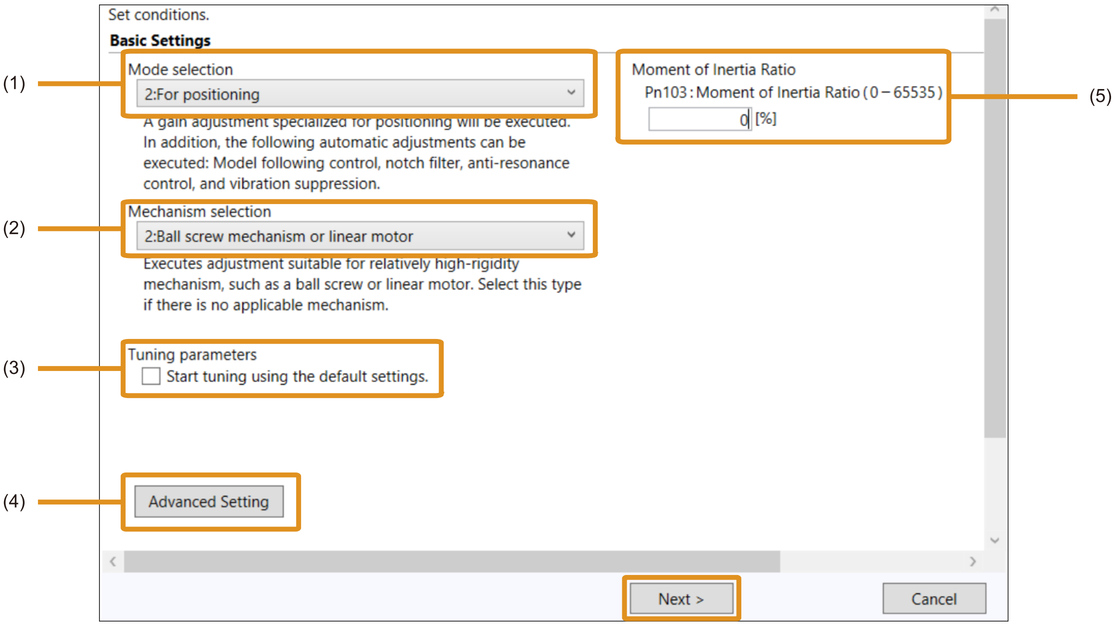
The moment of inertia (mass) ratio has not changed from the factory setting.

Before adjusting, set the moment of inertia (mass) ratio.
Set the correct moment of inertia (mass) ratio.

Vibration may occur if an incorrect moment of inertia (mass) ratio is set.
It may happen.

Do you want to continue processing?

6. **Set the conditions, and then click the [Next] button.**



Set conditions.

Basic Settings

Mode selection: 2:For positioning

A gain adjustment specialized for positioning will be executed. In addition, the following automatic adjustments can be executed: Model following control, notch filter, anti-resonance control, and vibration suppression.

Mechanism selection: 2:Ball screw mechanism or linear motor

Executes adjustment suitable for relatively high-rigidity mechanism, such as a ball screw or linear motor. Select this type if there is no applicable mechanism.

Tuning parameters

☐ Start tuning using the default settings.

Moment of Inertia Ratio

Pn103 : Moment of Inertia Ratio (0 – 65535) 0 [%]

No.	Item	Meaning
(1)	[Mode selection]	Set the mode. For details on the options, refer to the explanations on the window.
(2)	[Mechanism selection]	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. For details on the options, refer to the explanations on the window.
(3)	[Tuning parameters]	Specify the parameters to use for tuning. If you select [Start tuning using the default settings], the tuning parameters will be returned to the default settings before tuning is started.

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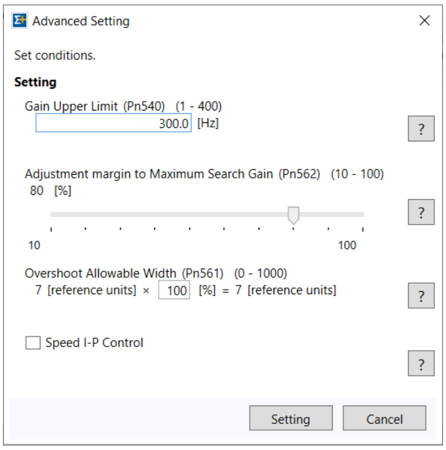
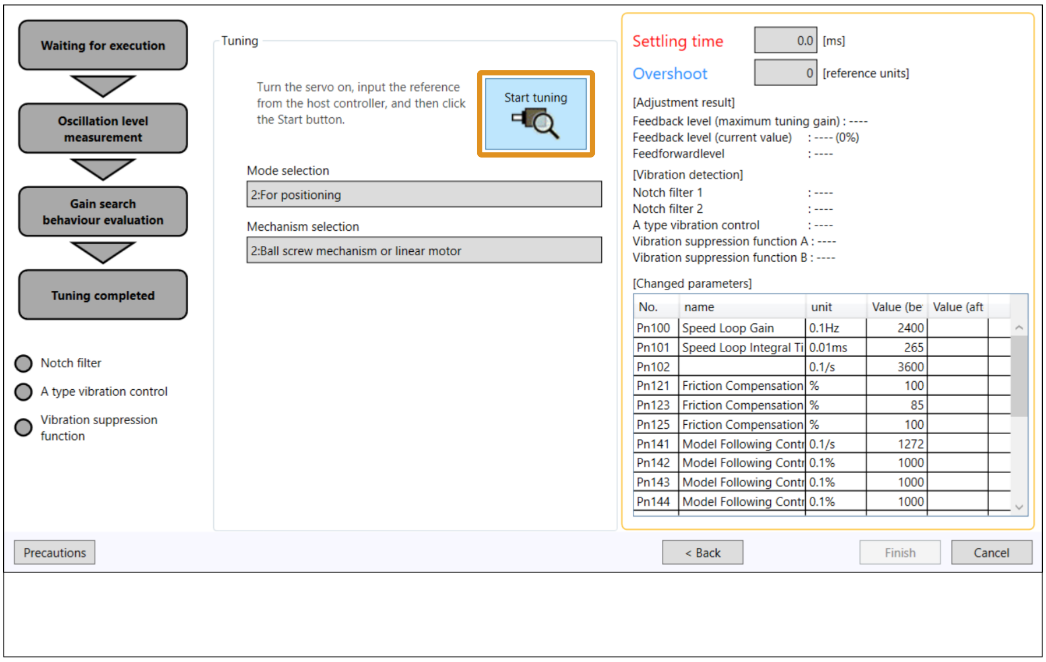
No.	Item	Meaning
(4)	[Advanced Setting] button	Click this button to display the [Advanced Setting] window on which you can set the details of tuning conditions. Configure detailed tuning conditions in the following cases: • To tune a higher response than the tuning results • When tuning fails with a large amount of overshoot • To tune with speed I-P control  Advanced Setting Set conditions. **Setting** Gain Upper Limit (Pn540) (1 - 400) 300.0 [Hz] Adjustment margin to Maximum Search Gain (Pn562) (10 - 100) 80 [%] Overshoot Allowable Width (Pn561) (0 - 1000) 7 [reference units] × 100 [%] = 7 [reference units] ☐ Speed I-P Control
(5)	[Moment of Inertia Ratio]	Change the settings as required.

7. **Turn ON the servo, enter a reference from the host controller, and then click the [Start tuning] button.**



Turn the servo on, input the reference from the host controller, and then click the Start button.

Mode selection: 2:For positioning

Mechanism selection: 2:Ball screw mechanism or linear motor

Settling time 0.0 [ms]

Overshoot 0 [reference units]

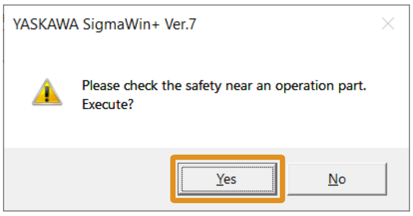
[Adjustment result]
Feedback level (maximum tuning gain) : ----
Feedback level (current value) : ---- (0%)
Feedforwardlevel : ----

[Vibration detection]
Notch filter 1 : ----
Notch filter 2 : ----
A type vibration control : ----
Vibration suppression function A : ----
Vibration suppression function B : ----

[Changed parameters]

No.	name	unit	Value (be	Value (aft
Pn100	Speed Loop Gain	0.1Hz	2400	
Pn101	Speed Loop Integral Ti	0.01ms	265	
Pn102		0.1/s	3600	
Pn121	Friction Compensation	%	100	
Pn123	Friction Compensation	%	85	
Pn125	Friction Compensation	%	100	
Pn141	Model Following Contr	0.1/s	1272	
Pn142	Model Following Contr	0.1%	1000	
Pn143	Model Following Contr	0.1%	1000	
Pn144	Model Following Contr	0.1%	1000	

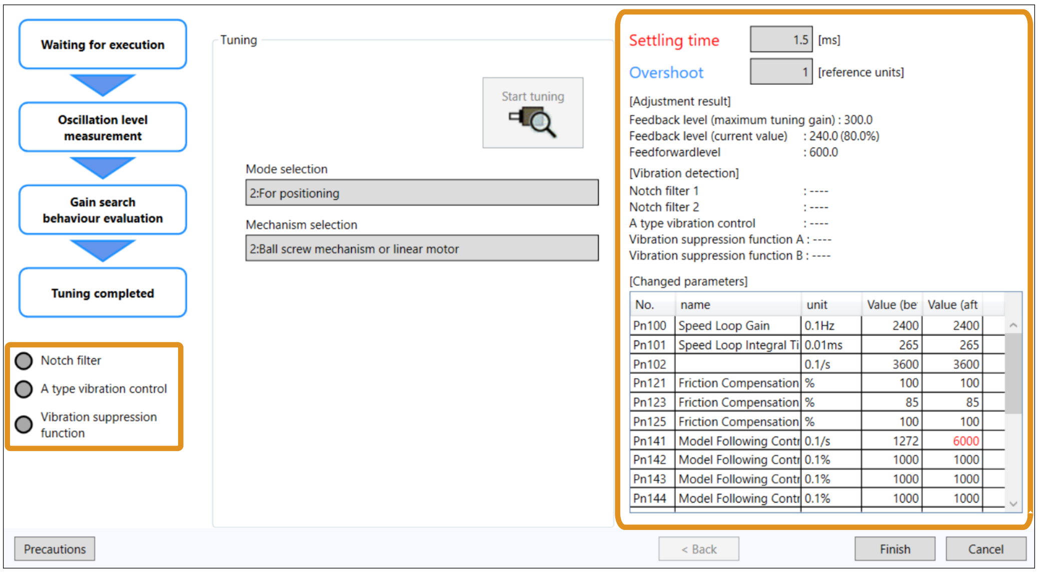
8. **Confirm safety around moving parts and click the [Yes] button.**



Please check the safety near an operation part.
Execute?

Tuning will be executed.

Vibration that occurs during tuning will be detected automatically and suitable settings will be made for that vibration. The content to set will be displayed on the right side of the window. When the settings have been completed, the indicators for the functions that were used will light at the lower left of the window.



Mode selection: 2:For positioning

Mechanism selection: 2:Ball screw mechanism or linear motor

Settling time 1.5 [ms]

Overshoot 1 [reference units]

[Adjustment result]
Feedback level (maximum tuning gain) : 300.0
Feedback level (current value) : 240.0 (80.0%)
Feedforwardlevel : 600.0

[Vibration detection]
Notch filter 1 : ----
Notch filter 2 : ----
A type vibration control : ----
Vibration suppression function A : ----
Vibration suppression function B : ----

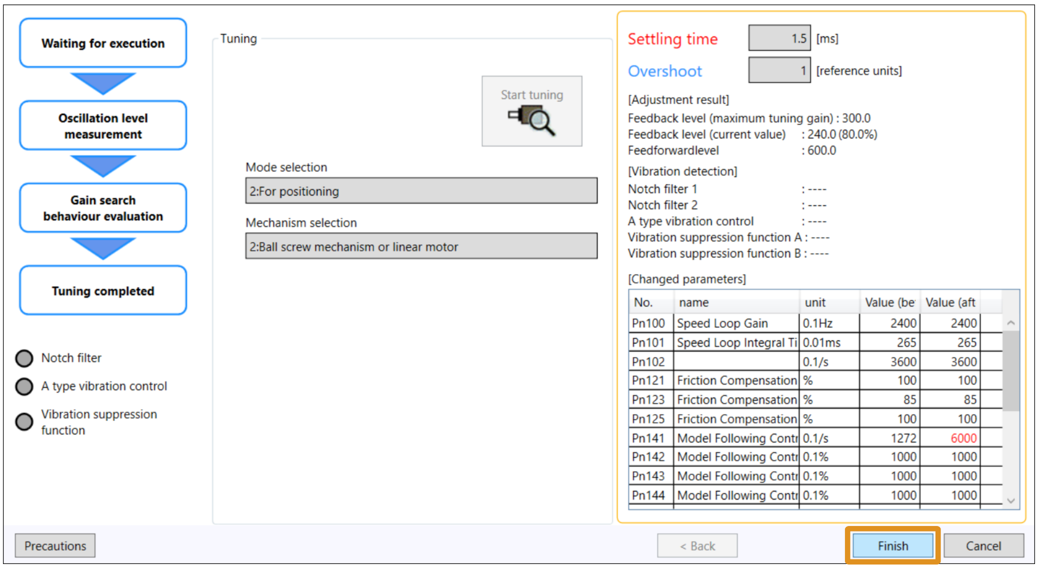
[Changed parameters]

No.	name	unit	Value (be	Value (aft
Pn100	Speed Loop Gain	0.1Hz	2400	2400
Pn101	Speed Loop Integral Ti	0.01ms	265	265
Pn102		0.1/s	3600	3600
Pn121	Friction Compensation	%	100	100
Pn123	Friction Compensation	%	85	85
Pn125	Friction Compensation	%	100	100
Pn141	Model Following Contr	0.1/s	1272	6000
Pn142	Model Following Contr	0.1%	1000	1000
Pn143	Model Following Contr	0.1%	1000	1000
Pn144	Model Following Contr	0.1%	1000	1000

Details on the content to set are shown below.

Item	Meaning
[Settling time]	Displays the settling time by the tuning results.
[Overshoot]	Displays the maximum overshoot by the tuning results.
[Feedback level (maximum tuning gain)]	Displays the maximum value of Pn100 (Speed Loop Gain) during tuning.
[Feedback level (current value)]	Displays the value of Pn100 (Speed Loop Gain) after tuning. The number in parentheses is the percentage of adjusting maximum gain.
[Feedforward level]	Displays the value of Pn141 (Model Following Control Gain) after tuning.
[Notch filter 1] [Notch filter 2]	Displays the frequencies set by the notch filters. "——" is displayed if not set.
[A type vibration control]	Displays the frequency set by anti-resonance control. "——" is displayed if not set.
[Vibration suppression function A] [Vibration suppression function B]	Displays the frequencies set by vibration suppression. "——" is displayed if not set.

9. **When tuning has been completed, click the [Finish] button.**



Mode selection: 2:For positioning

Mechanism selection: 2:Ball screw mechanism or linear motor

Settling time 1.5 [ms]

Overshoot 1 [reference units]

[Adjustment result]
Feedback level (maximum tuning gain) : 300.0
Feedback level (current value) : 240.0 (80.0%)
Feedforwardlevel : 600.0

[Vibration detection]
Notch filter 1 : ----
Notch filter 2 : ----
A type vibration control : ----
Vibration suppression function A : ----
Vibration suppression function B : ----

[Changed parameters]

No.	name	unit	Value (be	Value (aft
Pn100	Speed Loop Gain	0.1Hz	2400	2400
Pn101	Speed Loop Integral Ti	0.01ms	265	265
Pn102		0.1/s	3600	3600
Pn121	Friction Compensation	%	100	100
Pn123	Friction Compensation	%	85	85
Pn125	Friction Compensation	%	100	100
Pn141	Model Following Contr	0.1/s	1272	6000
Pn142	Model Following Contr	0.1%	1000	1000
Pn143	Model Following Contr	0.1%	1000	1000
Pn144	Model Following Contr	0.1%	1000	1000

The results of tuning will be set in the parameters and you will return to the [Tuning] window.

This concludes the procedure to perform autotuning with a host reference.

8.8.5 Operating Procedure for Multi-Axis Simultaneous Tuning

Multi-axis simultaneous tuning is a function you can use to tune multiple axes at the same time.

The conditions for using this function are:

- Two or more axes are connected to the SERVOPACK.
- The software version of the SERVOPACK is Ver. 0009 or later.

Use the following procedure to perform multi-axis simultaneous tuning.

NOTICE

If you are using an MP3000-Series Controller for phase control, set the mode selection to 1.

If 2 or 3 is selected for the mode, correct phase control may not be possible.

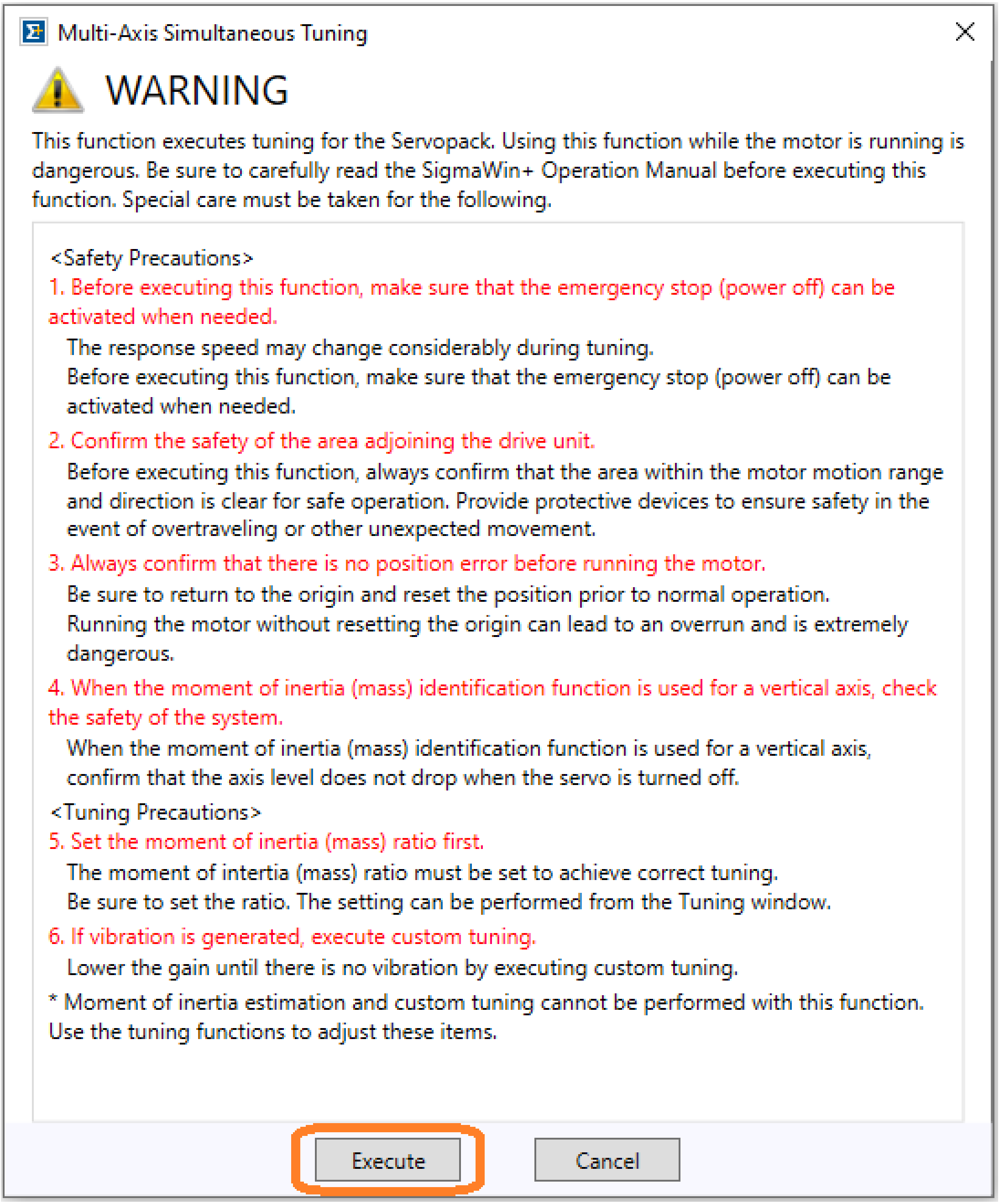
1. **Confirm that the value of Pn103 (Moment of Inertia Ratio) is set correctly.**
2. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

   The [Menu] window will be displayed.
3. **Click [Multi-Axis Simultaneous Tuning] in the [Tuning] area.**

   The [Multi-Axis Simultaneous Tuning] window will be displayed.

   Information Multi-axis simultaneous tuning cannot be executed if there is only one online SERVOPACK axis displayed in the workspace.

4. **Read the warnings and then click the [Execute] button.**



WARNING

This function executes tuning for the Servopack. Using this function while the motor is running is dangerous. Be sure to carefully read the SigmaWin+ Operation Manual before executing this function. Special care must be taken for the following.

<Safety Precautions>

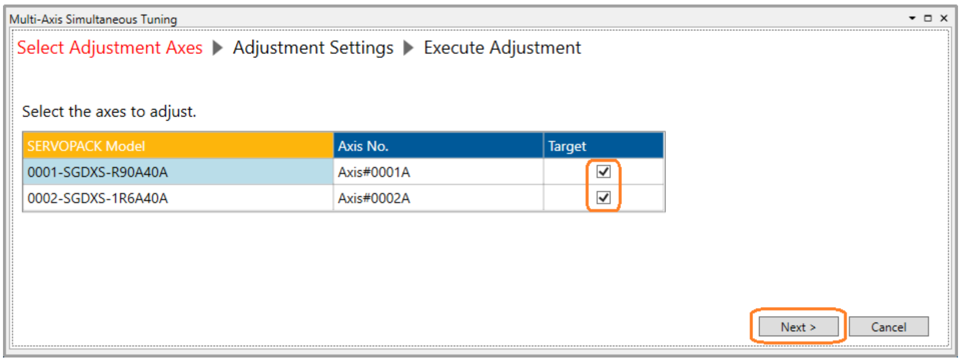
1. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
   The response speed may change considerably during tuning.
   Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
2. Confirm the safety of the area adjoining the drive unit.
   Before executing this function, always confirm that the area within the motor motion range and direction is clear for safe operation. Provide protective devices to ensure safety in the event of overtraveling or other unexpected movement.
3. Always confirm that there is no position error before running the motor.
   Be sure to return to the origin and reset the position prior to normal operation.
   Running the motor without resetting the origin can lead to an overrun and is extremely dangerous.
4. When the moment of inertia (mass) identification function is used for a vertical axis, check the safety of the system.
   When the moment of inertia (mass) identification function is used for a vertical axis, confirm that the axis level does not drop when the servo is turned off.

<Tuning Precautions>

5. Set the moment of inertia (mass) ratio first.
   The moment of intertia (mass) ratio must be set to achieve correct tuning.
   Be sure to set the ratio. The setting can be performed from the Tuning window.
6. If vibration is generated, execute custom tuning.
   Lower the gain until there is no vibration by executing custom tuning.

* Moment of inertia estimation and custom tuning cannot be performed with this function. Use the tuning functions to adjust these items.

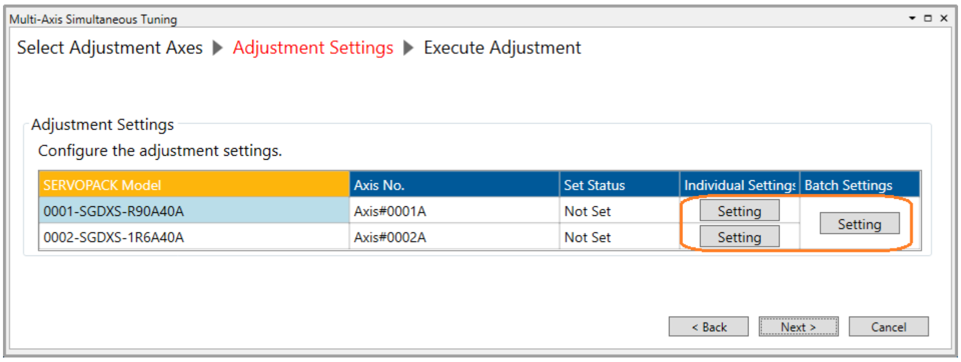
5. **Select the [Target] check box for the axes to tune and select [Next] button.**



Select the axes to adjust.

SERVOPACK Model	Axis No.	Target
0001-SGDXS-R90A40A	Axis#0001A	☑
0002-SGDXS-1R6A40A	Axis#0002A	☑

6. **To individually tune an axis, click the [Setting] button under the Individual Settings column. To batch tune axes, click the [Setting] button under the Batch Settings column.**

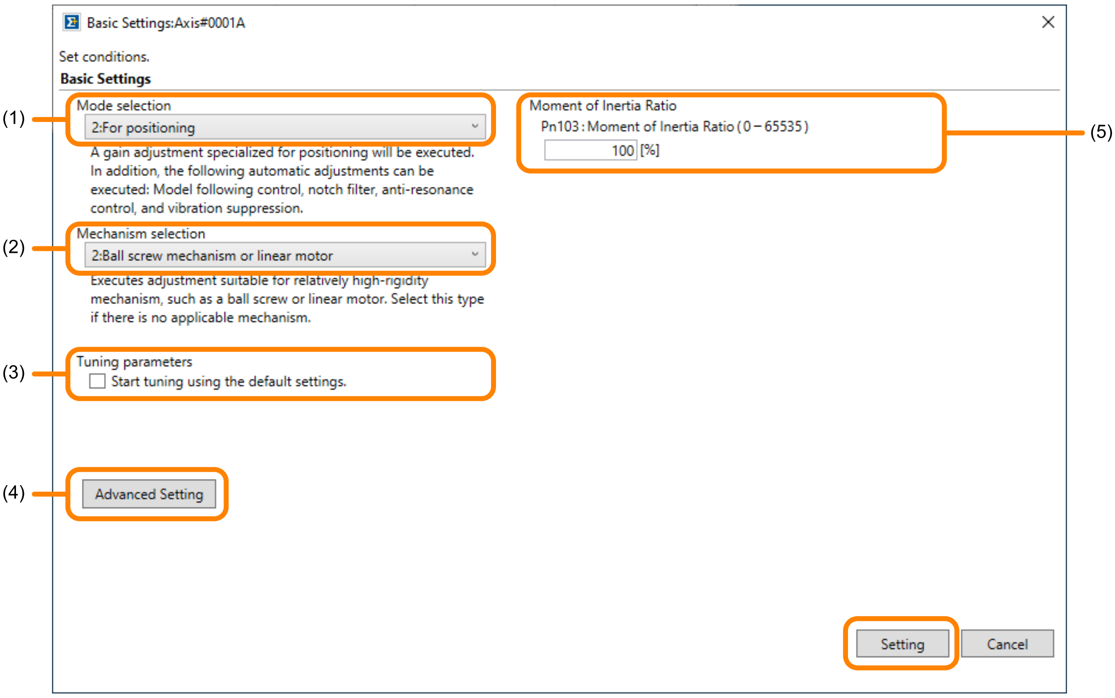


SERVOPACK Model	Axis No.	Set Status	Individual Settings	Batch Settings
0001-SGDXS-R90A40A	Axis#0001A	Not Set	Setting	Setting
0002-SGDXS-1R6A40A	Axis#0002A	Not Set	Setting	

The [Basic Settings] window will be displayed.

7. **Set the conditions, and then click the [Setting] button.**

Information For batch settings, the settings for the first axis in the tuning settings list will be displayed.



Mode selection: 2:For positioning

A gain adjustment specialized for positioning will be executed. In addition, the following automatic adjustments can be executed: Model following control, notch filter, anti-resonance control, and vibration suppression.

Mechanism selection: 2:Ball screw mechanism or linear motor

Executes adjustment suitable for relatively high-rigidity mechanism, such as a ball screw or linear motor. Select this type if there is no applicable mechanism.

Tuning parameters

☐ Start tuning using the default settings.

Moment of Inertia Ratio

Pn103 : Moment of Inertia Ratio (0 – 65535) 100 [%]

No.	Item	Meaning
(1)	[Mode selection]	Set the mode. For details on the options, refer to the explanations on the window.
(2)	[Mechanism selection]	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. For details on the options, refer to the explanations on the window.
(3)	[Tuning parameters]	Specify the parameters to use for tuning. If you select [Start tuning using the default settings], the tuning parameters will be returned to the default settings before tuning is started.

Continued on next page.

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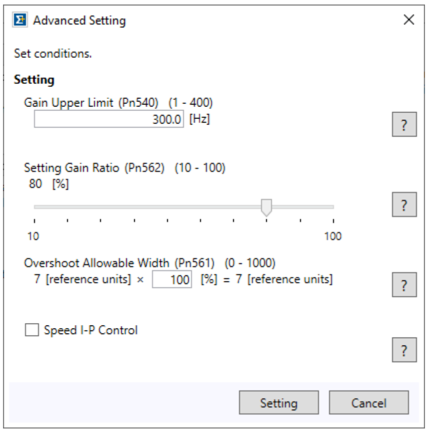
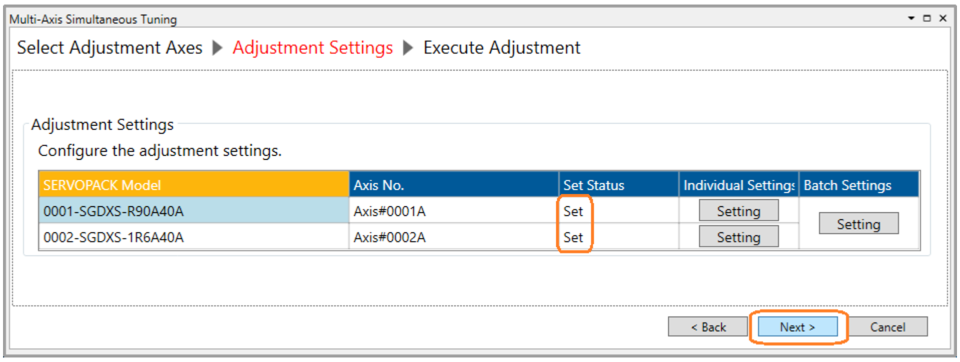
No.	Item	Meaning
(4)	[Advanced Setting] button	Click this button to display the [Advanced Setting] window on which you can set the details of tuning conditions. Configure detailed tuning conditions in the following cases: • To tune a higher response than the tuning results • When tuning fails with a large amount of overshoot • To tune with speed I-P control  Advanced Setting Set conditions. **Setting** Gain Upper Limit (Pn540) (1 - 400) 300.0 [Hz] Setting Gain Ratio (Pn562) (10 - 100) 80 [%] Overshoot Allowable Width (Pn561) (0 - 1000) 7 [reference units] × 100 [%] = 7 [reference units] ☐ Speed I-P Control
(5)	[Moment of Inertia Ratio]	Change the settings as required. For batch settings, the moment of inertia ratio cannot be set here because the setting of each axis will be used. Confirm that the value of Pn103 (Moment of Inertia Ratio) is correct, and then execute tuning.

8. **Confirm that [Set Status] for all axes has changed to [Set], and then click the [Next] button.**



Multi-Axis Simultaneous Tuning

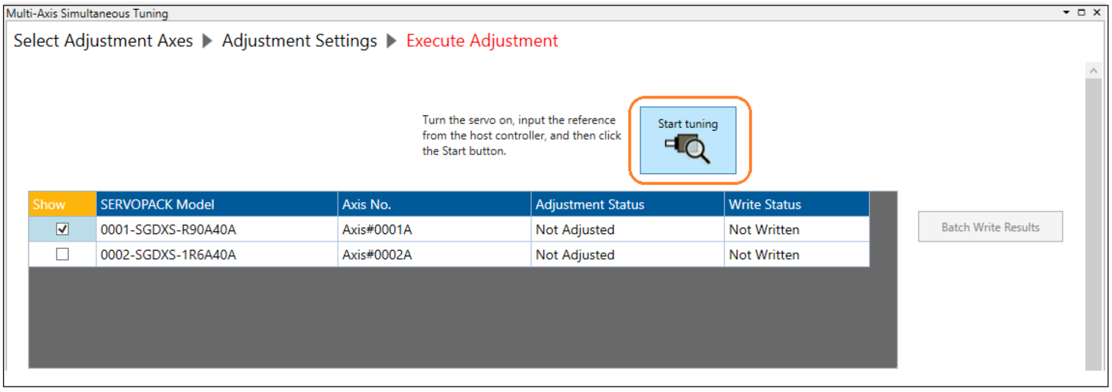
Select Adjustment Axes ▶ Adjustment Settings ▶ Execute Adjustment

Adjustment Settings

Configure the adjustment settings.

SERVOPACK Model	Axis No.	Set Status	Individual Settings	Batch Settings
0001-SGDXS-R90A40A	Axis#0001A	Set	Setting	Setting
0002-SGDXS-1R6A40A	Axis#0002A	Set	Setting	

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



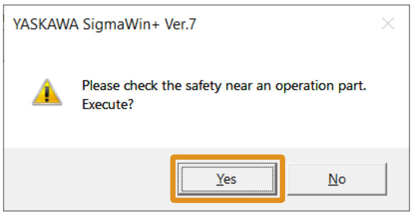
Multi-Axis Simultaneous Tuning

Select Adjustment Axes ▶ Adjustment Settings ▶ Execute Adjustment

Turn the servo on, input the reference from the host controller, and then click the Start button.

Show	SERVOPACK Model	Axis No.	Adjustment Status	Write Status
☑	0001-SGDXS-R90A40A	Axis#0001A	Not Adjusted	Not Written
☐	0002-SGDXS-1R6A40A	Axis#0002A	Not Adjusted	Not Written

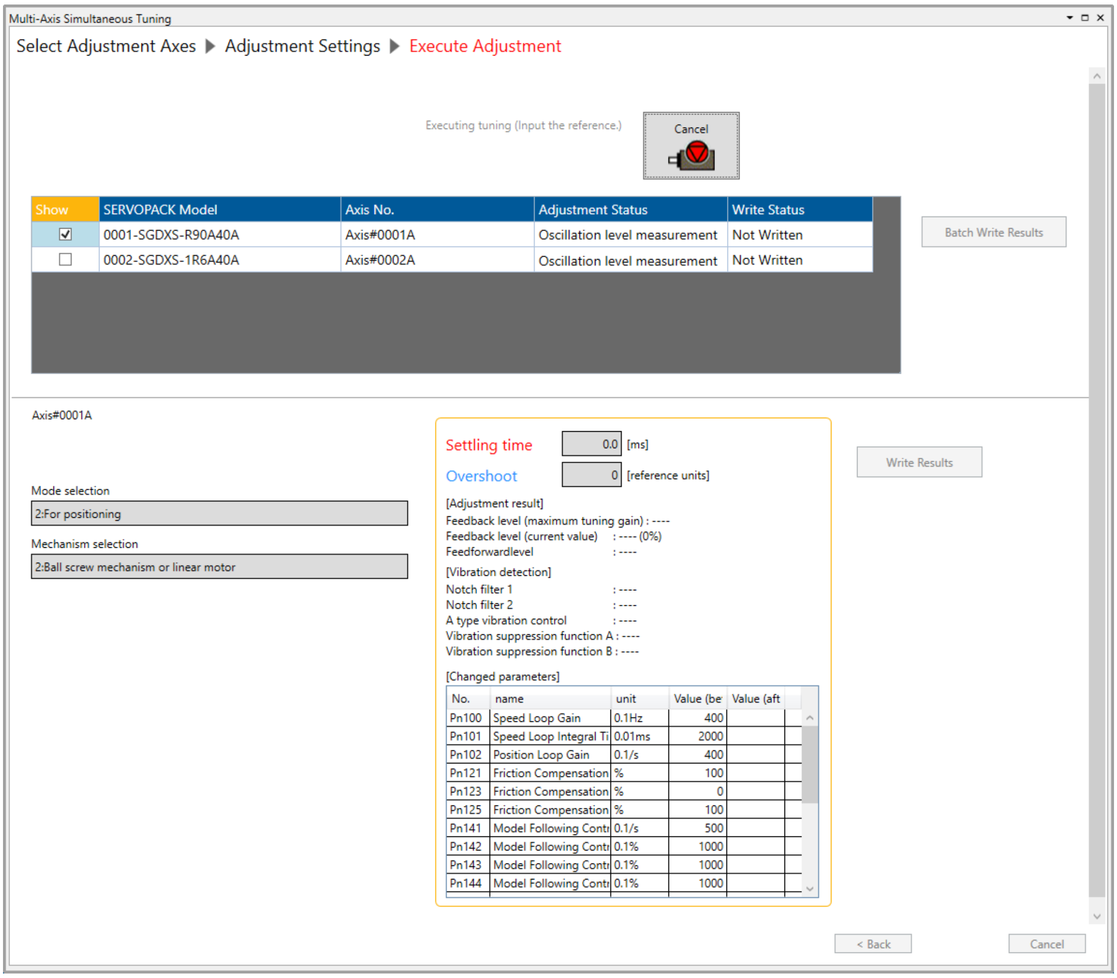
10. **Confirm safety around moving parts and click the [Yes] button.**



Please check the safety near an operation part.
Execute?

The servomotor shaft will rotate and tuning will start.

Vibration that occurs during tuning will be detected automatically and suitable tuning for that vibration will be performed. The tuned content will be displayed in the window.



Executing tuning (Input the reference.)

Show	SERVOPACK Model	Axis No.	Adjustment Status	Write Status
☑	0001-SGDXS-R90A40A	Axis#0001A	Oscillation level measurement	Not Written
☐	0002-SGDXS-1R6A40A	Axis#0002A	Oscillation level measurement	Not Written

Axis#0001A

Mode selection
2:For positioning

Mechanism selection
2:Ball screw mechanism or linear motor

Settling time 0.0 [ms]
Overshoot 0 [reference units]

[Adjustment result]
Feedback level (maximum tuning gain) : ----
Feedback level (current value) : ---- (0%)
Feedforwardlevel : ----

[Vibration detection]
Notch filter 1 : ----
Notch filter 2 : ----
A type vibration control : ----
Vibration suppression function A : ----
Vibration suppression function B : ----

[Changed parameters]

No.	name	unit	Value (be	Value (aft
Pn100	Speed Loop Gain	0.1Hz	400	
Pn101	Speed Loop Integral Ti	0.01ms	2000	
Pn102	Position Loop Gain	0.1/s	400	
Pn121	Friction Compensation	%	100	
Pn123	Friction Compensation	%	0	
Pn125	Friction Compensation	%	100	
Pn141	Model Following Contr	0.1/s	500	
Pn142	Model Following Contr	0.1%	1000	
Pn143	Model Following Contr	0.1%	1000	
Pn144	Model Following Contr	0.1%	1000	

Details on the tuned content are shown below.

Item	Meaning
[Settling time]	Displays the settling time by the tuning results.
[Overshoot]	Displays the maximum overshoot by the tuning results.
[Feedback level (maximum tuning gain)]	Displays the maximum value of Pn100 (Speed Loop Gain) during tuning.
[Feedback level (current value)]	Displays the value of Pn100 (Speed Loop Gain) after tuning. The number in parentheses is the percentage of adjusting maximum gain.
[Feedforward level]	Displays the value of Pn141 (Model Following Control Gain) after tuning.
[Notch filter 1] [Notch filter 2]	Displays the frequencies set by the notch filters. "——" is displayed if not set.

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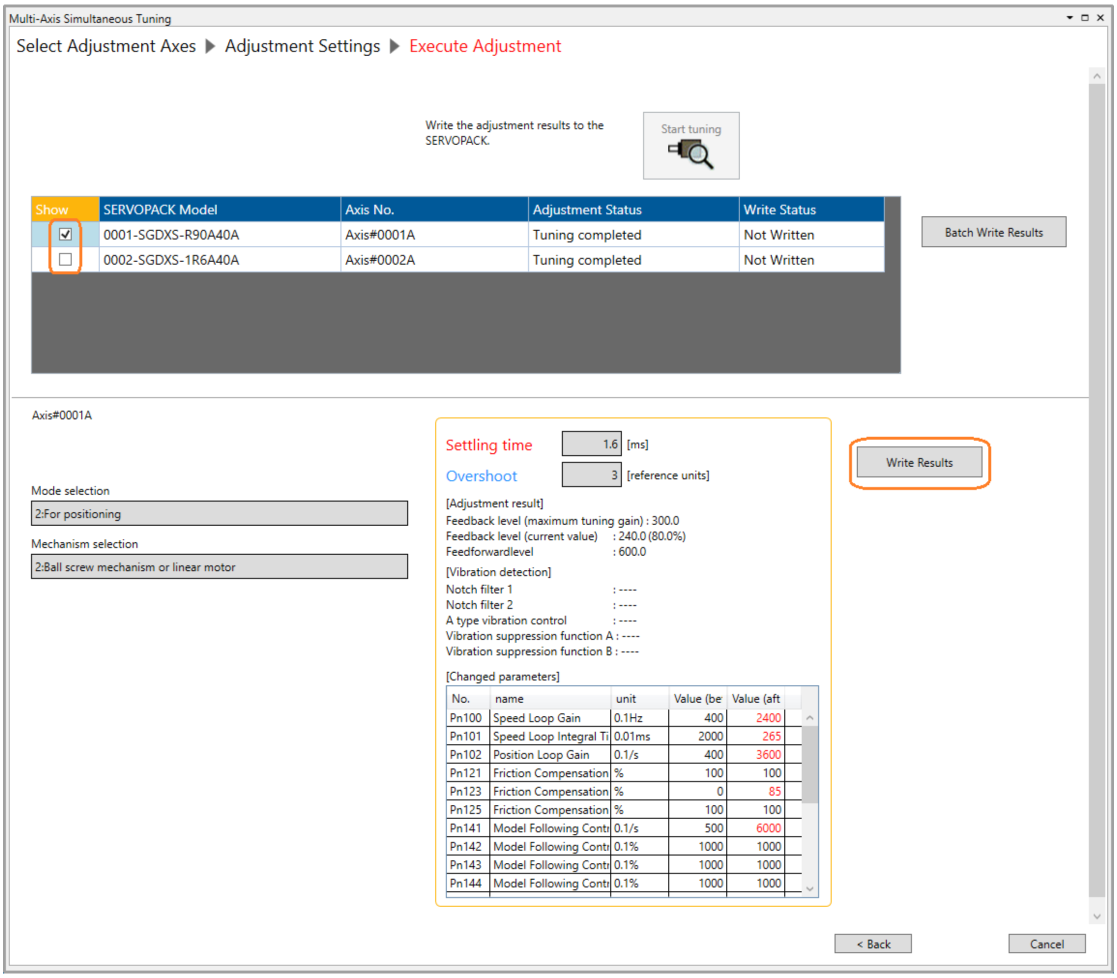
Item	Meaning
[A type vibration control]	Displays the frequency set by anti-resonance control. "——" is displayed if not set.
[Vibration suppression function A] [Vibration suppression function B]	Displays the frequencies set by vibration suppression. "——" is displayed if not set.

If tuning is completed normally, "Tuning completed" will be displayed in the [Adjustment Status] area.

11. **Select the [Show] check box for the axes with tuning results to save, and then click [Write Results] button.**

Information To batch write the tuning results for all axes, click the [Batch Write Results] button.



Show	SERVOPACK Model	Axis No.	Adjustment Status	Write Status
☑	0001-SGDXS-R90A40A	Axis#0001A	Tuning completed	Not Written
☐	0002-SGDXS-1R6A40A	Axis#0002A	Tuning completed	Not Written

Axis#0001A

Mode selection: 2:For positioning

Mechanism selection: 2:Ball screw mechanism or linear motor

Settling time 1.6 [ms]

Overshoot 3 [reference units]

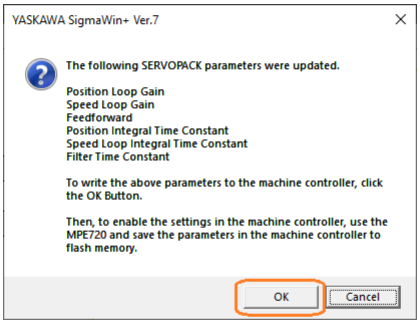
[Adjustment result]
Feedback level (maximum tuning gain) : 300.0
Feedback level (current value) : 240.0 (80.0%)
Feedforwardlevel : 600.0

[Vibration detection]
Notch filter 1 : ----
Notch filter 2 : ----
A type vibration control : ----
Vibration suppression function A : ----
Vibration suppression function B : ----

[Changed parameters]

No.	name	unit	Value (be	Value (aft
Pn100	Speed Loop Gain	0.1Hz	400	2400
Pn101	Speed Loop Integral Ti	0.01ms	2000	265
Pn102	Position Loop Gain	0.1/s	400	3600
Pn121	Friction Compensation	%	100	100
Pn123	Friction Compensation	%	0	85
Pn125	Friction Compensation	%	100	100
Pn141	Model Following Contr	0.1/s	500	6000
Pn142	Model Following Contr	0.1%	1000	1000
Pn143	Model Following Contr	0.1%	1000	1000
Pn144	Model Following Contr	0.1%	1000	1000

12. **Click the [OK] button.**



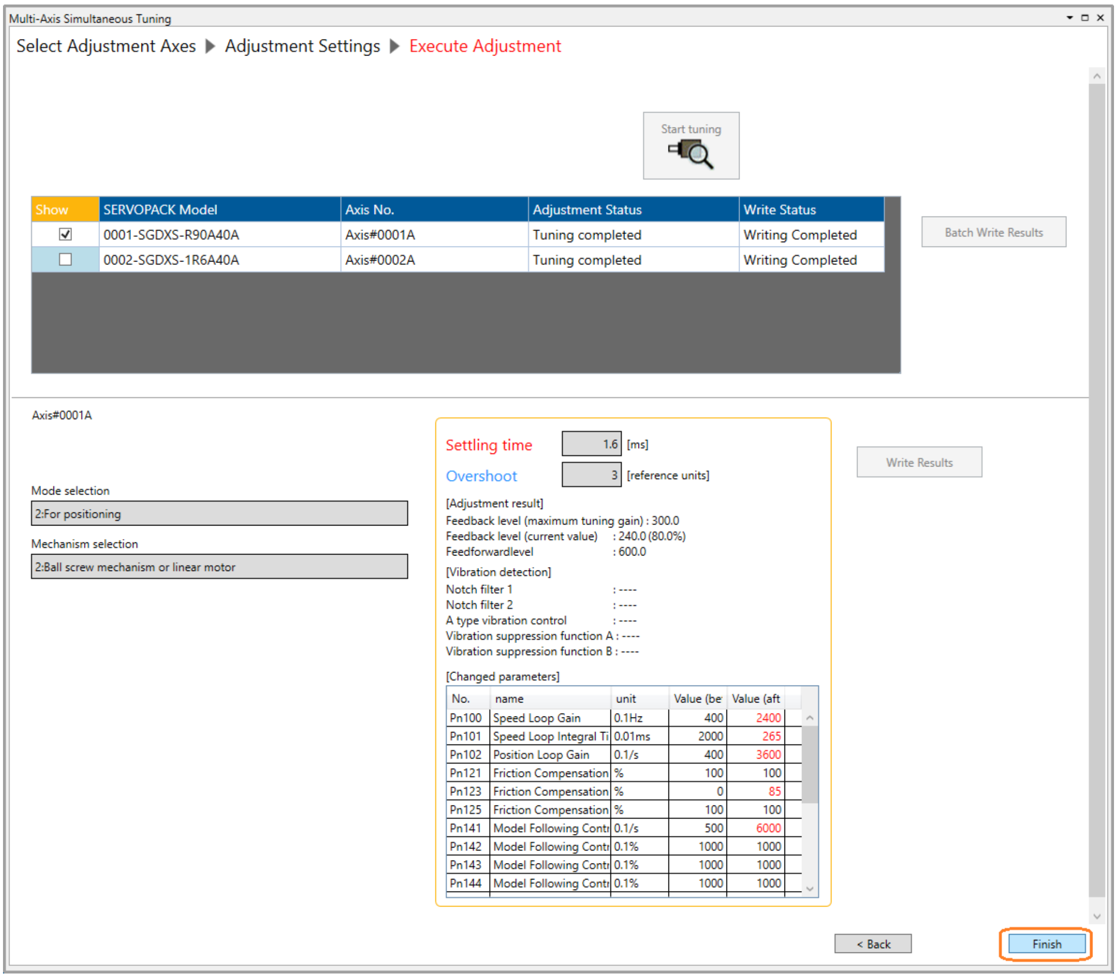
The following SERVOPACK parameters were updated.

Position Loop Gain
Speed Loop Gain
Feedforward
Position Integral Time Constant
Speed Loop Integral Time Constant
Filter Time Constant

To write the above parameters to the machine controller, click the OK Button.

Then, to enable the settings in the machine controller, use the MPE720 and save the parameters in the machine controller to flash memory.

13. **Click the [Finish] button.**



Show	SERVOPACK Model	Axis No.	Adjustment Status	Write Status
☑	0001-SGDXS-R90A40A	Axis#0001A	Tuning completed	Writing Completed
☐	0002-SGDXS-1R6A40A	Axis#0002A	Tuning completed	Writing Completed

Axis#0001A

Mode selection: 2:For positioning

Mechanism selection: 2:Ball screw mechanism or linear motor

Settling time 1.6 [ms]

Overshoot 3 [reference units]

[Adjustment result]
Feedback level (maximum tuning gain) : 300.0
Feedback level (current value) : 240.0 (80.0%)
Feedforwardlevel : 600.0

[Vibration detection]
Notch filter 1 : ----
Notch filter 2 : ----
A type vibration control : ----
Vibration suppression function A : ----
Vibration suppression function B : ----

[Changed parameters]

No.	name	unit	Value (be	Value (aft
Pn100	Speed Loop Gain	0.1Hz	400	2400
Pn101	Speed Loop Integral Ti	0.01ms	2000	265
Pn102	Position Loop Gain	0.1/s	400	3600
Pn121	Friction Compensation	%	100	100
Pn123	Friction Compensation	%	0	85
Pn125	Friction Compensation	%	100	100
Pn141	Model Following Contr	0.1/s	500	6000
Pn142	Model Following Contr	0.1%	1000	1000
Pn143	Model Following Contr	0.1%	1000	1000
Pn144	Model Following Contr	0.1%	1000	1000

This concludes the procedure to perform multi-axis simultaneous tuning.

8.8.6 Troubleshooting Problems in Autotuning with a Host Reference

The following tables give the causes of and corrections for problems that may occur in autotuning with a host reference.

(1) Autotuning with a Host Reference Was Not Performed

Possible Cause	Corrective Action
Main circuit power is OFF.	Turn ON the main circuit power.
An alarm or warning occurred.	Remove the cause of the alarm or warning.
Overtraveling occurred.	Remove the cause of overtraveling.
The gain 2 was selected with the gain selection.	Disable automatic gain switching.
The HWBB was activated.	Release the HWBB.

(2) Troubleshooting Errors

Error	Possible Cause	Corrective Action
The gain adjustments were not successfully completed.	Machine vibration occurs or the positioning completion signal is not stable when the servomotor stops.	• On the [Detailed Setting] window, increase the setting of Pn561 (Overshoot Detection Level). • Increase the setting of Pn522 (Positioning Completed Width). • On the [Detailed Setting] window, decrease the setting of Pn562 (Setting Gain Ratio). • Change the mode from 2 to 3. • If machine vibration occurs, suppress the vibration with the anti-resonance control adjustment and the vibration suppression function.
Positioning was not completed within approximately 10 seconds after position adjustment was completed.	The positioning completed width is too narrow or proportional control is being used.	• Increase the setting of Pn522 (Positioning Completed Width). • Turn OFF the /P-CON (Proportional Control Input) signal.

(3) Adjustment Results Are Not Satisfactory for Position Control

Configuring parameters as shown below may improve the adjustment results.

- Change Pn522 (Positioning Completed Width) and Pn20E/Pn210 (Electronic Gear Ratio).
- Adjust Pn561 (Overshoot Detection Level).
  You can change these parameters on the [Adjustment Settings] window. Details on the settings of Pn561 are shown below.

Setting of Pn561	Meaning
0% to 99%	This will allow tuning to be performed without overshooting within the positioning completed width, but the positioning completed width may be extended.
100% (default setting)	This will allow tuning with overshooting that is equivalent to the positioning completed width.
101% to 1000%	The settings that allow overshooting to exceed the positioning completed width. Adjust Pn561 (Overshoot Detection Level) without changing the positioning completed width. Increase this setting when high responsiveness is required even if overshooting increases.

- Increase the upper limits for tuning.
  However, the changes in these settings are valid only when the tuning results are Pn100 = 2400 [0.1 Hz] (speed loop gain = 240 Hz) and Pn141 = 6000 [0.1/s] (model following control gain = 600/s). If you increase the upper limits of tuning at this time, you may be able to further decrease the settling time.
  You can change the upper limits of tuning on the [Detailed Setting] window. Set the parameters as shown below.
  - Pn540 = 3000 [0.1 Hz] or higher (maximum search gain = 300 Hz [default setting] or higher)
  - Pn562 = 80 [%] or higher (setting gain ratio = 80% [default setting] or higher)

8.8.7 Automatically Adjusted Function Setting

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

☞ *8.7.6 Automatically Adjusted Function Setting on page 403*

8.8.8 Related Parameters

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

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

Parameter	Name	Automatic Changes
Pn100	Speed Loop Gain	Yes
Pn101	Speed Loop Integral Time Constant	Yes
Pn102	Position Loop Gain	Yes
Pn103	Moment of Inertia Ratio	No
Pn121	Friction Compensation Gain	Yes
Pn123	Friction Compensation Coefficient	Yes
Pn124	Friction Compensation Frequency Correction	No
Pn125	Friction Compensation Gain Correction	Yes
Pn401	First Stage First Torque Reference Filter Time Constant	Yes
Pn408	Torque-Related Function Selections	Yes
Pn409	First Stage Notch Filter Frequency	Yes
Pn40A	First Stage Notch Filter Q Value	Yes
Pn40C	Second Stage Notch Filter Frequency	Yes
Pn40D	Second Stage Notch Filter Q Value	Yes
Pn140	Model Following Control-Related Selections	Yes
Pn141	Model Following Control Gain	Yes
Pn142	Model Following Control Gain Correction	Yes
Pn143	Model Following Control Bias in the Forward Direction	Yes
Pn144	Model Following Control Bias in the Reverse Direction	Yes
Pn145	Vibration Suppression 1 Frequency A	Yes
Pn146	Vibration Suppression 1 Frequency B	Yes
Pn147	Model Following Control Speed Feedforward Compensation	Yes
Pn14F = n.□□□X	Model Following Control Type Selection	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.

8.9 Custom Tuning

This section describes custom tuning.

8.9.1 Outline

You can use custom tuning to manually adjust the servo during operation using a speed or position reference input from the host controller. You can use it to fine-tune adjustments that were made with autotuning.

The following items are adjusted automatically.

- Gains (e.g., speed loop gain, position loop gain, load fluctuation compensation response level)
- Filters (torque reference filter and notch filters)
- Friction compensation
- Anti-resonance control

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

☞ *8.9.7 Related Parameters on page 429*

There are three adjustment methods that you can use for custom tuning.

Tuning Mode		**Adjusting Method**
0	Set servo gains with priority given to stability.	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.
1	Set servo gains with priority given to response.	
2	Set servo gains for positioning application.	Two tuning levels are manipulated to reduce positioning time even further and set multiple servo gains. Model following control is used to reduce the positioning time. If vibration is detected, notch filters and anti-resonance control are automatically adjusted, and friction compensation is automatically set. Manual anti-resonance control adjustment and vibration suppression are also possible during custom tuning.
3	Set servo gains especially to prevent overshooting during positioning application.	
6	Set servo gains for application with large load fluctuations.	Load fluctuation compensation control is performed to suppress the variations in settling time that occur when the load fluctuates. In addition to gain adjustment, automatic setting of notch filters and anti-resonance control is provided.

⚠ CAUTION

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

8.9.2 Preparations

Always check the following before you execute custom tuning.

- Pn00C must be set to n.□□□0 (Function Selection for Test without a Motor is disabled).
- Pn170 must be set to n.□□□0 (Tuning-less Selection is disabled).
- If speed control is used, tuning mode 0 or 1 must be set.
- The parameters must not be write prohibited.

8.9.3 Applicable Tools

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

Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	You cannot perform custom tuning from the panel operator.	
Digital Operator	Fn203	🕮 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Tuning] - [Tuning]	☞ *8.9.4 Operating Procedure on page 423*

8.9.4 Operating Procedure

Use the following procedure to perform custom tuning.

⚠ CAUTION

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 you execute this function. 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 this function. 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.**

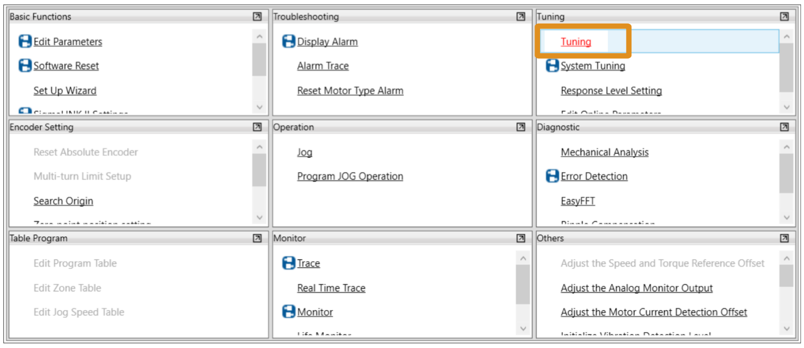
NOTICE

If you are using an MP3000-series controller for phase control, set the tuning mode to 0 or 1.

If 2 or 3 is selected for the tuning mode, correct phase control may not be possible.

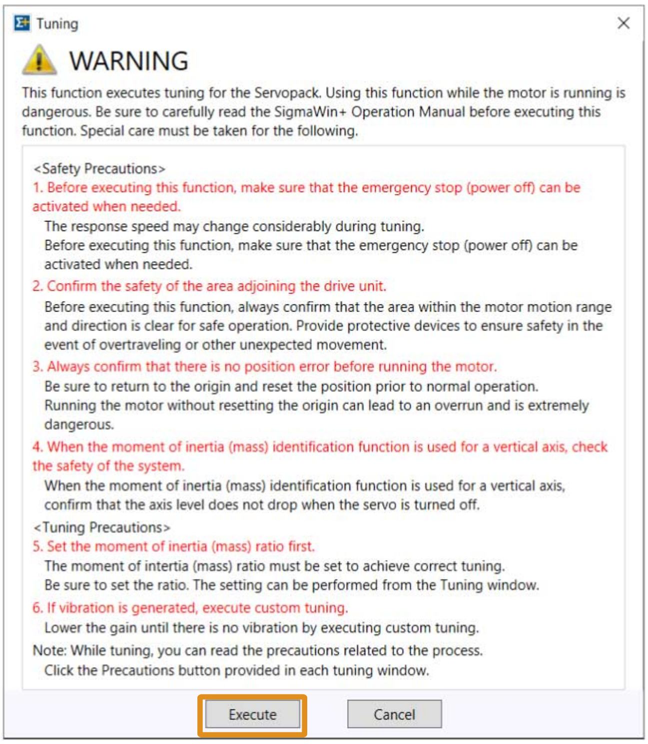
1. **Confirm that the value of Pn103 (Moment of Inertia Ratio) is set correctly.**
2. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

   The [Menu] window will be displayed.
3. **Click [Tuning] in the [Tuning] area.**



   The [Tuning] window will be displayed.

4. **Read the warnings and then click the [Execute] button.**



Tuning

WARNING

This function executes tuning for the Servopack. Using this function while the motor is running is dangerous. Be sure to carefully read the SigmaWin+ Operation Manual before executing this function. Special care must be taken for the following.

<Safety Precautions>

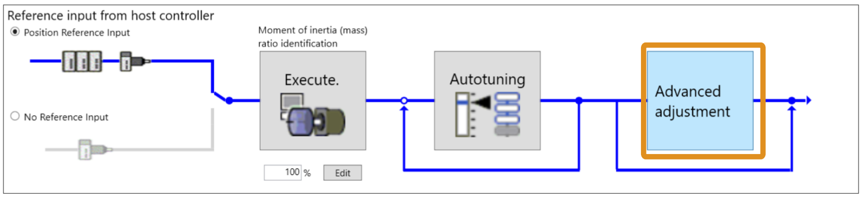
1. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
   The response speed may change considerably during tuning.
   Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
2. Confirm the safety of the area adjoining the drive unit.
   Before executing this function, always confirm that the area within the motor motion range and direction is clear for safe operation. Provide protective devices to ensure safety in the event of overtraveling or other unexpected movement.
3. Always confirm that there is no position error before running the motor.
   Be sure to return to the origin and reset the position prior to normal operation.
   Running the motor without resetting the origin can lead to an overrun and is extremely dangerous.
4. When the moment of inertia (mass) identification function is used for a vertical axis, check the safety of the system.
   When the moment of inertia (mass) identification function is used for a vertical axis, confirm that the axis level does not drop when the servo is turned off.

<Tuning Precautions>

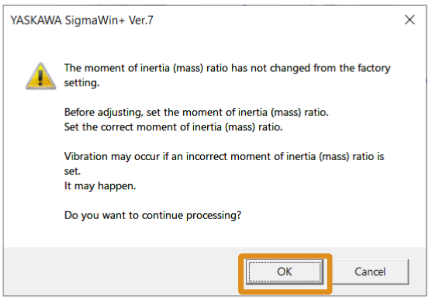
5. Set the moment of inertia (mass) ratio first.
   The moment of intertia (mass) ratio must be set to achieve correct tuning.
   Be sure to set the ratio. The setting can be performed from the Tuning window.
6. If vibration is generated, execute custom tuning.
   Lower the gain until there is no vibration by executing custom tuning.

Note: While tuning, you can read the precautions related to the process.
Click the Precautions button provided in each tuning window.

5. **Click the [Advanced adjustment] button.**



Information When the following message dialog box is displayed, click the [OK] button and then confirm that Pn103 (Moment of Inertia Ratio) is set correctly.



YASKAWA SigmaWin+ Ver.7

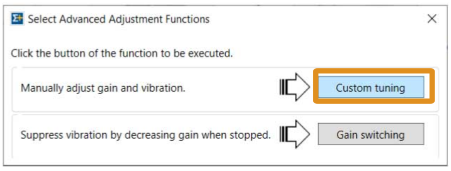
The moment of inertia (mass) ratio has not changed from the factory setting.

Before adjusting, set the moment of inertia (mass) ratio.
Set the correct moment of inertia (mass) ratio.

Vibration may occur if an incorrect moment of inertia (mass) ratio is set.
It may happen.

Do you want to continue processing?

6. **Click the [Custom tuning] button.**



Select Advanced Adjustment Functions

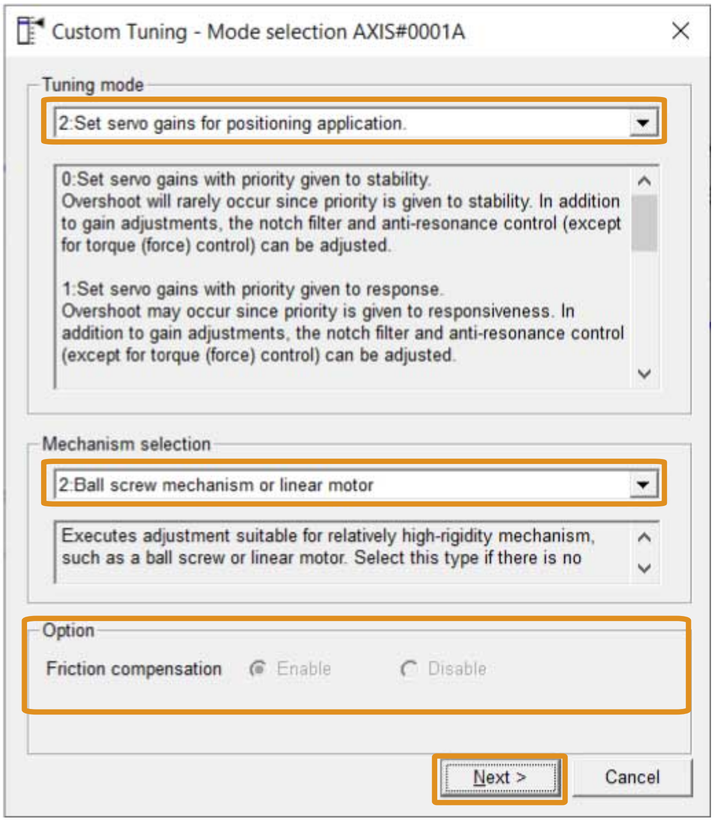
Click the button of the function to be executed.

Manually adjust gain and vibration.

Suppress vibration by decreasing gain when stopped.

The [Custom Tuning] window will be displayed.

7. **Select [Tuning mode], [Mechanism selection], and [Option], and then click the [Next] button.**



Custom Tuning - Mode selection AXIS#0001A

Tuning mode

2:Set servo gains for positioning application.

0:Set servo gains with priority given to stability.
Overshoot will rarely occur since priority is given to stability. In addition to gain adjustments, the notch filter and anti-resonance control (except for torque (force) control) can be adjusted.

1:Set servo gains with priority given to response.
Overshoot may occur since priority is given to responsiveness. In addition to gain adjustments, the notch filter and anti-resonance control (except for torque (force) control) can be adjusted.

Mechanism selection

2:Ball screw mechanism or linear motor

Executes adjustment suitable for relatively high-rigidity mechanism, such as a ball screw or linear motor. Select this type if there is no

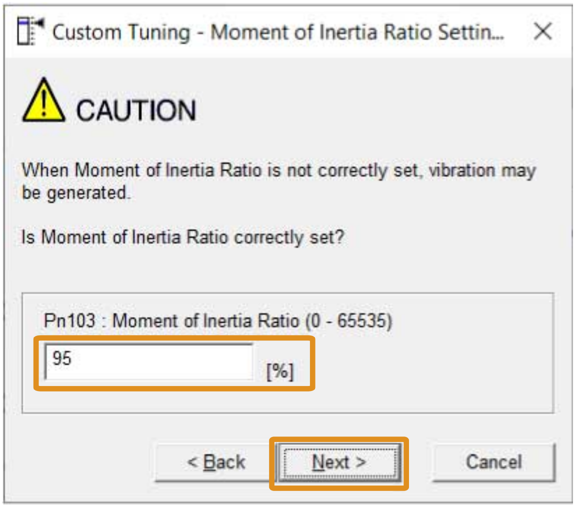
Option

Friction compensation ● Enable ○ Disable

For details on [Tuning mode] and [Mechanism selection], refer to the explanations on the above window.

The content displayed in [Option] changes according the selection of [Tuning mode].

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



Custom Tuning - Moment of Inertia Ratio Settin...

CAUTION

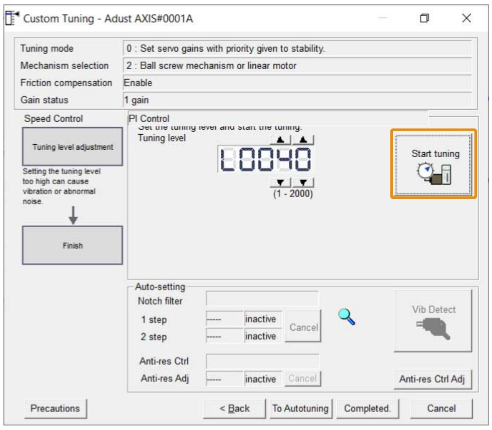
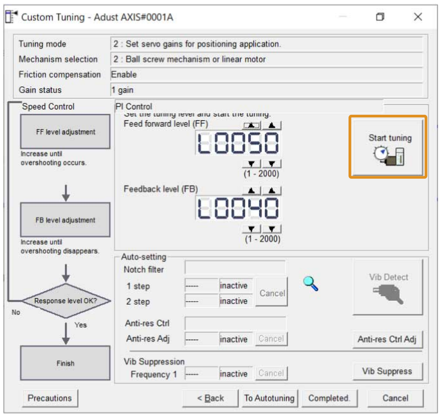
When Moment of Inertia Ratio is not correctly set, vibration may be generated.

Is Moment of Inertia Ratio correctly set?

Pn103 : Moment of Inertia Ratio (0 - 65535)

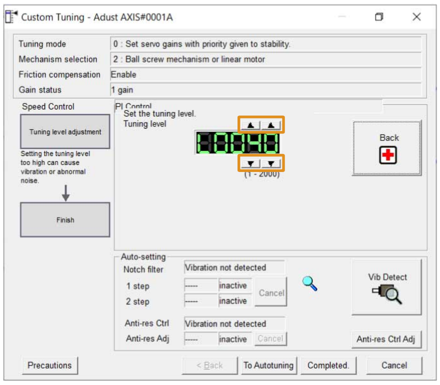
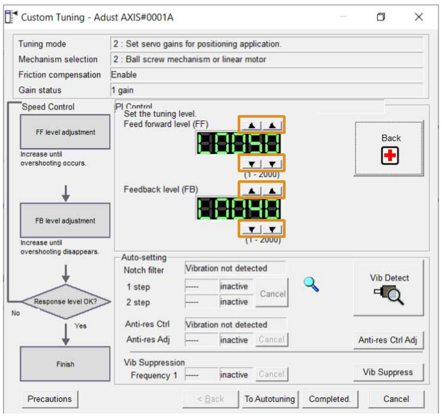
95 [%]

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

Tuning Mode 0 or 1 or 6	Tuning Mode 2 or 3
 Custom Tuning - Adust AXIS#0001A Tuning mode: 0 : Set servo gains with priority given to stability. Mechanism selection: 2 : Ball screw mechanism or linear motor Friction compensation: Enable Gain status: 1 gain Tuning level: L0040 (1 - 2000)	 Custom Tuning - Adust AXIS#0001A Tuning mode: 2 : Set servo gains for positioning application. Mechanism selection: 2 : Ball screw mechanism or linear motor Friction compensation: Enable Gain status: 1 gain Feed forward level (FF): L0050 (1 - 2000) Feedback level (FB): L0040 (1 - 2000)

10. **Use the [▲] and [▼] buttons to change the tuning level.**

Click the [Back] button during tuning to restore the setting to its original value. The tuning level will return to the value from before when custom tuning was started.

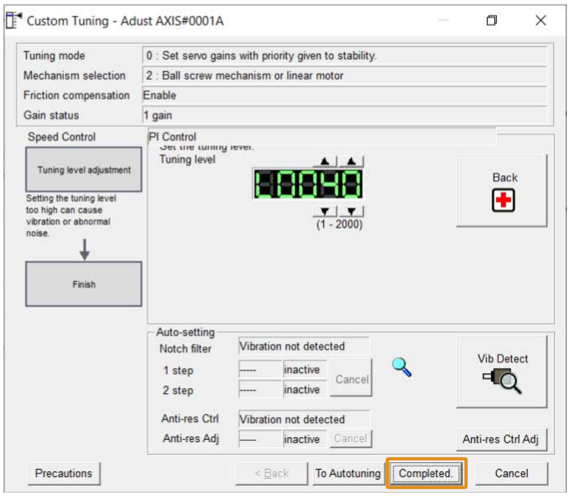
Tuning Mode 0 or 1 or 6	Tuning Mode 2 or 3
Increase the tuning level until overshooting occurs.  Custom Tuning - Adust AXIS#0001A Tuning mode: 0 : Set servo gains with priority given to stability. Mechanism selection: 2 : Ball screw mechanism or linear motor Friction compensation: Enable Gain status: 1 gain Notch filter: Vibration not detected Anti-res Ctrl: Vibration not detected	Increase the feedforward level until overshooting occurs and then increase the feedback level until overshooting is eliminated. Repeat these changes to make the adjustment. The new feedforward level will not be used until the positioning completed signal is output.  Custom Tuning - Adust AXIS#0001A Tuning mode: 2 : Set servo gains for positioning application. Mechanism selection: 2 : Ball screw mechanism or linear motor Friction compensation: Enable Gain status: 1 gain Notch filter: Vibration not detected Anti-res Ctrl: Vibration not detected

11. **You can set the functions to suppress vibration (notch filters, automatic anti-resonance control setting, anti-resonance control adjustment, and autotuning with a host reference) as required.**

Refer to the following section for details.

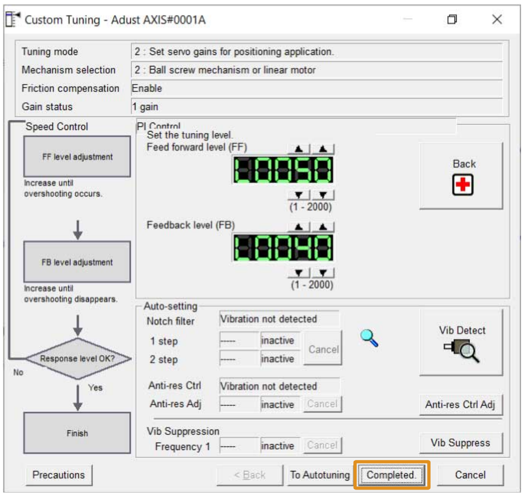
☞ *(1) Vibration Suppression Functions on page 427*

12. **When tuning has been completed, click the [Completed] button.**



Custom Tuning - Adjust AXIS#0001A

Tuning mode: 0 : Set servo gains with priority given to stability.
Mechanism selection: 2 : Ball screw mechanism or linear motor
Friction compensation: Enable
Gain status: 1 gain



Custom Tuning - Adjust AXIS#0001A

Tuning mode: 2 : Set servo gains for positioning application.
Mechanism selection: 2 : Ball screw mechanism or linear motor
Friction compensation: Enable
Gain status: 1 gain

The values that were changed will be saved in the SERVOPACK and you will return to the [Tuning] window.

This concludes the procedure to set up custom tuning.

(1) Vibration Suppression Functions

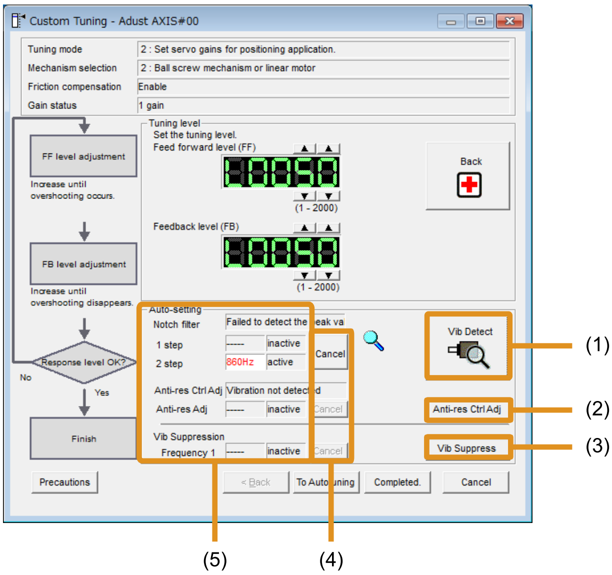
(a) Notch Filters and Automatic Anti-resonance Control Setting

If the vibration frequency that occurs when you increase the servo gains is at 1000 Hz or higher, notch filters are effective to suppress vibration. If the vibration is between 100 Hz and 1000 Hz, anti-resonance control is effective.

(b) 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.



Custom Tuning - Adjust AXIS#00

Tuning mode: 2 : Set servo gains for positioning application.
Mechanism selection: 2 : Ball screw mechanism or linear motor
Friction compensation: Enable
Gain status: 1 gain

No.	Item	Meaning
(1)	[Vib Detect] button	While the notch filter or automatic anti-resonance control setting function is enabled, you can click the [Vib Detect] button to manually detect vibration. When you click the [Vib Detect] button, the SERVOPACK will detect vibration at that time, and set the notch filter frequency (stage 1 or 2) or anti-resonance control frequency that is effective for the detected vibration. You can also perform manual vibration detection even when the SERVOPACK does not detect vibration.
(2)	[Anti-res Ctrl Adj] button	You can use the [Anti-res Ctrl Adj] button to execute the anti-resonance control adjustment if fine-tuning is required. Refer to the following section. ☞ *8.10 Anti-Resonance Control Adjustment on page 431*
(3)	[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. ☞ *8.11 Vibration Suppression on page 438*
(4)	[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.
(5)	[Auto-setting]	The usage status and frequencies of the automatically set notch filter, anti-resonance control, and vibration suppression are displayed here.

(c) Autotuning with a Host Reference

You can perform autotuning with a host reference. Refer to the following section for details.

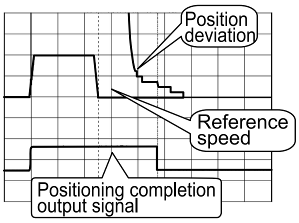
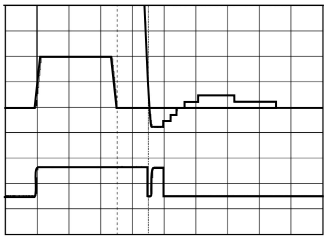
☞ *8.8 Autotuning with a Host Reference on page 407*

8.9.5 Automatically Adjusted Function Setting

You cannot use vibration suppression functions at the same time. Other automatic function settings are the same as for autotuning without a host reference. Refer to the following section.

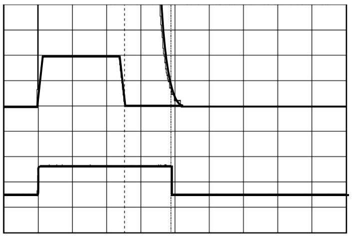
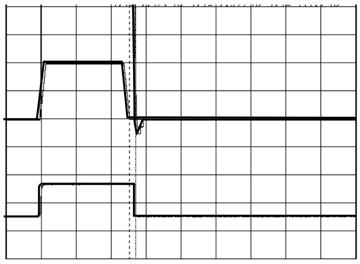
☞ *8.7.6 Automatically Adjusted Function Setting on page 403*

8.9.6 Tuning Example for Tuning Mode 2 or 3

Step	Measurement Display Examples	Operation
1		The positioning time is measured after Pn103 (Moment of Inertia Ratio) 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.

Continued on next page.

Continued from previous page.

Step	Measurement Display Examples	Operation
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.

8.9.7 Related Parameters

The following parameters are automatically adjusted or used as reference when you execute custom tuning. Do not change the settings while custom tuning is being executed.

Parameter	Name	Automatic Changes
Pn100	Speed Loop Gain	Yes
Pn101	Speed Loop Integral Time Constant	Yes
Pn102	Position Loop Gain	Yes
Pn103	Moment of Inertia Ratio	No
Pn121	Friction Compensation Gain	Yes
Pn123	Friction Compensation Coefficient	Yes
Pn124	Friction Compensation Frequency Correction	No
Pn125	Friction Compensation Gain Correction	Yes
Pn401	First Stage First Torque Reference Filter Time Constant	Yes
Pn408	Torque-Related Function Selections	Yes
Pn409	First Stage Notch Filter Frequency	Yes
Pn40A	First Stage Notch Filter Q Value	Yes
Pn40C	Second Stage Notch Filter Frequency	Yes
Pn40D	Second Stage Notch Filter Q Value	Yes
Pn140	Model Following Control-Related Selections	Yes
Pn141	Model Following Control Gain	Yes
Pn142	Model Following Control Gain Correction	Yes
Pn143	Model Following Control Bias in the Forward Direction	Yes
Pn144	Model Following Control Bias in the Reverse Direction	Yes
Pn145	Vibration Suppression 1 Frequency A	No

Continued on next page.

Continued from previous page.

Parameter	Name	Automatic Changes
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
Pn173	Load Fluctuation Compensation Control-Related Selections	Yes
Pn174	Load Fluctuation Compensation Control Response Level	Yes

Yes: The parameter is automatically set.

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

8.10 Anti-Resonance Control Adjustment

This section describes anti-resonance control.

8.10.1 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 1000 Hz that occur when the servo 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 function when there is vibration.

This function is automatically set by autotuning without a host reference or autotuning with a host reference. Use this function only if fine-tuning is required or readjustment is required as a result of a failure to detect vibration.

Perform custom tuning if required to increase the response after executing this function. If the servo gain is increased, e.g., when custom tuning is performed, vibration may occur again. If that occurs, execute this function again to fine-tune the parameters.

⚠ **CAUTION**

Related parameters will be set automatically when this function is executed. This may greatly affect the response before and after execution. Make sure that you can perform an emergency stop at any time.

Before you execute this function, set Pn103 (Moment of Inertia Ratio) correctly. If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.

Important

- This function detects vibration frequencies between 100 Hz and 1000 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 setting of Pn163 (Anti-Resonance Damping Gain), 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 servo gain by using a different method, such as custom tuning.

8.10.2 Preparations

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

- Pn170 must be set to n.□□□0 (Tuning-less Selection is disabled).
- Pn00C must be set to n.□□□0 (Function Selection for Test without a Motor is disabled).
- The control method must not be set to torque control.
- The parameters must not be write prohibited.

8.10.3 Applicable Tools

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

Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	You cannot execute anti-resonance control adjustment from the panel operator.	
Digital Operator	Fn204	📖 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Tuning] - [Tuning]	☞ *8.10.4 Operating Procedure on page 432*

8.10.4 Operating Procedure

To execute this function, an operation reference is input, and the adjustment is executed while vibration is occurring.

The following methods can be used to execute this function.

- To automatically detect the vibration frequency
- To manually set the vibration frequency

Use the following procedure to perform anti-resonance control.

⚠ CAUTION

Before you execute anti-resonance control adjustment, check the information provided in the SigmaWin+ operating manual. Observe the following precautions.

- **Make sure that you can perform an emergency stop at any time when you execute this function. Parameters will be set automatically when this function 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) at any time.**

Important

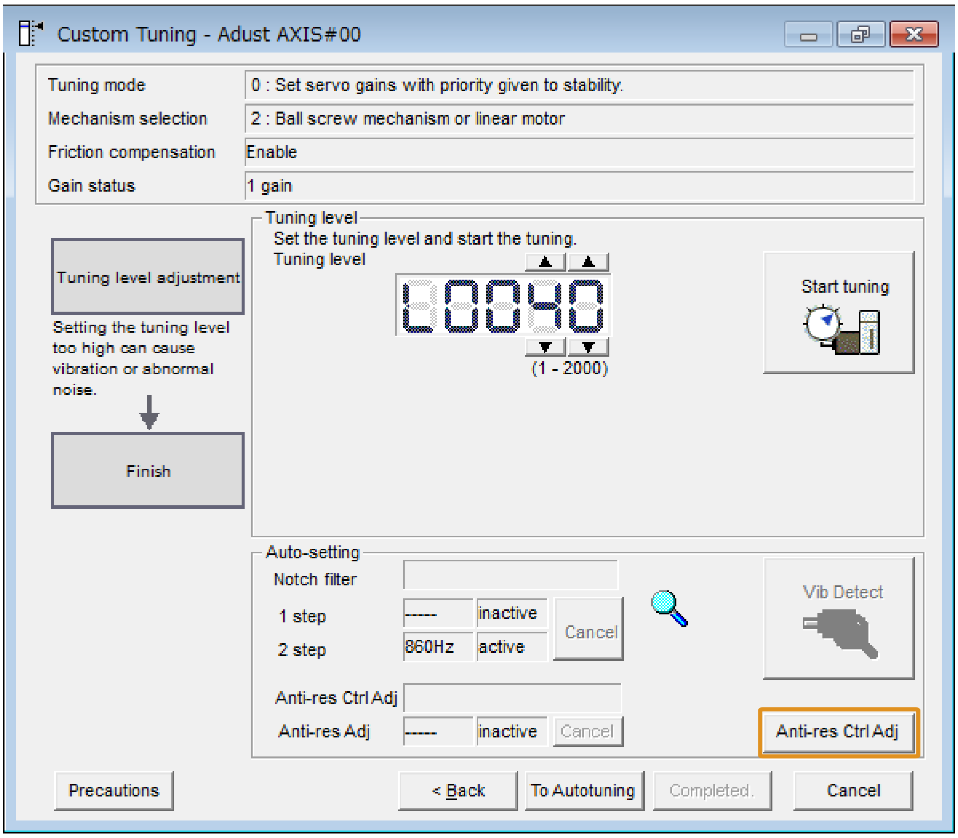
- Set the moment of inertia correctly before you execute this function.
  If the setting greatly differs from the actual moment of inertia, effective vibration reduction may not be possible.
- If you have already performed anti-resonance control adjustment and then you change the vibration frequency, 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 this function, cancel the function and lower the servo gain by using a different method, such as custom tuning.
- Perform custom tuning separately if required to increase the response after executing this function.
  If the servo gain is increased, e.g., when custom tuning is performed, vibration may occur again. If that occurs, execute this function again to fine-tune the parameters.

1. **Perform steps 1 to 9 of the procedure for custom tuning. Refer to the following section for details.**

   ☞ *8.9.4 Operating Procedure on page 423*

2. **Click the [Anti-res Ctrl Adj] button.**

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



Custom Tuning - Adust AXIS#00

Tuning mode: 0 : Set servo gains with priority given to stability.

Mechanism selection: 2 : Ball screw mechanism or linear motor

Friction compensation: Enable

Gain status: 1 gain

Setting the tuning level too high can cause vibration or abnormal noise.

Tuning level

Set the tuning level and start the tuning.

Tuning level: 0040 (1 - 2000)

Auto-setting

Notch filter

1 step: ----- inactive

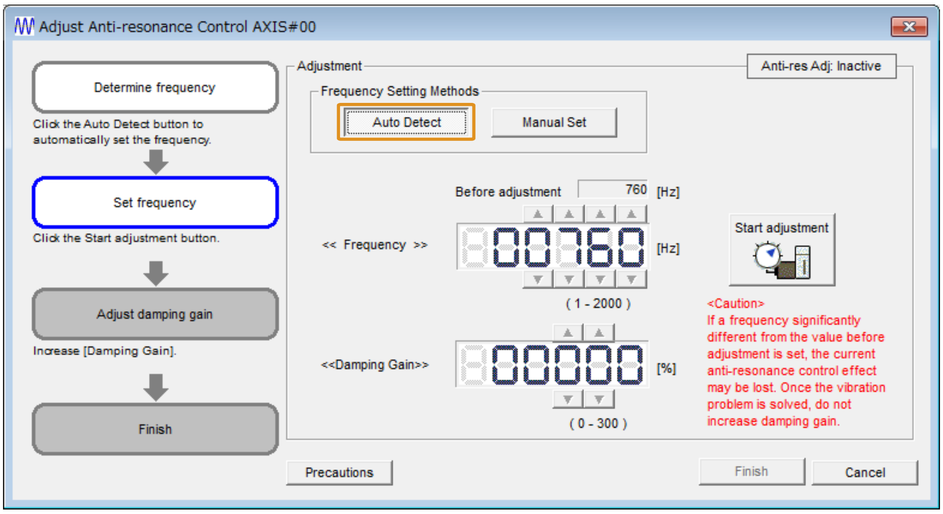
2 step: 860Hz active

Anti-res Ctrl Adj

Anti-res Adj: ----- inactive

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.



Click the Auto Detect button to automatically set the frequency.

Click the Start adjustment button.

Increase [Damping Gain].

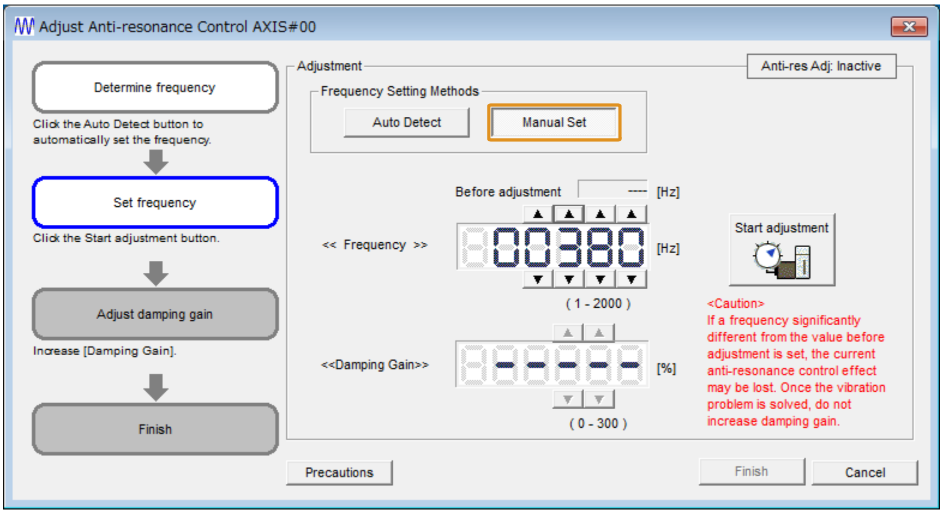
Before adjustment 760 [Hz]

<< Frequency >> 00760 [Hz] (1 - 2000)

<<Damping Gain>> 00000 [%] (0 - 300)

<Caution>
If a frequency significantly different from the value before adjustment is set, the current anti-resonance control effect may be lost. Once the vibration problem is solved, do not increase damping gain.

   - To manually set the vibration frequency



Click the Auto Detect button to automatically set the frequency.

Click the Start adjustment button.

Increase [Damping Gain].

Before adjustment ---- [Hz]

<< Frequency >> 00380 [Hz] (1 - 2000)

<<Damping Gain>> ----- [%] (0 - 300)

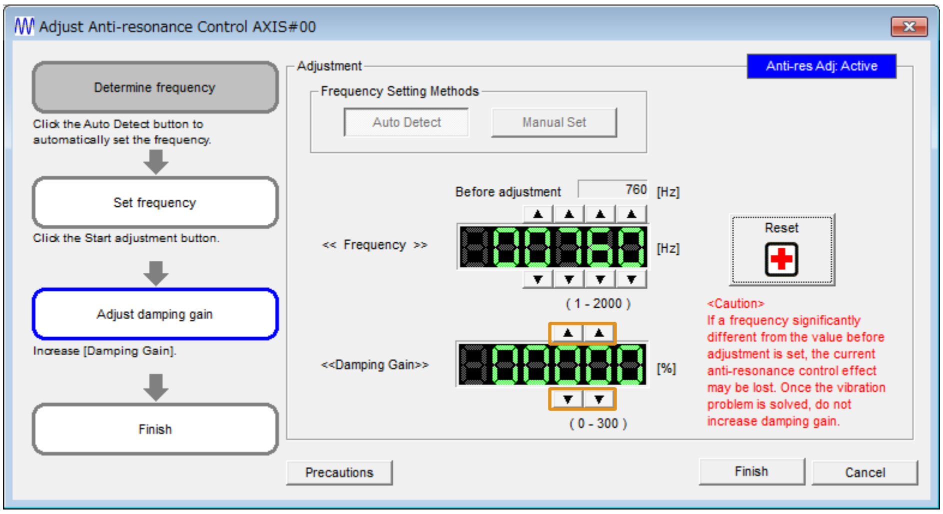
<Caution>
If a frequency significantly different from the value before adjustment is set, the current anti-resonance control effect may be lost. Once the vibration problem is solved, do not increase damping gain.

4. **Click the [Start adjustment] button.**

5. **Use the [▲] and [▼] buttons in [Adjustment] to change the settings.**

   Click the [Reset] button during tuning to restore the setting to its original value. The status from before when adjustment was started will be restored.

- To automatically detect the vibration frequency
  Change the setting of the damping gain.



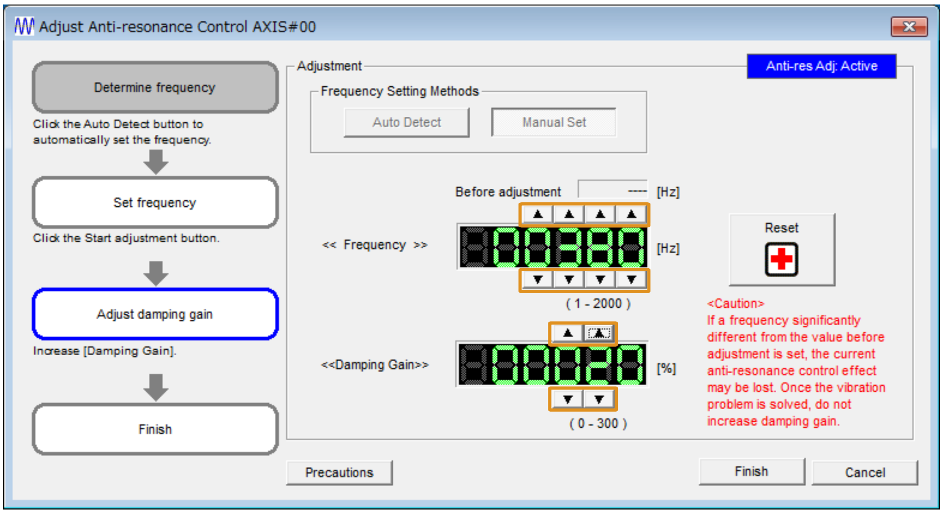
Click the Auto Detect button to automatically set the frequency.

Click the Start adjustment button.

Increase [Damping Gain].

<Caution>
If a frequency significantly different from the value before adjustment is set, the current anti-resonance control effect may be lost. Once the vibration problem is solved, do not increase damping gain.

- To manually set the vibration frequency
  Change the settings of the frequency and damping gain.



Click the Auto Detect button to automatically set the frequency.

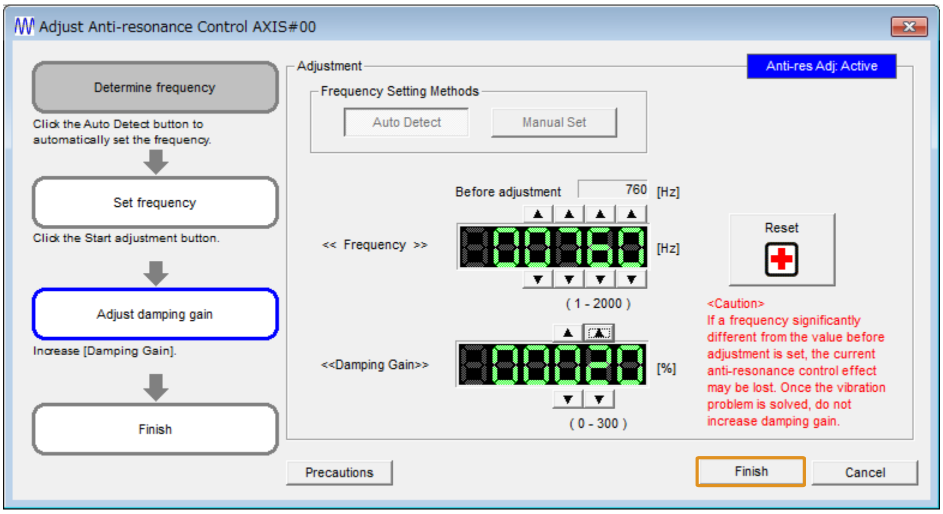
Click the Start adjustment button.

Increase [Damping Gain].

<Caution>
If a frequency significantly different from the value before adjustment is set, the current anti-resonance control effect may be lost. Once the vibration problem is solved, do not increase damping gain.

6. **When tuning 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] window.



Click the Auto Detect button to automatically set the frequency.

Click the Start adjustment button.

Increase [Damping Gain].

<Caution>
If a frequency significantly different from the value before adjustment is set, the current anti-resonance control effect may be lost. Once the vibration problem is solved, do not increase damping gain.

This concludes the procedure to set up anti-resonance control.

8.10.5 Related Parameters

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

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

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

Yes: The parameter is automatically set.

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

8.10.6 Suppressing Different Vibration Frequencies with Anti-resonance Control

When you use anti-resonance control and increase the servo gain, for some mechanism, vibration can occur at a higher frequency than the frequency for which vibration was suppressed. If this occurs, you can suppress vibration for more than one frequency by adjusting Pn166 (Anti-Resonance Damping Gain 2).

Information Guidelines for Vibration That Can Be Suppressed

Pn161 (Anti-Resonance Frequency): fa [Hz], another vibration frequency that occurs when the servo gain is increased: fb [Hz]

- Vibration frequencies: 100 Hz to 1000 Hz
- Range of different vibration frequencies: $1 < (fb/fa) \leq 3$ to 4

(1) Required Parameter Settings

The following parameter settings are required to use anti-resonance control for more than one vibration frequency.

Pn160	n.□□□X	Anti-Resonance Control Selection Speed Pos Trq		When Enabled
		0 Default	Do not use anti-resonance control.	Immediately
		1	Use anti-resonance control.	

Pn161	Anti-Resonance Frequency Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 20000	0.1 Hz	1000	Immediately
Pn162	Anti-Resonance Gain Correction Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 1000	1%	100	Immediately
Pn163	Anti-Resonance Damping Gain Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 300	1%	0	Immediately

Continued on next page.

Continued from previous page.

Pn164	Anti-Resonance Filter Time Constant 1 Correction Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	-1000 to 1000	0.01 ms	0	Immediately
Pn165	Anti-Resonance Filter Time Constant 2 Correction Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	-1000 to 1000	0.01 ms	0	Immediately
Pn166	Anti-Resonance Damping Gain 2 Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 1000	1%	0	Immediately

(2) Adjustment Procedure for Suppressing Different Vibration Frequencies with Anti-resonance Control

Use the following procedure to make adjustments to suppress different vibration frequencies with anti-resonance control.

Step	Operation
1	Use the gain adjustment and anti-resonance control. Refer to the following section for details. ☞ *8.10.4 Operating Procedure on page 432*
2	If there is vibration at a higher frequency than the vibration suppressed with anti-resonance control in step 1, adjust Pn166 (Anti-Resonance Damping Gain 2). If there is vibration at a lower frequency than the vibration suppressed with anti-resonance control in step 1, return to step 1, set Pn161 (Anti-Resonance Frequency) to the lower vibration frequency, and adjust Pn163 (Anti-Resonance Damping Gain) again. Then adjust Pn166 (Anti-Resonance Damping Gain 2).
3	Adjust Pn166 (Anti-Resonance Damping Gain 2) while checking to see if vibration reduction is effective. To adjust Pn166 (Anti-Resonance Damping Gain 2), increase the setting by 10% at a time starting from the value that resulted in Pn163 (Anti-Resonance Damping Gain) from the adjustment in step 1.
4	If the vibration disappears, the adjustment is completed. However, if the vibration does not disappear even when you adjust Pn166 (Anti-Resonance Damping Gain 2), reduce the tuning level or feedback level until vibration does not occur.

8.11 Vibration Suppression

This section describes vibration suppression.

8.11.1 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.

This function is automatically set by autotuning without a host reference or autotuning with a host reference. Use this function only if fine-tuning is required or readjustment is required as a result of a failure to detect vibration. To execute this function, input an operation reference and execute the function when there is vibration.

Perform custom tuning if required to increase the response after executing this function.

⚠ CAUTION

Related parameters will be set automatically when this function is executed. This may greatly affect the response before and after execution. Make sure that you can perform an emergency stop at any time.

Before you execute this function, set Pn103 (Moment of Inertia Ratio) correctly. If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.

Important

- This function 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.

(1) 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.

(2) 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 Pn560 (Residual Vibration Detection Width), which is set as a percentage of the setting of Pn522 (Positioning Completed Width). Perform the detection of vibration frequencies again after adjusting the setting of Pn560.

Pn560	Residual Vibration Detection Width			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 3000	0.1%	400	Immediately

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.

8.11.2 Preparations

Always check the following before you execute vibration suppression.

- Position control must be used.
- Pn170 must be set to n.□□□0 (Tuning-less Selection is disabled).
- Pn00C must be set to n.□□□0 (Function Selection for Test without a Motor is disabled).
- The parameters must not be write prohibited.

8.11.3 Applicable Tools

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

Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	You cannot execute vibration suppression from the panel operator.	
Digital Operator	Fn205	🕮 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Tuning] - [Tuning]	☞ *8.11.4 Operating Procedure on page 439*

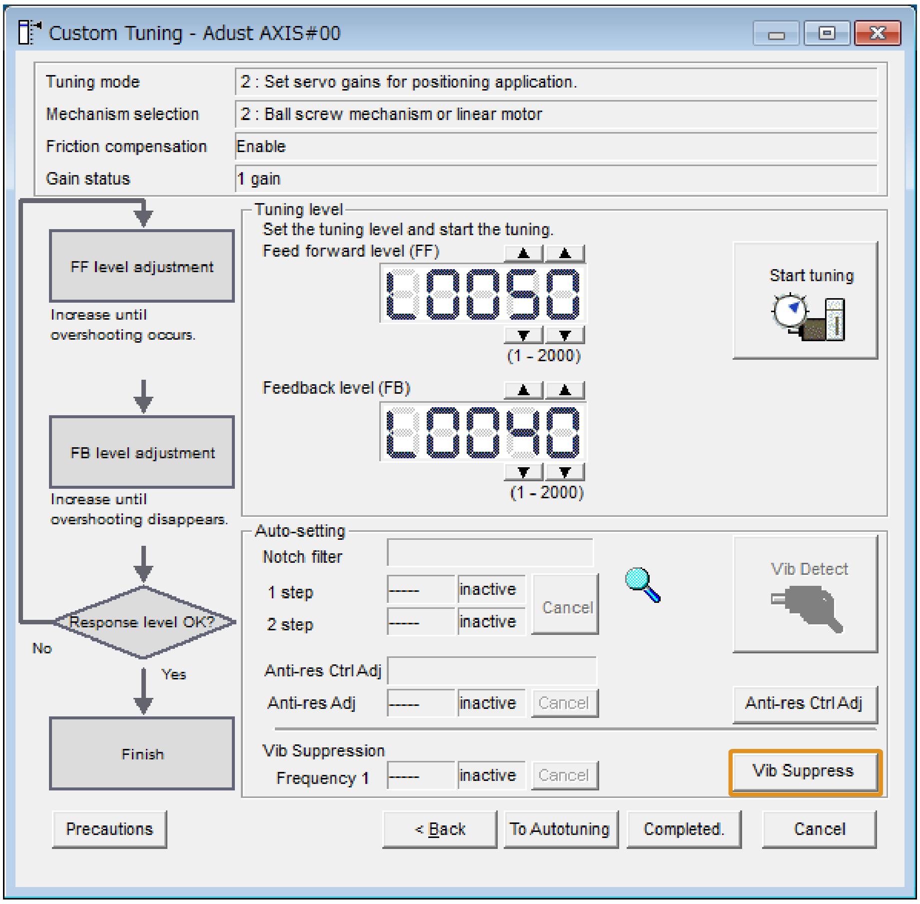
8.11.4 Operating Procedure

Use the following procedure to perform vibration suppression.

1. **Perform steps 1 to 9 of the procedure for custom tuning. Refer to the following section for details.**

   ☞ *8.9.4 Operating Procedure on page 423*

2. **Click the [Vib Suppress] button.**



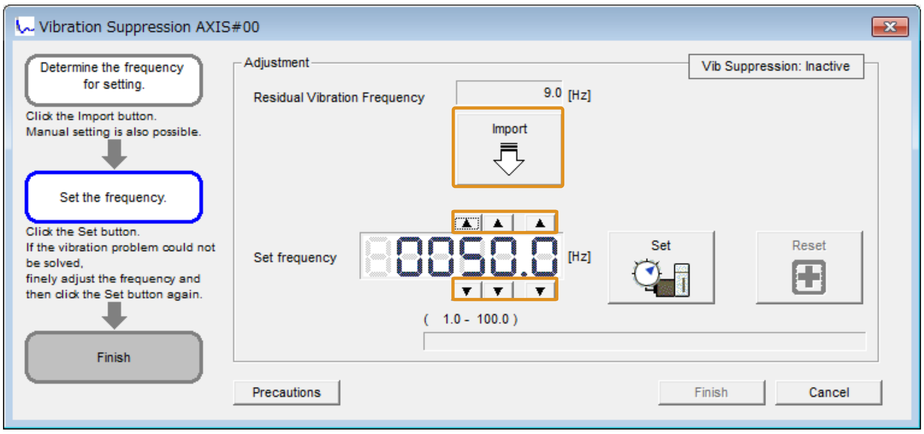
Tuning mode: 2 : Set servo gains for positioning application.
Mechanism selection: 2 : Ball screw mechanism or linear motor
Friction compensation: Enable
Gain status: 1 gain
Feed forward level (FF): 0050
Feedback level (FB): 0040
1 step: ----- inactive
2 step: ----- inactive
Anti-res Adj: ----- inactive
Frequency 1: ----- inactive

3. **Click the [Import] button or click the [▲] and [▼] buttons to manually adjust the set frequency.**

When you click the [Import] button, the residual vibration frequency in the servomotor is read as the set frequency. (The frequency can be read only when the residual vibration frequency is between 1.0 and 100.0.)

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.



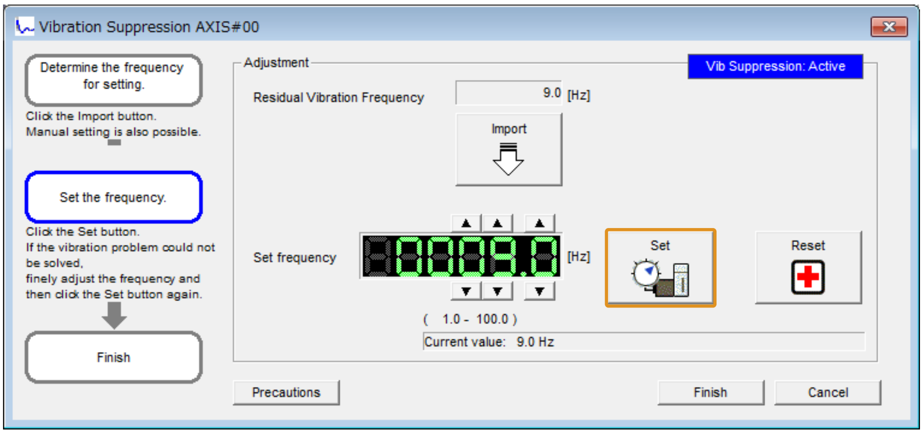
Vib Suppression: Inactive
Residual Vibration Frequency: 9.0 [Hz]
Set frequency: 0050.0 [Hz]

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.

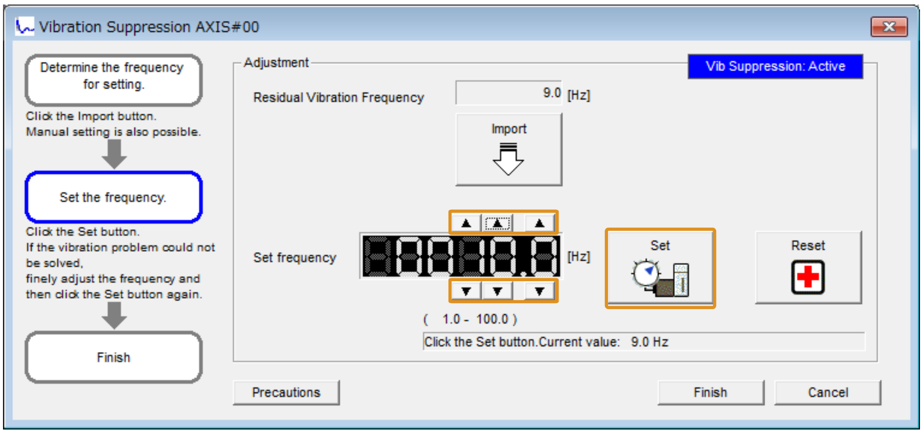


Click the Import button.
Manual setting is also possible.

Click the Set button.
If the vibration problem could not be solved,
finely adjust the frequency and then click the Set button again.

Current value: 9.0 Hz

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 Import button.
Manual setting is also possible.

Click the Set button.
If the vibration problem could not be solved,
finely adjust the frequency and then click the Set button again.

Click the Set button.Current value: 9.0 Hz

Click the [Reset] button during tuning 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 to set up vibration suppression.

8.11.5 Setting Combined Functions

You can also use the feedforward function when you execute vibration suppression.

In the default settings, Pn109 (Feedforward), the speed feedforward input, and the torque feedforward input are disabled.

To use the speed feedforward input, the torque feedforward input, and model following control from the host controller in the system, set Pn140 to n.1□□□ (use model following control and speed/torque feedforward together).

Pn140	n.X□□□	Speed Feedforward (VFF)/Torque Feedforward (TFF) Selection Speed Pos Trq		When Enabled
		0 Default	Do not use model following control and speed/torque feedforward together.	Immediately
		1	Use model following control and speed/torque feedforward together.	

Refer to the following section for information on the torque feedforward input and the speed feedforward input.

☞ *(2) Torque Feedforward and Speed Feedforward on page 488*

☞ ◆ *Speed Feedforward on page 490*

Important When model following control is used with this function, it is used to make optimum feedforward settings in the SERVOPACK. Therefore, model following control is not normally used together with either the speed feedforward input or torque feedforward input from the host controller. However, model following control can be used with the speed feedforward input or torque feedforward input if required. An unsuitable feedforward input may result in overshooting.

8.11.6 Related Parameters

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

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

Parameter	Name	Automatic Changes
Pn140	Model Following Control-Related Selections	Yes
Pn141	Model Following Control Gain	Yes
Pn142	Model Following Control Gain Correction	No
Pn143	Model Following Control Bias in the Forward Direction	No
Pn144	Model Following Control Bias in the Reverse Direction	No
Pn145	Vibration Suppression 1 Frequency A	Yes
Pn146	Vibration Suppression 1 Frequency B	Yes
Pn147	Model Following Control Speed Feedforward Compensation	No
Pn14A	Vibration Suppression 2 Frequency	No
Pn14B	Vibration Suppression 2 Correction	No

Yes: The parameter is automatically set.

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

8.12 Speed Ripple Compensation

This section describes speed ripple compensation.

8.12.1 Outline

Speed ripple compensation reduces the amount of ripple in the motor speed due to torque ripple or cogging torque. You can enable speed ripple compensation to achieve smoother operation. You do not need to perform any setup procedures to enable this function when a Σ-X-series rotary servomotor is connected to the SERVOPACK. If any other servomotor is connected to the SERVOPACK, perform the setup procedure with [Ripple Compensation] in the SigmaWin+.

⚠ **WARNING**

Speed ripple compensation setup is a tuning function that actually drives the machine and therefore presents hazards. Observe the following precautions.

- **Confirm safety around moving parts.**
- **This function involves automatic operation. Make sure that you can perform an emergency stop (to turn OFF the power supply) at any time.**

Important

Execute this function only after adjusting the gains.

- If the servomotor or SERVOPACK is replaced after this function is set up in the SigmaWin+, set up this function again.
- Execute speed ripple compensation after jogging to a position that ensures a suitable range of motion.

8.12.2 Speed Ripple Compensation when a Rotary Servomotor Is Connected

The following two methods are available to enable speed ripple compensation when a rotary servomotor is connected.

- Using the default adjustment value saved to the servomotor
- Using the user adjustment value set up with the SigmaWin+

(1) Using the Default Adjustment Value

This function enables speed ripple compensation by using the default adjustment value that is saved to the servomotor when shipped from the factory.

When a servomotor that supports the default adjustment value is connected to the SERVOPACK, this function can be enabled without performing any setup procedures with the SigmaWin+.

Pn423	n.□□□X	Speed Ripple Compensation Function Selection Speed Pos Trq		When Enabled
		0	Do not execute speed ripple compensation.	Immediately
		1	Execute speed ripple compensation using the value adjusted by the user.	
		2 Default	Execute speed ripple compensation using the default adjustment value.	

Information

When a servomotor that does not support the default adjustment value is connected to the SERVOPACK, this function will not be enabled even if Pn423 is set to n.□□□2 (execute speed ripple compensation using the default adjustment value).

If the servomotor is replaced when Pn423 is set to n.□□□2 (execute speed ripple compensation using the default adjustment value), the SERVOPACK will execute this function using the default adjustment value of the servomotor that was newly connected. As a result, A.942 (Speed Ripple Compensation Information Disagreement) will not occur.

(a) Restrictions

Only Σ-X-series rotary servomotors support the default adjustment value.

(b) Operating Procedure

Speed ripple compensation is enabled simply by connecting a servomotor that supports the default adjustment value.

This is because the default setting of the SERVOPACK is Pn423 = n.□□□2 (execute speed ripple compensation using the default adjustment value).

(2) Using the User Adjustment Value Set Up with the SigmaWin+

Speed ripple information analyzed in the SigmaWin+ can be saved to the SERVOPACK as the user adjustment value and used for speed ripple compensation.

Set up this function in the SigmaWin+ when you connect a servomotor that does not support the default adjustment value.

Information The default adjustment value saved to the servomotor and the user adjustment value set up in the SigmaWin+ are saved to separate locations in memory.

This allows you to switch between the default adjustment value and user adjustment value. The previous adjustment value will not disappear.

(a) Restrictions

The following restrictions apply to the setup for speed ripple compensation when a rotary servomotor is connected.

◆ Systems for which Execution Cannot Be Performed

There are no restrictions.

◆ Systems for Which Adjustments Cannot Be Made Accurately

- Systems for which there is not a suitable range of motion
- Equipment that is affected by other axes (e.g., gantry equipment)

◆ Preparations

Always check the following before you set up speed ripple compensation.

- The main circuit power must be ON.
- The servo must be OFF.
- There must be no alarms or warnings.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.
- There must be no impact from other axes.

(b) Applicable Tools

The following table lists the tools that you can set up speed ripple compensation.

Tool	Fn No./Function Name	Reference
Panel Operator	You cannot set up speed ripple compensation from the Panel Operator.	
Digital Operator	You cannot set up speed ripple compensation from the Digital Operator.	
SigmaWin+	[Diagnostic] - [Ripple Compensation]	☞ *(c) Operating Procedure on page 444*

(c) Operating Procedure

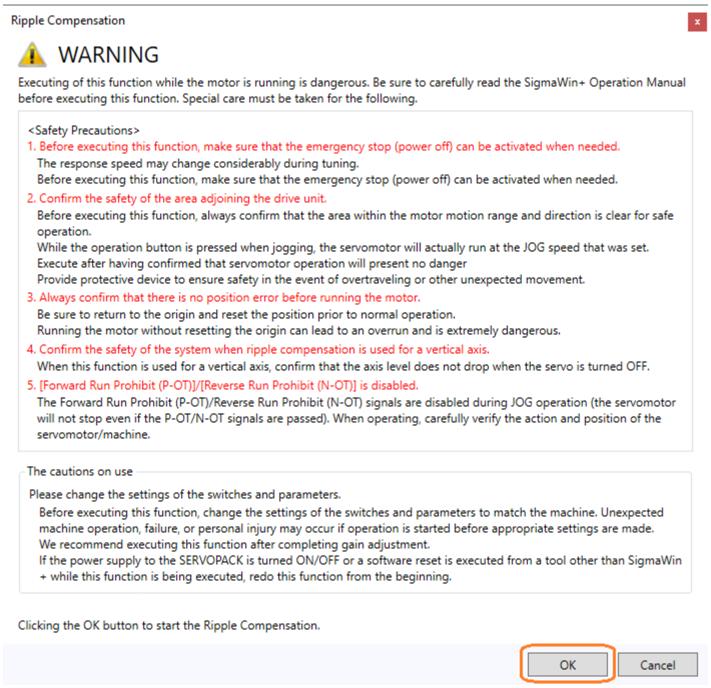
Use the following procedure to set up speed ripple compensation.

1. **Click the [▤] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

2. **Select [Ripple Compensation] in the [Menu] dialog box.**

   The [Ripple Compensation] dialog box will be displayed.

3. **Read the warnings and then click the [OK] button.**



Ripple Compensation

WARNING

Executing of this function while the motor is running is dangerous. Be sure to carefully read the SigmaWin+ Operation Manual before executing this function. Special care must be taken for the following.

<Safety Precautions>

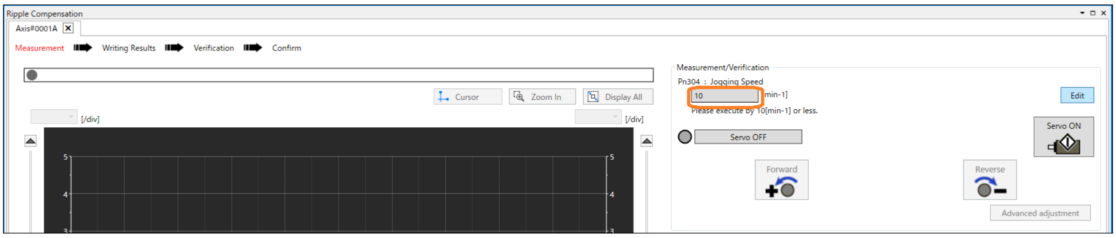
1. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
   The response speed may change considerably during tuning.
   Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
2. Confirm the safety of the area adjoining the drive unit.
   Before executing this function, always confirm that the area within the motor motion range and direction is clear for safe operation.
   While the operation button is pressed when jogging, the servomotor will actually run at the JOG speed that was set.
   Execute after having confirmed that servomotor operation will present no danger
   Provide protective device to ensure safety in the event of overtraveling or other unexpected movement.
3. Always confirm that there is no position error before running the motor.
   Be sure to return to the origin and reset the position prior to normal operation.
   Running the motor without resetting the origin can lead to an overrun and is extremely dangerous.
4. Confirm the safety of the system when ripple compensation is used for a vertical axis.
   When this function is used for a vertical axis, confirm that the axis level does not drop when the servo is turned OFF.
5. [Forward Run Prohibit (P-OT)]/[Reverse Run Prohibit (N-OT)] is disabled.
   The Forward Run Prohibit (P-OT)/Reverse Run Prohibit (N-OT) signals are disabled during JOG operation (the servomotor will not stop even if the P-OT/N-OT signals are passed). When operating, carefully verify the action and position of the servomotor/machine.

The cautions on use

Please change the settings of the switches and parameters.
Before executing this function, change the settings of the switches and parameters to match the machine. Unexpected machine operation, failure, or personal injury may occur if operation is started before appropriate settings are made.
We recommend executing this function after completing gain adjustment.
If the power supply to the SERVOPACK is turned ON/OFF or a software reset is executed from a tool other than SigmaWin+ while this function is being executed, redo this function from the beginning.

Clicking the OK button to start the Ripple Compensation.

A jogging speed for the speed ripple measurement will be automatically set.



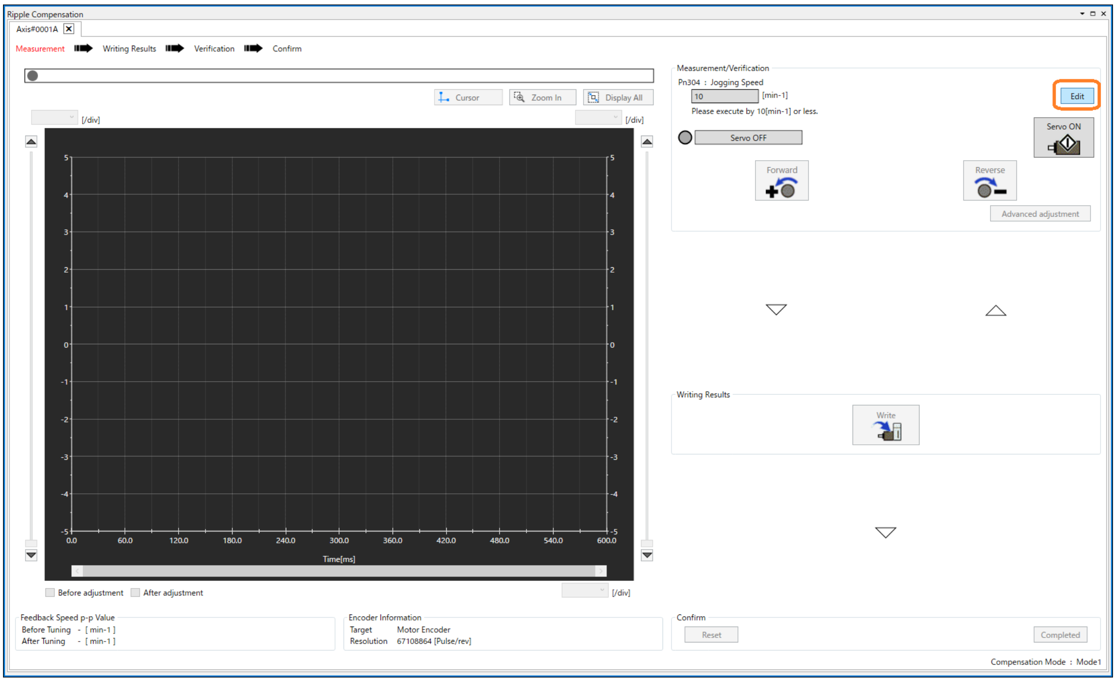
Measurement/Verification

Pn304 : Jogging Speed

10 [min-1]

Please execute by 10[min-1] or less.

4. **Check the jogging speed. If the jogging speed that was set is OK, proceed to step 6. To change the jogging speed, click the [Edit] button.**



Measurement/Verification

Pn304 : Jogging Speed

10 [min-1]

Please execute by 10[min-1] or less.

Writing Results

☐ Before adjustment ☐ After adjustment

Feedback Speed p-p Value

Before Tuning - [min-1]

After Tuning - [min-1]

Encoder Information

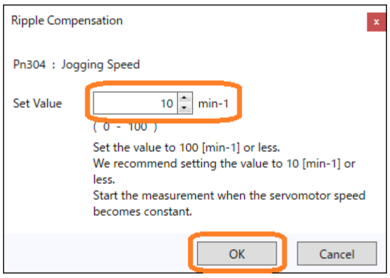
Target Motor Encoder

Resolution 67108864 [Pulse/rev]

Confirm

Compensation Mode : Mode1

5. **Enter the jogging speed in [Set Value] and click the [OK] button.**



Ripple Compensation

Pn304 : Jogging Speed

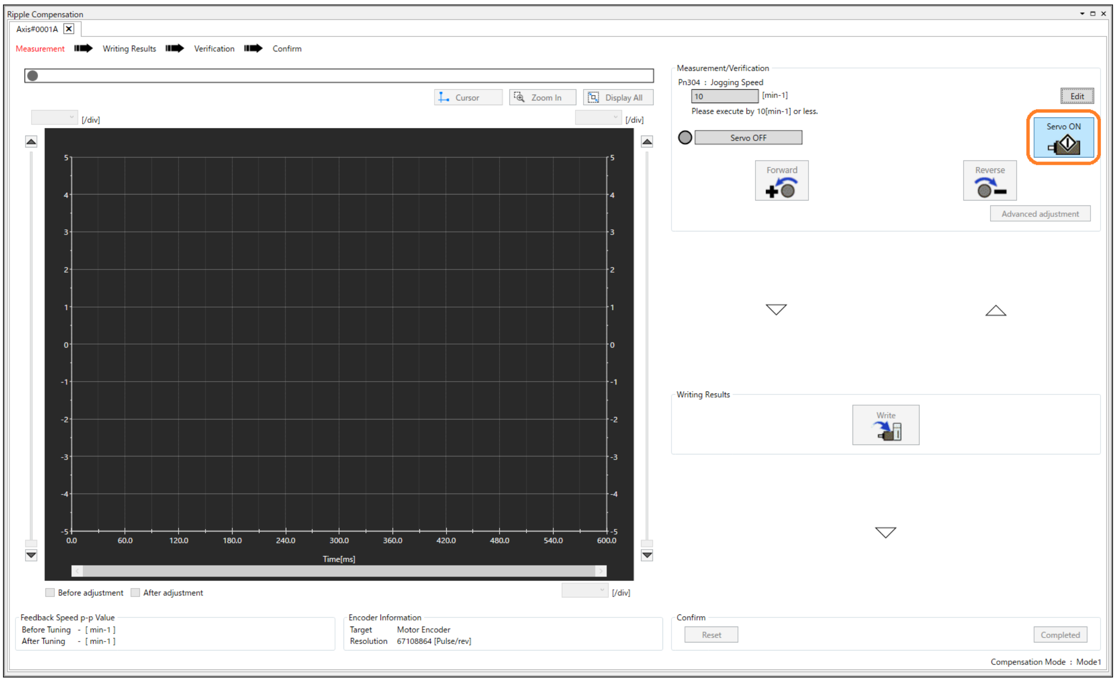
Set Value 10 min-1

(0 - 100)

Set the value to 100 [min-1] or less.
We recommend setting the value to 10 [min-1] or less.
Start the measurement when the servomotor speed becomes constant.

The Main Window will return.

6. **Confirm safety around moving parts and click the [Servo ON] button.**



Ripple Compensation

Axis#0001A

Measurement/Verification

Pn304 : Jogging Speed

10 [min-1]

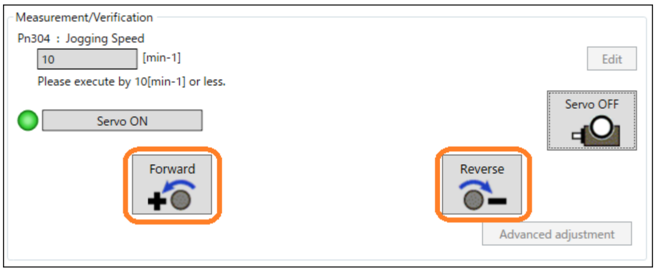
Please execute by 10[min-1] or less.

Feedback Speed p-p Value
Before Tuning - [min-1]
After Tuning - [min-1]

Encoder Information
Target Motor Encoder
Resolution 67108864 [Pulse/rev]

Compensation Mode : Mode1

7. **Click and hold the [Forward] button or the [Reverse] button.**



Measurement/Verification

Pn304 : Jogging Speed

10 [min-1]

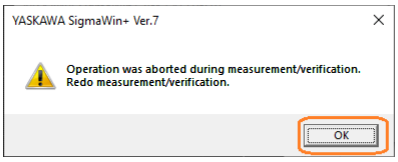
Please execute by 10[min-1] or less.

The servomotor shaft will rotate at the preset jogging speed while you hold down the [Forward] or [Reverse] button and the speed ripple will be measured.

After the speed ripple measurement has completed, the feedback speed and torque reference waveform during jogging will be displayed in the graph area.

Information If you stop pressing the [Forward] button or the [Reverse] button before the measurement has completed, the following message dialog box will be displayed.

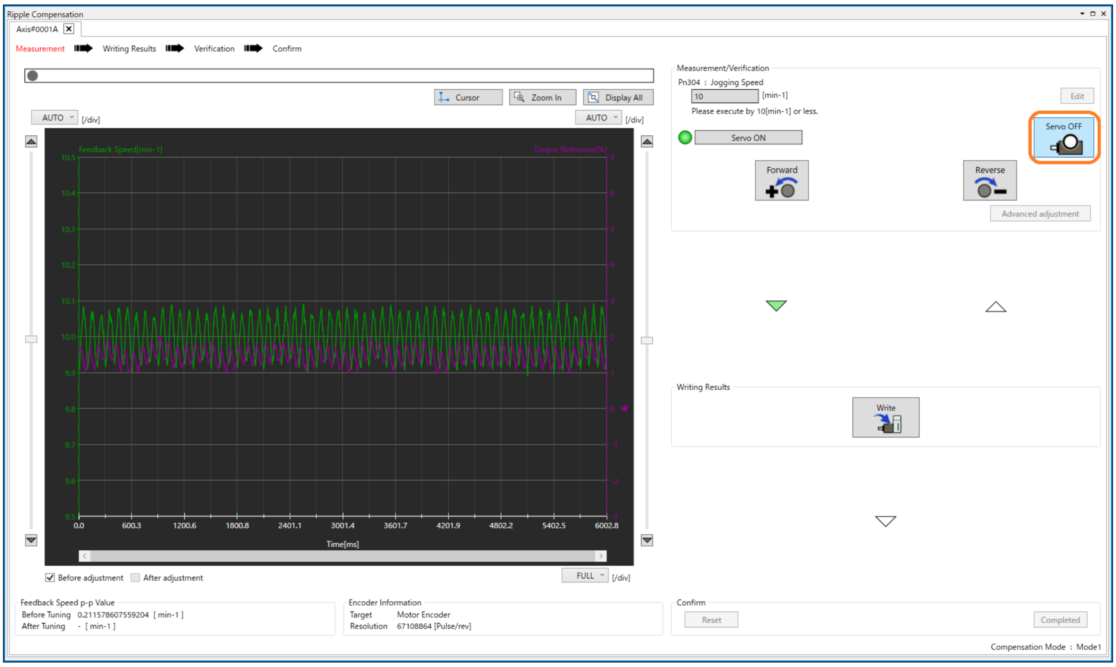
Click the [OK] button and repeat the measurement.



YASKAWA SigmaWin+ Ver.7

Operation was aborted during measurement/verification.
Redo measurement/verification.

8. **After speed ripple measurement has been completed, click the [Servo OFF] button.**



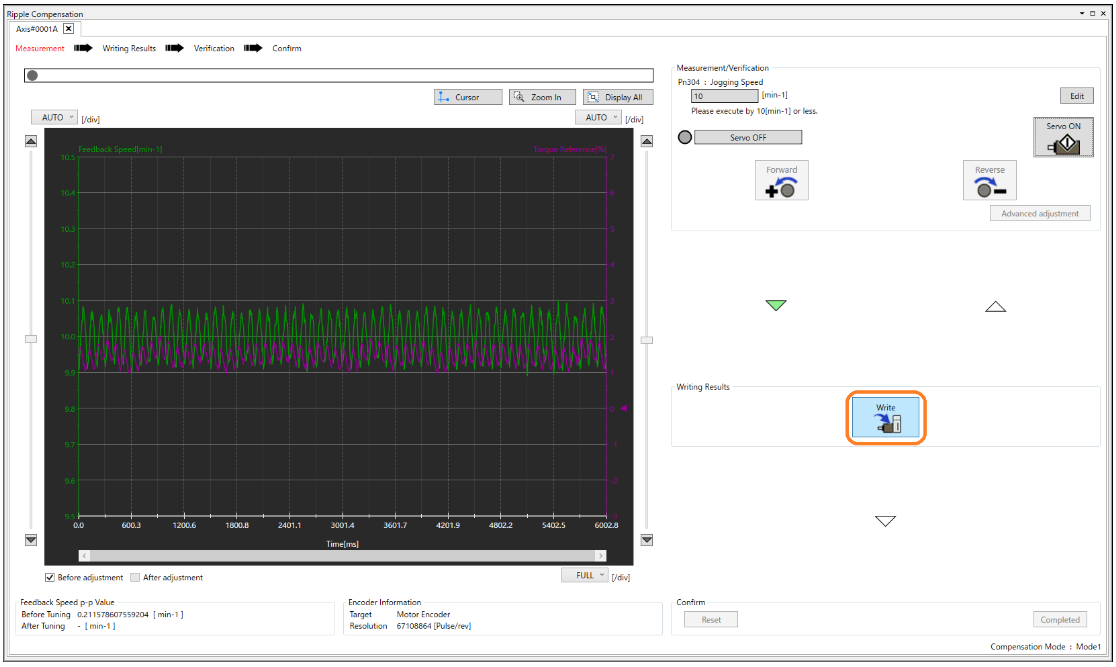
Pn304 : Jogging Speed
10 [min-1]
Please execute by 10[min-1] or less.

Feedback Speed p-p Value
Before Tuning 0.211578607559204 [min-1]
After Tuning - [min-1]

Encoder Information
Target Motor Encoder
Resolution 67108864 [Pulse/rev]

Compensation Mode : Mode1

9. **Click the [Write] button.**



Pn304 : Jogging Speed
10 [min-1]
Please execute by 10[min-1] or less.

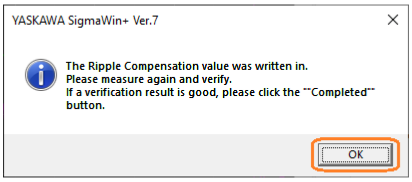
Feedback Speed p-p Value
Before Tuning 0.211578607559204 [min-1]
After Tuning - [min-1]

Encoder Information
Target Motor Encoder
Resolution 67108864 [Pulse/rev]

Compensation Mode : Mode1

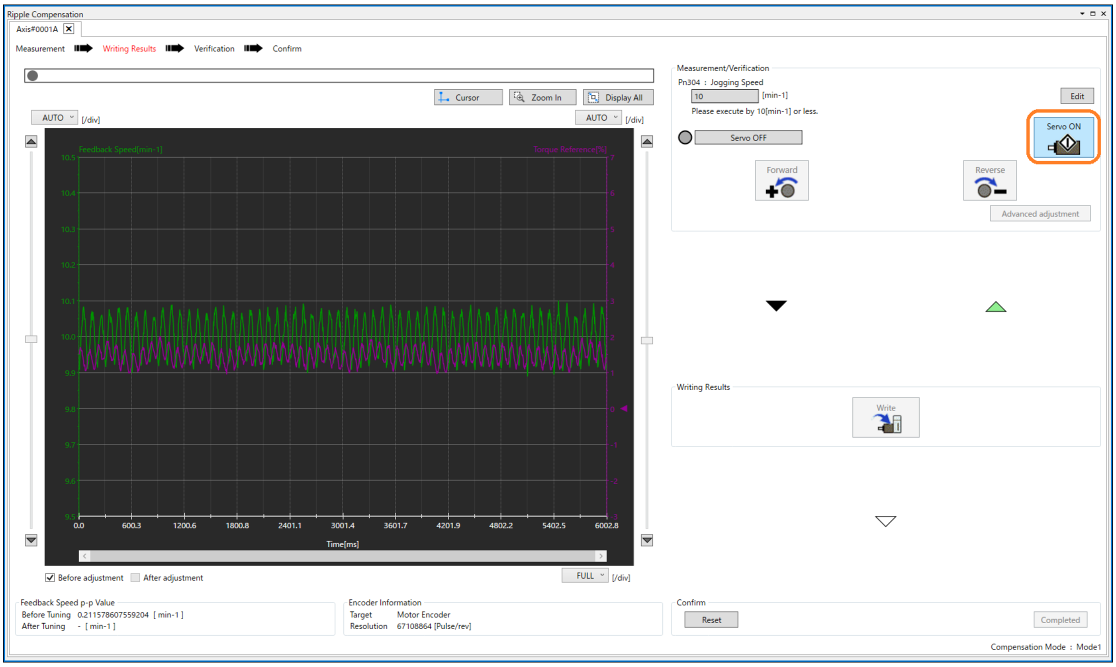
The ripple compensation value will be written to the SERVOPACK.

10. **After writing has been completed, click the [OK] button.**



The Ripple Compensation value was written in.
Please measure again and verify.
If a verification result is good, please click the ""Completed"" button.

11. **Click the [Servo ON] button.**



☑ Before adjustment ☐ After adjustment

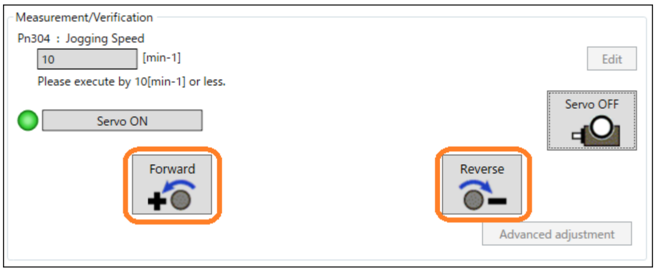
Pn304 : Jogging Speed 10 [min-1]
Please execute by 10[min-1] or less.

Feedback Speed p-p Value
Before Tuning 0.211578607559204 [min-1]
After Tuning - [min-1]

Encoder Information
Target Motor Encoder
Resolution 67108864 [Pulse/rev]

Compensation Mode : Mode1

12. **Click and hold the [Forward] button or the [Reverse] button.**



Pn304 : Jogging Speed 10 [min-1]
Please execute by 10[min-1] or less.

The servomotor shaft will rotate at the preset jogging speed while you hold down the [Forward] or [Reverse] button and the speed ripple will be measured.

The waveform during verification operation with speed ripple compensation applied to it will be displayed overlapping in the graph area.

13. **If you obtained satisfactory results in the verification of speed ripple compensation, first click the [Servo OFF] button, and then click the [Completed] button.**

☑ Before adjustment ☑ After adjustment

Pn304 : Jogging Speed 10 [min-1]
Please execute by 10[min-1] or less.

Feedback Speed p-p Value
Before Tuning 0.211578607559204 [min-1]
After Tuning 0.11749267578125 [min-1]

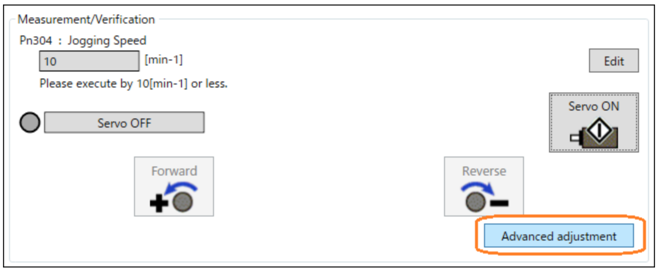
Encoder Information
Target Motor Encoder
Resolution 67108864 [Pulse/rev]

Compensation Mode : Mode1

The tuning results will be set for the parameters and the [Ripple Compensation] window will close.

Information

- To increase the effect of the speed ripple compensation, click the [Advanced adjustment] button. You can change the speed ripple compensation gain.



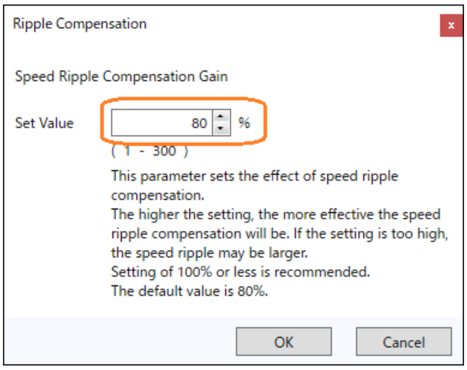
Measurement/Verification

Pn304 : Jogging Speed

10 [min-1]

Please execute by 10[min-1] or less.

We recommend setting the speed ripple compensation gain to 100% or less because speed ripple may grow larger if the gain setting is too high.



Ripple Compensation

Speed Ripple Compensation Gain

Set Value 80 %

(1 - 300)

This parameter sets the effect of speed ripple compensation.
The higher the setting, the more effective the speed ripple compensation will be. If the setting is too high, the speed ripple may be larger.
Setting of 100% or less is recommended.
The default value is 80%.

- To discard the setup results and perform setup again, click the [Reset] button and redo the measurement from step 3.

This concludes the setup for speed ripple compensation.

8.12.3 Speed Ripple Compensation when a Linear Servomotor Is Connected

When a linear servomotor is connected to the SERVOPACK, you must complete the setup procedure in the SigmaWin+ to enable speed ripple compensation.

Set the range of motion (start point and end point) with the setup procedure in the SigmaWin+. Speed ripple compensation is enabled in this range of motion.

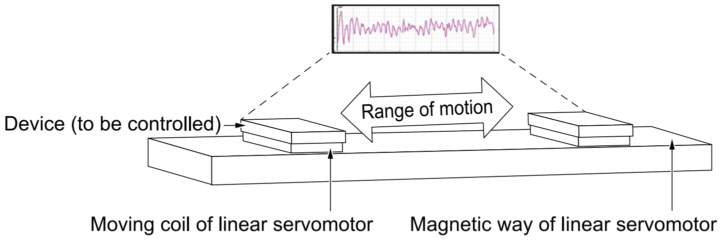
Important

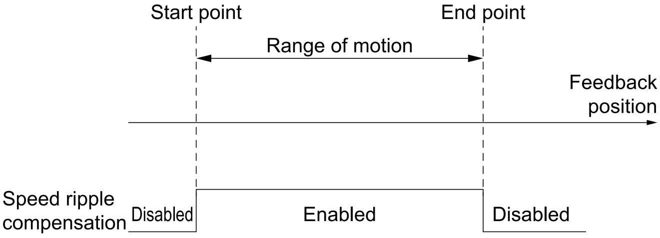
- This function is enabled in the range of motion set during the setup procedure. Speed ripple may increase outside the range of motion.
- If the speed ripple measurement range exceeds 2.5 m, the compensation effect may diminish. If the effect is insufficient, make the speed ripple measurement range narrower.

The timing at which speed ripple compensation is enabled depends on your encoder.

Type of Encoder		When Speed Ripple Compensation Is Enabled
Absolute linear encoder		After power ON
Incremental linear encoder	One of the following: • Multiple Origin Signal (Ref) outputs in range of motion • No Origin Signal (Ref) outputs in range of motion	After power ON
	Only one Origin Signal (Ref) outputs in range of motion	After power ON and after Origin Signal (Ref) is detected

The speed ripple is compensated based on the speed ripple information in the set range of motion.





(1) Restrictions

The following restrictions apply to the setup for speed ripple compensation when a linear servomotor is connected.

(a) Systems for Which Adjustments Cannot Be Made Accurately

- Systems for which there is not a suitable range of motion
- Equipment that is affected by other axes (e.g., gantry equipment)

(b) Preparations

Always check the following before you set up speed ripple compensation.

- The main circuit power must be ON.
- The servo must be OFF.
- There must be no alarms or warnings.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.
- There must be no impact from other axes.

In addition, if you are using an incremental encoder that has one output position for the Origin Signal (Ref), check the following items.

- Speed ripple compensation must not be executed between when the power is turned ON and when the Origin Signal (Ref) is detected.
  When the power is turned ON, execute the origin return operation and confirm that the Speed Ripple Compensation in Progress monitor is ON before starting normal operation.

(2) Applicable Tools

The following table lists the tools that you can set up speed ripple compensation.

Tool	Fn No./Function Name	Reference
Panel Operator	You cannot set up speed ripple compensation from the Panel Operator.	
Digital Operator	You cannot set up speed ripple compensation from the Digital Operator.	
SigmaWin+	[Diagnostic] - [Ripple Compensation]	☞ *(3) Operating Procedure on page 450*

(3) Operating Procedure

Use the following procedure to set up speed ripple compensation when a linear servomotor is connected.

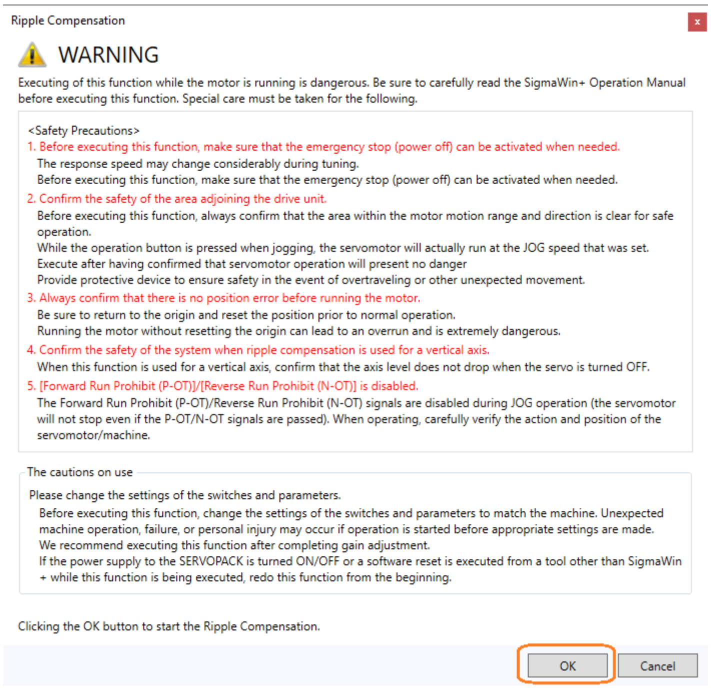
1. Set the range of motion and check operation.
2. Perform measurement operation.
3. Perform verification operation.

(a) Setting the Range of Motion/Checking Operation

Use the following procedure to set the range of motion and check operation.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Select [Ripple Compensation] in the [Menu] dialog box.**

   The [Ripple Compensation] dialog box will be displayed.
3. **Read the warnings and then click the [OK] button.**



Ripple Compensation

WARNING

Executing of this function while the motor is running is dangerous. Be sure to carefully read the SigmaWin+ Operation Manual before executing this function. Special care must be taken for the following.

<Safety Precautions>

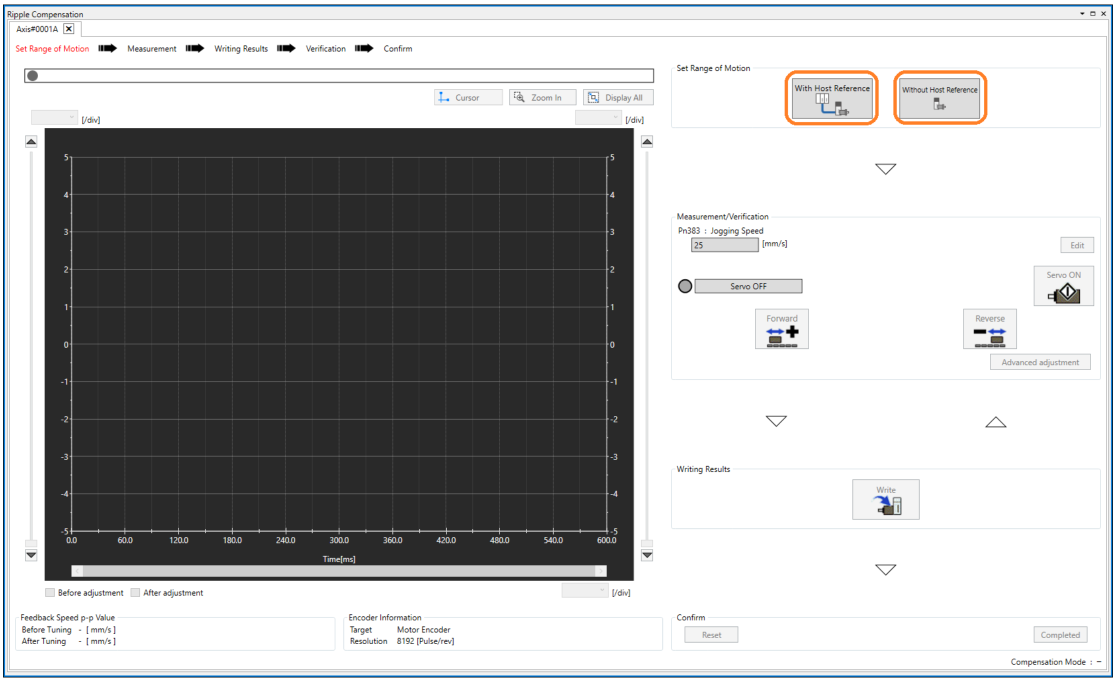
1. Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
   The response speed may change considerably during tuning.
   Before executing this function, make sure that the emergency stop (power off) can be activated when needed.
2. Confirm the safety of the area adjoining the drive unit.
   Before executing this function, always confirm that the area within the motor motion range and direction is clear for safe operation.
   While the operation button is pressed when jogging, the servomotor will actually run at the JOG speed that was set.
   Execute after having confirmed that servomotor operation will present no danger
   Provide protective device to ensure safety in the event of overtraveling or other unexpected movement.
3. Always confirm that there is no position error before running the motor.
   Be sure to return to the origin and reset the position prior to normal operation.
   Running the motor without resetting the origin can lead to an overrun and is extremely dangerous.
4. Confirm the safety of the system when ripple compensation is used for a vertical axis.
   When this function is used for a vertical axis, confirm that the axis level does not drop when the servo is turned OFF.
5. [Forward Run Prohibit (P-OT)]/[Reverse Run Prohibit (N-OT)] is disabled.
   The Forward Run Prohibit (P-OT)/Reverse Run Prohibit (N-OT) signals are disabled during JOG operation (the servomotor will not stop even if the P-OT/N-OT signals are passed). When operating, carefully verify the action and position of the servomotor/machine.

The cautions on use

Please change the settings of the switches and parameters.
Before executing this function, change the settings of the switches and parameters to match the machine. Unexpected machine operation, failure, or personal injury may occur if operation is started before appropriate settings are made.
We recommend executing this function after completing gain adjustment.
If the power supply to the SERVOPACK is turned ON/OFF or a software reset is executed from a tool other than SigmaWin+ while this function is being executed, redo this function from the beginning.

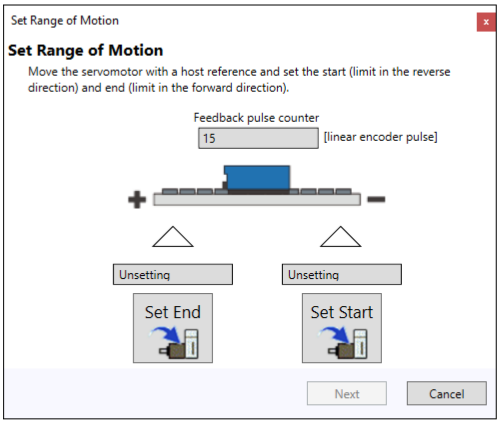
Clicking the OK button to start the Ripple Compensation.

4. **Click one of the following buttons according to the reference method to use when setting the range of motion.**
   - To set the range of motion with a reference from the host controller: Click the [With Host Reference] button.
   - To set the range of motion by jogging: Click the [Without Host Reference] button.



The [Set Range of Motion] window will be displayed.

5. **Confirm safety around moving parts and turn ON the servo with one of the following methods according to the reference method.**
   - If [With Host Reference] was selected in step 4: Turn ON the servo from the host controller.
   - If [Without Host Reference] was selected in step 4: Click the [Servo ON] button.

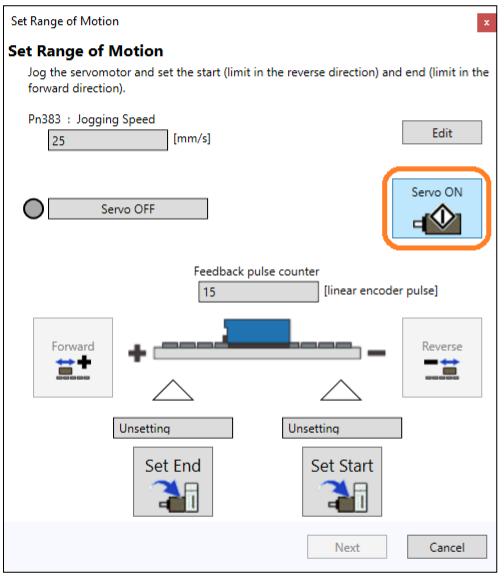


Set Range of Motion

Set Range of Motion

Move the servomotor with a host reference and set the start (limit in the reverse direction) and end (limit in the forward direction).

Feedback pulse counter: 15 [linear encoder pulse]



Set Range of Motion

Set Range of Motion

Jog the servomotor and set the start (limit in the reverse direction) and end (limit in the forward direction).

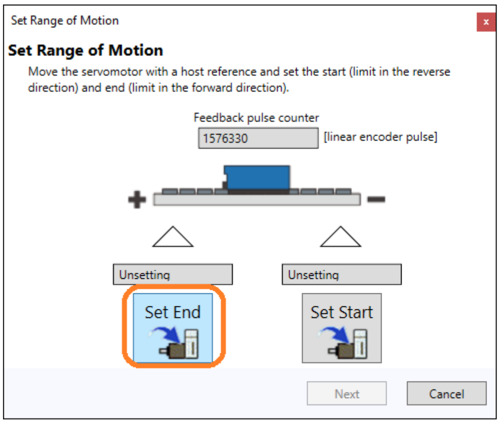
Pn383 : Jogging Speed: 25 [mm/s]

Feedback pulse counter: 15 [linear encoder pulse]

6. **Move the linear servomotor in the forward direction with one of the following methods according to the reference method. Click the [Set End] button when the linear servomotor has moved to the position to set as the end of the range of motion in the forward direction.**
   - If [With Host Reference] was selected in step 4: Move the linear servomotor from the host controller.
   - If [Without Host Reference] was selected in step 4: Click and hold the [Forward] button.

Important

- Speed ripple may worsen outside the range of motion set during setup.
- If you are using an incremental encoder that has one output position for the Origin Signal (Ref), set the range of motion so that it includes that output position.
- Speed ripple may worse if you are using an incremental encoder that has multiple output positions for the Origin Signal (Ref) and the set range of motion includes only one of those output positions. Set the range of motion so that it includes multiple output positions for the Origin Signal (Ref).
- Set the end point at a sufficient distance from the limit switch to prevent overtravel for occurring.

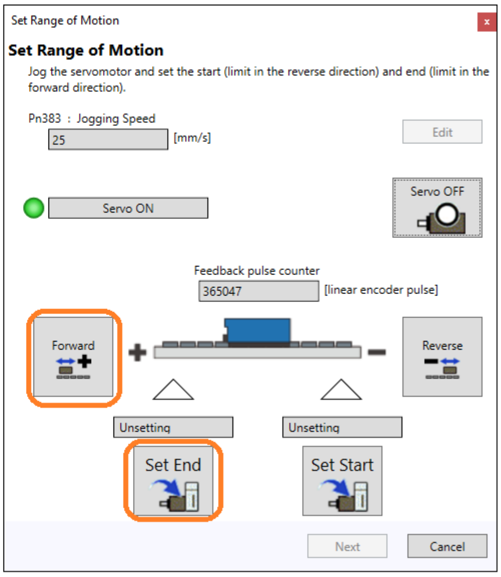


Set Range of Motion

Set Range of Motion

Move the servomotor with a host reference and set the start (limit in the reverse direction) and end (limit in the forward direction).

Feedback pulse counter: 1576330 [linear encoder pulse]



Set Range of Motion

Set Range of Motion

Jog the servomotor and set the start (limit in the reverse direction) and end (limit in the forward direction).

Pn383 : Jogging Speed: 25 [mm/s]

Feedback pulse counter: 365047 [linear encoder pulse]

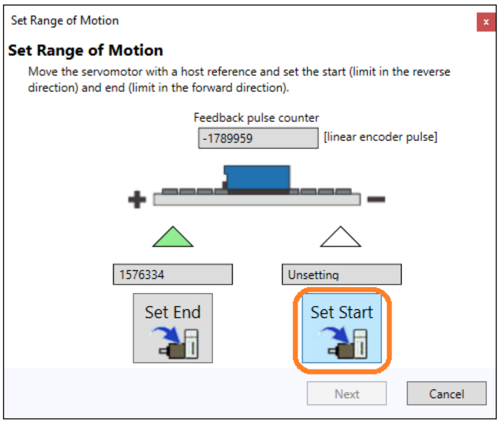
7. **Move the linear servomotor in the reverse direction with one of the following methods according to the reference method. Click the [Set Start] button when the linear**

servomotor has moved to the position to set as the end of the range of motion in the reverse direction.

- If [With Host Reference] was selected in step 4: Move the linear servomotor from the host controller.
- If [Without Host Reference] was selected in step 4: Click and hold the [Reverse] button.

Important

- Speed ripple may worsen outside the range of motion set during setup.
- If you are using an incremental encoder that has one output position for the Origin Signal (Ref), set the range of motion so that it includes that output position.
- Speed ripple may worse if you are using an incremental encoder that has multiple output positions for the Origin Signal (Ref) and the set range of motion includes only one of those output positions. Set the range of motion so that it includes multiple output positions for the Origin Signal (Ref).
- Set the end point at a sufficient distance from the limit switch to prevent overtravel for occurring.


Set Range of Motion

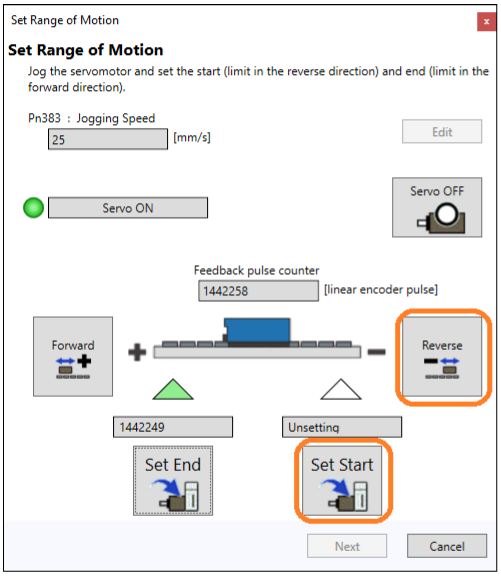
Set Range of Motion

Move the servomotor with a host reference and set the start (limit in the reverse direction) and end (limit in the forward direction).

Feedback pulse counter: -1789959 [linear encoder pulse]

1576334

Unsetting


Set Range of Motion

Set Range of Motion

Jog the servomotor and set the start (limit in the reverse direction) and end (limit in the forward direction).

Pn383 : Jogging Speed: 25 [mm/s]

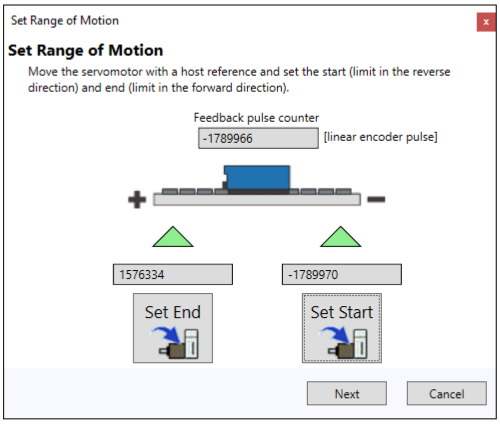
Feedback pulse counter: 1442258 [linear encoder pulse]

1442249

Unsetting

8. **Turn OFF the servo with one of the following methods according to the reference method.**

- If [With Host Reference] was selected in step 4: Turn OFF the servo from the host controller.
- If [Without Host Reference] was selected in step 4: Click the [Servo OFF] button.


Set Range of Motion

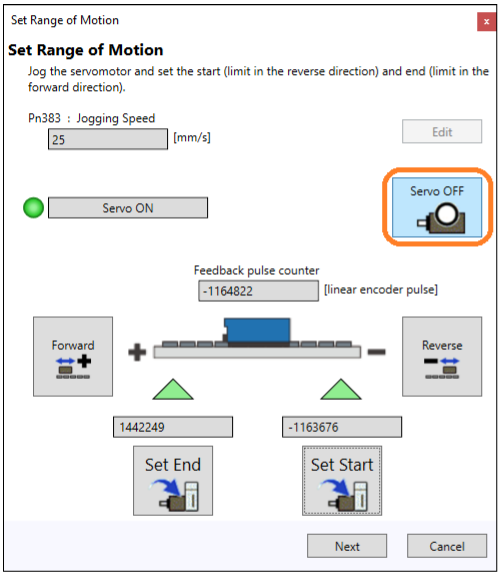
Set Range of Motion

Move the servomotor with a host reference and set the start (limit in the reverse direction) and end (limit in the forward direction).

Feedback pulse counter: -1789966 [linear encoder pulse]

1576334

-1789970


Set Range of Motion

Set Range of Motion

Jog the servomotor and set the start (limit in the reverse direction) and end (limit in the forward direction).

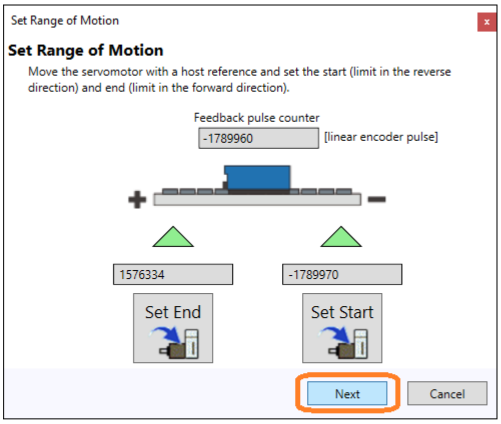
Pn383 : Jogging Speed: 25 [mm/s]

Feedback pulse counter: -1164822 [linear encoder pulse]

1442249

-1163676

9. **Click the [Next] button.**


Set Range of Motion

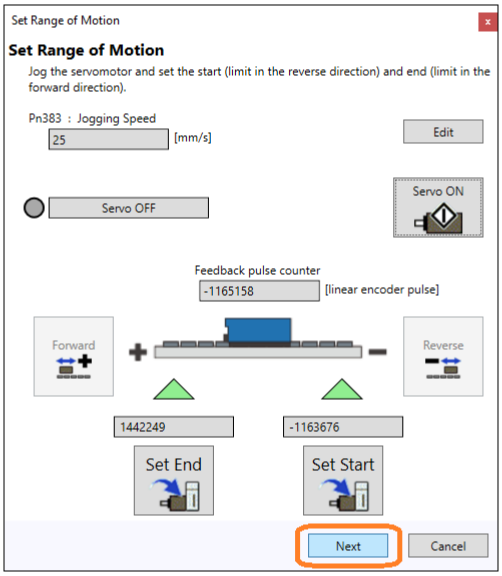
Set Range of Motion

Move the servomotor with a host reference and set the start (limit in the reverse direction) and end (limit in the forward direction).

Feedback pulse counter: -1789960 [linear encoder pulse]

1576334

-1789970


Set Range of Motion

Set Range of Motion

Jog the servomotor and set the start (limit in the reverse direction) and end (limit in the forward direction).

Pn383 : Jogging Speed: 25 [mm/s]

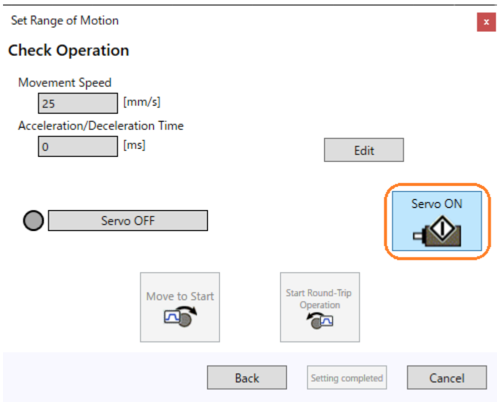
Servo OFF

Feedback pulse counter: -1165158 [linear encoder pulse]

1442249

-1163676

10. **Perform trial operation to check for problems in the range of motion that was set. Confirm safety around moving parts and click the [Servo ON] button.**


Set Range of Motion

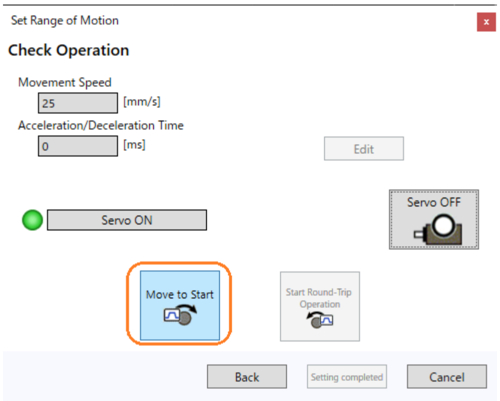
Check Operation

Movement Speed: 25 [mm/s]

Acceleration/Deceleration Time: 0 [ms]

Servo OFF

11. **Click the [Move to Start] button.**


Set Range of Motion

Check Operation

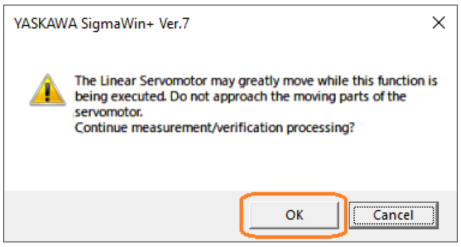
Movement Speed: 25 [mm/s]

Acceleration/Deceleration Time: 0 [ms]

Servo ON

The message dialog box will be displayed.

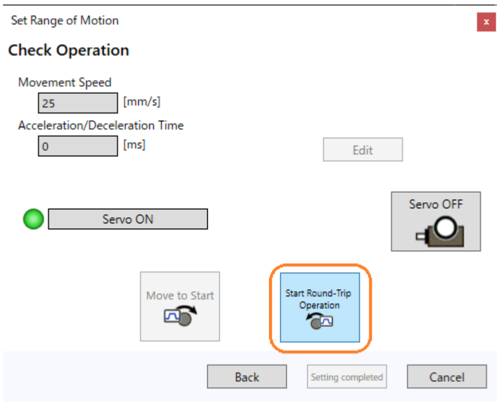
12. **Confirm the contents of the message and click the [OK] button.**


YASKAWA SigmaWin+ Ver.7

The Linear Servomotor may greatly move while this function is being executed. Do not approach the moving parts of the servomotor.
Continue measurement/verification processing?

The linear servomotor will move to the start point that was set.

13. **Click the [Start Round-Trip Operation] button.**

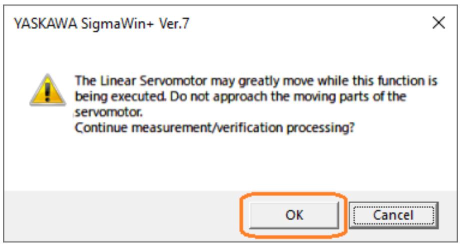


Movement Speed 25 [mm/s]

Acceleration/Deceleration Time 0 [ms]

The message dialog box will be displayed.

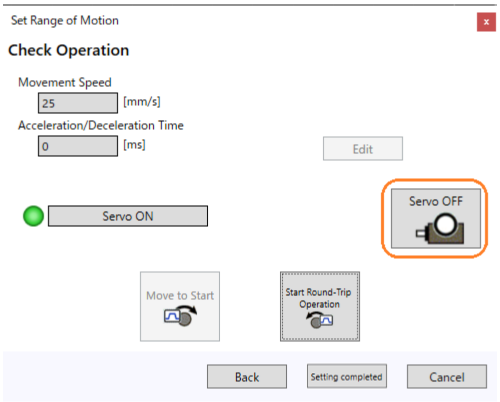
14. **Confirm the contents of the message and click the [OK] button.**



The Linear Servomotor may greatly move while this function is being executed. Do not approach the moving parts of the servomotor.
Continue measurement/verification processing?

The linear servomotor will perform round-trip operation in the range of motion that was set.

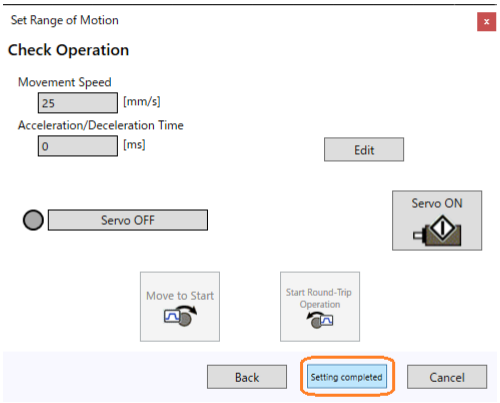
15. **Click the [Servo OFF] button.**



Movement Speed 25 [mm/s]

Acceleration/Deceleration Time 0 [ms]

16. **Click the [Setting completed] button.**

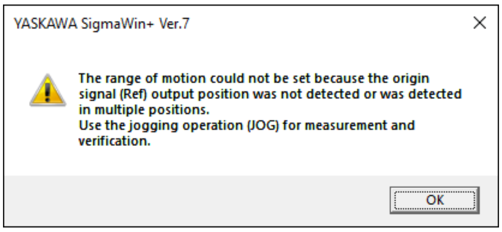


Movement Speed 25 [mm/s]

Acceleration/Deceleration Time 0 [ms]

The [Ripple Compensation] window will return.

Information Click the [Setting completed] button and the following message dialog box may be displayed.



The range of motion could not be set because the origin signal (Ref) output position was not detected or was detected in multiple positions.
Use the jogging operation (JOG) for measurement and verification.

This dialog box will be displayed in the following cases.

- Output of the Origin Signal (Ref) cannot be confirmed when using an increment encoder
- Multiple output positions of Origin Signal (Ref) were confirmed

When this dialog box is displayed, you must measure and verify the range of motion by jogging the servomotor. The operating procedure is the same as starting from step 4 in the operating procedure for speed ripple compensation when a rotary servomotor is connected. Refer to the following section and complete the procedure.

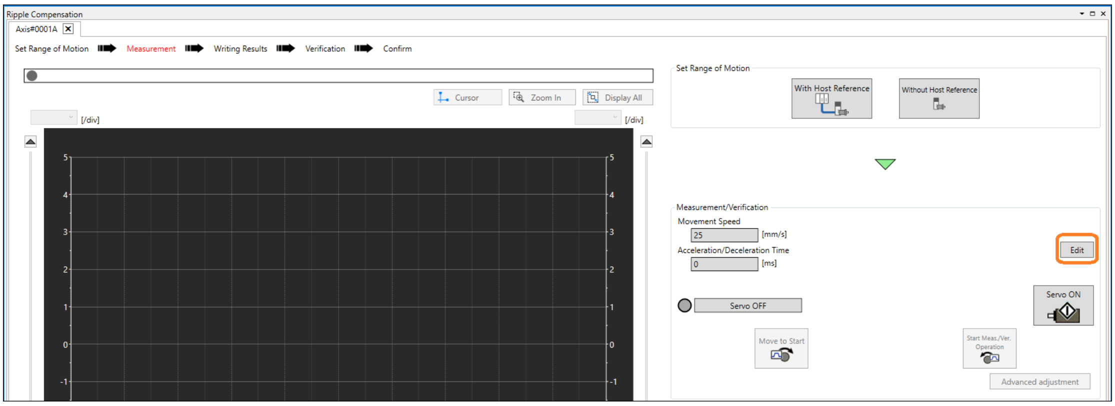
☞ *(c) Operating Procedure on page 444*

This concludes the procedure to set the range of motion and check operation.

(b) Measurement Operation

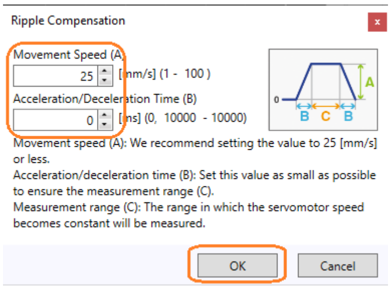
Use the following procedure to perform measurement operation.

1. **Check the values for travel speed and acceleration/deceleration time. If you will not change the values, proceed to step 3. To change the travel speed and acceleration/deceleration time, click the [Edit] button.**



Movement Speed
25 [mm/s]
Acceleration/Deceleration Time
0 [ms]

2. **Enter the operating conditions in [Movement Speed (A)] and [Acceleration/Deceleration Time (B)], and then click the [OK] button.**

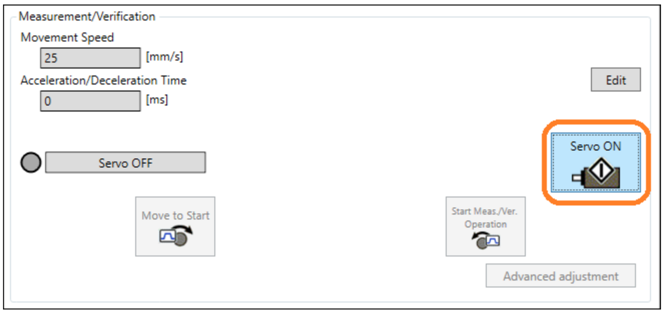


Movement Speed (A)
25 [mm/s] (1 - 100)
Acceleration/Deceleration Time (B)
0 [ms] (0, 10000 - 10000)

Movement speed (A): We recommend setting the value to 25 [mm/s] or less.
Acceleration/deceleration time (B): Set this value as small as possible to ensure the measurement range (C).
Measurement range (C): The range in which the servomotor speed becomes constant will be measured.

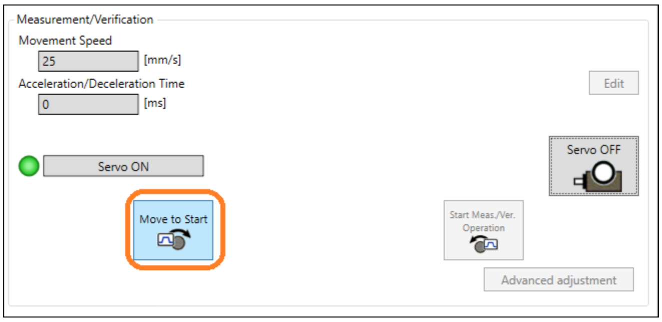
The Main Window will return.

3. **Confirm safety around moving parts and click the [Servo ON] button.**



Movement Speed 25 [mm/s]
Acceleration/Deceleration Time 0 [ms]

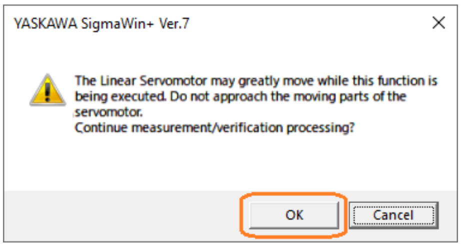
4. **Click the [Move to Start] button.**



Movement Speed 25 [mm/s]
Acceleration/Deceleration Time 0 [ms]

The message dialog box will be displayed.

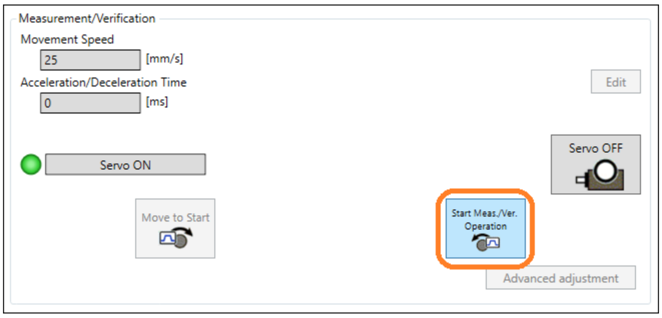
5. **Confirm the contents of the message and click the [OK] button.**



The Linear Servomotor may greatly move while this function is being executed. Do not approach the moving parts of the servomotor.
Continue measurement/verification processing?

The linear servomotor will move to the start point that was set.

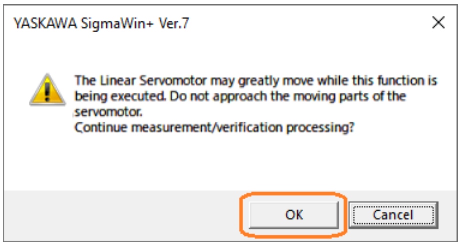
6. **Click the [Start Meas./Ver. Operation] button.**



Movement Speed 25 [mm/s]
Acceleration/Deceleration Time 0 [ms]

The message dialog box will be displayed.

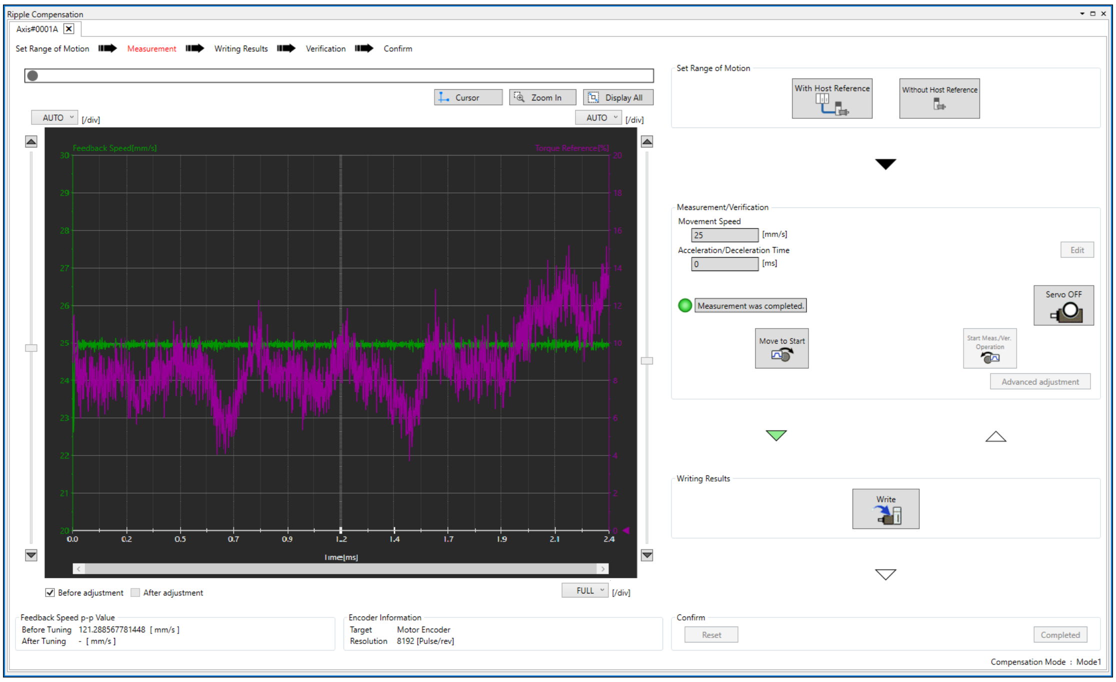
7. **Confirm the contents of the message and click the [OK] button.**



The Linear Servomotor may greatly move while this function is being executed. Do not approach the moving parts of the servomotor.
Continue measurement/verification processing?

The linear servomotor will move to the end point that was set and speed ripple will be measured.

After the speed ripple measurement has completed, the feedback speed and torque reference waveform during measurement operation will be displayed in the graph area.



☑ Before adjustment ☐ After adjustment FULL [/div]

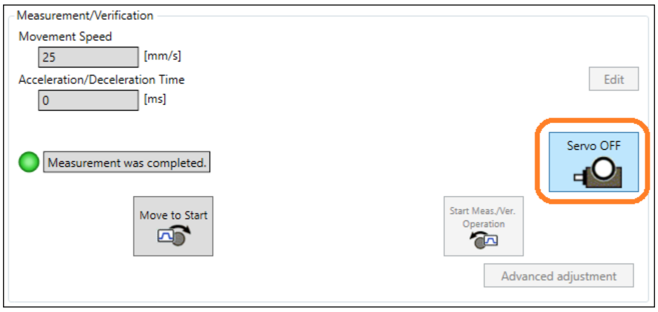
Measurement/Verification
Movement Speed 25 [mm/s]
Acceleration/Deceleration Time 0 [ms]
Measurement was completed.

Feedback Speed p-p Value
Before Tuning 121.288567781448 [mm/s]
After Tuning - [mm/s]

Encoder Information
Target Motor Encoder
Resolution 8192 [Pulse/rev]

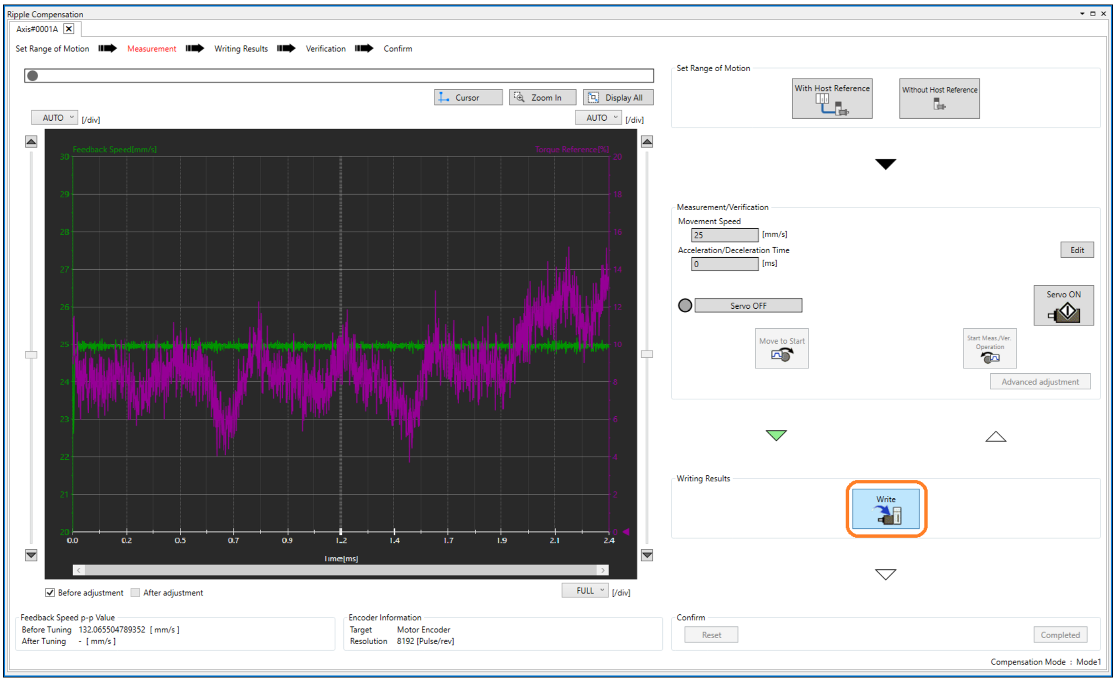
Compensation Mode : Mode1

8. **After speed ripple measurement has been completed, click the [Servo OFF] button.**



Measurement/Verification
Movement Speed 25 [mm/s]
Acceleration/Deceleration Time 0 [ms]
Measurement was completed.

9. **Click the [Write] button.**



☑ Before adjustment ☐ After adjustment FULL [/div]

Measurement/Verification
Movement Speed 25 [mm/s]
Acceleration/Deceleration Time 0 [ms]
Servo OFF

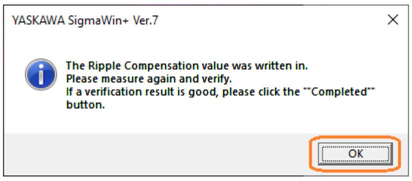
Feedback Speed p-p Value
Before Tuning 132.065504789352 [mm/s]
After Tuning - [mm/s]

Encoder Information
Target Motor Encoder
Resolution 8192 [Pulse/rev]

Compensation Mode : Mode1

The ripple compensation value will be written to the SERVOPACK.

10. **Click the [OK] button.**



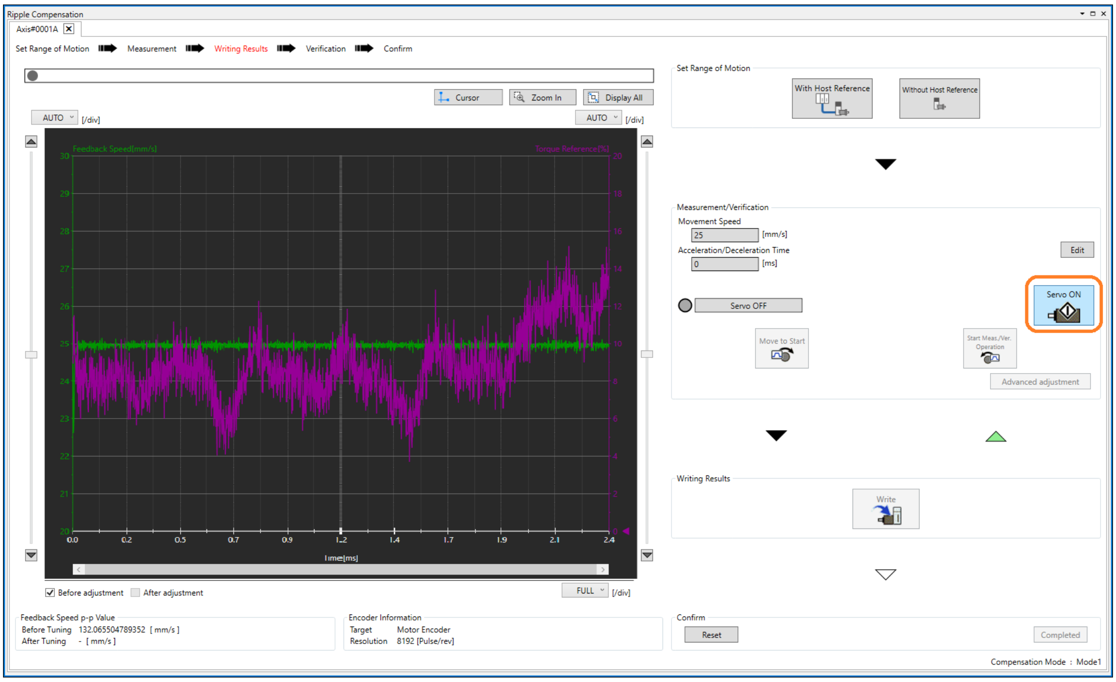
The Ripple Compensation value was written in.
Please measure again and verify.
If a verification result is good, please click the ""Completed"" button.

This concludes the measurement operation procedure.

(c) Verification Operation

Use the following procedure to perform verification operation.

1. **Click the [Servo ON] button.**



Movement Speed 25 [mm/s]
Acceleration/Deceleration Time 0 [ms]

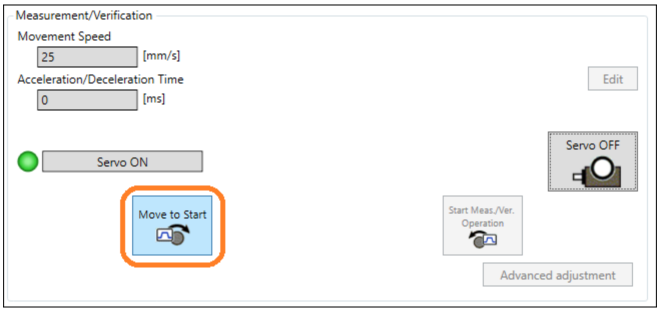
☑ Before adjustment ☐ After adjustment

Feedback Speed p-p Value
Before Tuning 132.065504789352 [mm/s]
After Tuning - [mm/s]

Encoder Information
Target Motor Encoder
Resolution 8192 [Pulse/rev]

Compensation Mode : Mode1

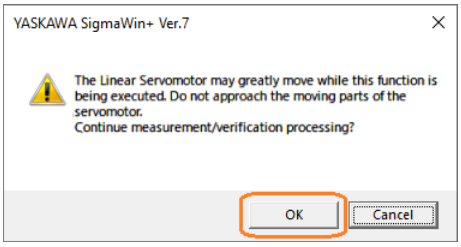
2. **Click the [Move to Start] button.**



Movement Speed 25 [mm/s]
Acceleration/Deceleration Time 0 [ms]

The message dialog box will be displayed.

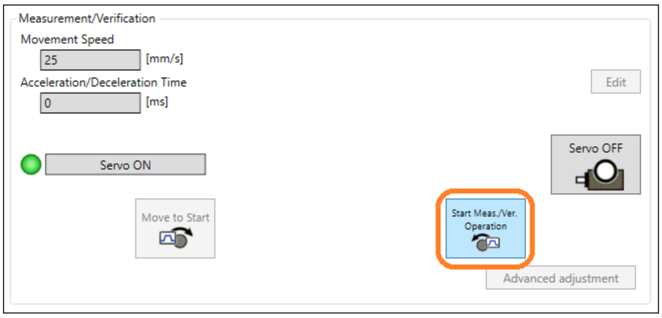
3. **Confirm the contents of the message and click the [OK] button.**



The Linear Servomotor may greatly move while this function is being executed. Do not approach the moving parts of the servomotor.
Continue measurement/verification processing?

The linear servomotor will move to the start point that was set.

4. **Click the [Start Meas./Ver. Operation] button.**



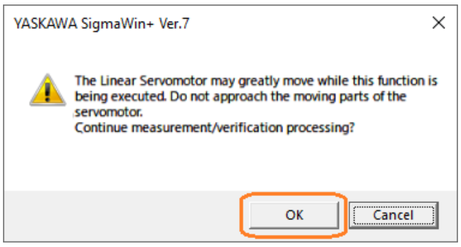
Measurement/Verification

Movement Speed: 25 [mm/s]

Acceleration/Deceleration Time: 0 [ms]

The message dialog box will be displayed.

5. **Confirm the contents of the message and click the [OK] button.**

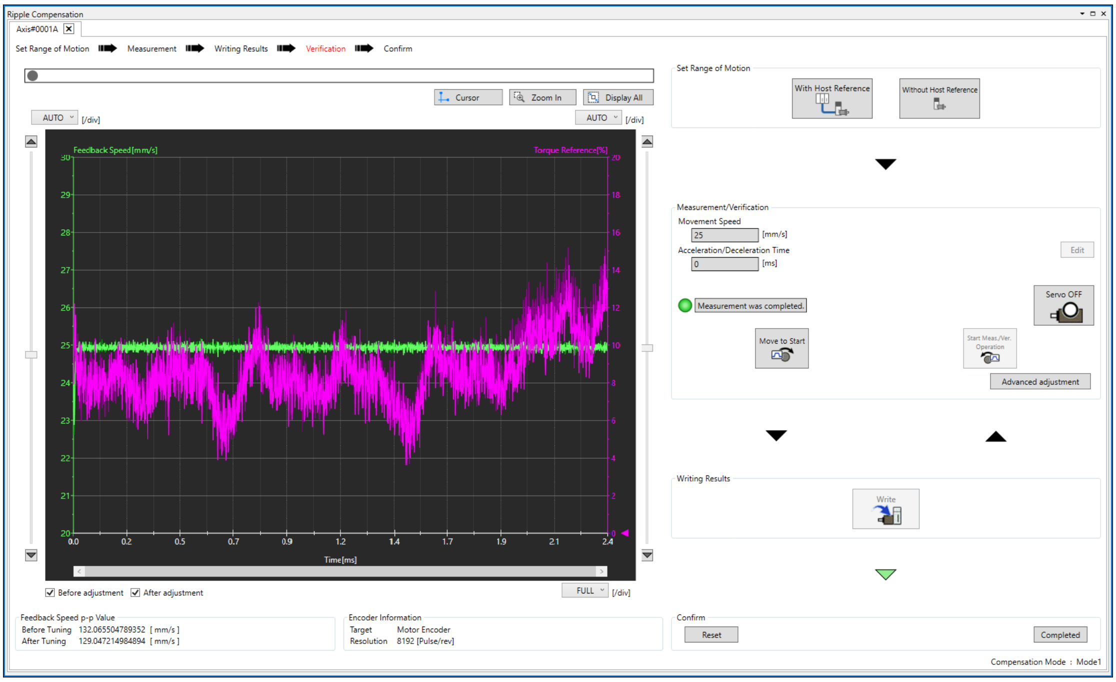


YASKAWA SigmaWin+ Ver.7

The Linear Servomotor may greatly move while this function is being executed. Do not approach the moving parts of the servomotor.
Continue measurement/verification processing?

The linear servomotor will move to the end point that was set.

The waveform during verification operation with speed ripple compensation applied to it will be displayed overlapping in the graph area.



Ripple Compensation

Axis#0001A

Set Range of Motion → Measurement → Writing Results → Verification → Confirm

Measurement/Verification

Movement Speed: 25 [mm/s]

Acceleration/Deceleration Time: 0 [ms]

Measurement was completed.

☑ Before adjustment ☑ After adjustment

Feedback Speed p-p Value

Before Tuning 132.065504789352 [mm/s]

After Tuning 129.047214984894 [mm/s]

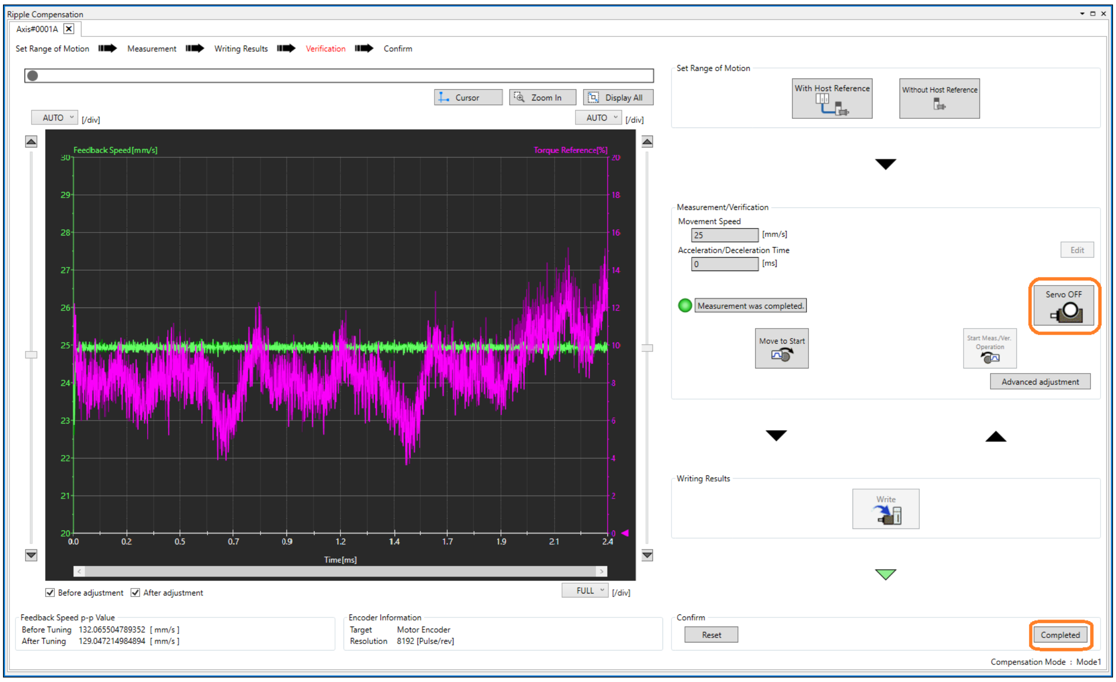
Encoder Information

Target Motor Encoder

Resolution 8192 [Pulse/rev]

Compensation Mode : Mode1

6. **If you obtained satisfactory results in the verification of speed ripple compensation, first click the [Servo OFF] button, and then click the [Completed] button.**



☑ Before adjustment ☑ After adjustment

Movement Speed: 25 [mm/s]
Acceleration/Deceleration Time: 0 [ms]
Measurement was completed.

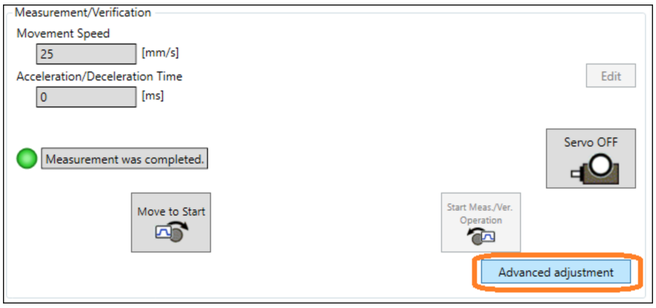
Feedback Speed p-p Value
Before Tuning 132.065504789352 [mm/s]
After Tuning 129.047214984894 [mm/s]

Encoder Information
Target Motor Encoder
Resolution 8192 [Pulse/rev]

Compensation Mode : Mode1

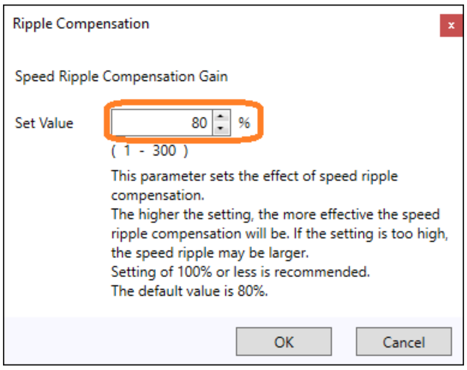
Information

- To increase the effect of the speed ripple compensation, click the [Advanced adjustment] button. You can change the speed ripple compensation gain.



Movement Speed: 25 [mm/s]
Acceleration/Deceleration Time: 0 [ms]
Measurement was completed.

We recommend setting the speed ripple compensation gain to 100% or less because speed ripple may grow larger if the gain setting is too high.



Speed Ripple Compensation Gain
Set Value 80 %
(1 - 300)
This parameter sets the effect of speed ripple compensation.
The higher the setting, the more effective the speed ripple compensation will be. If the setting is too high, the speed ripple may be larger.
Setting of 100% or less is recommended.
The default value is 80%.

- If there was a problem, click the [Reset] button and redo the settings from "*(a) Setting the Range of Motion/Checking Operation on page 451*".

This concludes the setup for speed ripple compensation.

8.12.4 Speed Ripple Compensation during Torque Control Mode and during Torque Limits

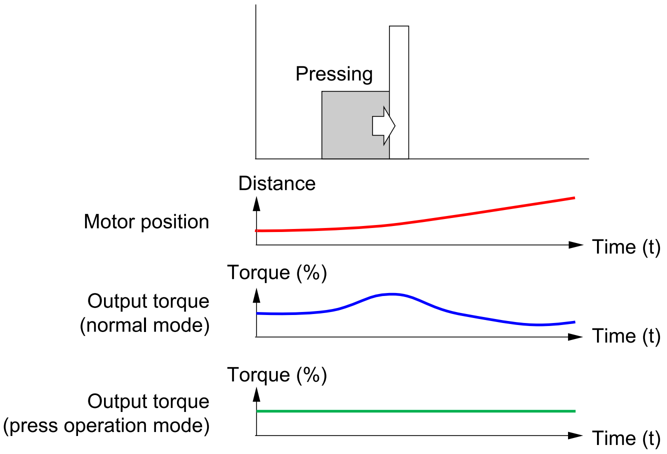
Speed ripple compensation during torque control mode and speed ripple compensation during torque limits are disabled by default.

To enable speed ripple compensation during torque control mode and speed ripple compensation during torque limits, use the following procedure to enable press operation mode.

Information During press operation mode, the torque reference monitor and trace waveform may change depending on the speed ripple compensation value, even if a constant torque reference is input.

Even when press operation mode is set, speed ripple will not be compensated in such a way as to exceed the maximum torque that can be output by the servomotor and SERVOPACK.

Pn423	n.X□□□	Speed Ripple Compensation Function Operation Mode Selection Speed Pos Trq		When Enabled
		0 Default	Execute speed ripple compensation in normal mode.	After restart
		1	Execute speed ripple compensation in press operation mode.	
		2	Reserved (Do not use.)	
		3	Reserved (Do not use.)	



Tiny variations in motor position from pressing
→ Output torque changes due to cogging torque

During press operation mode, speed ripple compensation is enabled during torque control and during torque limits
→ Compensation applied to make output torque constant

(1) Operating Procedure

Use the following procedure to execute speed ripple compensation in press operation mode.

1. **Perform setup for speed ripple compensation.**

   Refer to the following sections for details.

   ☞ *(c) Operating Procedure on page 444*

   ☞ *(3) Operating Procedure on page 450*

2. **Set Pn423 to n.1□□□ (execute speed ripple compensation in press operation mode).**

3. **Turn the power to the SERVOPACK OFF and ON again.**
   Press operation mode will be enabled.

This concludes the procedure to execute speed ripple compensation in press operation mode.

8.12.5 Parameter Settings

The default setting for speed ripple compensation is Pn423 = n.□□□2 (execute speed ripple compensation using the default adjustment value). If you set up the function using the SigmaWin+, Pn423 will be set to n.□□□1 (execute speed ripple compensation using the user adjustment value). To disable speed ripple compensation, set Pn423 to n.□□□0 (disable speed ripple compensation) to disable the function.

Note:

If Easy FFT is enabled, speed ripple compensation will be forcibly disabled.

Pn423	n.□□□X	Speed Ripple Compensation Function Selection	Speed Pos Trq	When Enabled
		0	Do not execute speed ripple compensation.	Immediately
		1	Execute speed ripple compensation using the value adjusted by the user.	
		2 Default	Execute speed ripple compensation using the default adjustment value.	

If you enable speed ripple compensation, a compensation reference will be applied to reduce ripple even when stopped at a 0 speed reference. In speed control mode, this may result in the servomotor moving slightly. To prevent this, set Pn423 to n.□X□□ (Speed Ripple Compensation Enable Condition Selection) and Pn427 or Pn49F (Speed Ripple Compensation Enable Speed).

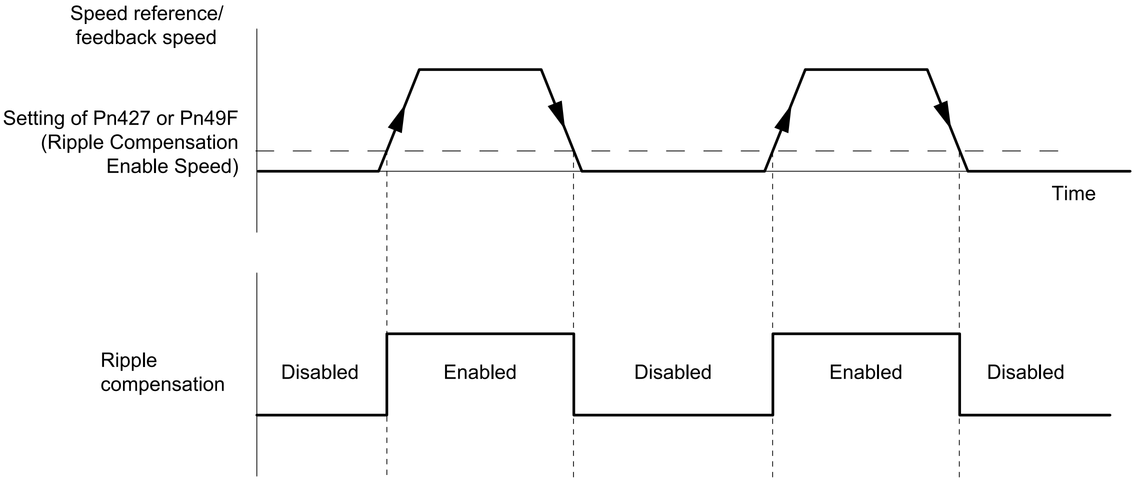
Pn423	n.□X□□	Speed Ripple Compensation Enable Condition Selection	Speed Pos Trq	When Enabled
		0 Default	Speed Reference	After restart
		1	Motor Speed	

- Rotary Servomotors

Pn427	Speed Ripple Compensation Enable Speed			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 min^{-1}	0	Immediately

- Linear Servomotors

Pn49F	Speed Ripple Compensation Enable Speed (Linear)			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 mm/s	0	Immediately



(1) Speed Ripple Compensation Warnings

The speed ripple compensation value is specific to each servomotor. If you replace the servomotor while speed ripple compensation using the user adjustment value is enabled, A.942 (Speed Ripple Compensation Information Disagreement) will occur to warn you.

You can use any of the following methods to clear A.942.

- Reset the speed ripple compensation value on the SigmaWin+.
- Set Pn423 to n.□□□0 (disable speed ripple compensation).
- Set Pn423 to n.□□□2 (execute speed ripple compensation using the default adjustment value).
- Set Pn423 to n.□□1□ (disable detection of A.942).

Information **Information on A.942 When a Linear Servomotor Is Replaced**

A.942 may not occur when a linear servomotor or a linear encoder is replaced. When these devices are replaced, be sure to set up this function again in the SigmaWin+.

Pn423	n.□□□X	Speed Ripple Compensation Function Selection	Speed Pos Trq	When Enabled
		0	Do not execute speed ripple compensation.	Immediately
		1	Execute speed ripple compensation using the value adjusted by the user.	
		2 Default	Execute speed ripple compensation using the default adjustment value.	
Pn423	n.□□X□	Speed Ripple Compensation Information Disagreement Warning Detection Selection	Speed Pos Trq	When Enabled
		0 Default	Detect A.942 alarms.	After restart
		1	Do not detect A.942 alarms.	

(2) Press Operation Mode for Speed Ripple Compensation

To enable speed ripple compensation during torque control mode and during torque limits, set Pn423 to n.1□□□.

Pn423	n.X□□□	Speed Ripple Compensation Function Operation Mode Selection	Speed Pos Trq	When Enabled
		0 Default	Execute speed ripple compensation in normal mode.	After restart
		1	Execute speed ripple compensation in press operation mode.	
		2	Reserved (Do not use.)	
		3	Reserved (Do not use.)	

8.13 Load Fluctuation Compensation Control

This section describes load fluctuation compensation control.

8.13.1 Outline

Load fluctuation compensation control is used to control fluctuations in response for applications where the load (moment of inertia) fluctuates greatly due to the operating status and posture of the machine, such as robots and transfer equipment.

Load fluctuation compensation control implements operation that suppresses variations in settling time when the load fluctuates ±500% in relation to the set moment of inertia ratio (Pn103) (e.g., if Pn103 is 2000%, between 1500% and 2500%).

This function can be combined with notch filters, anti-resonance control, and model following control.

To use this function, set Pn173 to n.□□□1 (enable load fluctuation compensation control).

Important

- For a machine with low rigidity, such as a machine that vibrates at 100 Hz or less, the variation in settling time may not fall to within 10 ms or less.
- If combined with model following control, overshooting may increase.

8.13.2 Application Restrictions

The restrictions for load fluctuation compensation control are given below.

- Load fluctuation compensation control cannot be used during torque control.
- This function cannot be combined with I-P control or friction compensation.
- Load fluctuation compensation control cannot be used if the encoder resolution is 13 bits or less.

8.13.3 Preparations

Always check the following before you execute load fluctuation compensation control.

- The test without a motor function must be disabled (Pn00C = n.□□□0).
- The tuning-less function must be disabled (Pn170 = n.□□□0).
- The parameters must not be write prohibited.

8.13.4 Required Parameter Settings

The following parameter settings are required to use load fluctuation compensation control.

Pn173	n.□□□X	Load Fluctuation Compensation Control Selection Speed Pos Trq		When Enabled
		0 Default	Do not use load fluctuation compensation control.	Immediately
		1	Use load fluctuation compensation control.	

Pn103	Moment of Inertia Ratio Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	1%	100	Immediately

Pn174	Load Fluctuation Compensation Control Response Level			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 20000	0.1	400	Immediately

8.13.5 Operating Procedure

Use the following procedure to perform load fluctuation compensation control.

1. **If Pn170 is set to n.□□□1 (enable tuning-less function), change Pn170 to n.□□□0 (disable tuning-less function), and then turn the SERVOPACK power OFF and ON again.**
2. **Set Pn173 to n.□□□1 (use load fluctuation compensation control).**
3. **Execute various operations so the load increases to the maximum and decreases to the minimum and monitor the moment of inertia ratio.**

   You can use the [Operation] monitor in the SigmaWin+ or the Un07C monitor on panel operator of the SERVOPACK to check the identified moment of inertia ratio. Refer to the following sections for details.

   ☞ *9.2.2 Operation Monitor, Status Monitor, and I/O Monitor on page 504*

   ☞ *14.3 Monitor Display (Un□□□) Operations on the Panel Operator on page 640*
4. **Identify the minimum and maximum of the moment of inertia ratio, and set the median value of those two to Pn103 (Moment of Inertia Ratio).**

   Note:

   The fluctuation range of the moment of inertia that can be compensated by this function is ±500%.
5. **Input the references for normal operation from the host controller and operate the servomotor.**
6. **While checking the response with the tracing function, increase Pn174 (Load Fluctuation Compensation Control Response Level). If vibration or residual vibration when stopped increases, set and adjust vibration suppression, such as anti-resonance control and the notch filters. If vibration cannot be sufficiently suppressed with the vibration suppression adjustments, lower Pn174 to a level at which vibration can be tolerated, and then end the adjustments.**

This concludes the procedure to set up load fluctuation compensation control.

8.13.6 Parameters Disabled by a Load Fluctuation Compensation Control

When Pn173 is set to n.□□□1 (when load fluctuation compensation control is enabled), the parameters in the following table are disabled.

Parameter Name	Parameter Number
Speed Loop Gain Second Speed Loop Gain	Pn100 Pn104
Speed Loop Integral Time Constant Second Speed Loop Integral Time Constant	Pn101 Pn105
Position Loop Gain Second Position Loop Gain	Pn102 Pn106
Speed Loop Control Method	Pn10B = n.□□X□
Friction Compensation Function Selection	Pn408 = n.X□□□
Gain Switching Selection	Pn139 = n.□□□X
First Stage First Torque Reference Filter Time Constant	Pn401

Load fluctuation compensation control is disabled during torque control, Easy FFT, and mechanical analysis for a vertical axis. In addition, Pn100, Pn104, Pn101, Pn105, Pn102, and Pn106 in the above table are enabled for torque control, Easy FFT, and mechanical analysis for a vertical axis. Of these, only Pn100 and Pn104 are enabled for torque control.

Information Pn401 (First Stage First Torque Reference Filter Time Constant) is disabled, but the torque reference filter time constant that works in conjunction with Pn174 (Load Fluctuation Compensation Control Response Level) is applied to the first stage first torque reference filter.

8.14 Additional Adjustment Functions

This section describes the functions that you can use to make adjustments after you perform autotuning without a host reference, autotuning with a host reference, and custom tuning.

Function	Applicable Control Methods	Reference
Gain Switching	Position control, speed control, or torque control *1	☞ *8.14.1 Gain Switching on page 468*
Friction Compensation	Position control or speed control	☞ *8.14.2 Friction Compensation on page 472*
Gravity Compensation	Position control, speed control, or torque control	☞ *8.14.3 Gravity Compensation on page 473*
Output Torque Compensation	Position control, speed control, or torque control	☞ *8.14.4 Output Torque Compensation on page 474*
Current Control Mode Selection	Position control, speed control, or torque control	☞ *8.14.5 Current Control Mode Selection on page 475*
Current Gain Level Setting	Position control or speed control	☞ *8.14.6 Current Gain Level Setting on page 475*
Speed Detection Method Selection	Position control, speed control, or torque control	☞ *8.14.7 Speed Detection Method Selection on page 475*
Speed Feedback Filter	Position control or speed control	☞ *8.14.8 Speed Feedback Filter on page 476*
P Control	Position control or speed control	☞ *8.14.9 P Control on page 476*

*1 Automatic gain switching is enabled only for position control.

8.14.1 Gain Switching

Two gain switching functions are available, manual switching and automatic switching. The manual switching function uses an external input signal to select the gains, and the automatic switching function changes the gains automatically.

You can use gain switching to shorten the positioning time by increasing the gains during positioning and suppressing vibration by decreasing the gains while stopping.

Pn139	n.□□□X	Gain Switching Selection	Speed Pos Trq	When Enabled
		0 Default	Manual Gain Switching The gain is switched manually with the /G-SEL (Gain Selection Input) signal.	Immediately
		1	Reserved (Do not use.)	
		2	Use automatic gain switching pattern 1. The gain settings 1 switch automatically to 2 when switching condition A is satisfied. The gain settings 2 switch automatically to 1 when switching condition A is not satisfied.	

Note:

n.□□□1 is a reserved setting. Do not use this setting.

Refer to the following section for gain switching combinations.

☞ *(1) Gain Switching Combinations on page 469*

Refer to the following sections for information on manual and automatic gain switching.

☞ *(2) Manual Gain Switching on page 469*

☞ *(3) Automatic Gain Switching on page 469*

(1) Gain Switching Combinations

Selected Gains	Speed Loop Gain	Speed Loop Integral Time Constant	Position Loop Gain	Torque Reference Filter	Model Following Control Gain	Model Following Control Gain Correction	Friction Compensation Gain
Gain 1	Pn100 (Speed Loop Gain)	Pn101 (Speed Loop Integral Time Constant)	Pn102 (Position Loop Gain)	Pn401 (First Stage First Torque Reference Filter Time Constant)	Pn141 (Model Following Control Gain) *1	Pn142 (Model Following Control Gain Correction) *1	Pn121 (Friction Compensation Gain)
Gain 2	Pn104 (Second Speed Loop Gain)	Pn105 (Second Speed Loop Integral Time Constant)	Pn106 (Second Position Loop Gain)	Pn412 (First Stage Second Torque Reference Filter Time Constant)	Pn148 (Second Model Following Control Gain) *1	Pn149 (Second Model Following Control Gain Correction) *1	Pn122 (Second Friction Compensation Gain)

*1 Gain switching for the model following control gain and the model following control gain correction is applicable only to manual gain switching.
To enable gain switching with these parameters, a gain switching input signal must be used and the following conditions must be met. If the conditions are not met, these parameters will not be changed even if the other parameters in the above table are changed.

- There must be no reference.
- The motor must be stopped.

(2) Manual Gain Switching

With manual gain switching, you use the external signal (/G-SEL (Gain Selection) signal) to change between gain 1 and gain 2.

Type	Command Name	Connector Pin No.	Setting	Meaning
Input	GSEL	Must be allocated.	ON	Changes the gain settings to gain 1.
			OFF	Changes the gain settings to gain 2.

(3) Automatic Gain Switching

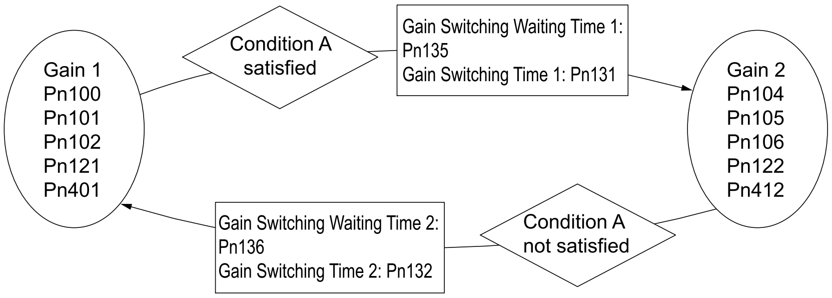
Automatic gain switching is enabled only for position control. The switching conditions are specified by using the following settings.

Parameter		Switching Condition	Selected Gains	Switching Waiting Time	Switching Time
Pn139	n.□□□2	Condition A satisfied	Gain 1 to gain 2	Gain Switching Waiting Time 1 Pn135	Gain Switching Time 1 Pn131
		Condition A not satisfied	Gain 2 to gain 1	Gain Switching Waiting Time 2 Pn136	Gain Switching Time 2 Pn132

Select one of the following settings for switching condition A.

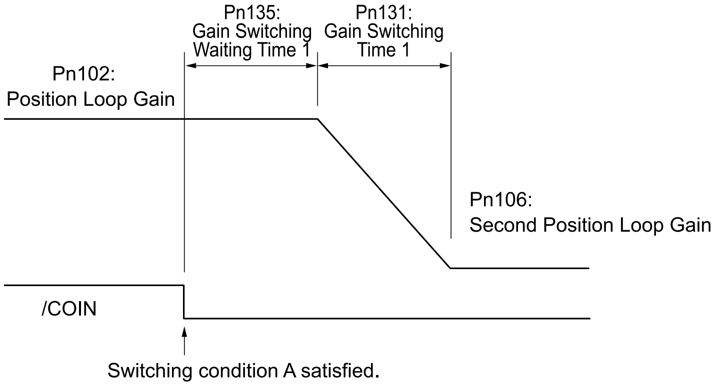
Parameter		Position Control Gain Switching Condition A	For Control Methods Other Than Position Control (No Switching)	When Enabled
Pn139	n.□□0□ (default setting)	/COIN (Positioning Completion) signal ON	Gain 1 used.	Immediately
	n.□□1□	/COIN (Positioning Completion) signal OFF	Gain 2 used.	
	n.□□2□	/NEAR (Near) signal ON	Gain 1 used.	
	n.□□3□	/NEAR (Near) signal OFF	Gain 2 used.	
	n.□□4□	Position reference filter output is 0 and reference pulse input is OFF.	Gain 1 used.	
	n.□□5□	Position reference pulse input is ON.	Gain 2 used.	

Pn139 = n.□□□2 (use automatic gain switching pattern 1)



(a) Relationship between the Waiting Times and Switching Times for Gain Switching

In this example, an ON /COIN (Positioning Completion Input) signal is set as condition A for automatic gain switching. The position loop gain is changed from the value in Pn102 (Position Loop Gain) to the value in Pn106 (Second Position Loop Gain). When the /COIN signal turns ON, the switching operation begins after Pn135 (Gain Switching Waiting Time 1). The switching operation changes the position loop gain linearly from the gain set in Pn102 to the gain set in Pn106 over Pn131 (Gain Switching Time 1).



Information Gain switching can be performed when Pn10B is set to n.□□0□ or n.□□1□ (Speed Loop Control Method is PI control or I-P control).

(4) Related Parameters

Pn100	Speed Loop Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 20000	0.1 Hz	400	Immediately
Pn101	Speed Loop Integral Time Constant			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	15 to 51200	0.01 ms	2000	Immediately
Pn102	Position Loop Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 20000	0.1/s	400	Immediately
Pn401	First Stage First Torque Reference Filter Time Constant			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.01 ms	100	Immediately
Pn141	Model Following Control Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 20000	0.1/s	500	Immediately
Pn142	Model Following Control Gain Correction			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	500 to 2000	0.1%	1000	Immediately

Continued on next page.

Continued from previous page.

Pn121	Friction Compensation Gain			**Speed** **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 1000	1%	100	Immediately
Pn104	Second Speed Loop Gain			**Speed** **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 20000	0.1 Hz	400	Immediately
Pn105	Second Speed Loop Integral Time Constant			**Speed** **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	15 to 51200	0.01 ms	2000	Immediately
Pn106	Second Position Loop Gain			**Speed** **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 20000	0.1/s	400	Immediately
Pn412	First Stage Second Torque Reference Filter Time Constant			**Speed** **Pos** **Trq**
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.01 ms	100	Immediately
Pn148	Second Model Following Control Gain			Speed **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 20000	0.1/s	500	Immediately
Pn149	Second Model Following Control Gain Correction			Speed **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	500 to 2000	0.1%	1000	Immediately
Pn122	Second Friction Compensation Gain			**Speed** **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 1000	1%	100	Immediately

(5) Parameters Related to Automatic Gain Switching

Pn131	Gain Switching Time 1			**Speed** **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	1 ms	0	Immediately
Pn132	Gain Switching Time 2			**Speed** **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	1 ms	0	Immediately
Pn135	Gain Switching Waiting Time 1			**Speed** **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	1 ms	0	Immediately
Pn136	Gain Switching Waiting Time 2			**Speed** **Pos** Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	1 ms	0	Immediately

(6) Related Monitoring

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

Parameter	Analog Monitor	Monitor Name	Output Value	Meaning
Pn006 Pn007	n.□□0B	Active Gain Monitor	1 V	Gain 1 is enabled.
			2 V	Gain 2 is enabled.

8.14.2 Friction Compensation

Friction compensation is used to compensate for viscous friction fluctuations and regular load fluctuations.

You can automatically adjust friction compensation with autotuning without a host reference, autotuning with a host reference, or custom tuning, or you can manually adjust it with the following procedure.

(1) Required Parameter Settings

The following parameter settings are required to use friction compensation.

Pn408	n.X□□□	Friction Compensation Function Selection	Speed Pos Trq	When Enabled
		0 Default	Disable friction compensation.	Immediately
		1	Enable friction compensation.	

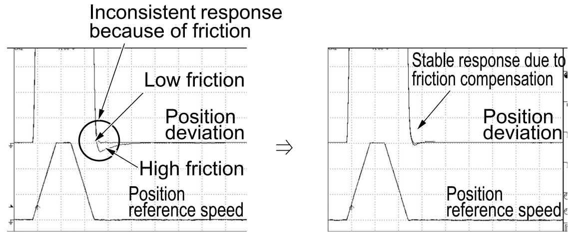
Pn121	Friction Compensation Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 1000	1%	100	Immediately
Pn122	Second Friction Compensation Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 1000	1%	100	Immediately
Pn123	Friction Compensation Coefficient			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 100	1%	0	Immediately
Pn124	Friction Compensation Frequency Correction			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	-10000 to 10000	0.1 Hz	0	Immediately
Pn125	Friction Compensation Gain Correction			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 1000	1%	100	Immediately

(2) Operating Procedure for Friction Compensation

Use the following procedure to perform friction compensation.

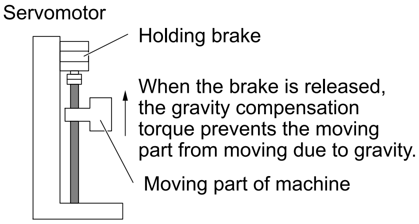
⚠ CAUTION

Before you execute this function, set Pn103 (Moment of Inertia Ratio) correctly. If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.

Step	Operation
1	Set the following parameters related to friction compensation to their default settings. Pn121 (Friction Compensation Gain) → default setting: 100 Pn122 (Second Friction Compensation Gain) → default setting: 100 Pn123 (Friction Compensation Coefficient) → default setting: 0 Pn124 (Friction Compensation Frequency Correction) → default setting: 0 Pn125 (Friction Compensation Gain Correction) → default setting: 100 **Note:** Always use the default settings for Pn124 (Friction Compensation Frequency Correction) and Pn125 (Friction Compensation Gain Correction).
2	Gradually increase the setting of Pn123 (Friction Compensation Coefficient) to check the effect of friction compensation. **Note:** Usually, set Pn123 (Friction Compensation Coefficient) to 95% or less. If the effect is insufficient, increase the setting of Pn121 (Friction Compensation Gain) by 10% increments until vibration stops. Effect of Adjusted Parameters Pn121: Friction Compensation Gain and Pn122: Second Friction Compensation Gain These parameters set the response to external disturbances. The higher the setting is, the better the response will be. If the machine has a resonance frequency, however, vibration may occur if the setting is too high. Pn123: Friction Compensation Coefficient This parameter sets the effect of friction compensation. The higher the setting is, the more effective friction compensation will be. If the setting is too high, however, vibration will occur more easily. Usually, set the value to 95% or less.
3	Effect of Adjustments The following graphs show the response with and without adjustment.  Before Friction Compensation After Friction Compensation

8.14.3 Gravity Compensation

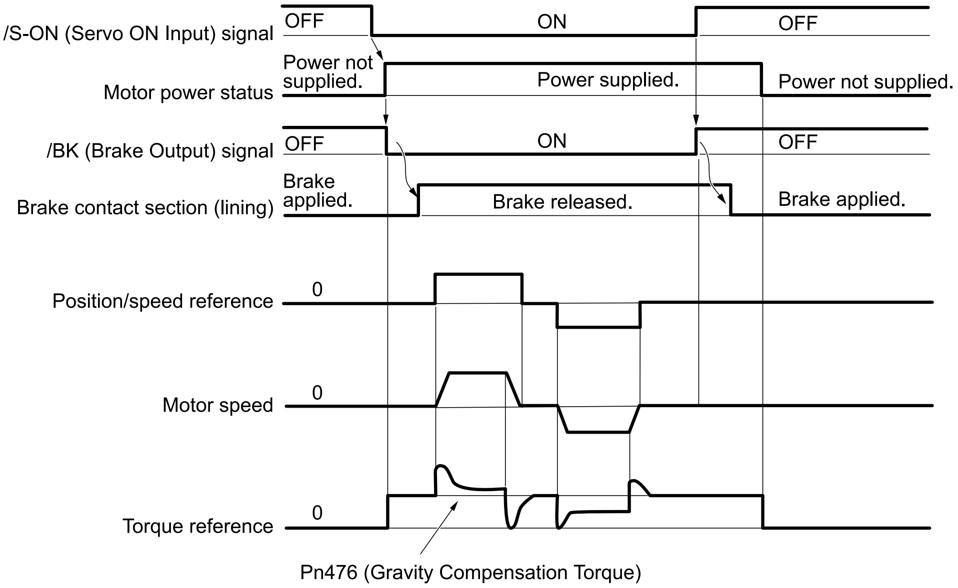
When the servomotor is used with a vertical axis, gravity compensation prevents the moving part from falling due to the machine's own weight when the brake is released.



A timing chart for when the moving part is raised then lowered is provided below.

Refer to the following section for details on brake operation timing.

☞ *5.13.1 Brake Operating Sequence on page 191*



(1) Required Parameter Settings

The following parameter settings are required to use gravity compensation.

		Gravity Compensation Selection **Speed** **Pos** **Trq**		When Enabled
Pn475	n.□□□X	0 Default	Disable gravity compensation.	After restart
		1	Enable gravity compensation.	

	Gravity Compensation Torque **Speed** **Pos** **Trq**			
Pn476	Setting Range	Setting Unit	Default Setting	When Enabled
	-1000 to 1000	0.1%	0	Immediately

(2) Operating Procedure for Gravity Compensation

Use the following procedure to perform gravity compensation.

1. **Set Pn475 to n.□□□1 (enable gravity compensation).**
2. **To enable changes to the settings, turn the power to the SERVOPACK OFF and ON again.**
3. **Use SigmaWin+ or an analog monitor to find the torque reference value when the motor is stopped with the servo ON.**
4. **Set the torque reference value found in step 3 in Pn476 (Gravity Compensation Torque).**
5. **Turn the servo ON and OFF a few times and fine-tune Pn476 so that the moving part of the machine does not fall.**

8.14.4 Output Torque Compensation

Output torque compensation is used to compensate the offset from the torque reference for output torque.

Output torque may become offset from the reference value due to motor temperature and load status, and this offset can be reduced with compensation.

This function is enabled by default. To disable this function, set Pn428 to n.□□□0 (disable output torque compensation).

		Output Torque Compensation Function Selection Speed Pos Trq		When Enabled
Pn428	n.□□□X	0	Disable output torque compensation.	After restart
		1 Default	Enable output torque compensation.	

8.14.5 Current Control Mode Selection

Current control mode selection reduces noise while the servomotor is being stopped and during high-speed rotation.

To use this function, set Pn009 to n.□□2□ (current control mode 2), Pn009 to n.□□3□ (current control mode 3), or Pn009 to n.□□4□ (current control mode 4).

		Current Control Mode Selection Speed Pos Trq		When Enabled
Pn009	n.□□X□	0	Use current control mode 1.	After restart
		1	• SERVOPACK Models SGDXS-R70A, -R90A, -1R6A, -2R8A, - 3R8A, -5R5A, -7R6A: Use current control mode 1. • SERVOPACK Models SGDXS-120A, -180A, -200A, -330A, -470A, -550A, -590A, -780A: Use current control mode 2. (For noise reduction when the motor is stopped)	
		2	Use current control mode 2. (For noise reduction when the motor is stopped)	
		3	Use current control mode 3. (For noise reduction when the motor is operating at high speed)	
		4 Default	Use current control mode 4. (For noise reduction when the motor is stopped and operating at high speed)	

8.14.6 Current Gain Level Setting

You can set the current gain level to reduce noise by adjusting the parameter for current control inside the SERVOPACK according to the setting of Pn100 (Speed Loop Gain). The noise level can be reduced by decreasing the setting of Pn13D (Current Gain Level) from its default setting of 2000% (disabled). However, if the setting is decreased, the level of noise will be lowered, but the response characteristic of the SERVOPACK will also be reduced. Adjust the current gain level within the range that maintains the SERVOPACK response characteristic.

This function is always disabled during Pn000 is set to n.□□2□ (torque control).

	Current Gain Level Speed Pos Trq			
Pn13D	Setting Range	Setting Unit	Default Setting	When Enabled
	100 to 2000	1%	2000	Immediately

Important

If the current gain level is changed, the response characteristic of the speed loop will also change. Servo tuning must therefore be performed again.

8.14.7 Speed Detection Method Selection

You can use the speed detection method selection to ensure smooth servomotor speed changes during operation. To ensure smooth motor speed changes during operation, set Pn009 to n.□1□□ (use speed detection 2).

With a linear servomotor, you can reduce the noise level of the running motor when the linear encoder scale pitch is large.

Pn009	n.□X□□	Speed Detection Method Selection	Speed Pos Trq	When Enabled
		0 Default	Use speed detection 1.	After restart
		1	Use speed detection 2.	

Important

If the speed detection method is changed, the response characteristic of the speed loop will also change. Servo tuning must therefore be performed again.

8.14.8 Speed Feedback Filter

You can set a first order lag filter for the speed feedback in the speed loop. This ensures smooth changes in the feedback speed to reduce vibration. If a large value is set, it will increase the delay and make response slower.

Pn308	Speed Feedback Filter Time Constant			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.01 ms	0	Immediately

8.14.9 P Control

You can input the /P-CON (Proportional Control Input) signal from the host controller to select P control.

The speed control section uses proportional-integral control (PI control) if the reference remains at zero during speed control. The integral effect may cause the servomotor to move. To prevent that, you can change from PI control to P control.

P control is set using Pn000 = n.□□X□ and the /P-CON signal.

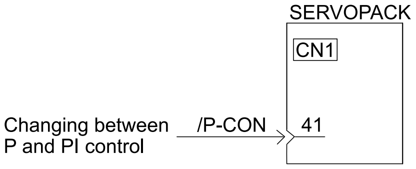
However, if Pn000 is set to n.□□A□ (switching between speed control with analog references and speed control with zero clamping), a position loop will be formed. Therefore, there is no need to use this function. P control is used while the P-CON signal is ON.

(1) P-CON (Proportional Control Input) Signal

The /P-CON signal is used to switch between P control and PI control.

Type	Signal	Connector Pin No.	Setting	Meaning
Input	/P-CON	CN1-41 (default setting)	ON (closed)	Changes to P control.
			OFF (open)	Changes to PI control.

Information When Using the Default Input Signal Allocations



(2) Control Methods and P Control Input Signals

Changing to P control is enabled when the control method is set to speed control or position control.

Parameter	Control Method Selection	Description	Changing to P Control
Pn000	n.□□0□ (default setting)	Speed control with analog references	You can change to P control with the default setting (CN1-41 = /P-CON) You can also allocate the /P-CON signal to another connector pin.
	n.□□1□	Position control with pulse train references	
	n.□□2□	Torque control with analog references	You cannot change to P control.
	n.□□3□	Internal set speed control with contact commands	You must allocate the /P-CON signal to CN1-40 to CN1-46.
	n.□□4□	Switching between internal set speed control with contact references and speed control with analog references	
	n.□□5□	Switching between internal set speed control with contact references and position control with pulse train references	
	n.□□6□	Switching between internal set speed control with contact references and torque control with analog references	
	n.□□7□	Switching between position control with pulse train references and speed control with analog references	
	n.□□8□	Switching between position control with pulse train references and torque control with analog references	
	n.□□9□	Switching between torque control with analog references and speed control with analog references	
	n.□□A□	Switching between speed control with analog references and speed control with zero clamping	
	n.□□B□	Switching between position control with pulse train references and position control with reference pulse inhibition	

Note:

Refer to the following section for information on switching signal of the control method.

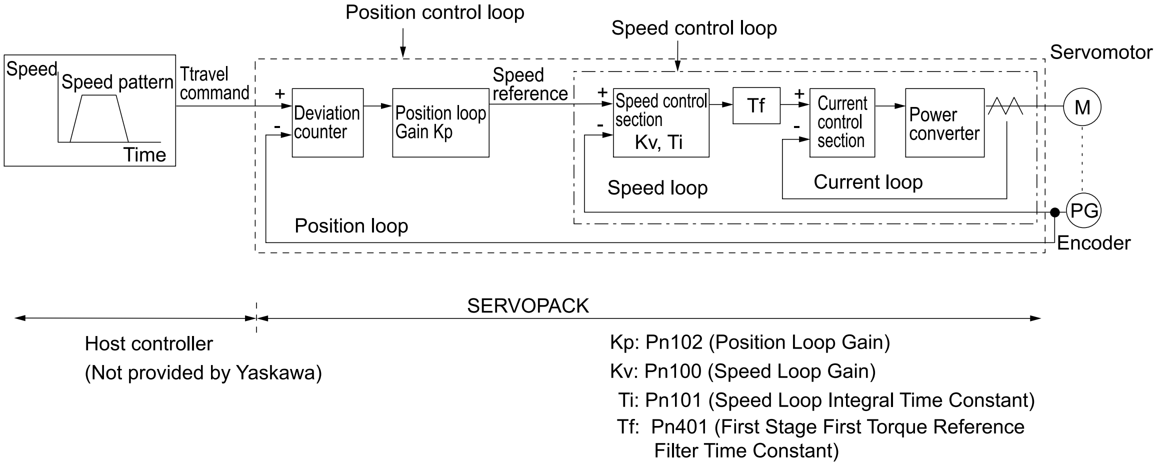
☞ *6.10 Selecting Combined Control Methods on page 275*

8.15 Manual Tuning

This section describes manual tuning.

8.15.1 Tuning the Servo Gains

(1) Servo Gains



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

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

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

(2) Outline

You can use manual tuning to set the servo gains in the SERVOPACK to increase the response characteristic of the SERVOPACK. For example, you can reduce the positioning time for position control.

Use manual tuning in the following cases.

- When tuning with autotuning without a host reference or autotuning with a host reference does not achieve the desired results
- When you want to increase the servo gains higher than the gains that resulted from autotuning without a host reference or autotuning with a host reference
- When you want to determine the servo gains and moment of inertia ratio yourself

You start manual tuning either from the default parameter settings or from the gain settings that resulted from autotuning without a host reference or autotuning with a host reference.

(3) Applicable Tools

You can monitor the servo gains with the SigmaWin+ or with the analog monitor.

(4) Precautions

Vibration may occur while you are tuning the servo gains. We recommend that you set Pn310 to n.□□□2 (output an alarm (A.520) if vibration is detected). Refer to the following section for information on vibration detection.

☞ *6.15 Vibration Detection Level Initialization on page 314*

Vibration alarms are not detected for all vibration. Also, an emergency stop method is necessary to stop the machine safely when an alarm occurs. You must provide an emergency stop device and activate it immediately whenever vibration occurs.

(5) Tuning Procedure Example (for Position Control or Speed Control)

Step	Description
1	Adjust the setting of Pn401 (First Stage First Torque Reference Filter Time Constant) so that vibration does not occur.
2	Increase the setting of Pn100 (Speed Loop Gain) and reduce the setting of Pn101 (Speed Loop Integral Time Constant) as far as possible within the range that does not cause machine vibration.
3	Repeat steps 1 and 2 and return the settings about 10% to 20% from the values that you set.
4	For position control, increase the setting of Pn102 (Position Loop Gain) 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.

(6) Adjusted Servo Gains

You can set the following gains to adjust the response characteristic of the SERVOPACK.

Parameter No.	Name	Reference
Pn100	Speed Loop Gain	☞ *(b) Speed Loop Gain on page 480*
Pn101	Speed Loop Integral Time Constant	☞ *(c) Speed Loop Integral Time Constant on page 480*
Pn102	Position Loop Gain	☞ *(a) Position Loop Gain on page 479*
Pn401	First Stage First Torque Reference Filter Time Constant	☞ *(d) Torque Reference Filter on page 480*

(a) 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.

<table>
<tr><td rowspan="3">Pn102</td><td colspan="4">Position Loop Gain   Speed Pos Trq</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Default Setting</td><td>When Enabled</td></tr>
<tr><td>10 to 20000</td><td>0.1/s</td><td>400</td><td>Immediately</td></tr>
</table>

Information For machines for which Pn102 (Position Loop Gain) cannot be set to a high value, the A.d00 alarm (Position Deviation Overflow) 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 condition as a guideline for determining the setting.

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

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

Pn520	Position Deviation Overflow Alarm Level			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 1073741823	1 reference unit	6116694	Immediately

(b) Speed Loop Gain

This parameter determines the response characteristic of the speed loop. If the response characteristic of the speed loop is low, it becomes a delay factor for the position loop located outside of the speed loop. This will result in overshooting and vibration in the speed reference. Therefore, setting the speed loop gain as high as possible within the range that will not cause the machine system to vibrate will produce a stable servo system with a good response characteristic.

Pn100	Speed Loop Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 20000	0.1 Hz	400	Immediately

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

The default setting of Pn103 (Moment of Inertia Ratio) is 100. Before you tune the servo, calculate the moment of inertia ratio with the above formula and set Pn103 to the calculation result.

Pn103	Moment of Inertia Ratio			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	1%	100	Immediately

(c) Speed Loop Integral Time Constant

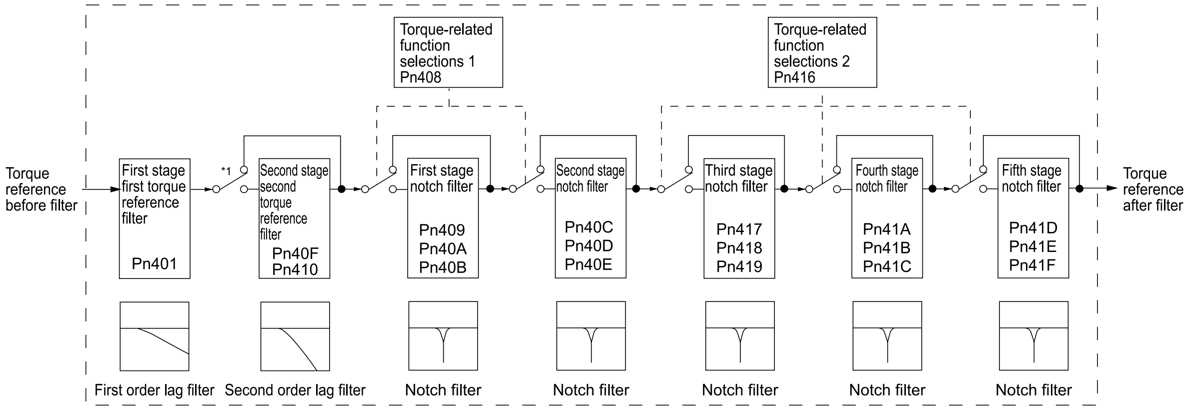
To enable response to even small inputs, the speed loop has an integral element. The integral element becomes a delay factor in the servo system. If the time constant is set too high, overshooting will occur, positioning settling time will increase, and the response characteristic will suffer.

Pn101	Speed Loop Integral Time Constant			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	15 to 51200	0.01 ms	2000	Immediately

(d) Torque Reference Filter

As shown in the following diagram, the torque reference filter contains a first order lag filter and notch filters arranged in series, and each filter operates independently.

The notch filters can be enabled and disabled with Pn408 = n.□X□X and Pn416 = n.□XXX.



*1 The second stage second torque reference filter is disabled when Pn40F is set to 5000 (default setting) and it is enabled when Pn40F is set to a value lower than 5000.

◆ Torque Reference Filter

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

Pn401	First Stage First Torque Reference Filter Time Constant			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.01 ms	100	Immediately
Pn40F	Second Stage Second Torque Reference Filter Frequency			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	100 to 5000	1 Hz	5000	Immediately
Pn410	Second Stage Second Torque Reference Filter Q Value			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	50 to 100	0.01	50	Immediately

Note:

The filter is disabled if you set Pn40F to 5000.

◆ 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.

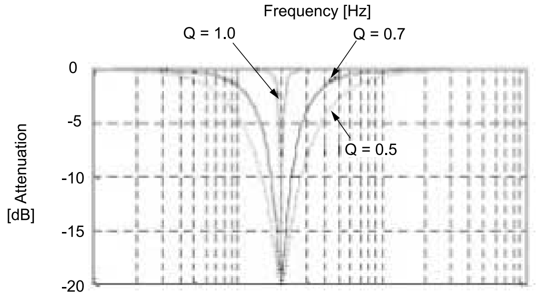
The notch filter puts a notch in the gain curve at the specific vibration frequency (called the notch frequency). The frequency components near the notch frequency can be reduced or removed with a notch filter.

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 frequencies (width of the notch) changes with the notch filter Q value. The larger the notch filter Q value is, the narrower the width of frequencies that are filtered is (the steeper the notch is).

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



Note:

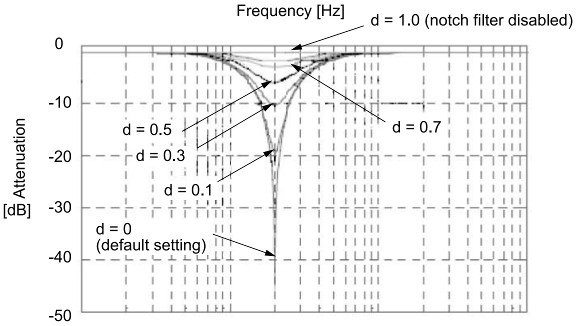
The above notch filter frequency characteristics are based on calculated values and may be different from actual characteristics.

◆ Notch Filter Depth

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

The notch filter is disabled if the notch filter depth, d, is set to 1.0 (i.e., if Pn419 is set to 1000).

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



Note:

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

You can enable or disable the notch filter with Pn408 and Pn416.

Pn408	n.□□□X	Notch Filter Selection 1	Speed Pos Trq	When Enabled
		0 Default	Disable first stage notch filter.	Immediately
		1	Enable first stage notch filter.	
Pn408	n.□X□□	Notch Filter Selection 2	Speed Pos Trq	When Enabled
		0 Default	Disable second stage notch filter.	Immediately
		1	Enable second stage notch filter.	
Pn416	n.□□□X	Notch Filter Selection 3	Speed Pos Trq	When Enabled
		0 Default	Disable third stage notch filter.	Immediately
		1	Enable third stage notch filter.	
Pn416	n.□□X□	Notch Filter Selection 4	Speed Pos Trq	When Enabled
		0 Default	Disable fourth stage notch filter.	Immediately
		1	Enable fourth stage notch filter.	
Pn416	n.□X□□	Notch Filter Selection 5	Speed Pos Trq	When Enabled
		0 Default	Disable fifth stage notch filter.	Immediately
		1	Enable fifth stage notch filter.	

Set the machine vibration frequencies in the notch filter parameters.

Pn409	First Stage Notch Filter Frequency			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 5000	1 Hz	5000	Immediately

Pn40A	First Stage Notch Filter Q Value			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	50 to 1000	0.01	70	Immediately

Pn40B	First Stage Notch Filter Depth			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 1000	0.001	0	Immediately

Pn40C	Second Stage Notch Filter Frequency			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 5000	1 Hz	5000	Immediately

Pn40D	Second Stage Notch Filter Q Value			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	50 to 1000	0.01	70	Immediately

Pn40E	Second Stage Notch Filter Depth			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 1000	0.001	0	Immediately

Pn417	Third Stage Notch Filter Frequency			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 5000	1 Hz	5000	Immediately

Pn418	Third Stage Notch Filter Q Value			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	50 to 1000	0.01	70	Immediately

Pn419	Third Stage Notch Filter Depth			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 1000	0.001	0	Immediately

Pn41A	Fourth Stage Notch Filter Frequency			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 5000	1 Hz	5000	Immediately

Pn41B	Fourth Stage Notch Filter Q Value			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	50 to 1000	0.01	70	Immediately

Pn41C	Fourth Stage Notch Filter Depth			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 1000	0.001	0	Immediately

Pn41D	Fifth Stage Notch Filter Frequency			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 5000	1 Hz	5000	Immediately

Pn41E	Fifth Stage Notch Filter Q Value			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	50 to 1000	0.01	70	Immediately

Continued on next page.

Continued from previous page.

Pn41F	Fifth Stage Notch Filter Depth			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 1000	0.001	0	Immediately

Important

- Do not set Pn409, Pn40C, Pn417, Pn41A, and Pn41D (notch filter frequencies) that are close to the speed loop's response frequency. Set a frequency that is at least four times the setting of Pn100 (Speed Loop Gain). (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 settings of Pn409, Pn40C, Pn417, Pn41A, and Pn41D (notch filter frequencies) only while the servomotor is stopped. Vibration may occur if a notch filter frequency is changed during operation.

(7) Guidelines for Manually Tuning Servo Gains

When you manually adjust the parameters, make sure that you completely understand the information in the product manual and use the following conditional expressions as guidelines. The appropriate values of the parameter settings are influenced by the machine specifications, so they cannot be determined universally. When you adjust the parameters, actually operate the machine and use the SigmaWin+ or analog monitor to monitor operating conditions. Even if the status is stable while the motor is stopped, an unstable condition may occur when an operation reference is input. Therefore, input operation references and adjust the servo gains as you operate the servomotor.

Adjustment Value for Manual Tuning	Description
Stable Value	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 Value	Settings for which the parameters affect each other Depending on the machine conditions, overshooting and vibration may occur and operation may not be stable. If the critical gain condition expressions are not met, operation will become more unstable, and there is a risk of abnormal motor shaft vibration and round-trip operation with a large amplitude. Always stay within the critical gain conditions. If you use the torque reference filter, second torque reference filter, and notch filters together, the interference between the filters and the speed loop gain will be superimposed. Allow leeway in the adjustments.

Important

The following adjusted value guidelines require that the setting of Pn103 (Moment of Inertia Ratio) is correctly set for the actual machine.

Term

P control :

Proportional control.

PI control :

Proportional - integral control.

I-P control :

Proportional - integral control in which the proportional operation works for the controlled variable only and the integral operation works for the control deviation only.

Information

Selecting the Speed Loop Control Method (PI Control or I-P Control)

Usually, I-P control is effective for high-speed positioning and high-speed, high-precision processing applications. With I-P control, you can use a lower position loop gain than for PI control to reduce the positioning time and reduce arc radius reduction. However, if you can use mode switching to change to proportional control to achieve the desired application, then using PI control would be the normal choice.

(a) When Pn10B = n.□□0□ (PI Control)

Guidelines are given below for gain 1.

The same guidelines apply to gain 2 (Pn104, Pn105, Pn106, and Pn412).

- Pn100 (Speed Loop Gain) [Hz] and Pn102 (Position Loop Gain) [/s]
  Stable gain: Pn102 [/s] ≤ 2π × Pn100/4 [Hz]
  Critical gain: Pn102 [/s] < 2π × Pn100 [Hz]
- Pn100 (Speed Loop Gain) [Hz] and Pn101 (Speed Loop Integral Time Constant) [ms]
  Stable gain: Pn101 [ms] ≥ 4000/(2π × Pn100 [Hz])
  Critical gain: Pn101 [ms] > 1000/(2π × Pn100 [Hz])
- Pn100 (Speed Loop Gain) [Hz] and Pn401 (First Stage First Torque Reference Filter Time Constant) [ms]
  Stable gain: Pn401 [ms] ≤ 1000/(2π × Pn100 [Hz] × 4)
  Critical gain: Pn401 [ms] < 1000/(2π × Pn100 [Hz] × 1)
- Pn100 (Speed Loop Gain) [Hz] and Pn40F (Second Stage Second Torque Reference Filter Frequency) [Hz]
  Critical gain: Pn40F [Hz] > 4 × Pn100 [Hz]

  Note:

  Set Pn410 (Second Stage Second Torque Reference Filter Q Value) to 0.70.
- Pn100 (Speed Loop Gain) [Hz] and Pn409 (First Stage Notch Filter Frequency) [Hz] (or Pn40C (Second Stage Notch Filter Frequency) [Hz])
  Critical gain: Pn409 [Hz] > 4 × Pn100 [Hz]
- Pn100 (Speed Loop Gain) [Hz] and Pn308 (Speed Feedback Filter Time Constant) [ms]
  Stable gain: Pn308 [ms] ≤ 1000/(2π × Pn100 [Hz] × 4)
  Critical gain: Pn308 [ms] < 1000/(2π × Pn100 [Hz] × 1)

(b) When Pn10B = n.□□1□ (I-P Control)

Guidelines are given below for gain 1.

The same guidelines apply to gain 2 (Pn104, Pn105, Pn106, and Pn412).

For I-P control, the relationships between the speed loop integral time constant, speed loop gain, and position loop gain are different from the relationships for PI control. The relationship between other servo gains is the same as for PI control.

- Pn100 (Speed Loop Gain) [Hz] and Pn101 (Speed Loop Integral Time Constant) [ms]
  Stable gain: Pn100 [Hz] ≥ 320/Pn101 [ms]
- Pn102 (Position Loop Gain) [/s] and Pn101 (Speed Loop Integral Time Constant) [ms]
  Stable gain: Pn102 [/s] ≤ 320/Pn101 [ms]

(c) Decimal Points in Parameter Settings

For the SERVOPACKs, decimal places are given for the settings of parameters on the digital operator, panel operator, and in the manual. For example with Pn100 (Speed Loop Gain), Pn100 = 40.0 is used to indicate a setting of 40.0 Hz. In the following adjusted value guidelines, the decimal places are also given.

Information Pn100 (Speed Loop Gain) [Hz] and Pn101 (Speed Loop Integral Time Constant) [ms]

Stable gain: Pn101 [ms] ≥ 4000/(2π × Pn100 [Hz])

If Pn100 = 40.0 [Hz], then Pn101 = 4000/(2π × 40.0) ≈ 15.92 [ms].

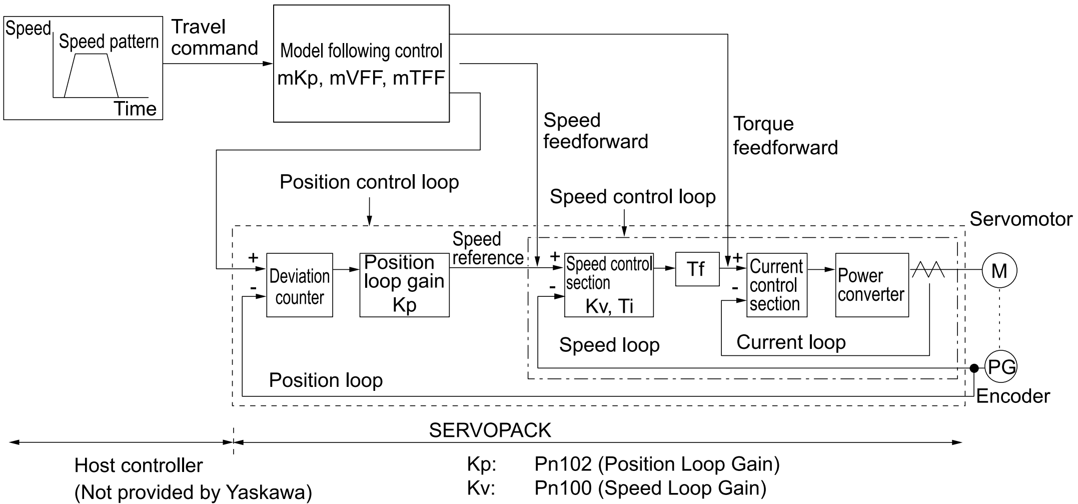
(8) Model Following Control

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

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

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

The block diagram for model following control is provided below.



Kp: Pn102 (Position Loop Gain)
Kv: Pn100 (Speed Loop Gain)
Ti: Pn101 (Speed Loop Integral Time Constant)
Tf: Pn401 (First Stage First Torque Reference Filter Time Constant)
mKp: Pn141 (Model Following Control Gain)
mTFF: Pn143 (Model Following Control Bias in the Forward Direction)
Pn144 (Model Following Control Bias in the Reverse Direction)
mVFF: Pn147 (Model Following Control Speed Feedforward Compensation)

(a) Manual Tuning Procedure

Use the following tuning procedure for using model following control.

Step	Description
1	Friction compensation must also be used. Set the friction compensation parameters. Refer to the following section for the setting procedure. ☞ *8.14.2 Friction Compensation on page 472*
2	Adjust the servo gains. Refer to the following section for an example procedure. ☞ *(5) Tuning Procedure Example (for Position Control or Speed Control) on page 479* **Note:** 1. Set Pn103 (Moment of Inertia Ratio) as accurately as possible. 2. Refer to the guidelines for manually tuning the servo gains and set a stable value to Pn102 (Position Loop Gain). ☞ *(7) Guidelines for Manually Tuning Servo Gains on page 484*
3	Increase the setting of Pn141 (Model Following Control Gain) as much as possible within the range in which overshooting and vibration do not occur.
4	If overshooting occurs or if the response is different for forward and reverse operation, fine-tune model following control with the following settings: Pn143 (Model Following Control Bias in the Forward Direction), Pn144 (Model Following Control Bias in the Reverse Direction), and Pn147 (Model Following Control Speed Feedforward Compensation).

(b) 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 = n.□□2□. When you also perform vibration suppression, adjust vibration suppression with custom tuning in advance.

Note:

If you set Pn140 to n.□□1□ or n.□□2□ (use vibration suppression), always set Pn140 to n.□□□1 (use model following control).

Pn140	n.□□□X	Model Following Control Selection	Speed Pos Trq	When Enabled
		0 Default	Do not use model following control.	Immediately
		1	Use model following control.	
Pn140	n.□□X□	Vibration Suppression Selection	Speed Pos Trq	When Enabled
		0 Default	Do not perform vibration suppression.	Immediately
		1	Perform vibration suppression for a specific frequency.	
		2	Perform vibration suppression for two specific frequencies.	

◆ Model Following Control Gain

The model following control gain determines the response characteristic of the servo system. If you increase the setting of the model following control gain, the response characteristic will improve and the positioning time will be shortened. The response characteristic of the servo system is determined by this parameter, and not by Pn102 (Position Loop Gain).

Pn141	Model Following Control Gain			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 20000	0.1/s	500	Immediately

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.

$$\text{Pn520} \geq \frac{\text{Maximum feed speed [reference units/s]}}{\text{Pn141/10 [1/s]}} \times 2.0$$

Pn520	Position Deviation Overflow Alarm Level			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 1073741823	1 reference unit	6116694	Immediately

◆ 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			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	0.1%	1000	Immediately
Pn144	Model Following Control Bias in the Reverse Direction			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	0.1%	1000	Immediately

◆ Model Following Control Speed Feedforward Compensation

If overshooting occurs even after you adjust the model following control gain, model following control bias in the forward direction, and model following control bias in the reverse direction, you may be able to improve performance by setting the following parameter.

If you decrease the settings, the response characteristic will be lowered but overshooting will be less likely to occur.

Pn147	Model Following Control Speed Feedforward Compensation			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	0.1%	1000	Immediately

◆ Model Following Control Type Selection

When you enable model following control, you can select the model following control type. Normally, set Pn14F to n.□□□0 (use overshoot control type for model following control.model) (default setting). To further increase responsiveness, set Pn14F to n.□□□1 (response emphasis type for model following control).

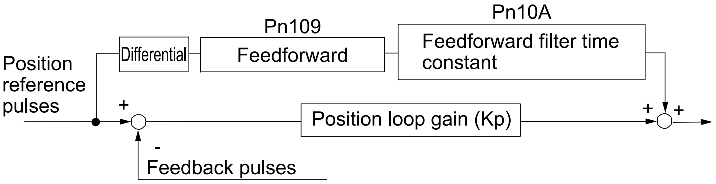
Pn14F	n.□□□X	Model Following Control Type Selection	Speed Pos Trq	When Enabled
		0 Default	Use overshoot control type for model following control.	After restart
		1	Use response emphasis type for model following control.	

8.15.2 Compatible Adjustment Functions

The compatible adjustment functions are used together with manual tuning. You can use these functions to improve adjustment results. These functions allow you to use the same functions as for Σ-III-series SERVOPACKs to adjust Σ-X-series SERVOPACKs.

(1) Feedforward

The feedforward function applies feedforward compensation to position control to shorten the positioning time.



Pn109	Feedforward			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 100	1%	0	Immediately
Pn10A	Feedforward Filter Time Constant			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 6400	0.01 ms	0	Immediately

Note:

If you set the feedforward value too high, the machine may vibrate. As a guideline, use a setting of 80% or less.

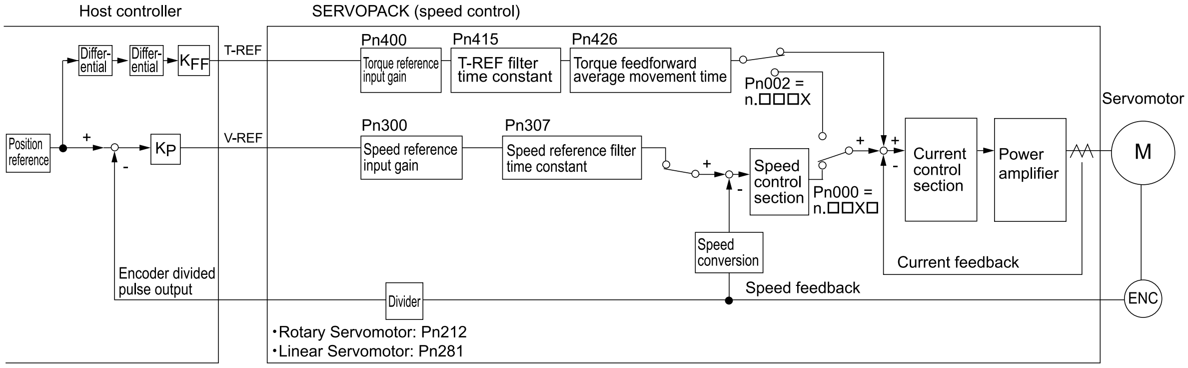
(2) Torque Feedforward and Speed Feedforward

You can use the torque feedforward and speed feedforward functions to help shorten the positioning time. The reference is created from the differential of the position reference at the host controller.

Function	Description
Torque Feedforward	This is effective for speed control or position control. It is sent from the host controller along with the speed reference. Connect the speed reference from the host controller to the V-REF (CN1-5 and CN1-6) signal and the torque feedforward reference from the host controller to the T-REF (CN1-9 and CN1-10) signal.
Speed Feedforward	This is effective only for position control. It is sent to the SERVOPACK from the host controller along with the position reference. Connect the position reference from the host controller to the PULS and SIGN (CN1-7, CN1 -8, CN1-11, and CN1-12) signals and the speed feedforward reference from the host controller to the V-REF (CN1-5 and CN1-6) signal.

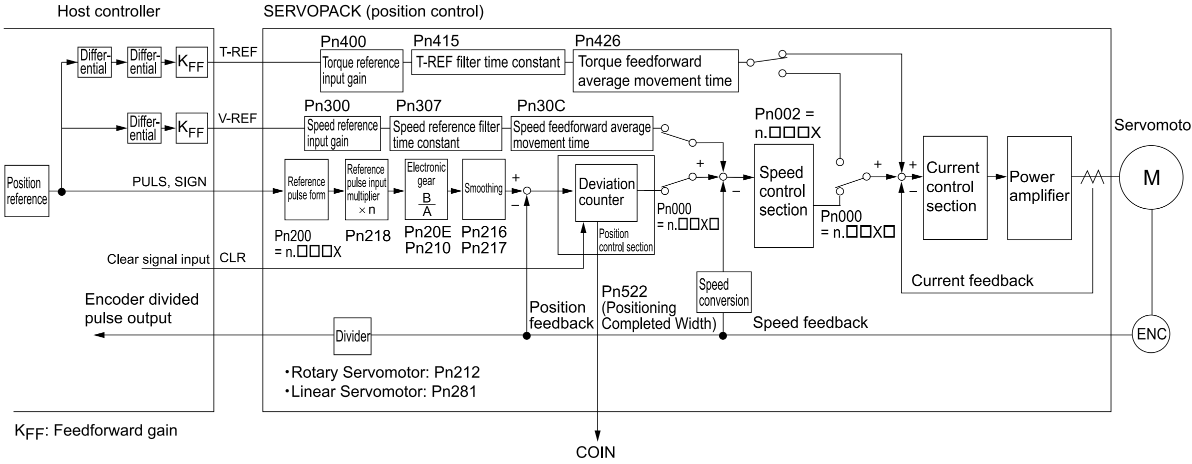
(a) Examples of Connections to Host Controllers

◆ When SERVOPACK Performs Speed Control



Kp: Position loop gain
KFF: Feedforward gain

◆ When SERVOPACK Performs Position Control



KFF: Feedforward gain

(b) Related Parameters

◆ Torque Feedforward

Torque feedforward is set with Pn002 = n.□□□X (T-REF allocation), Pn400 (Torque Reference Input Gain), and Pn415 (T-REF Filter Time Constant).

The default setting of Pn400 is 30. Therefore, if the torque feedforward value is ±3 V, then the torque is limited to ±100% of the rated torque.

Pn002	n.□□□X	Speed/Position Control Option (T-REF Input Allocation) Speed Pos Trq		When Enabled
		0 Default	Do not use T-REF.	After restart
		1	Use T-REF as an external torque limit input.	
		2	Use T-REF as a torque feedforward input.	
		3	Use T-REF as an external torque limit input when /P-CL or /N-CL is enabled.	

Pn400	Torque Reference Input Gain Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	10 to 100	0.1 V/ rated torque	30	Immediately
Pn415	T-REF Filter Time Constant Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.01 ms	0	Immediately

Continued on next page.

Continued from previous page.

Pn426	Torque Feedforward Average Movement Time Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 5100	0.1 ms	0	Immediately

Note:

- Overshooting will occur if you set the torque feedforward too high. Set the optimum value while monitoring the response.
- You cannot use the torque feedforward function together with torque limiting with an analog voltage reference.

◆ Speed Feedforward

You set the speed feedforward function with Pn207 = n.□□X□ (Position Control Option) and Pn300 (Speed Reference Input Gain).

The default setting of Pn300 is 600. Therefore, if the speed feedforward value is ±6 V, then it will indicate the rated speed.

Pn207	n.□□X□	Position Control Option Speed Pos Trq		When Enabled
		0 Default	Do not use V-REF.	After restart
		1	Use V-REF as a speed feedforward input.	

Pn300	Speed Reference Input Gain Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	150 to 3000	0.01 V/ Rated speed	600	Immediately
Pn307	Speed Reference Filter Time Constant Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 65535	0.01 ms	40	Immediately
Pn30C	Speed Feedforward Average Movement Time Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 5100	0.1 ms	0	Immediately

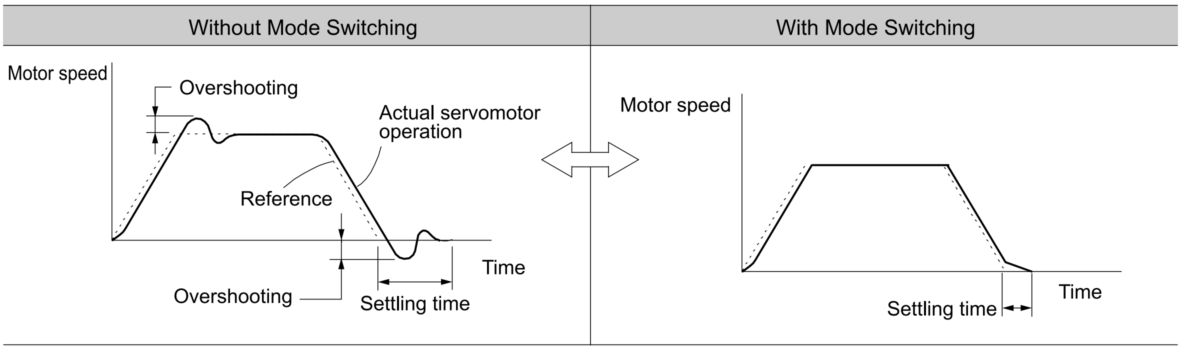
Note:

Overshooting will occur if you set the feedforward too high. Set the optimum value while monitoring the response.

(3) Mode Switching (Changing between P and PI Control)

You can use mode switching to automatically change between P 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.



(a) Related Parameters

Select the switching condition for mode switching with Pn10B = n.□□□X.

Parameter		**Mode Switching Selection**	**Parameter That Sets the Level**		**When Enabled**
			Rotary Servomotor	**Linear Servomotor**	
Pn10B	n.□□□0 (default setting)	Use the internal torque reference as the condition.	Pn10C		Immediately
	n.□□□1	Use the speed reference as the condition.	Pn10D	Pn181	
	n.□□□2	Use the acceleration as the condition.	Pn10E	Pn182	
	n.□□□3	Use the position deviation as the condition.	Pn10F		
	n.□□□4	Do not use mode switching.	–		

◆ Parameters That Set the Switching Levels

- Rotary Servomotors

Pn10C	Mode Switching Level for Torque Reference Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	200	Immediately
Pn10D	Mode Switching Level for Speed Reference Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 min^{-1}	0	Immediately
Pn10E	Mode Switching Level for Acceleration Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 30000	1 min^{-1}/s	0	Immediately
Pn10F	Mode Switching Level for Position Deviation Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 reference unit	0	Immediately

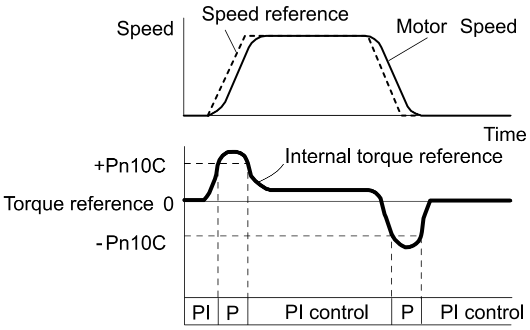
- Linear Servomotors

Pn10C	Mode Switching Level for Torque Reference Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 800	1%	200	Immediately
Pn181	Mode Switching Level for Speed Reference Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 mm/s	0	Immediately
Pn182	Mode Switching Level for Acceleration Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 30000	1 mm/s^2	0	Immediately
Pn10F	Mode Switching Level for Position Deviation Speed Pos Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	1 reference unit	0	Immediately

◆ Using the Internal Torque Reference as the Mode Switching Condition (Default Setting)

When the internal torque reference equals or exceeds the torque set for Pn10C (Mode Switching Level for Torque Reference), the speed loop is changed to P control.

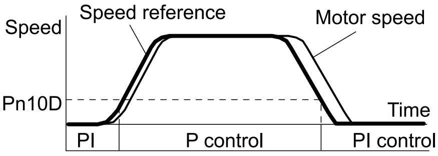
The default setting for the torque reference level is 200%.



◆ Using the Speed Reference as the Mode Switching Condition

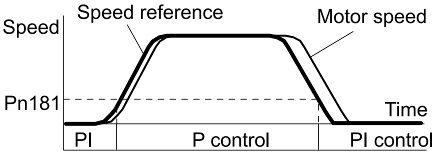
- Rotary Servomotors

  When the speed reference equals or exceeds the speed set for Pn10D (Mode Switching Level for Speed Reference), the speed loop is changed to P control.



- Linear Servomotors

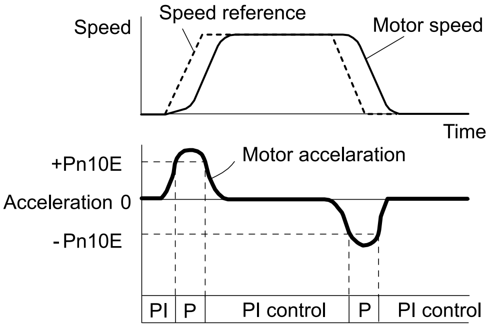
  When the speed reference equals or exceeds the speed set for Pn181 (Mode Switching Level for Speed Reference), the speed loop is changed to P control.



◆ Using the Acceleration as the Mode Switching Condition

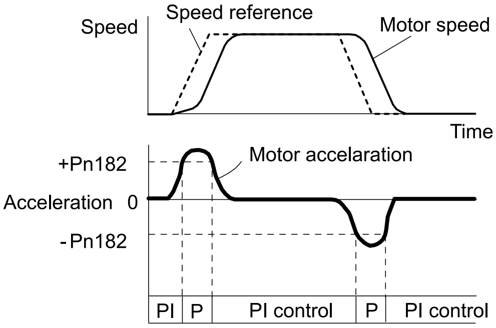
- Rotary Servomotors

  When the speed reference equals or exceeds the acceleration rate set for Pn10E (Mode Switching Level for Position Deviation), the speed loop is changed to P control.



- Linear Servomotors

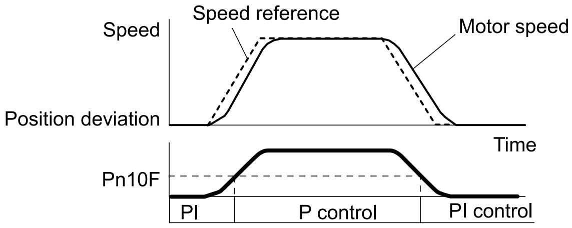
  When the speed reference equals or exceeds the acceleration rate set for Pn182 (Mode Switching Level for Acceleration), the speed loop is changed to P control.



◆ Using the Position Deviation as the Mode Switching Condition

When the position deviation equals or exceeds the value set for Pn10F (Mode Switching Level for Position Deviation), the speed loop is changed to P control.

This setting is enabled only for position control.



(4) Position Integral

The position integral is the integral function of the position loop. It is used for the electronic cams and electronic shafts when using the SERVOPACK with a Yaskawa MP3000-series machine controller.

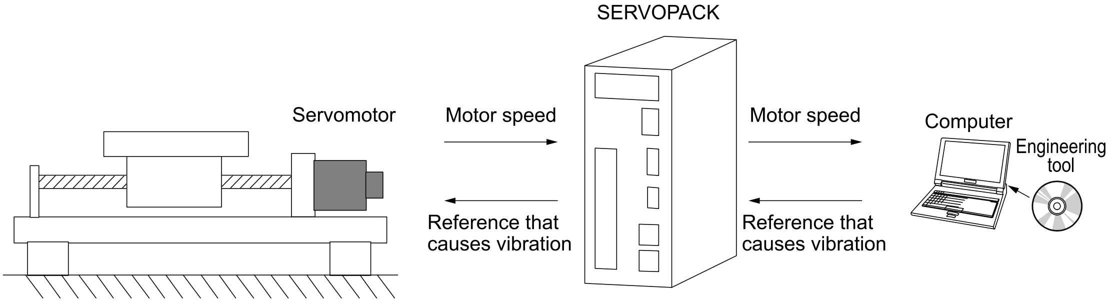
Pn11F	Position Integral Time Constant Speed **Pos** Trq			
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 50000	0.1 ms	0	Immediately

8.16 Diagnostic Tool

8.16.1 Mechanical Analysis

(1) Overview

You can connect the SERVOPACK to a computer to measure the frequency characteristics of the machine. This allows you to measure the frequency characteristics of the machine without using a measuring instrument.



The servomotor is used to cause machine vibration and then the speed frequency characteristics for the motor torque are measured. The measured frequency characteristics can be used to determine the machine resonance.

You determine the machine resonance for use in servo tuning and as reference for considering changes to the machine. The performance of the servo cannot be completely utilized depending on the rigidity of the machine. You may need to consider making changes to the machine. The information can also be used as reference for servo tuning to help you adjust parameters, such as the servo rigidity and torque filter time constant.

You can also use the information to set parameters, such as the notch filters.

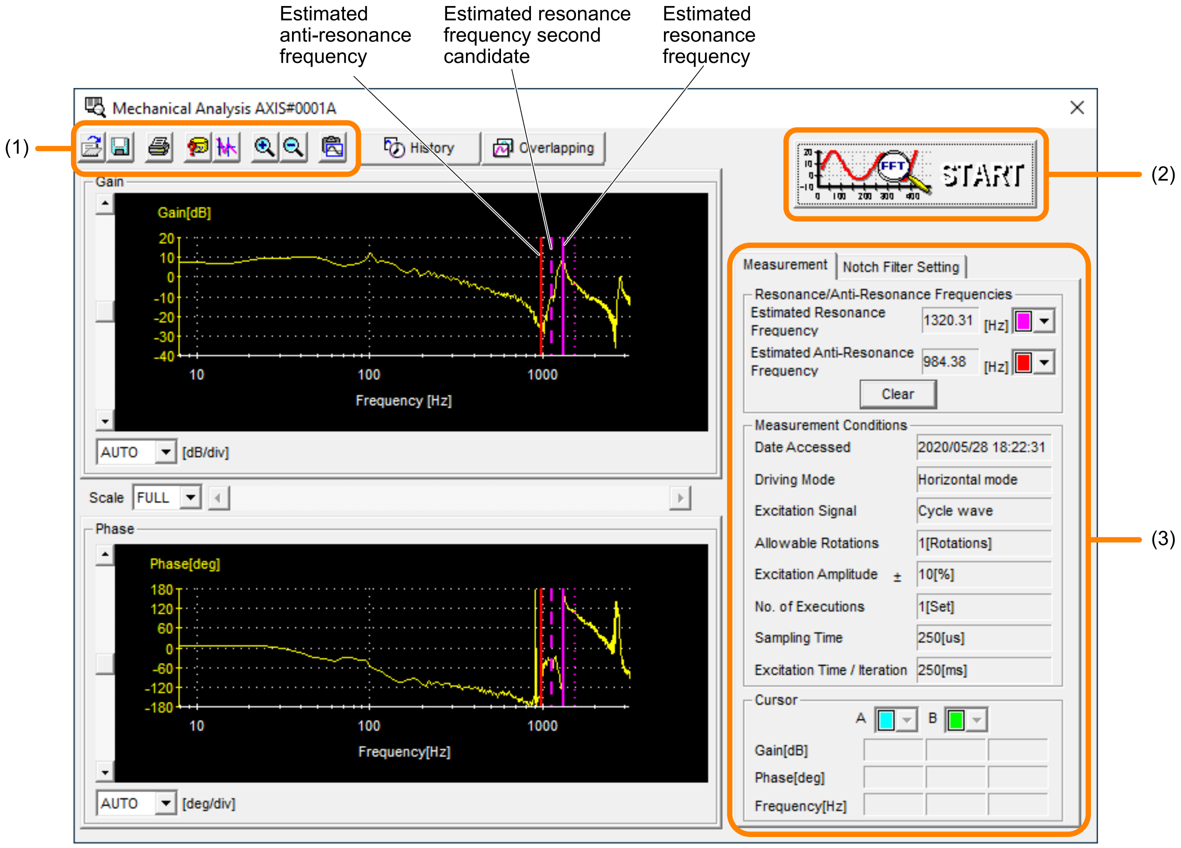
⚠ **WARNING**

Mechanical analysis is a measurement function that actually drives the machine and therefore presents hazards. Before you execute mechanical analysis, check the information provided in the SigmaWin+ operating manual.

(2) Frequency Characteristics

The motor is used to cause the machine to vibrate and the frequency characteristics from the torque to the motor speed are measured to determine the machine characteristics. For a normal machine, the resonance frequencies are clear when the frequency characteristics are plotted on graphs with the gain and phase (Bode plots). The Bode plots show the size (gain) of the response of the machine to which the torque is applied, and the phase delay (phase) in the response for each frequency. Also, the machine resonance frequency can be determined from the maximum frequency of the valleys (anti-resonance) and peaks (resonance) of the gain and the phase delay.

For a servomotor without a load or for a rigid mechanism, the gain and phase change gradually in the Bode plots.



Resonance/Anti-Resonance Frequencies

Estimated Resonance Frequency: 1320.31 [Hz]

Estimated Anti-Resonance Frequency: 984.38 [Hz]

Measurement Conditions

Date Accessed	2020/05/28 18:22:31
Driving Mode	Horizontal mode
Excitation Signal	Cycle wave
Allowable Rotations	1[Rotations]
Excitation Amplitude ±	10[%]
No. of Executions	1[Set]
Sampling Time	250[us]
Excitation Time / Iteration	250[ms]

No.	Item	Meaning
(1)	Toolbar	-
(2)	[START] button	Click the [START] button to start analysis.
(3)	[Measurement] tab and [Notch Filter Setting] tab	[Measurement] tab: Displays detailed information on the results of analysis. [Notch Filter Setting] tab: Displays the notch filter frequencies. You can set these values in the parameters.

8.16.2 Easy FFT

The machine is made to vibrate and a resonance frequency is detected from the generated vibration to set notch filters according to the detected resonance frequencies. This is used to eliminate high-frequency vibration and noise.

During execution of Easy FFT, a frequency waveform reference is sent from the SERVOPACK to the servomotor to automatically cause the shaft to rotate multiple times within 1/4th of a rotation, thus causing the machine to vibrate.

Execute this function after the servo is turned OFF if operation of the SERVOPACK results in high frequency noise and vibration.

⚠ WARNING

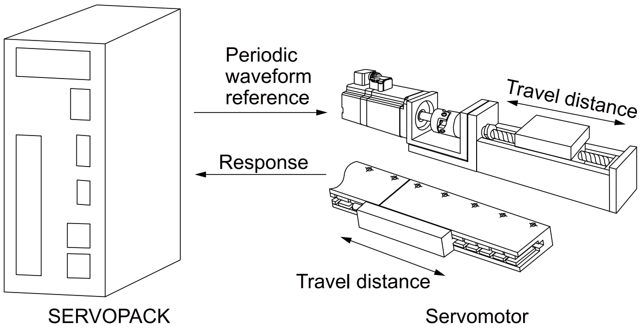
Never touch the servomotor or machine during execution of Easy FFT.

There is a risk of injury.

⚠ CAUTION

Use Easy FFT when the servo gain is low, such as in the initial stage of servo tuning.

If you execute Easy FFT after you increase the gain, the machine may vibrate depending on the machine characteristics or gain balance.



This function is built into the SERVOPACK for compatibility with previous products. Normally use autotuning without a host reference for tuning.

(1) Preparations

Always check the following before you execute Easy FFT.

- The parameters must not be write prohibited.
- The main circuit power must be ON.
- Pn00C must be set to n.□□□0 (Function Selection for Test without a Motor is disabled).
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- The servo must be OFF.
- There must be no overtravel.
- An external reference must not be input.

(2) Applicable Tools

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

Tool	Fn No./Function Name	Operating Procedure Reference
Panel Operator	Fn206	☞ *14.4.33 Easy FFT (Fn206) on page 662*
Digital Operator	Fn206	🕮 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Diagnostic] – [Easy FFT]	☞ *(3) Operating Procedure on page 496*

(3) Operating Procedure

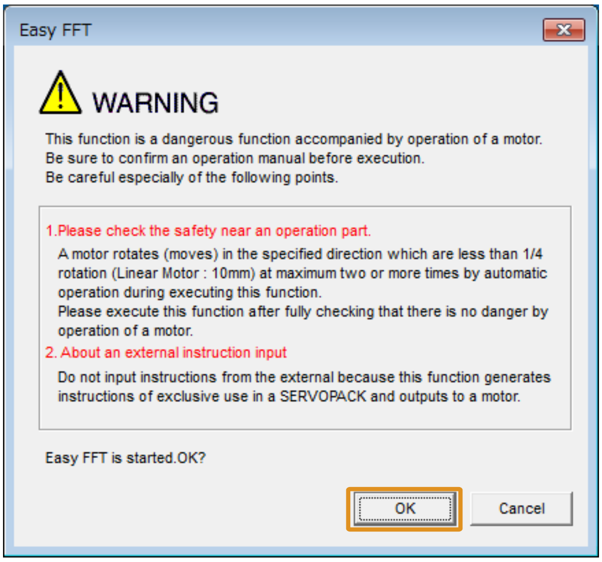
Use the following procedure for Easy FFT.

1. **Click the [] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Click [Easy FFT] in the [Menu] window.**

   The [Easy FFT] window will be displayed.

   Click the [Cancel] button to cancel Easy FFT. The Main Window will return.

3. **Click the [OK] button.**



Easy FFT

WARNING

This function is a dangerous function accompanied by operation of a motor.
Be sure to confirm an operation manual before execution.
Be careful especially of the following points.

1.Please check the safety near an operation part.

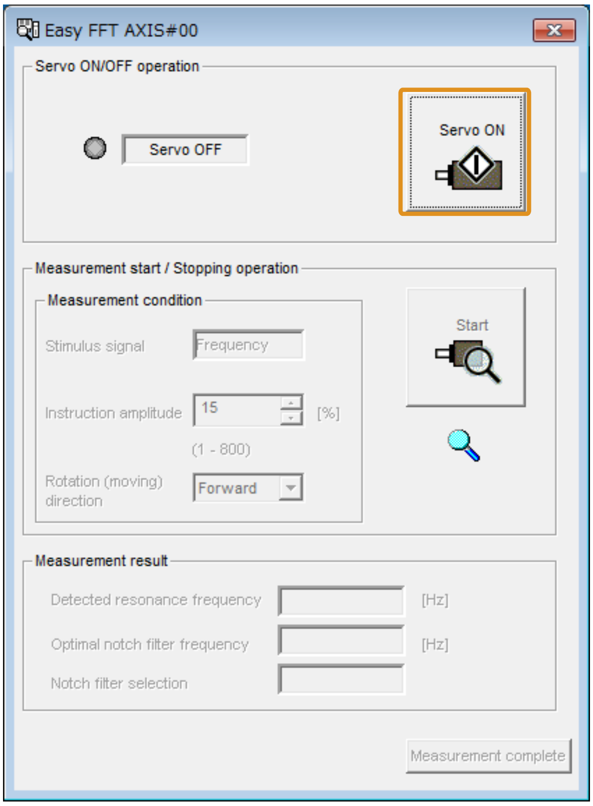
A motor rotates (moves) in the specified direction which are less than 1/4 rotation (Linear Motor : 10mm) at maximum two or more times by automatic operation during executing this function.
Please execute this function after fully checking that there is no danger by operation of a motor.

2. About an external instruction input

Do not input instructions from the external because this function generates instructions of exclusive use in a SERVOPACK and outputs to a motor.

Easy FFT is started.OK?

4. **Click the [Servo ON] button.**



Easy FFT AXIS#00

Stimulus signal: Frequency

Instruction amplitude: 15 [%] (1 - 800)

Rotation (moving) direction: Forward

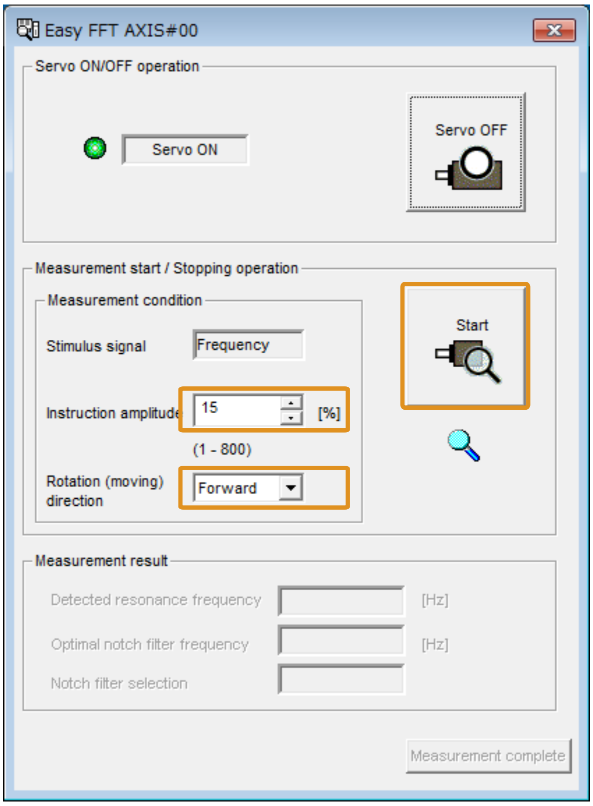
Detected resonance frequency [Hz]

Optimal notch filter frequency [Hz]

Notch filter selection

5. **Select [instruction amplitude] and [Rotation (moving) direction] in [Measurement condition], and then click the [Start] button.**

The servomotor shaft will rotate and measurements will start.



Servo ON

Stimulus signal: Frequency

Instruction amplitude: 15 [%]

(1 - 800)

Rotation (moving) direction: Forward

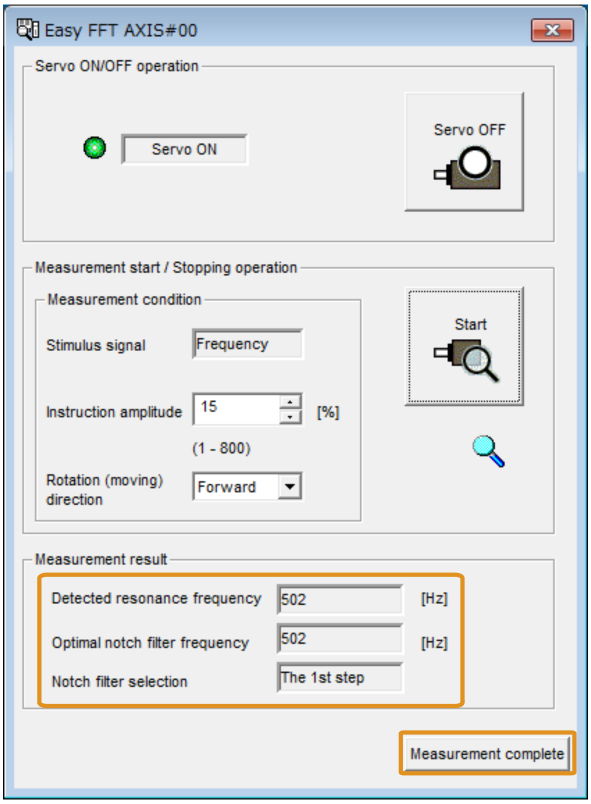
Detected resonance frequency: [Hz]

Optimal notch filter frequency: [Hz]

Notch filter selection:

When measurements have been completed, the measurement results will be displayed.

6. **Check the results in [Measurement result] and then click the [Measurement complete] button.**



Servo ON

Stimulus signal: Frequency

Instruction amplitude: 15 [%]

(1 - 800)

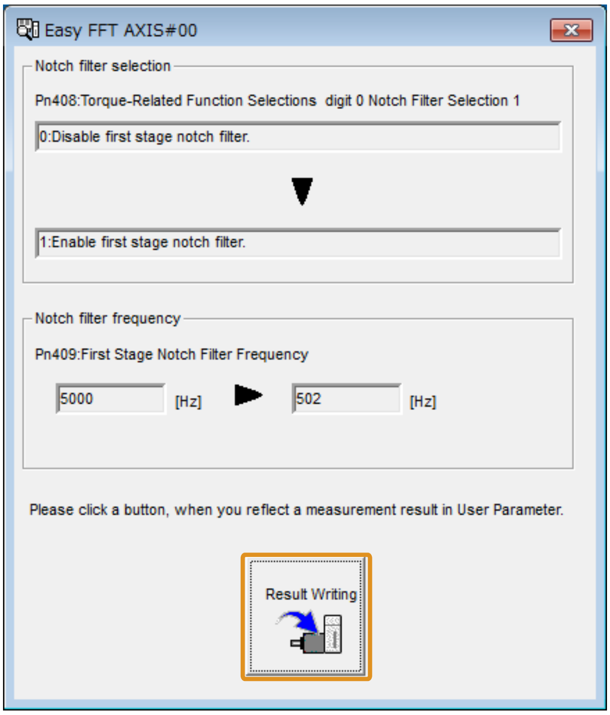
Rotation (moving) direction: Forward

Detected resonance frequency: 502 [Hz]

Optimal notch filter frequency: 502 [Hz]

Notch filter selection: The 1st step

7. **Click the [Result Writing] button if you want to set the measurement results in the parameters.**



Easy FFT AXIS#00

Notch filter selection

Pn408:Torque-Related Function Selections digit 0 Notch Filter Selection 1

0:Disable first stage notch filter.

1:Enable first stage notch filter.

Notch filter frequency

Pn409:First Stage Notch Filter Frequency

5000 [Hz] 502 [Hz]

Please click a button, when you reflect a measurement result in User Parameter.

This concludes the procedure to set up Easy FFT.

(4) Related Parameters

The following parameters are automatically adjusted or used as reference when you execute Easy FFT.

Do not change the settings of these parameters during execution of Easy FFT.

Parameter	Name	Automatic Changes
Pn408	Torque-Related Function Selections	Yes
Pn409	First Stage Notch Filter Frequency	Yes
Pn40A	First Stage Notch Filter Q Value	No
Pn40C	Second Stage Notch Filter Frequency	Yes
Pn40D	Second Stage Notch Filter Q Value	No
Pn456	Sweep Torque Reference Amplitude	No

Yes: The parameter is automatically set.

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

9

Monitoring

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

The items that you can monitor in the [Product Information] window of the SigmaWin+ are listed below.

Monitor Items	
Information on SERVOPACKs	• Model/Type • Serial Number • Manufacturing Date • Software version (SW Ver.) • Remarks
Information on Servomotors	• Model/Type • Serial Number • Manufacturing Date • Remarks
Information on Encoders	• Model/Type • Serial Number • Manufacturing Date • Software version (SW Ver.) • Remarks
Information on Option Modules	• Model/Type • Serial Number • Manufacturing Date • Software version (SW Ver.) • Remarks

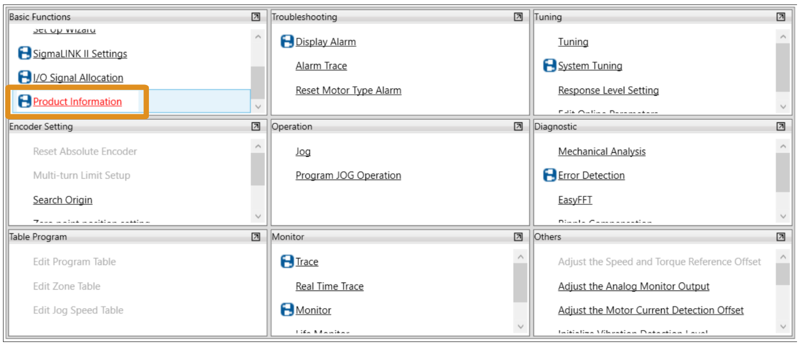
9.1.2 Operating Procedure

Use the following procedure to display the servo drive information.

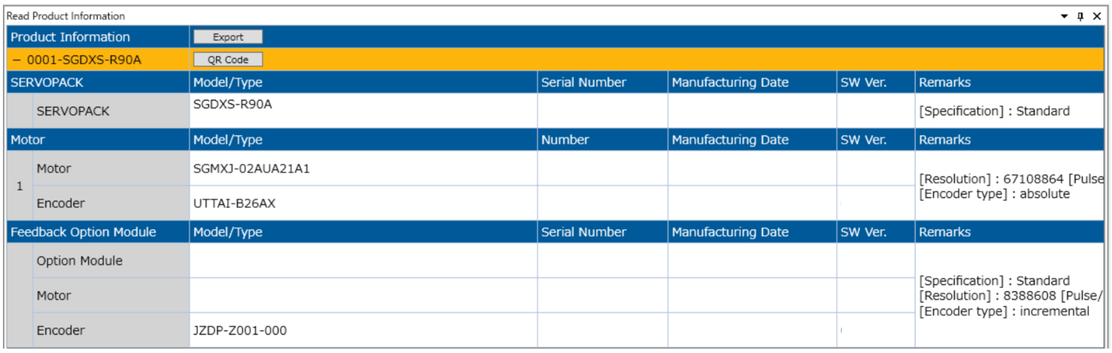
1. **Click the [▤] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

   The [Menu] window will be displayed.

2. **Click [Product Information] in the [Basic Functions] area.**



   The [Read Product Information] window will be displayed.



Product Information					
− 0001-SGDXS-R90A					
SERVOPACK	Model/Type	Serial Number	Manufacturing Date	SW Ver.	Remarks
SERVOPACK	SGDXS-R90A				[Specification] : Standard
Motor	Model/Type	Number	Manufacturing Date	SW Ver.	Remarks
1 Motor	SGMXJ-02AUA21A1				[Resolution] : 67108864 [Pulse [Encoder type] : absolute
Encoder	UTTAI-B26AX				
Feedback Option Module	Model/Type	Serial Number	Manufacturing Date	SW Ver.	Remarks
Option Module					[Specification] : Standard [Resolution] : 8388608 [Pulse/ [Encoder type] : incremental
Motor					
Encoder	JZDP-Z001-000				

Information

- With the panel operator, you can use Fn011 and Fn012 to monitor this information. Refer to the following sections for the differences in the monitor items compared with the SigmaWin+.
  ☞ *14.4.16 Display Servomotor Model (Fn011) on page 654*
  ☞ *14.4.17 Display Software Version (Fn012) on page 655*
- With the digital operator, you can use Fn011, Fn012, and Fn01E to monitor this information. Refer to the following manual for the differences in the monitor items compared with the SigmaWin+.

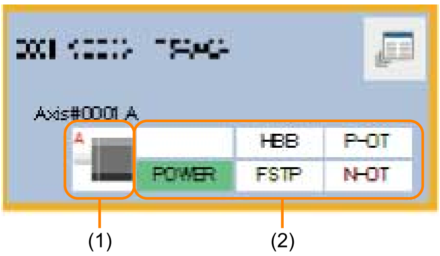
  📖 Σ-7-/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)

9.2 Monitoring SERVOPACK Status

9.2.1 Servo Drive Information

Use the following procedure to display the servo drive Information.

- Start the SigmaWin+. The servo drive status will be automatically displayed when you go online with a SERVOPACK.



Symbol	Description
(1)	The servomotor type is displayed.
(2)	The servo drive status is displayed.

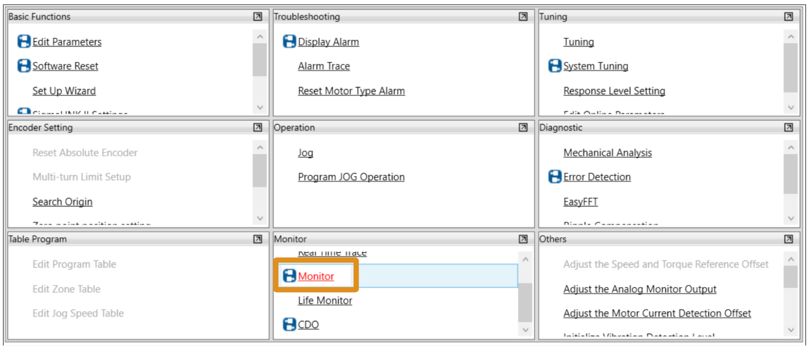
9.2.2 Operation Monitor, Status Monitor, and I/O Monitor

(1) Operating Procedure

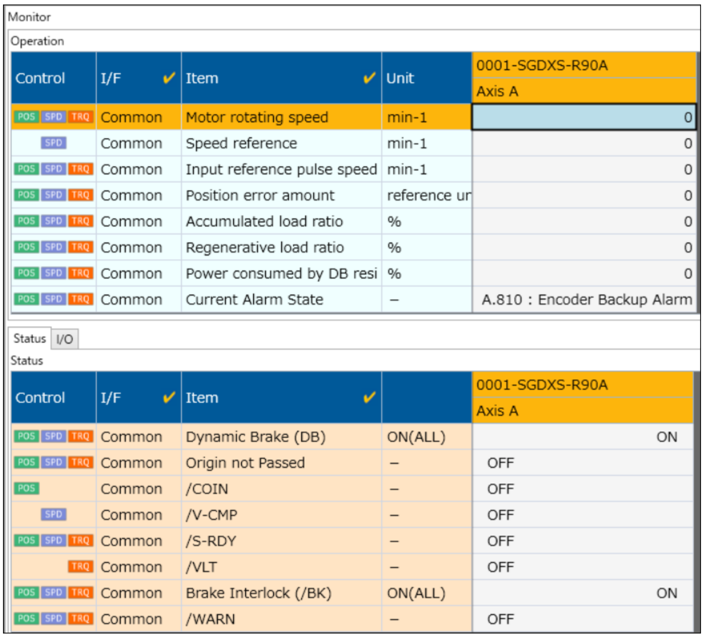
1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

   The [Menu] window will be displayed.

2. **Click [Monitor] in the [Monitor] area.**



[Operation], [Status], and [I/O] will be displayed in the [Monitor] window.



Monitor

Operation

Control	I/F	Item	Unit	0001-SGDXS-R90A Axis A
POS SPD TRQ	Common	Motor rotating speed	min-1	0
SPD	Common	Speed reference	min-1	0
POS SPD TRQ	Common	Input reference pulse speed	min-1	0
POS SPD TRQ	Common	Position error amount	reference ur	0
POS SPD TRQ	Common	Accumulated load ratio	%	0
POS SPD TRQ	Common	Regenerative load ratio	%	0
POS SPD TRQ	Common	Power consumed by DB resi	%	0
POS SPD TRQ	Common	Current Alarm State	–	A.810 : Encoder Backup Alarm

Status I/O

Status

Control	I/F	Item		0001-SGDXS-R90A Axis A
POS SPD TRQ	Common	Dynamic Brake (DB)	ON(ALL)	ON
POS SPD TRQ	Common	Origin not Passed	–	OFF
POS	Common	/COIN	–	OFF
SPD	Common	/V-CMP	–	OFF
POS SPD TRQ	Common	/S-RDY	–	OFF
TRQ	Common	/VLT	–	OFF
POS SPD TRQ	Common	Brake Interlock (/BK)	ON(ALL)	ON
POS SPD TRQ	Common	/WARN	–	OFF

Information You can flexibly change the contents that are displayed in the [Monitor] window. Refer to the following manual for details.

📖 Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

(2) Items That You Can Monitor

The items that you can monitor in the [Operation] window, [Status] window, and [I/O] window are listed below.

(a) [Operation] Window

Important The margins that can be monitored are the margins for the operating limits of the SERVOPACK and servomotor. However, these margins provide no guarantees about the long-term reliability of the product.

Monitor Items	Description	Setting Unit
Motor Speed	Displays the current motor speed.	min^{-1}
Speed Reference	Displays the current speed reference value.	min^{-1}
Torque Reference	Displays the current torque reference value.	%
Angle of Rotation 1 (number of encoder pulses from origin within one encoder rotation)	Displays the number of pulses that the encoder has rotated (moved) from the origin.	pulse
Angle of Rotation 2 (electrical angle from origin within one encoder rotation)	Displays the angle that the encoder has rotated (moved) from the origin.	deg
Input Reference Pulse Speed	Displays the speed reference value by pulse reference input.	min^{-1}
Deviation Counter (Position Deviation)	Displays the position deviation during position control.	reference unit
Cumulative Load	Displays the effective value in a 10-second cycle with rated torque as 100%.	%
Regenerative Load	Displays the effective value in a 10-second cycle with the processable power in the regenerative resistor as 100%.	%
DB Resistor Consumption Power	Displays the effective value in a 10-second cycle with the processable power in the dynamic brake resistor as 100%.	%

Continued on next page.

Continued from previous page.

Monitor Items	Description	Setting Unit
Input Reference Pulse Counter	Displays the counter value of the pulse reference input.	reference unit
Feedback Pulse Counter	Displays the number of pulses that were fed back to the SERVOPACK from the encoder.	pulse
Fully Closed Feedback Pulse Counter	Displays the number of pulses that were fed back to the SERVOPACK from the external encoder used in fully-closed loop control.	External encoder resolution
Upper Limit Setting of Motor Maximum Speed/ Upper Limit Setting of Encoder Output Resolution	Displays the upper limit value of the maximum motor speed setting or the encoder resolution setting.	–
Total Operating Time	Displays the cumulative time that the control and main circuit power supplies of the SERVOPACK were turned ON.	100 ms
Overheat Protection Input	Displays the voltage input by the Overheat Protection Input (TH) signal.	0.01 V
Power Consumption	Displays the power consumption of the SERVOPACK.	W
Consumed Power	Displays the power consumption of the SERVOPACK.	0.001 Wh
Cumulative Power Consumption	Displays the cumulative power consumption of the SERVOPACK from power ON.	Wh
Absolute Encoder Multiturn Data	Displays the current multiturn data of the absolute encoder.	–
Absolute Encoder Position within One Rotation	Displays the position information within one rotation of the absolute encoder.	Pulse
Lower Bits of Absolute Encoder Position	Displays the current position information (lower bits) of the absolute encoder.	pulse
Upper Bits of Absolute Encoder Position	Displays the current position information (upper bits) of the absolute encoder.	pulse
Estimated Vibration	Displays the estimated value of vibration by analyzing the vibration component from servomotor response.	$\min^{-1}$
Maximum Value of Amplitude of Estimated Vibration	Displays the maximum value of estimated vibration from power ON.	$\min^{-1}$
Estimated External Disturbance Torque	Displays the estimated value of disturbance by analyzing the disturbance component from motor response.	%
Maximum Value of Estimated External Disturbance Torque	Displays the maximum value of estimated external disturbance torque from power ON.	%
Minimum Value of Estimated External Disturbance Torque	Displays the minimum value of estimated external disturbance torque from power ON.	%
Identified Moment of Inertia Ratio	Displays the result of estimating the load moment of inertia during SERVOPACK operation.	%
Maximum Identified Moment of Inertia Ratio	Displays the maximum value of the identified moment of inertia ratio from power ON.	%
Minimum Identified Moment of Inertia Ratio	Displays the minimum value of the identified moment of inertia ratio from power ON.	%
Number of Serial Encoder Communications Errors	Displays the total number of serial encoder communications errors from when the power was turned ON.	Time
Settling Time	Displays the time from the position reference distribution completed (DEN) signal to the rise in the positioning completion (/COIN or PSET) signal.	0.1 ms
Maximum Settling Time	Displays the maximum value of the settling time from power ON.	0.1 ms
Amount of Overshoot	Displays the maximum value of position deviation overshooting by analyzing the positioning status in the servo.	reference unit

Continued on next page.

Continued from previous page.

Monitor Items	Description	Setting Unit
Maximum Amount of Overshoot	Displays the maximum value of the amount of overshoot from power ON.	reference unit
Residual Vibration Frequency	Displays the residual vibration (shaking in a short cycle by machine stand vibration) frequency by analyzing the positioning status in the servo.	0.1 Hz
Maximum Value of Accumulated Load Ratio	Displays the maximum value of Un009 (Accumulated Load Ratio).	%
Margin until Overload	Displays the margin until A.710 (Instantaneous Overload) or A.720 (Continuous Overload) is detected. If the margin until overload drops below 0%, A.710 (Instantaneous Overload) or A.720 (Continuous Overload) is detected.	0.01%
Margin until Regenerative Overload	Displays the margin until A.320 (Regenerative Overload) is detected. If the margin until regenerative overload drops below 0%, A.320 (Regenerative Overload) is detected.	0.01%
Margin until Overvoltage	Displays the margin until A.400 (Overvoltage) is detected. If the margin until overvoltage drops below 0 V, A.400 (Overvoltage) is detected.	V
Margin until Undervoltage	Displays the margin until A.410 (Undervoltage) is detected. If the margin until undervoltage drops below 0 V, A.410 (Undervoltage) is detected.	V
Temperature Margin until SERVOPACK Overheats	Displays the margin until A.7A1 (Internal Temperature Error 1) or A.7A2 (Internal Temperature Error 2) is detected. If the temperature margin until the SERVOPACK overheats drops below 0°C, A.7A1 (Internal Temperature Error 1) or A.7A2 (Internal Temperature Error 2) is detected.	°C
Temperature Margin until Servomotor Overheats	Displays the margin until A.860 (Encoder Overheated) is detected. If the temperature margin drops below 0°C, A.860 (Encoder Overheated) is detected.	°C
Encoder Power Supplied Time	Displays the cumulative time that power was supplied to the encoder.	100 ms
Encoder Power Supply Voltage	Displays the power supply voltage supplied to the encoder. A guildeline for the normal value is given next. • Standard specification servomotor: 3.9 V or higher • Σ-7-compatible specification servomotor: 4.5 V to 5.5 V	0.1 V
Encoder Battery Voltage	Displays the voltage of the battery for the absolute encoder. If the voltage drops below 2.7 V, A.930 (Low Battery Voltage) occurs.	0.1 V
Motor Total Number of Rotations	Displays the total number of rotations that the motor rotated since it was shipped from the factory. The value is incremented even if the motor does not complete one rotation.	100 rev
Maintenance Prediction Monitor - Bearings	Displays the prediction value for when to perform maintenance on the servomotor bearings. The prediction value is displayed with the unused status of the servomotor treated as 100%, and the value decreases according to the total number of rotations of the motor. Use a monitor value of 0% as a guideline for the maintenance period.	%
Maintenance Prediction Monitor - Oil Seal	Displays the prediction value for when to perform maintenance on the servomotor oil seal. The prediction value is displayed with the unused status of the servomotor treated as 100%, and the value decreases according to the total number of rotations of the motor. Use a monitor value of 0% as a guideline for the maintenance period.	%

Continued on next page.

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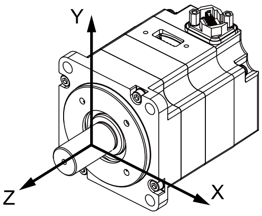
<table>
<tr><th>Monitor Items</th><th colspan="2">Description</th><th>Setting Unit</th></tr>
<tr><td>Motor Vibration in X-Axis Direction</td><td>Displays the vibration in the X-axis direction of the accelerometer built into the servomotor.
The refresh cycle is 1 ms.</td><td rowspan="3">The following figure shows the X-axis, Y-axis, and Z-axis directions of vibration in the motor. Vibration in the direction of the arrow is a positive value, and the opposite direction is a negative value.
 </td><td>0.0001 G
(Resolution: 0.0625 G)</td></tr>
<tr><td>Motor Vibration in Y-Axis Direction</td><td>Displays the vibration in the Y-axis direction of the accelerometer built into the servomotor.
The refresh cycle is 1 ms.</td><td>0.0001 G
(Resolution: 0.0625 G)</td></tr>
<tr><td>Motor Vibration in Z-Axis Direction</td><td>Displays the vibration in the Z-axis direction of the accelerometer built into the servomotor.
The refresh cycle is 1 ms.</td><td>0.0001 G
(Resolution: 0.0625 G)</td></tr>
<tr><td>Motor Vibration XYZ Composite Value</td><td colspan="2">Displays the composite value of vibration in the X-axis, Y-axis, and Z-axis directions of the motor.
The refresh cycle is 1 ms.</td><td>0.0001 G
(Resolution: 0.0625 G)</td></tr>
<tr><td>Maximum Motor Vibration</td><td colspan="2">Displays the maximum value of the motor vibration XYZ composite value from power ON.</td><td>0.0001 G
(Resolution: 0.0625 G)</td></tr>
<tr><td>Σ-LINK II Response Data 1 to 8</td><td colspan="2">Displays the values of input signals for devices connected over Σ-LINK II.</td><td>–</td></tr>
<tr><td>Σ-LINK II Sequence Input Signal Monitor</td><td colspan="2">Displays the status of a signal when a Σ-LINK II input signal is allocated to a SERVOPACK function.</td><td>–</td></tr>
<tr><td>Σ-LINK II Data Status</td><td colspan="2">Displays the status related to Σ-LINK II data.</td><td>–</td></tr>
</table>

(b) [Status] Window

<table>
<tr><th colspan="2">Monitor Items</th></tr>
<tr><td>• Active Gain Monitor
• Safety Input Signal Monitor 1 (/HWBB1)
• Safety Input Signal Monitor 2 (/HWBB2)
• Main Circuit
• Encoder (PGRDY)
• Motor Power (Request)
• Motor Power ON
• Dynamic Brake (DB)
• Rotation Direction
• Mode Switch
• Speed Reference (V-Ref)</td><td>• Torque Reference (T-Ref)
• Position Reference (PULS)
• Position Reference Direction
• Clear Signal (CLR)
• AC Power ON
• Surge Current Limiting Resistor Short Relay
• Regenerative Transistor
• Regenerative Error Detection
• Overcurrent
• Origin Not Passed
• Speed Ripple Compensation in Progress</td></tr>
</table>

(c) [I/O] Window

Monitor Items	
Input Signal Status	**Output Signal Status**
• /S-ON (Servo ON Input) Signal • /P-CON (Proportional Control Input) Signal • P-OT (Forward Drive Prohibit Input) Signal • N-OT (Reverse Drive Prohibit Input) Signal • /P-CL (Forward External Torque Limit Input) Signal • /N-CL (Reverse External Torque Limit Input) Signal • /ALM-RST (Alarm Reset Input) Signal • SEN (Absolute Data Request Input) Signal • /SPD-D (Motor Direction Input) Signal • /SPD-A (Internal Set Speed Selection Input) Signal • /SPD-B (Internal Set Speed Selection Input) Signal • /C-SEL (Control Selection Input) Signal • /ZCLAMP (Zero Clamping Input) Signal • /INHIBIT (Reference Pulse Inhibit Input) Signal • /G-SEL (Gain Selection Input) Signal • /P-DET (Polarity Detection Input) Signal • PULS (Pulse Reference Input) Signal • SIGN (Sign Reference Input) Signal • CLR (Position Deviation Clear Input) Signal • /PSEL (Reference Pulse Input Multiplication Switch Input) Signal • FSTP (Forced Stop Input) Signal • Σ-LINK II Sequence Input Signal Monitor	• ALM (Servo Alarm Output) Signal • /COIN (Positioning Completion Output) Signal • /V-CMP (Speed Coincidence Detection Output) Signal • /TGON (Rotation Detection Output) Signal • /S-RDY (Servo Ready Output) Signal • /CLT (Torque Limit Detection Output) Signal • /VLT (Speed Limit Detection Output) Signal • /BK (Brake Output) Signal • /WARN (Warning Output) Signal • /NEAR (Near Output) Signal • ALO1 (Alarm Code Output) Signal • ALO2 (Alarm Code Output) Signal • ALO3 (Alarm Code Output) Signal • PAO (Encoder Divided Pulse Output Phase A) Signal • PBO (Encoder Divided Pulse Output Phase B) Signal • PCO (Encoder Divided Pulse Output Phase C) Signal • /PSELA (Reference Pulse Input Multiplication Switching Output) Signal • /PM (Preventative Maintenance Output) Signal • Σ-LINK II Sequence Output Signal Monitor

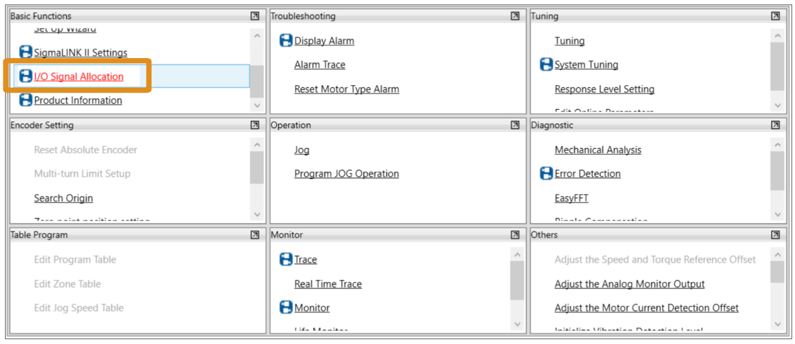
9.2.3 I/O Signals Status Monitor

Use the following procedure to check the status of the I/O signals.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

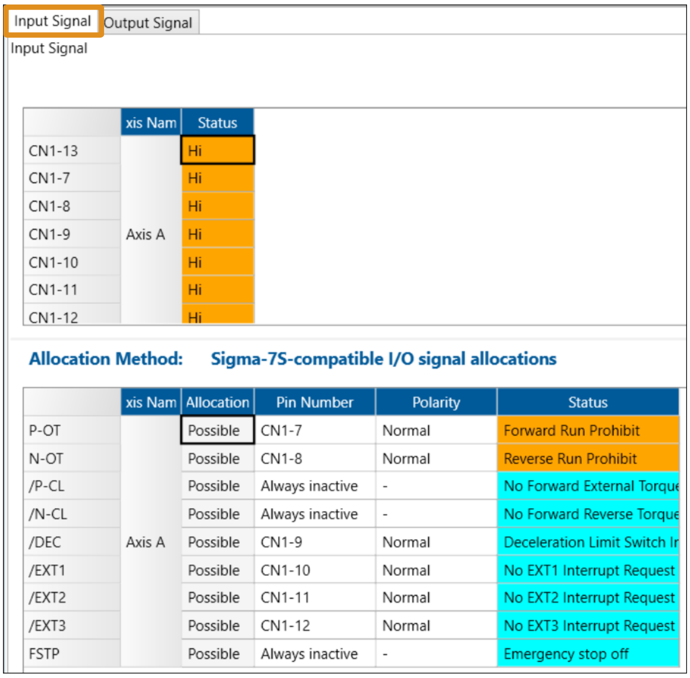
   The [Menu] window will be displayed.

2. **Click [I/O Signal Allocation] in the [Basic Functions] area.**



The [I/O Signal Allocation] window will be displayed.

3. **Click the [Input Signal] tab to check the status of input signals.**



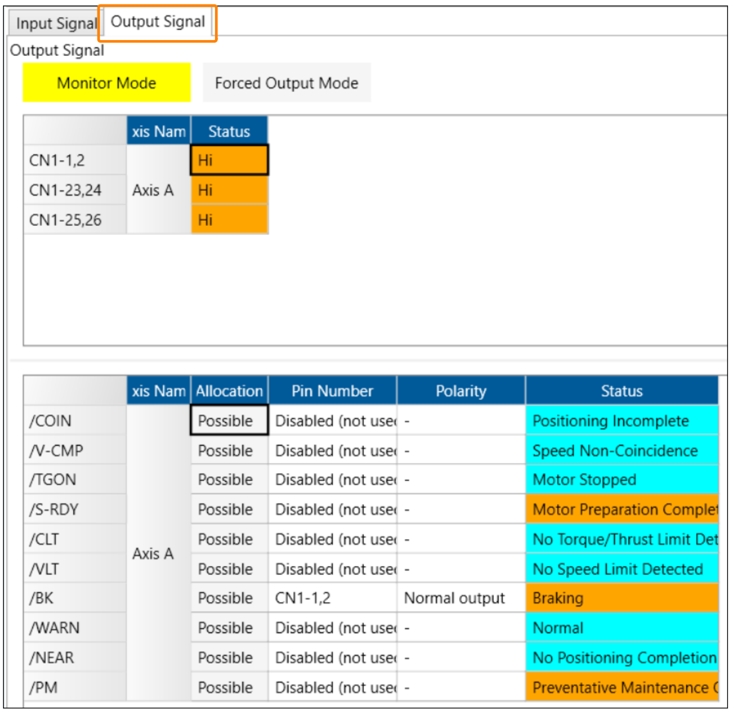
Input Signal

	xis Nam	Status
CN1-13	Axis A	Hi
CN1-7		Hi
CN1-8		Hi
CN1-9		Hi
CN1-10		Hi
CN1-11		Hi
CN1-12		Hi

Allocation Method: **Sigma-7S-compatible I/O signal allocations**

	xis Nam	Allocation	Pin Number	Polarity	Status
P-OT	Axis A	Possible	CN1-7	Normal	Forward Run Prohibit
N-OT		Possible	CN1-8	Normal	Reverse Run Prohibit
/P-CL		Possible	Always inactive	-	No Forward External Torque
/N-CL		Possible	Always inactive	-	No Forward Reverse Torque
/DEC		Possible	CN1-9	Normal	Deceleration Limit Switch Ir
/EXT1		Possible	CN1-10	Normal	No EXT1 Interrupt Request
/EXT2		Possible	CN1-11	Normal	No EXT2 Interrupt Request
/EXT3		Possible	CN1-12	Normal	No EXT3 Interrupt Request
FSTP		Possible	Always inactive	-	Emergency stop off

4. **Click the [Output Signal] tab to check the status of output signals.**



Output Signal

	xis Nam	Status
CN1-1,2	Axis A	Hi
CN1-23,24		Hi
CN1-25,26		Hi

	xis Nam	Allocation	Pin Number	Polarity	Status
/COIN	Axis A	Possible	Disabled (not use(	-	Positioning Incomplete
/V-CMP		Possible	Disabled (not use(	-	Speed Non-Coincidence
/TGON		Possible	Disabled (not use(	-	Motor Stopped
/S-RDY		Possible	Disabled (not use(	-	Motor Preparation Complet
/CLT		Possible	Disabled (not use(	-	No Torque/Thrust Limit Det
/VLT		Possible	Disabled (not use(	-	No Speed Limit Detected
/BK		Possible	CN1-1,2	Normal output	Braking
/WARN		Possible	Disabled (not use(	-	Normal
/NEAR		Possible	Disabled (not use(	-	No Positioning Completion
/PM		Possible	Disabled (not use(	-	Preventative Maintenance (

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 [Forced 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 [Forced Output Mode] button while the servo is ON.

Refer to the following manual for details.

📖 Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

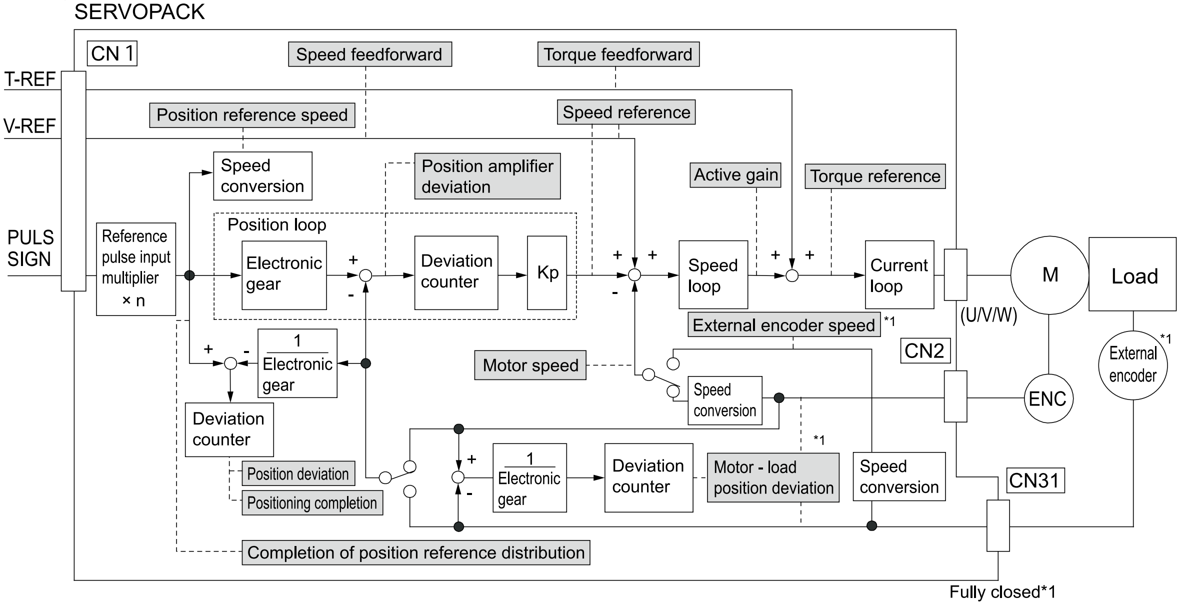
9.3 Monitoring Machine Operation Status and Signal Waveforms

To monitor waveforms, use the SigmaWin+ trace function or a measuring instrument.

9.3.1 Items That You Can Monitor

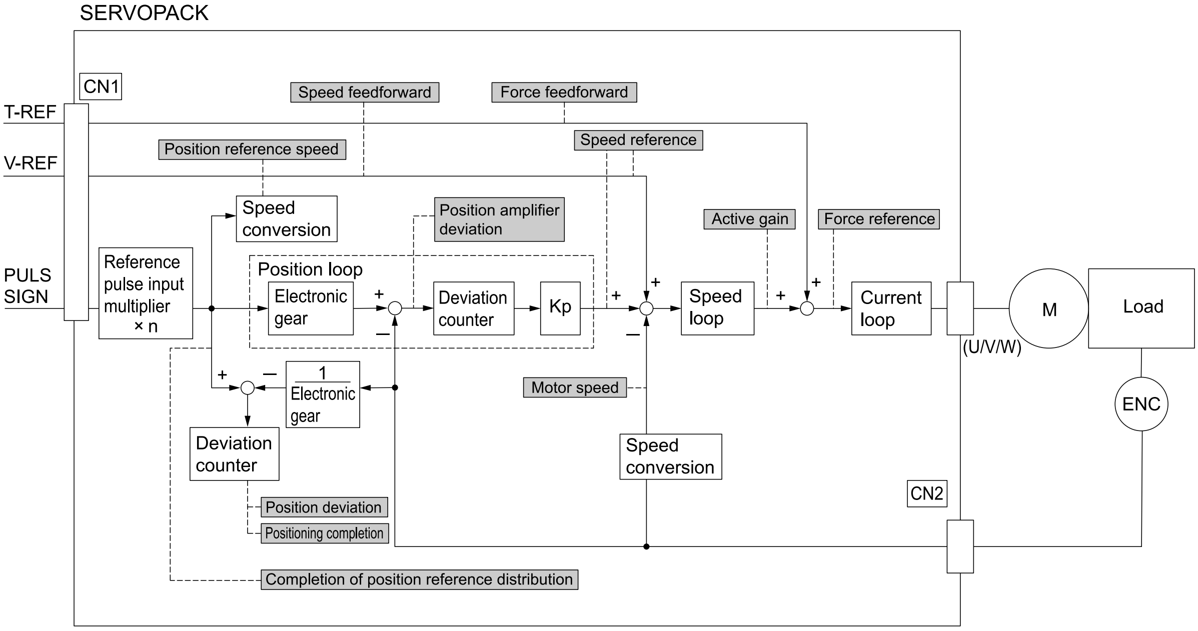
You can use the SigmaWin+ or a measuring instrument to monitor the shaded items in the following block diagram.

- Rotary Servomotors



*1 Enabled when fully-closed loop control is being used.

- Linear Servomotors



9.3.2 Using the SigmaWin+

This section describes how to trace data and I/O with the SigmaWin+.

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

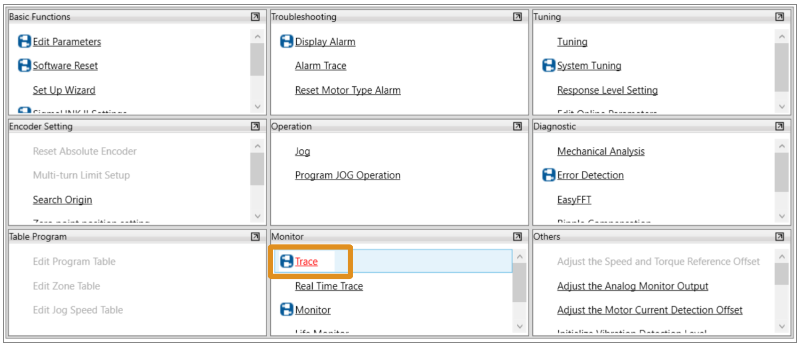
📖 Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

(1) Operating Procedure

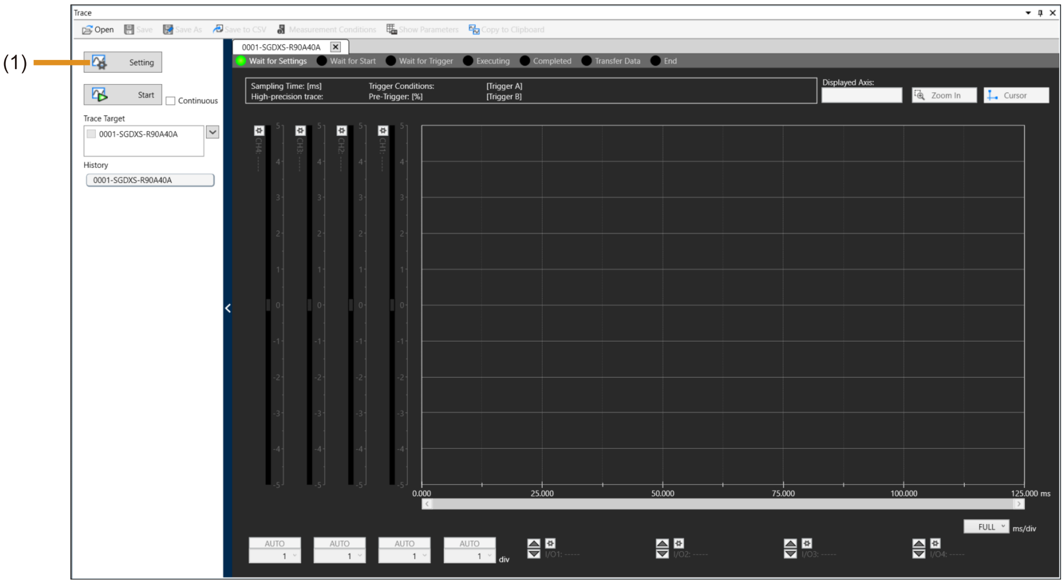
1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

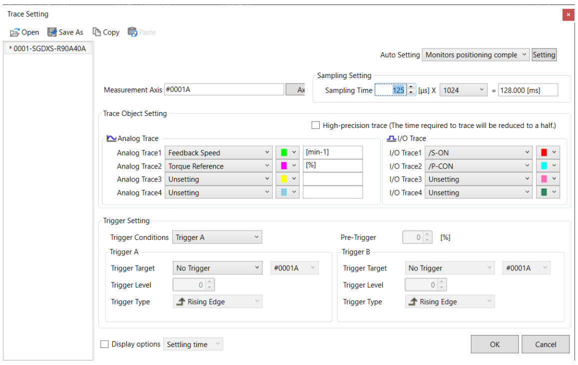
   The [Menu] window will be displayed.

2. **Click [Trace] in the [Monitor] area.**



The [Trace] window will be displayed.



No.	Meaning
(1)	Click this button to display the [Trace Setting] window shown below, and set the data to trace and the trace conditions.  Trace Setting Open Save As Copy Paste * 0001-SGDXS-R90A40A Auto Setting: Monitors positioning comple Measurement Axis: #0001A Sampling Setting — Sampling Time: 125 [μs] X 1024 = 128.000 [ms] Trace Object Setting ☐ High-precision trace (The time required to trace will be reduced to a half.) Analog Trace — Analog Trace1: Feedback Speed [min-1]; Analog Trace2: Torque Reference [%]; Analog Trace3: Unsetting; Analog Trace4: Unsetting I/O Trace — I/O Trace1: /S-ON; I/O Trace2: /P-CON; I/O Trace3: Unsetting; I/O Trace4: Unsetting Trigger Setting — Trigger Conditions: Trigger A; Pre-Trigger: 0 [%] Trigger A — Trigger Target: No Trigger, #0001A; Trigger Level: 0; Trigger Type: Rising Edge Trigger B — Trigger Target: No Trigger, #0001A; Trigger Level: 0; Trigger Type: Rising Edge ☐ Display options: Settling time OK Cancel

(2) Trace Objects

You can trace the following items.

(a) Data Tracing

Trace Objects	
• Feedback Speed • Torque Reference • Reference Speed • Position Reference Speed • Position Error (Deviation) • Position Amplifier Error (Deviation) • Motor - Load Position Deviation • Speed Feedforward • Torque Feedforward • Effective (Active) Gain • Main Circuit DC Voltage • External Encoder Speed	• Σ-LINK II Response Data 1 to 8 • Σ-LINK II Command Data 1 to 4 • Margin until Regenerative Overload • Margin until Overload • Temperature Margin until SERVOPACK Overheats • Temperature Margin until Servomotor Overheats • Margin until Undervoltage • Margin until Overvoltage • Identified Moment of Inertia Ratio • Motor Vibration in X-Axis Direction • Motor Vibration in Y-Axis Direction • Motor Vibration in Z-Axis Direction • Motor Vibration XYZ Composite Value • Current Reference

(b) I/O Tracing

Trace Objects	
Input Signals	Output Signals
• /S-ON (Servo ON Input) Signal • /P-CON (Proportional Control Input) Signal • P-OT (Forward Drive Prohibit Input) Signal • N-OT (Reverse Drive Prohibit Input) Signal • /ALM-RST (Alarm Reset Input) Signal • /P-CL (Forward External Torque Limit Input) Signal • /N-CL (Reverse External Torque Limit Input) Signal • /SPD-D (Motor Direction Input) Signal • /SPD-A (Internal Set Speed Selection Input) Signal • /SPD-B (Internal Set Speed Selection Input) Signal • /C-SEL (Control Selection Input) Signal • /ZCLAMP (Zero Clamping Input) Signal • /INHIBIT (Reference Pulse Inhibit Input) Signal • /G-SEL (Gain Selection Input) Signal • /P-DET (Polarity Detection Input) Signal • FSTP (Forced Stop Input) Signal • SEN (Absolute Data Request Input) Signal • PULS (Pulse Reference Input) Signal • SIGN (Sign Reference Input) Signal • CLR (Position Deviation Clear Input) Signal • /PSEL (Reference Pulse Input Multiplication Switch Input) Signal • /HWBB1 (Hard Wire Base Block Input 1) Signal • /HWBB2 (Hard Wire Base Block Input 2) Signal • Σ-LINK II Sequence Input 0 to 7	• ALM (Servo Alarm Output) Signal • /COIN (Positioning Completion Output) Signal • /V-CMP (Speed Coincidence Detection Output) Signal • /TGON (Rotation Detection Output) Signal • /S-RDY (Servo Ready Output) Signal • /CLT (Torque Limit Detection Output) Signal • /VLT (Speed Limit Detection Output) Signal • /BK (Brake Output) Signal • /WARN (Warning Output) Signal • /NEAR (Near Output) Signal • ALO1 (Alarm Code Output) Signal • ALO2 (Alarm Code Output) Signal • ALO3 (Alarm Code Output) Signal • PAO (Encoder Divided Pulse Output Phase A) Signal • PBO (Encoder Divided Pulse Output Phase B) Signal • PCO (Encoder Divided Pulse Output Phase C) Signal • /PSELA (Reference Pulse Input Multiplication Switching Output) Signal • ACON (Main Circuit ON) Signal • PDETCMP (Polarity Detection Completed) Signal • DEN (Position Reference Distribution Completed) Signal • Σ-LINK II Sequence Output 1 to 4

9.3.3 Using the Analog Monitors

Connect a measuring instrument to the analog monitor connector (CN5) on the SERVOPACK to monitor analog signal waveforms. The measuring instrument is not provided by Yaskawa.

Refer to the following section for details on the connection.

☞ *4.10 Using the Analog Monitors on page 153*

(1) Setting the Monitor Object

Use Pn006 = n.□□XX and Pn007 = n.□□XX (Analog Monitor 1 and 2 Signal Selections) to set the items to monitor.

Line Color	Signal	Parameter Setting
White	Analog monitor 1	Pn006 = n.□□XX
Red	Analog monitor 2	Pn007 = n.□□XX
Black (2 lines)	GND	–

	Analog Monitor 1 Signal Selection **Analog Monitor 2 Signal Selection** Speed Pos Trq				**When Enabled**
	Description	**Monitor Signal**	**Output Unit**	**Remarks**	
Pn006 **Pn007**	n.□□00 [Default setting of Pn007]	Motor Speed	• Rotary servomotor: 1 V/1000 min^{-1} • Linear servomotor: 1 V/1000 mm/s	–	Immediately
	n.□□01	Speed Reference	• Rotary servomotor: 1 V/1000 min^{-1} • Linear servomotor: 1 V/1000 mm/s	–	
	n.□□02 [Default setting of Pn006]	Torque Reference	1 V/100% rated torque	–	
	n.□□03	Position Deviation	0.05 V/reference unit	0 V for speed or torque control	
	n.□□04	Position Amplifier Deviation	0.05 V/encoder pulse unit	Position deviation after electronic gear conversion	
	n.□□05	Position Command Speed	• Rotary servomotor: 1 V/1000 min^{-1} • Linear servomotor: 1 V/1000 mm/s	The input reference pulses will be multiplied by n to output the position command speed.	
	n.□□06	Reserved (Do not use.)	–	–	
	n.□□07	Motor - Load Position Deviation	0.01 V/reference unit	–	
	n.□□08	Positioning Completion	Positioning completed: 5 V Positioning not completed: 0 V	Completion is indicated by the output voltage.	
	n.□□09	Speed Feedforward	• Rotary servomotor: 1 V/1000 min^{-1} • Linear servomotor: 1 V/1000 mm/s	–	
	n.□□0A	Torque Feedforward	1 V/100% rated torque	–	
	n.□□0B	Active Gain *1	1st gain: 1 V 2nd gain: 2 V	The gain that is active is indicated by the output voltage.	
	n.□□0C	Completion of Position Reference Distribution	Distribution completed: 5 V Distribution not completed: 0 V	Completion is indicated by the output voltage.	
	n.□□0D	External Encoder Speed	1 V/1000 min^{-1}	Value calculated at the motor shaft	
	n.□□10	Main Circuit DC Voltage	1 V/100 V (main circuit DC voltage)	–	

*1 Refer to the following section for details.
☞ *8.14.1 Gain Switching on page 468*

(2) Changing the Monitor Factor and Offset

You can change the monitor factors and offsets for the output voltages for analog monitor 1 and analog monitor 2. The relationships to the output voltages are as follows:

$$\text{Analog monitor 1 output voltage} = (-1) \times \left\{ \begin{array}{l}\text{Pn006 = n.□□XX}\\ \text{(Analog Monitor 1 Signal Selection)}\end{array} \times \begin{array}{l}\text{Pn552}\\ \text{(Analog Monitor 1 Magnification)}\end{array} + \begin{array}{l}\text{Pn550}\\ \text{(Analog Monitor 1 Offset Voltage)}\end{array} \right\}$$

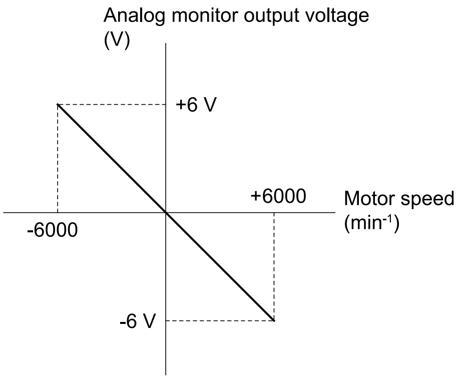
$$\text{Analog monitor 2 output voltage} = (-1) \times \left\{ \begin{array}{l}\text{Pn007 = n.□□XX}\\ \text{(Analog Monitor 2 Signal Selection)}\end{array} \times \begin{array}{l}\text{Pn553}\\ \text{(Analog Monitor 2 Magnification)}\end{array} + \begin{array}{l}\text{Pn551}\\ \text{(Analog Monitor 2 Offset Voltage)}\end{array} \right\}$$

The following parameters are set.

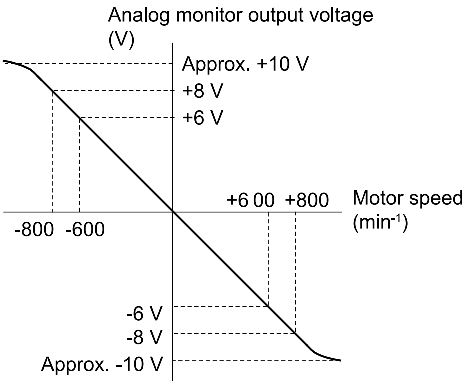
Pn550	Analog Monitor 1 Offset Voltage			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	-10000 to 10000	0.1 V	0	Immediately
Pn551	Analog Monitor 2 Offset Voltage			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	-10000 to 10000	0.1 V	0	Immediately
Pn552	Analog Monitor 1 Magnification			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	-10000 to 10000	× 0.01	100	Immediately
Pn553	Analog Monitor 2 Magnification			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	-10000 to 10000	× 0.01	100	Immediately

Example: To set the monitor item to Pn006 = n.□□00 (Motor Speed)

When Pn552 = 100 (Setting unit: ×0.01)



When Pn552 = 1000 (Setting unit: ×0.01)



Note: The valid linearity range is ±8 V.
The resolution is 16 bits.

(3) Adjusting the Analog Monitor Output

You can manually adjust the offset and gain for the analog monitor outputs for the torque reference monitor and motor speed monitor.

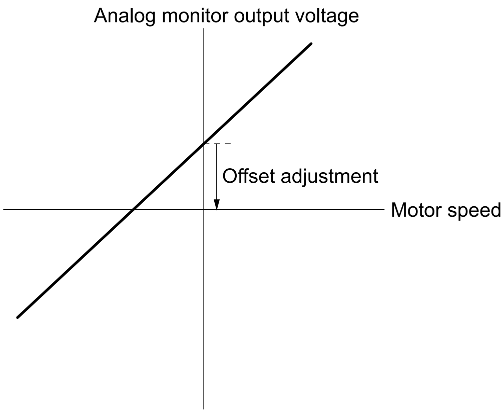
The offset is adjusted to compensate for offset in the zero point caused by output voltage drift or noise in the monitoring system.

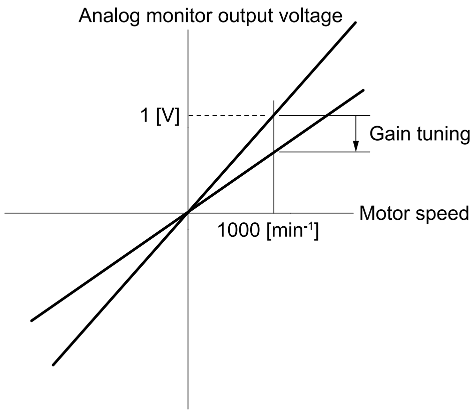
The gain is adjusted to match the sensitivity of the measuring system.

The offset and gain are adjusted at the factory. You normally do not need to adjust them.

(4) Adjustment Example

An example of adjusting the output of the motor speed monitor is provided below.

<table>
<tr><th>Offset Adjustment</th><th>Gain Adjustment</th></tr>
<tr>
<td>


<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Offset Adjustment Range</td><td>-2.4 V to 2.4 V</td></tr>
<tr><td>Adjustment Unit</td><td>18.9 mV/LSB</td></tr>
</table>
</td>
<td>


<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>Gain Adjustment Range</td><td>100 ±50%</td></tr>
<tr><td>Adjustment Unit</td><td>0.4%/LSB</td></tr>
</table>
The gain adjustment range is made using a 100% output value (gain adjustment of 0) as the reference value with an adjustment range of 50% to 150%. A setting example is given below.

Setting the Adjustment Value to -125
100 + (-125 × 0.4) = 50 [%]
Therefore, the monitor output voltage goes to 50% of the original value.
Setting the Adjustment Value to 125
100 + (125 × 0.4) = 150 [%]
Therefore, the monitor output voltage goes to 150% of the original value.

</td>
</tr>
</table>

Information

- The adjustment values do not use parameters, so they will not change even if the parameter settings are initialized.
- Adjust the offset with the measuring instrument connected so that the analog monitor output value goes to zero. The following setting example achieves a zero output.
  - While power is not supplied to the servomotor, set the monitor signal to the torque reference.
  - In speed control, set the monitor signal to the position deviation.

(5) Preparations

Always check the following before you adjust the analog monitor output.

- The parameters must not be write prohibited.

(6) Applicable Tools

The following table lists the tools that you can use to perform analog monitor output tuning.

- Offset Adjustment

Tool	Fn No./Function Name	Reference
Panel Operator	Fn00C	☞ *14.4.11 Adjust Analog Monitor Output Offset (Fn00C) on page 650*
Digital Operator	Fn00C	🕮 Σ-7-/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Others] - [Adjusting the Analog Monitor Output]	☞ *(7) Operating Procedure on page 517*

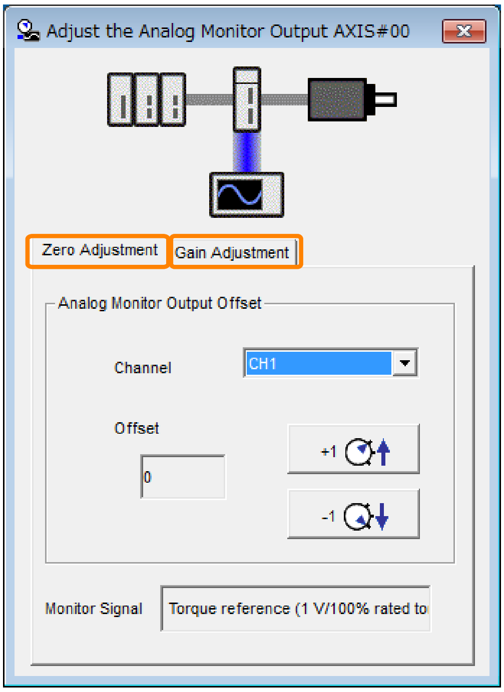
- Gain Adjustment

Tool	Fn No./Function Name	Reference
Panel Operator	Fn00D	☞ *14.4.12 Adjust Analog Monitor Output Gain (Fn00D) on page 651*
Digital Operator	Fn00D	🕮 Σ-7-/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Others] - [Adjusting the Analog Monitor Output]	☞ *(7) Operating Procedure on page 517*

(7) Operating Procedure

Use the following procedure to adjust the analog monitor output.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Click [Adjust the Analog Monitor Output] in the [Menu] window.**
   The [Adjust the Analog Monitor Output] window will be displayed.
3. **Click the [Zero Adjustment] or [Gain Adjustment] tab.**

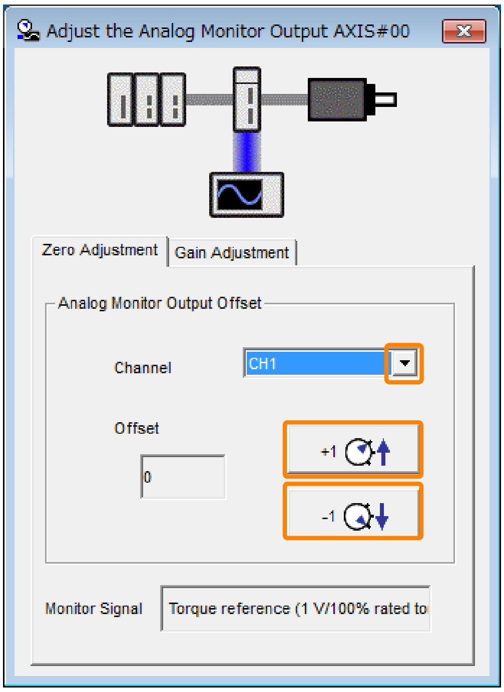


Channel: CH1

Offset: 0

Monitor Signal: Torque reference (1 V/100% rated to

4. **While watching the analog monitor, use the [+1] and [-1] buttons to adjust the offset.**
   There are two channels: CH1 and CH2. If necessary, click the down arrow on the [Channel] and select the channel.



Channel: CH1

Offset: 0

Monitor Signal: Torque reference (1 V/100% rated to

This concludes adjusting the analog monitor output.

9.4 Monitoring Product Life

9.4.1 Items That You Can Monitor

Monitor Items	Description
SERVOPACK Installation Environment	The operating status of the SERVOPACK in terms of the installation environment is displayed. Implement one or more of the following actions if the monitor value exceeds 100%. • Lower the surrounding temperature. • Decrease the load.
Servomotor Installation Environment	
Built-in Fan Service Life Prediction	The unused status of the SERVOPACK is treated as the 100% value. The value decreases each time the main circuit power supply is turned ON and each time the servo is turned OFF. Use a monitor value of 0% as a guideline for the replacement period. Refer to the following section for part replacement guidelines. ☞ *13.1.2 Guidelines for Part Replacement on page 577*
Capacitor Service Life Prediction	
Inrush Current Prevention Circuit Service Life Prediction	The unused status of the SERVOPACK is treated as the 100% value. The value decreases each time the main circuit power supply is turned ON and each time the servo is turned OFF. Use a monitor value of 0% as a guideline for the replacement period. Refer to the following section for part replacement guidelines. ☞ *13.1.2 Guidelines for Part Replacement on page 577*
Dynamic Brake Circuit Service Life Prediction	
Maintenance Prediction of Bearings	The prediction value is displayed with the unused status of the servomotor treated as 100%, and the value decreases according to the total number of rotations of the motor. Use a monitor value of 0% as a guideline for the maintenance period. The prediction value is calculated from the standard service life time for motor parts and the motor total number of rotations when the motor has rotated continuously at the rated speed. (The standard service life of the bearings is 20,000 hours. The service life depends on the actual usage conditions and environment.) Example: Servomotor with a rated speed of 3000 min^{-1} Rated speed 3000 [min^{-1}] × 60 [min] × 20000 [hours] = 3600 × 10^6 [revolutions] Maintenance prediction monitor: bearings [%] = (1 - (Current total number of rotations / 3600 × 10^6)) × 100 Refer to the following manual for details on the service life of motor parts. 📖 Σ-X-Series Rotary Servomotor Product Manual (Manual No.: SIEP C230210 00)
Maintenance Prediction of Oil Seal	The prediction value is displayed with the unused status of the servomotor treated as 100%, and the value decreases according to the total number of rotations of the motor. Use a monitor value of 0% as a guideline for the maintenance period. The prediction value is calculated from the standard service life time for motor parts and the motor total number of rotations when the motor has rotated continuously at the rated speed. (The standard service life of the oil seal is 5,000 hours. The service life depends on the actual usage conditions and environment.) Example: Servomotor with a rated speed of 3000 min^{-1} Rated speed 3000 [min^{-1}] × 60 [min] × 5000 [hours] = 900 × 10^6 [revolutions] Maintenance prediction monitor: oil seal [%] = (1 - (Current total number of rotations / 900 × 10^6)) × 100 Refer to the following manual for details on the service life of motor parts. 📖 Σ-X-Series Rotary Servomotor Product Manual (Manual No.: SIEP C230210 00)

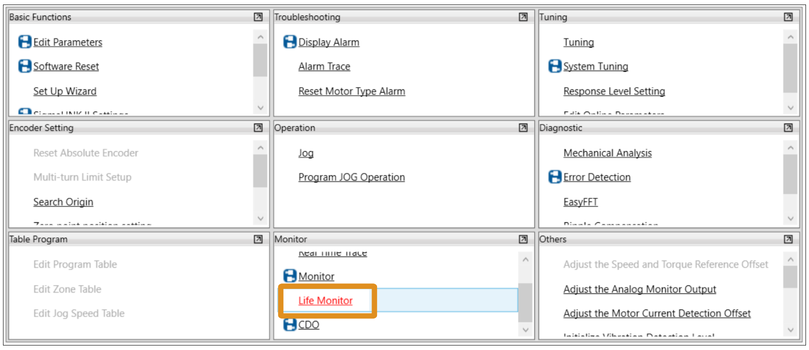
9.4.2 Operating Procedure

Use the following procedure to monitor the installation environment, service life predictions, and maintenance predictions.

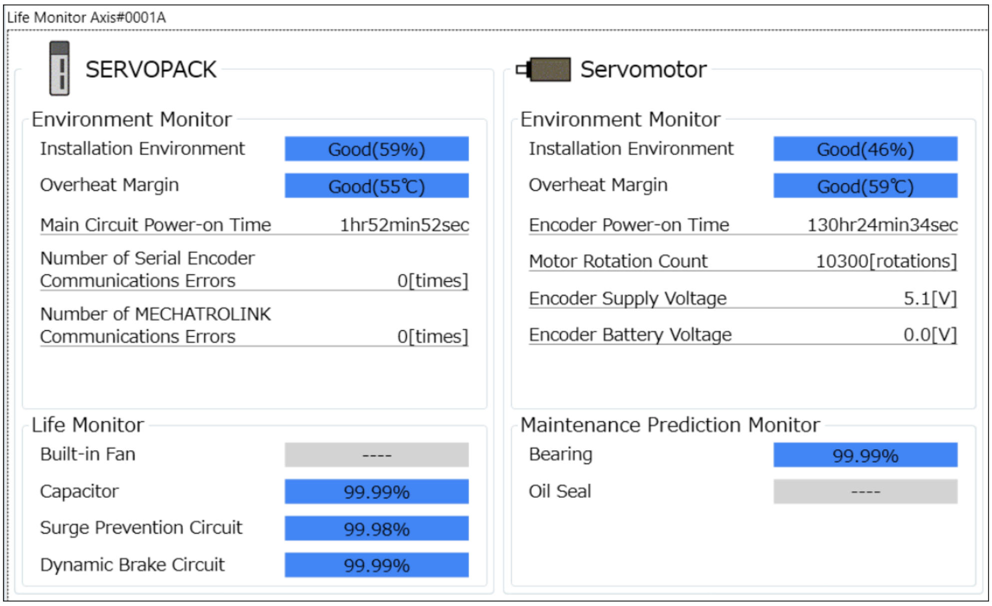
1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

   The [Menu] window will be displayed.

2. **Click [Life Monitor] in the [Monitor] area.**



The [Life Monitor] window will be displayed.



Life Monitor Axis#0001A

SERVOPACK

Environment Monitor

Installation Environment	Good(59%)
Overheat Margin	Good(55℃)
Main Circuit Power-on Time	1hr52min52sec
Number of Serial Encoder Communications Errors	0[times]
Number of MECHATROLINK Communications Errors	0[times]

Life Monitor

Built-in Fan	----
Capacitor	99.99%
Surge Prevention Circuit	99.98%
Dynamic Brake Circuit	99.99%

Servomotor

Environment Monitor

Installation Environment	Good(46%)
Overheat Margin	Good(59℃)
Encoder Power-on Time	130hr24min34sec
Motor Rotation Count	10300[rotations]
Encoder Supply Voltage	5.1[V]
Encoder Battery Voltage	0.0[V]

Maintenance Prediction Monitor

Bearing	99.99%
Oil Seal	----

Information With the panel operator or digital operator, you can use Un025 to Un02A, Un183 to Un188 to monitor this information.

9.4.3 Preventative Maintenance

You can use the following functions for preventative maintenance.

- Preventative maintenance warnings
- /PM (Preventative Maintenance Output) Signal

The SERVOPACK can notify the host controller when it is time to replace any of the main parts and when the service life of bearings and oil seals are reached.

(1) Preventative Maintenance Warning

(a) SERVOPACK Preventative Maintenance Warning

An A.9b0 warning (SERVOPACK Preventative Maintenance Warning) is detected when any of the following service life prediction values drops to 10% or less: SERVOPACK built-in fan life, capacitor life, inrush current prevention circuit life, and dynamic brake circuit life. You can change the setting of Pn00F = n.□□□X to enable or disable the SERVOPACK preventative maintenance warning.

		SERVOPACK Preventative Maintenance Warning Selection **Speed** **Pos** **Trq**		When Enabled
Pn00F	n.□□□X	0 Default	Do not detect SERVOPACK preventative maintenance warnings.	After restart
		1	Detect SERVOPACK preventative maintenance warnings.	

(b) Servomotor Preventative Maintenance Warning

For bearings and oil seals, which are consumable parts in the servomotor, an A.9b1 (Servomotor Preventative Maintenance Warning) is detected when one of the maintenance prediction values becomes 10% or lower. Use this warning as a guideline for when to perform maintenance.

You can change the setting of Pn00F = n.□□X□ to enable or disable the servomotor preventative maintenance warning.

Pn00F	n.□□X□	Servomotor Preventative Maintenance Warning Selection Speed Pos Trq		When Enabled
		0 Default	Do not detect servomotor preventative maintenance warnings.	After restart
		1	Detect servomotor preventative maintenance warnings.	

(2) /PM (Preventative Maintenance Output) Signal

The /PM (Preventative Maintenance Output) signal is output when any of the following service life prediction items reaches 10% or less.

- SERVOPACK fan service life prediction
- SERVOPACK capacitor service life prediction
- SERVOPACK inrush current prevention circuit service life prediction
- SERVOPACK dynamic brake circuit service life prediction
- Servomotor maintenance prediction of bearings
- Servomotor maintenance prediction of oil seal

Even if Pn00F is set to n.□□□0 (do not detect SERVOPACK preventative maintenance warnings) or Pn00F is set to n.□□0□ (do not detect servomotor preventative maintenance warnings), the /PM signal will still be output as long as it is allocated.

Classification	Signal	Connector Pin No.	Signal Status	Description
Output	/PM	Must be allocated.	ON (closed)	A service life prediction item has reached 10% or less.
			OFF (open)	All service life prediction items are greater than 10%.

Note:

You must allocate the /PM signal to use it. Use Pn514 = n.□X□□ (/PM (Preventative Maintenance Output) Signal Allocation) to allocate the signal to connector pins. Refer to the following section for details.

☞ *6.1.4 Output Signal Allocations on page 224*

9.5 Alarm Tracing

Alarm tracing records data in the SERVOPACK from before and after an alarm occurs. This data helps you to isolate the cause of the alarm.

You can display the data recorded in the SERVOPACK as a trace waveform on the SigmaWin+.

Information
- Alarms that occur when the power supply is turned ON are not recorded.
- Alarms that occur during the recording of alarm trace data are not recorded.
- Alarms that occur while utility functions are being executed are not recorded.

9.5.1 Data for Which Alarm Tracing Is Performed

Two types of data are recorded for alarm tracing: numeric data and I/O signal ON/OFF data.

Numeric Data	ON/OFF Data
• Torque reference [%] • Feedback speed [min^{-1}] • Reference speed [min^{-1}] • Position command speed [min^{-1}] • Position deviation [reference units] • Motor-load position deviation [reference units] • Main circuit DC voltage [V]	• ALM • Servo ON command (/S-ON) • Proportional control command (/P-CON) • Forward torque command (/P-CL) • Reverse torque command (/N-CL) • G-SEL1 signal (/G-SEL1) • ACON

9.5.2 Applicable Tools

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

Tool	Fn No./Function Name	Reference
Panel Operator	You cannot display alarm tracing data from the panel operator.	
Digital Operator	You cannot display alarm tracing data from the digital operator.	
SigmaWin+	[Troubleshooting] - [Alarm Trace]	🕮 Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

9.6 Error Detection Setting

9.6.1 Outline

Error detection is a function that compares the values of normal operating characteristics saved to the SERVOPACK in advance with the actual values during operation to judge errors. You can use this function to detect deterioration and failures in machines and equipment and to detect defective products. The detected results can be checked from the host controller.

The following table gives the steps to execute error detection and references for each step.

Step	Item	Reference
1	Preparing Trace Data for Sample Data	☞ *9.6.2 Preparing Trace Data to Create Sample Data on page 522*
2	Creating Sample Data and Setting the Error Judgment Baseline	☞ *9.6.3 Creating Sample Data and Setting the Error Judgment Baseline on page 523*
3	Executing Error Detection	☞ *9.6.4 Executing Error Detection on page 527*

Information

Error detection is performed by calculating the Mahalanobis distance of each sampling point from sample data saved to the SERVOPACK in advance and trace data obtained during operation. For the Mahalanobis distance of each sampling point, A.905 (Error Detection Warning) will occur when the number of points that exceed the judgment level registered in advance is greater than or equal to the number of error detection points. You can select up to two trace targets for calculating the Mahalanobis distance.

Term

Sample Data :

Sample data is the data set saved to the SERVOPACK in advance for error detection processing. The sample data is created by calculating the mean value and distribution value in waveform sample points from multiple waveforms when the SERVOPACK performed the same operation.

Mahalanobis Distance :

The Mahalanobis distance is an index that expresses the degree to which the operating values deviate from the sample data. The greater the Mahalanobis distance, the more the operating values are deviating from the sample data.

9.6.2 Preparing Trace Data to Create Sample Data

Prepare the trace data to create sample data.

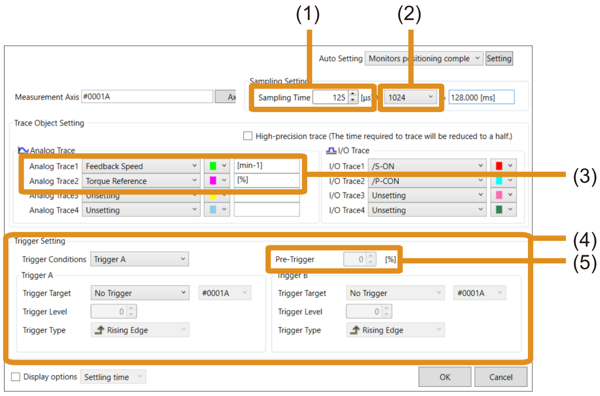
Perform tracing using the same procedure as normal tracing and obtain multiple items of trace data (std file).

Important

If the SERVOPACK software version is 0007 or later, use the SigmaWin+ Ver. 7.42 or later to use error detection.

Important

Be careful of the following settings when acquiring trace data.



Auto Setting: Monitors positioning comple
Measurement Axis: #0001A
Sampling Time: 125 [μs] × 1024 = 128.000 [ms]
☐ High-precision trace (The time required to trace will be reduced to a half.)
Analog Trace1: Feedback Speed [min-1]
Analog Trace2: Torque Reference [%]
Analog Trace3: Unsetting
Analog Trace4: Unsetting
I/O Trace1: /S-ON
I/O Trace2: /P-CON
I/O Trace3: Unsetting
I/O Trace4: Unsetting
Trigger Conditions: Trigger A
Pre-Trigger: 0 [%]
Trigger A: Trigger Target: No Trigger #0001A; Trigger Level: 0; Trigger Type: Rising Edge
Trigger B: Trigger Target: No Trigger #0001A; Trigger Level: 0; Trigger Type: Rising Edge
☐ Display options: Settling time

No.	Setting
(1)	Make this the same as the sampling time.
(2)	Set to “1024”.
(3)	Set analog trace 1 and analog trace 2 to the data for error detection (trace targets with which to calculate the Mahalanobis distance).
(4)	Make this the same as the trigger settings.
(5)	Set the pre-trigger to 0.

9.6.3 Creating Sample Data and Setting the Error Judgment Baseline

1. **Check if the trace data is finished being prepared, and check if the trace data (std file) is saved to the same computer.**

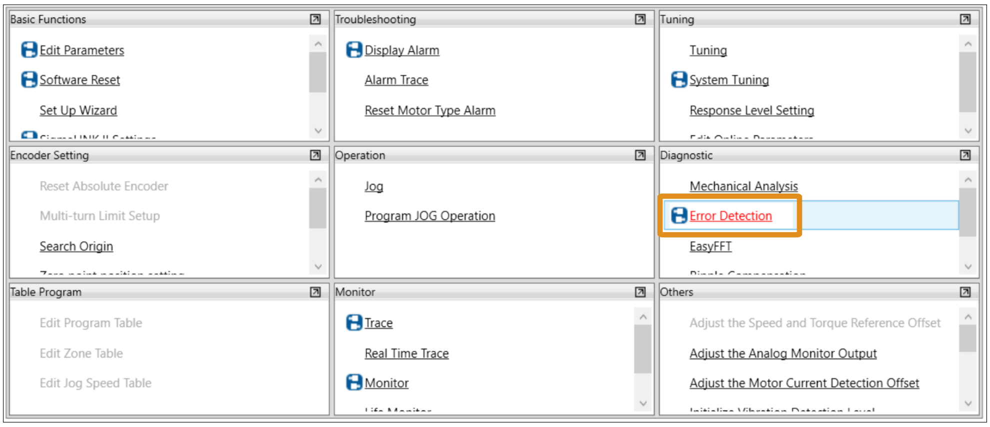
   Refer to the following section for details on preparing the trace data.

   ☞ *9.6.2 Preparing Trace Data to Create Sample Data on page 522*

2. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

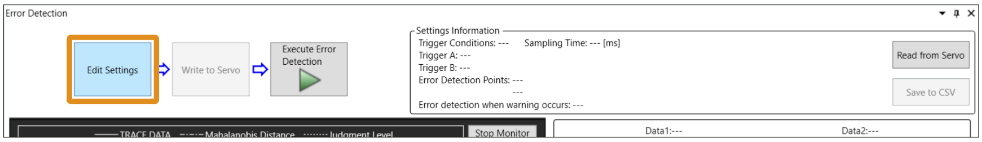
   The [Menu] window will be displayed.

3. **Click [Error Detection] in the [Diagnostic] area.**



   The [Error Detection] window will be displayed.

4. **Click the [Edit Settings] button.**

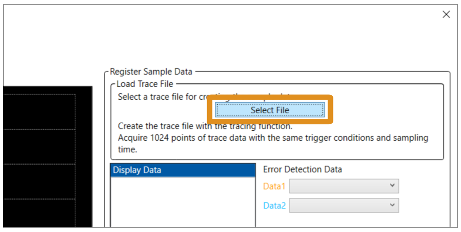


Settings Information
Trigger Conditions: ---
Sampling Time: --- [ms]
Trigger A: ---
Trigger B: ---
Error Detection Points: ---

Error detection when warning occurs: ---
Data1:---
Data2:---

The [Edit Error Detection Settings] window will be displayed.

5. **Click the [Select File] button.**

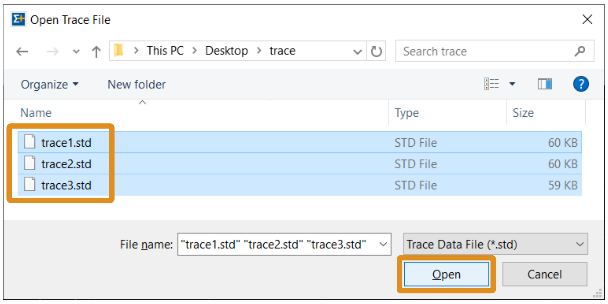


Select a trace file for cr

Create the trace file with the tracing function.
Acquire 1024 points of trace data with the same trigger conditions and sampling time.

The [Open Trace File] window will be displayed.

6. **Select the prepared trace data (std file), and then click the [Open] button.**



Name	Type	Size
trace1.std	STD File	60 KB
trace2.std	STD File	60 KB
trace3.std	STD File	59 KB

File name: "trace1.std" "trace2.std" "trace3.std"

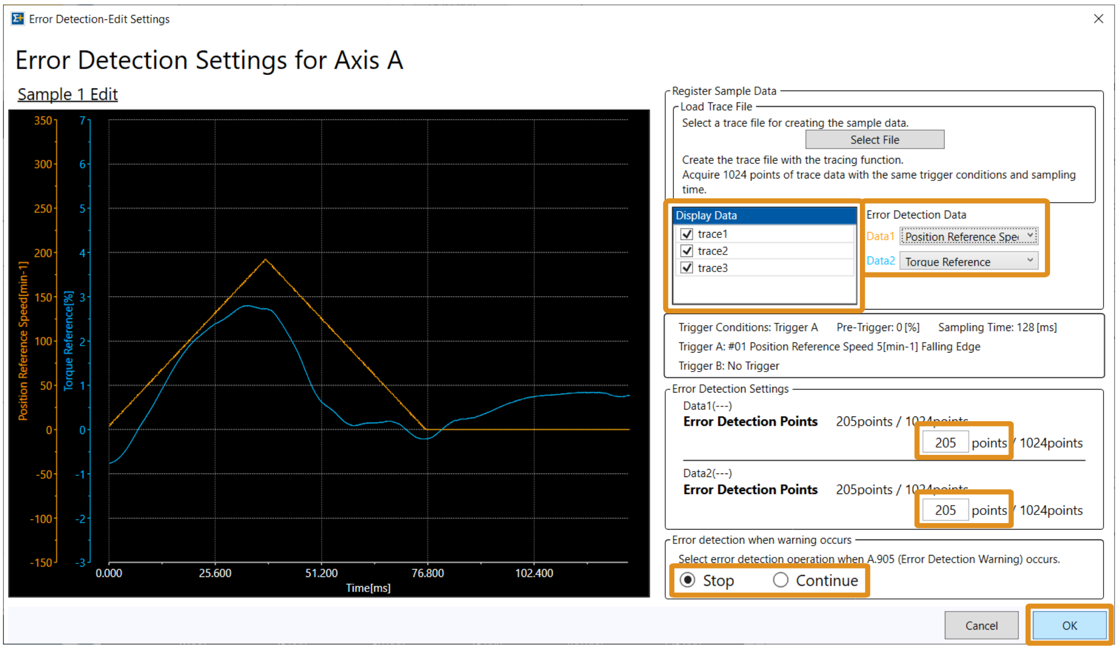
Trace Data File (*.std)

Information You can select multiple files by using the [Shift] key and [Ctrl] key while selecting files.

The selected files will be displayed on the [Error Detection-Edit Settings] window.

7. **Configure the following settings, and then click the [OK] button.**

- Select the check boxes for the data to use to create the sample data.
- Set the data to use for error detection in [Data 1] and [Data 2].
- Set the number of error detection points.
  Set whether to trigger A.905 when a difference of the number of points is detected for the sample data. If the setting is low, the odds of A.905 being triggered will increase. If the setting is 1024, A.905 will no longer be triggered.
  The number of error detection points can be changed when using error detection. The appropriate setting will depend on the device and usage conditions, so adjust the setting while actually using error detection.
- Select the error detection trace execution setting.



Select a trace file for creating the sample data.

Create the trace file with the tracing function.
Acquire 1024 points of trace data with the same trigger conditions and sampling time.

☑ trace1
☑ trace2
☑ trace3

Data1 Position Reference Spe
Data2 Torque Reference

Trigger Conditions: Trigger A Pre-Trigger: 0 [%] Sampling Time: 128 [ms]
Trigger A: #01 Position Reference Speed 5[min-1] Falling Edge
Trigger B: No Trigger

Data1(---)
Error Detection Points 205points / 1024points
205 points / 1024points

Data2(---)
Error Detection Points 205points / 1024points
205 points / 1024points

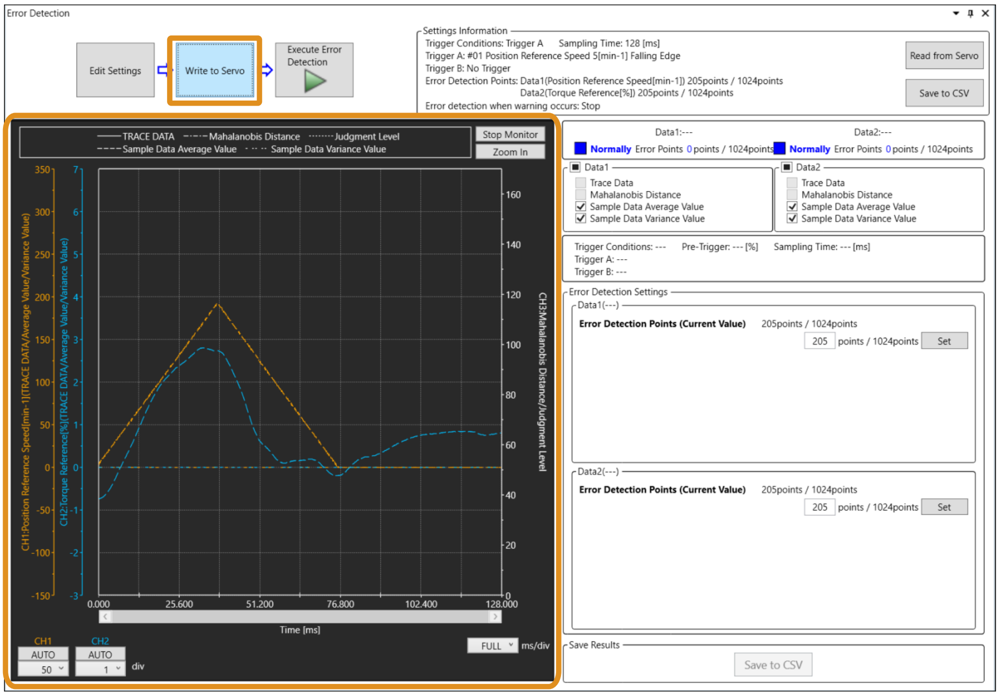
Select error detection operation when A.905 (Error Detection Warning) occurs.
● Stop ○ Continue

The average and dispersion values of the sample data will be displayed on the [Error Detection] window.

Information You can also set the error detection trace execution setting with the parameter. The following table gives details on the parameter to set.

		Execution Selection when Error Detection Warning **Speed** **Pos** **Trq**		When Enabled
Pn5C3	n.□□X□	0 Default	Stop error detection when A.905 (Error Detection Warning) occurs.	After restart
		1	Do not stop error detection when A.905 (Error Detection Warning) occurs.	

8. **Check the waveforms of the sample data, and then click [Write to Servo] button.**



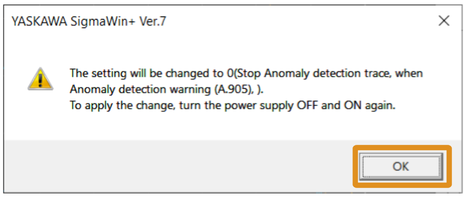
Settings Information
Trigger Conditions: Trigger A   Sampling Time: 128 [ms]
Trigger A: #01 Position Reference Speed 5[min-1] Falling Edge
Trigger B: No Trigger
Error Detection Points: Data1(Position Reference Speed[min-1]) 205points / 1024points
Data2(Torque Reference[%]) 205points / 1024points
Error detection when warning occurs: Stop

Trigger Conditions: ---   Pre-Trigger: --- [%]   Sampling Time: --- [ms]
Trigger A: ---
Trigger B: ---

Error Detection Settings
Data1(---)
Error Detection Points (Current Value) 205points / 1024points
205 points / 1024points Set
Data2(---)
Error Detection Points (Current Value) 205points / 1024points
205 points / 1024points Set

The message dialog box will be displayed.

9. **Click the [OK] button.**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The setting will be changed to 0(Stop Anomaly detection trace, when Anomaly detection warning (A.905),).
To apply the change, turn the power supply OFF and ON again.

The displayed sample data will be written to the SERVOPACK.

10. **To enable the sample data saved to the SERVOPACK, turn the power to the SERVOPACK OFF and ON again.**

Information To edit the sample data, click the [Edit Settings] button. The [Edit Error Detection Settings] window will be displayed, and you can change the settings.

This concludes the procedure to create sample data. Next, use error detection. Refer to the following section for details.

☞ *9.6.4 Executing Error Detection on page 527*

(1) Related Parameters

The following section describes the setting procedure using the SigmaWin+.

☞ *9.6.3 Creating Sample Data and Setting the Error Judgment Baseline on page 523*

You can also configure these settings with SERVOPACK parameters. The parameters related to the settings are shown next.

Information The number of error detection points and the error judgment levels can be set with parameters.

The error detection data cannot be set with parameters. Use the SigmaWin+ to set the error detection data.

You cannot use the SigmaWin+ to set the error judgment levels. You can use only the parameters to set the error judgment levels.

(a) Number of Error Detection Points

Pn5C4	Error Detection Sample Data Set 1 Warning Level 1			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	0.01%	2000	Immediately
Pn5C6	Error Detection Sample Data Set 1 Warning Level 2			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	0.01%	2000	Immediately
Pn5C8	Error Detection Sample Data Set 2 Warning Level 1			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	0.01%	2000	Immediately
Pn5CA	Error Detection Sample Data Set 2 Warning Level 2			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	0.01%	2000	Immediately

Information In the SigmaWin+, set error detection points, but with parameters, set error rate (level).

For example, to set the level for the torque reference data of sample data 1, configure the settings as shown below.

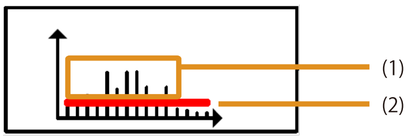
1. For [Error Detection Data: Data 1] in the SigmaWin+, set the torque reference data.
2. In Pn5C4 (Error Detection Sample Data Set 1 Warning Level 1), set the error rate for reference data.
   For example, to trigger A.905 when the error rate is 30%, set Pn5C4 to 3000.
   Or to no longer trigger A.905, set Pn5C4 to 10000.

(b) Error Judgment Level

It is normally not necessary to change the error judgment level, but it can be changed with parameters. The error judgment level cannot be changed in the SigmaWin+. The following table lists the related parameters for changing the error judgment level.

Pn5C5	Error Detection Sample Data Set 1 Judgment Level 1			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	–	1520	Immediately
Pn5C7	Error Detection Sample Data Set 1 Judgment Level 2			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	–	1520	Immediately
Pn5C9	Error Detection Sample Data Set 2 Judgment Level 1			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	–	1520	Immediately
Pn5CB	Error Detection Sample Data Set 2 Judgment Level 2			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 10000	–	1520	Immediately

The following table shows the relationship between the Mahalanobis distance and the parameters to set.



No.	Description	Parameter to Set
(1)	Set what percentage the judgment level should be exceeded in order to trigger A.905. This percentage is called the error rate, which can be calculated with the following equation. Error rate [%] = Number of samples that exceed the judgment level [count] / Number of samples of trace data [count]	Pn5C4 Pn5C6 Pn5C8 Pn5CA
(2)	Set the judgment level at which an error is judged. It is normally not necessary to change these settings from the default values.	Pn5C5 Pn5C7 Pn5C9 Pn5CB

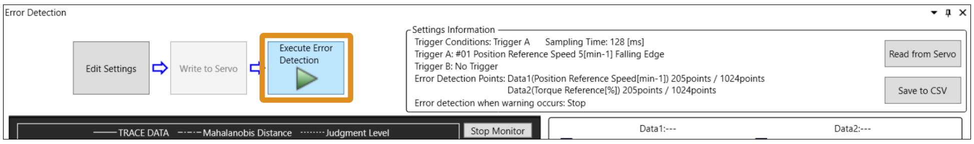
9.6.4 Executing Error Detection

This section describes how to use error detection.

Information Refer to the following section for the preparations to use error detection.

☞ *9.6.3 Creating Sample Data and Setting the Error Judgment Baseline on page 523*

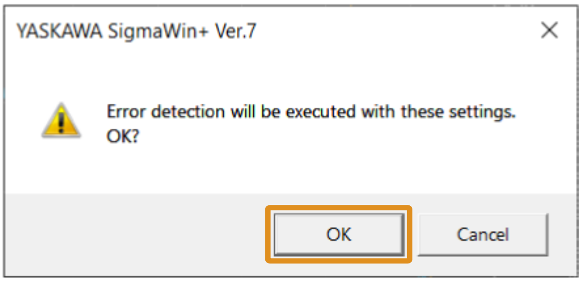
1. **Click the [Execute Error Detection] button in the SigmaWin+.**



Settings Information
Trigger Conditions: Trigger A Sampling Time: 128 [ms]
Trigger A: #01 Position Reference Speed 5[min-1] Falling Edge
Trigger B: No Trigger
Error Detection Points: Data1(Position Reference Speed[min-1]) 205points / 1024points
Data2(Torque Reference[%]) 205points / 1024points
Error detection when warning occurs: Stop

The message dialog box will be displayed.

2. **Click the [OK] button.**



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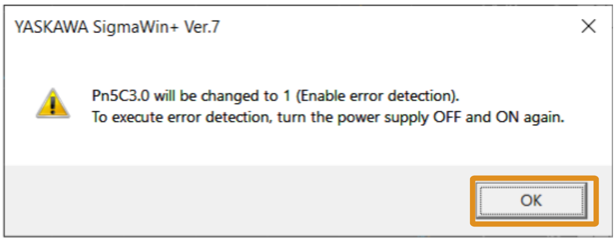
Error detection will be executed with these settings.
OK?

Another message dialog box will be displayed.

3. **Click the [OK] button.**



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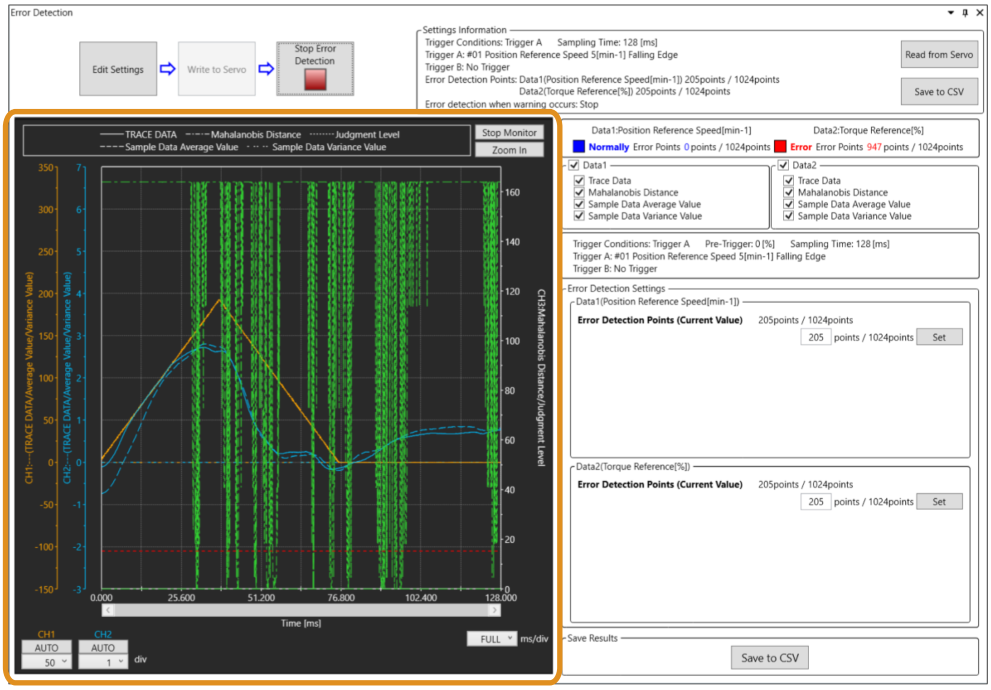
Pn5C3.0 will be changed to 1 (Enable error detection).
To execute error detection, turn the power supply OFF and ON again.

4. **Turn the power to the SERVOPACK OFF and ON again.**
5. **Run the machine and equipment as you would normally.**

The sample data and running trace data will be displayed.



Settings Information
Trigger Conditions: Trigger A Sampling Time: 128 [ms]
Trigger A: #01 Position Reference Speed 5[min-1] Falling Edge
Trigger B: No Trigger
Error Detection Points: Data1(Position Reference Speed[min-1]) 205points / 1024points
Data2(Torque Reference[%]) 205points / 1024points
Error detection when warning occurs: Stop

Data1:Position Reference Speed[min-1] Data2:Torque Reference[%]
🟦 Normally Error Points 0points / 1024points 🟥 Error Error Points 947points / 1024points

☑ Data1
☑ Trace Data
☑ Mahalanobis Distance
☑ Sample Data Average Value
☑ Sample Data Variance Value

☑ Data2
☑ Trace Data
☑ Mahalanobis Distance
☑ Sample Data Average Value
☑ Sample Data Variance Value

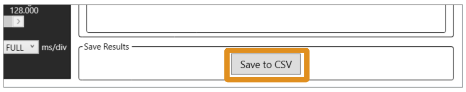
Trigger Conditions: Trigger A Pre-Trigger: 0 [%] Sampling Time: 128 [ms]
Trigger A: #01 Position Reference Speed 5[min-1] Falling Edge
Trigger B: No Trigger

Error Detection Settings
Data1(Position Reference Speed[min-1])
Error Detection Points (Current Value) 205points / 1024points
205 points / 1024points

Data2(Torque Reference[%])
Error Detection Points (Current Value) 205points / 1024points
205 points / 1024points

When an error is detected according to the set conditions and content, A.905 (Error Detection Warning) will occur.

Click the [Save to CSV] button to save the on-screen data to a CSV file.



(1) Restrictions

- If the SERVOPACK software version is 0007 or later, use the SigmaWin+ Ver. 7.42 or later to use error detection.
- You cannot execute utility functions at the same time as error detection. Error detection will stop if you execute the following utility functions.

SigmaWin+		Digital Operator		Reference
Button in [Menu] Window	**SigmaWin+ Function Name**	**Fn No.**	**Utility Function Name**	
Monitor	Trace	–	–	☞ *9.3 Monitoring Machine Operation Status and Signal Waveforms on page 511*
Tuning	Tuning - Moment of Inertia Ratio Settings - Execute	–	–	☞ *8.5 Moment of Inertia Estimation without a Host Reference on page 373*
Diagnostic	Mechanical Analysis	–	–	☞ *8.16.1 Mechanical Analysis on page 494*

10

Fully-Closed Loop Control

Provides detailed information on performing fully-closed loop control with the SERVOPACK.

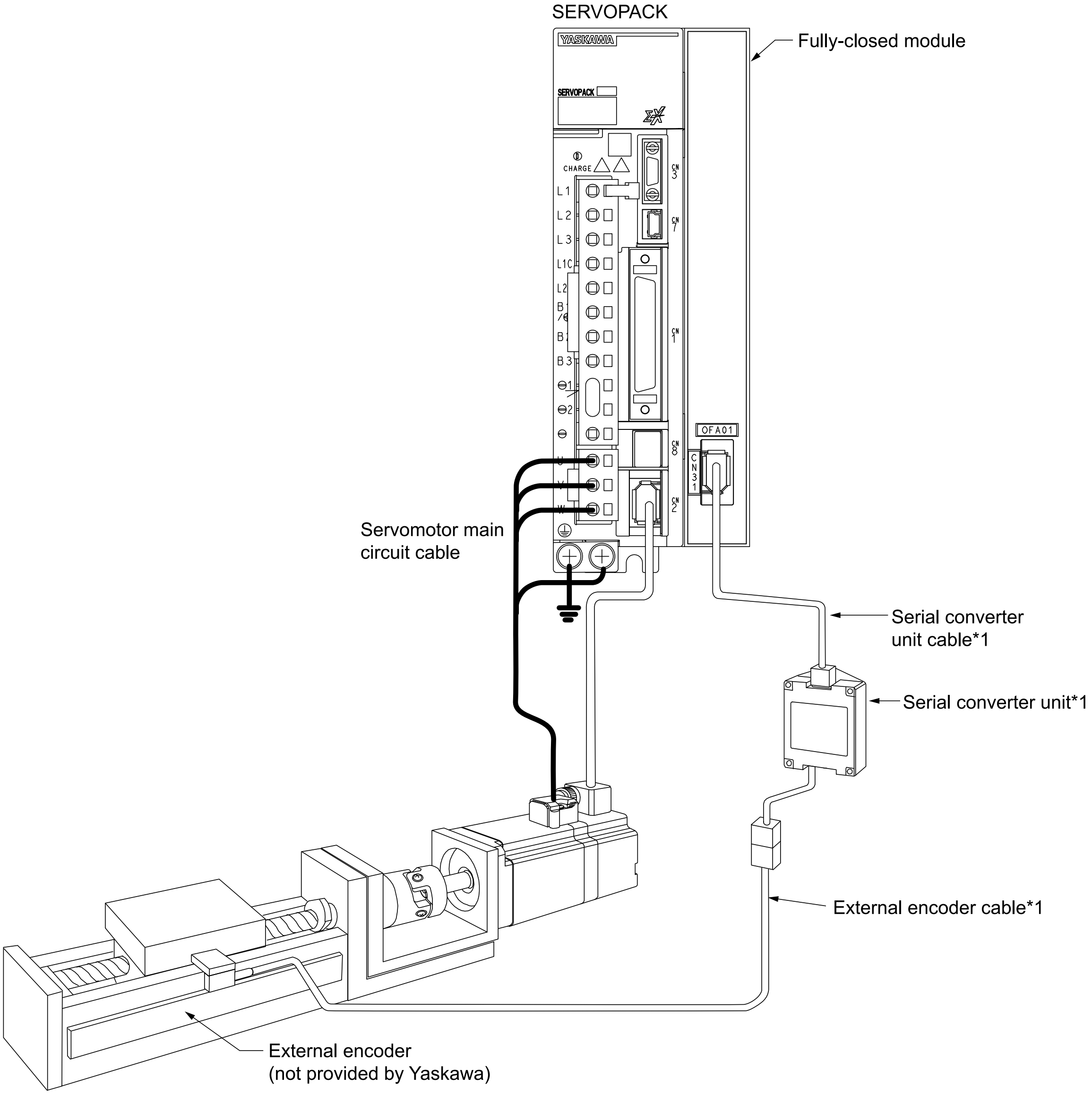
10.1 Fully-Closed System

With a fully-closed system, an externally installed encoder is used to detect the position of the controlled machine and the machine's position information is fed back to the SERVOPACK. High-precision positioning is possible because the actual machine position is fed back directly. With a fully-closed system, looseness or twisting of mechanical parts may cause vibration or oscillation, resulting in unstable positioning.

Refer to the following manual for details on fully-closed modules.

📖 Σ-X-Series Peripheral Device Selection Manual (Manual No.: SIEP C710812 12)

The following figure shows an example of the system configuration.



*1 The connected devices and cables depend on the type of external linear encoder that is used.

Note:

Refer to the following section for details on connections that are not shown above, such as connections to power supplies and peripheral devices.

☞ *2.4 Examples of Standard Connections between SERVOPACKs and Peripheral Devices on page 90*

10.2 SERVOPACK Commissioning Procedure

First, confirm that the SERVOPACK operates correctly with semi-closed loop control, and then confirm that it operates correctly with fully-closed loop control.

The commissioning procedure for the SERVOPACK for fully-closed loop control is given below.

Step	Description	Operation	Required Parameter Settings	Controlling Device
1	Check operation of the entire sequence with semi-closed loop control and without a load. Items to Check • Power supply circuit wiring • Servomotor wiring • Encoder wiring • Wiring of I/O signal lines from the host controller • Servomotor rotation direction, motor speed, and multiturn data • Operation of safety mechanisms, such as the holding brakes and the overtravel mechanisms	Set the parameters so that the SERVOPACK operates correctly in semi-closed loop control without a load and check the following points. Set Pn002 to n.0□□□ (do not use an external encoder) to specify semi-closed loop control. • Are there any errors in the SERVOPACK? • Does jogging operation function correctly when you operate the SERVOPACK without a load? • Do the I/O signals turn ON and OFF correctly? • Is power supplied to the servomotor when the /S-ON (Servo ON Input) signal is input? • Does the servomotor operate correctly when a position reference is input by the host controller?	• Pn000 (Basic Function Selections 0) • Pn001 (Application Function Selections 1) • Pn002 = n.X□□□ (External Encoder Usage) • Pn20E (Electronic Gear Ratio (Numerator)) • Pn210 (Electronic Gear Ratio (Denominator)) • Pn50A to Pn517 or Pn50A to Pn517, Pn590, Pn591, Pn598, Pn599 (Output Signal Selections)	SERVOPACK or host controller
2	Check operation with the servomotor connected to the machine with semi-closed loop control. Items to Check • Initial response of the system connected to the machine • Movement direction, travel distance, and movement speed as specified by the references from the host controller	Connect the servomotor to the machine. Set the moment of inertia ratio in Pn103 using autotuning without a host reference. Check that the machine's movement direction, travel distance, and movement speed agree with the references from the host controller.	Pn103 (Moment of Inertia Ratio)	Host controller
3	Check the external encoder. Items to Check Is the signal from the external encoder received correctly?	Set the parameters related to fully-closed loop control and move the machine with your hand without turning ON the power to the servomotor. Check the following status with the panel operator, digital operator, or SigmaWin+. • Does the fully-closed feedback pulse counter count up when the servomotor moves in the forward direction? • Is the travel distance of the machine visually about the same as the amount counted by the fully-closed feedback pulse counter? **Note:** The unit for the fully-closed feedback pulse counter is pulses, which is equivalent to the external encoder sine wave pitch.	• Pn002 = n.X□□□ (External Encoder Usage) • Pn20A (Number of External Encoder Scale Pitches) • Pn20E (Electronic Gear Ratio (Numerator)) • Pn210 (Electronic Gear Ratio (Denominator)) • Pn281 (Encoder Output Resolution) • Pn51B (Motor-Load Position Deviation Overflow Detection Level) • Pn522 (Positioning Completed Width) • Pn52A (Multiplier per Fully-closed Rotation)	–

Continued on next page.

Continued from previous page.

Step	Description	Operation	Required Parameter Settings	Controlling Device
4	Perform a program jogging. Items to Check Does the fully-closed system operate correctly for the SERVOPACK without a load?	Perform a program jogging and confirm that the travel distance is the same as the reference value in Pn531 (Program Jogging Travel Distance). When you perform program jogging, start from a low speed and gradually increase the speed.	Pn530 to Pn536 (program jogging-related parameters)	SERVOPACK
5	Operate the SERVOPACK. Items to Check Does the fully-closed system operate correctly, including the host controller?	Input a position reference and confirm that the SERVOPACK operates correctly. Start from a low speed and gradually increase the speed.	–	Host controller

10.3 Parameter Settings for Fully-Closed Loop Control

10.3.1 Parameters to Set and Reference Information

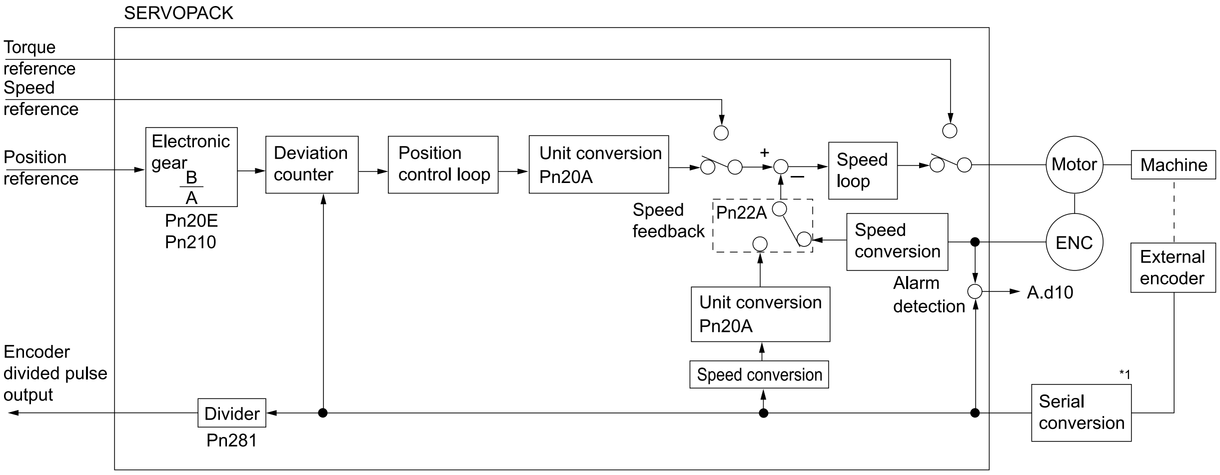
This section describes the parameter settings that are related to fully-closed loop control.

Parameter to Set	Setting	Availability *1			Reference
		Position Control	Speed Control	Torque Control	
Pn000 = n.□□□X	Motor rotation direction	○	○	○	☞ *10.3.3 Setting the Motor Rotation Direction and the Machine Movement Direction on page 534*
Pn002 = n.X□□□	External encoder usage method	○	○	○	
Pn20A	Number of external encoder scale pitches	○	○	○	☞ *10.3.4 Setting the Number of External Encoder Scale Pitches on page 535*
Pn281	PAO, PBO, and PCO (Encoder Divided Pulse Output) signals from the SERVOPACK	○	○	○	☞ *10.3.5 Setting the PAO, PBO, and PCO (Encoder Divided Pulse Output) Signals on page 535*
–	External absolute encoder data reception sequence	○	○	○	☞ *6.13.4 Reading the Position Data from the Absolute Linear Encoder on page 305*
Pn20E or Pn210	Electronic gear ratio	○	–	–	☞ *5.16 Electronic Gear Settings on page 200*
Pn51B	Motor-load position deviation overflow detection level	○	–	–	☞ *10.3.8 Alarm Detection Settings on page 537*
Pn52A	Multiplier per fully-closed rotation	○	–	–	
Pn006/Pn007	Analog monitor signal	○	○	○	☞ *10.3.9 Analog Monitor Signal Settings on page 537*
Pn22A = n.X□□□	Speed feedback method during fully-closed loop control	○	–	–	☞ *10.3.10 Setting to Use an External Encoder for Speed Feedback on page 539*

*1 ○: Can be set, –: Cannot be set

10.3.2 Control Block Diagram for Fully-Closed Loop Control

The control block diagram for fully-closed loop control is provided below.



*1 The connected device depends on the type of external encoder.

Note:

You can use either an incremental or an absolute encoder. If you use an absolute encoder, set Pn002 to n.□1□□ (use the absolute encoder as an incremental encoder).

10.3.3 Setting the Motor Rotation Direction and the Machine Movement Direction

You must set the motor rotation direction and the machine movement direction. To perform fully-closed loop control, you must set the motor rotation direction with both Pn000 = n.□□□X (Rotation Direction Selection) and Pn002 = n.X□□□ (External Encoder Usage).

Parameter			Pn002 = n.X□□□ (External Encoder Usage)			
			n.1□□□		n.3□□□	
Pn000 = n.□□□X (Motor Direction Selection)	**n.□□□0**	Reference direction	Forward reference	Reverse reference	Forward reference	Reverse reference
		Motor rotation direction	CCW	CW	CCW	CW
		External encoder	Forward movement	Reverse movement	Reverse movement	Forward movement
	n.□□□1	Reference direction	Forward reference	Reverse reference	Forward reference	Reverse reference
		Motor rotation direction	CW	CCW	CW	CCW
		External encoder	Reverse movement	Forward movement	Forward movement	Reverse movement

- Phase B leads in the divided pulses for a forward reference regardless of the setting of Pn000 = n.□□□X.
- Forward direction: The direction in which the pulses are counted up.
- Reverse direction: The direction in which the pulses are counted down.

(1) Related Parameters

- Pn000 = n.□□□X
  Refer to the following section for details.
  ☞ *5.6 Motor Direction Setting on page 172*
- Pn002 = n.X□□□
  When you perform fully-closed loop control, set Pn002 to n.1□□□ or n.3□□□.

Pn002	n.X□□□	External Encoder Usage	Speed Pos Trq	When Enabled
		0 Default	Do not use an external encoder.	After restart
		1	The external encoder moves in the forward direction for CCW motor rotation.	
		2	Reserved (Do not use.)	
		3	The external encoder moves in the reverse direction for CCW motor rotation.	
		4	Reserved (Do not use.)	

Information Determine the setting of Pn002 = n.X□□□ as described below.

1. Set Pn000 to n.□□□0 (use the direction in which the linear encoder counts up as the forward direction) and set Pn002 to n.1□□□ (the external encoder moves in the forward direction for CCW motor rotation).
2. Manually rotate the motor shaft counterclockwise.
3. If the fully-closed feedback pulse counter counts up, do not change the setting of Pn002 (Pn002 = n.1□□□).
   If the fully-closed feedback pulse counter counts down, set Pn002 to n.3□□□.

10.3.4 Setting the Number of External Encoder Scale Pitches

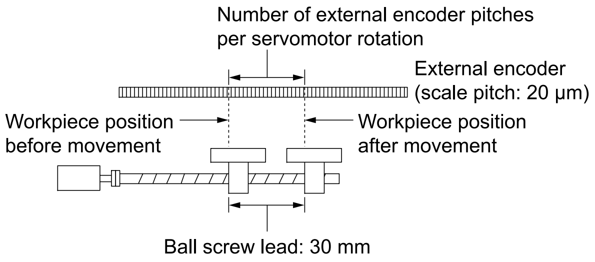
Set the number of external encoder scale pitches per servomotor rotation in Pn20A.

(1) Setting Example

Specifications

- External encoder scale pitch: 20 μm
- Ball screw lead: 30 mm

If the external encoder is connected directly to the servomotor, the setting will be 1500 (30 mm/0.02 mm = 1500).



Note:

1. If there is a fraction, round off the digits below the decimal point.
2. If the number of external encoder scale pitches per servomotor rotation is not an integer, there will be deviation in the position loop gain (Kp), feedforward, and position reference speed monitor. This is not relevant for the position loop and it therefore does not interfere with the position accuracy.

(2) Related Parameters

Pn20A	Number of External Encoder Scale Pitches			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	4 to 1048576	1 scale pitch/revolution	32768	After restart

10.3.5 Setting the PAO, PBO, and PCO (Encoder Divided Pulse Output) Signals

Set the position resolution in Pn281 (Encoder Output Resolution).

Enter the number of phase A and phase B edges for the setting.

(1) Setting Example

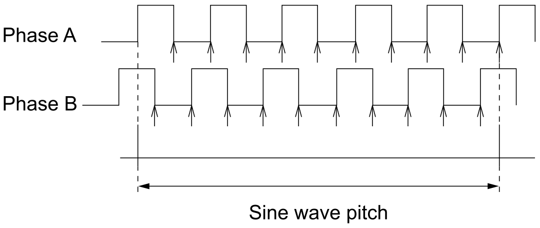
Specifications

- External encoder scale pitch: 20 µm
- Ball screw lead: 30 mm
- Speed:1600 mm/s

If a single pulse (multiplied by 4) is output for 1 µm, the setting would be 20.

If a single pulse (multiplied by 4) is output for 0.5 µm, the setting would be 40.

The encoder divided pulse output would have the following waveform if the setting is 20.



"↑" indicates the edge positions. In this example, the set value is 20 and therefore the number of edges is 20.

Note:

The upper limit of the encoder signal output frequency (multiplied by 4) is 6.4 Mpps. Do not set a value that would cause the output to exceed 6.4 Mpps. If the output exceeds the upper limit, an A.511 alarm (Encoder Output Pulse Overspeed) will be output.

Information If the setting is 20 and the speed is 1600 mm/s, the output frequency would be 1600 mm/s /0.001 mm = 1600000 = 1.6 Mpps.

Because 1.6 Mpps is less than 6.4 Mpps, this setting can be used.

(2) Related Parameters

Pn281	Encoder Output Resolution			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	1 to 4096	1 edge/pitch	20	After restart

Note:

- The maximum setting for the encoder output resolution is 4096. If the resolution of the external encoder exceeds 4096, pulse output will no longer be possible at the resolution given in the following section.
  ☞ ◆ *Feedback Resolution of Linear Encoder: Incremental Linear Encoder on page 202*
  ☞ ◆ *Feedback Resolution of Linear Encoder: Absolute Linear Encoder on page 202*
- If the setting of Pn281 exceeds the resolution of the external encoder, an A.041 alarm (Encoder Output Pulse Setting Error) will be output.

10.3.6 External Absolute Encoder Data Reception Sequence

Refer to the following sections for details.

☞ *6.13.4 Reading the Position Data from the Absolute Linear Encoder on page 305*

With fully-closed loop control, the same sequence as for a linear servomotor is used.

10.3.7 Electronic Gear Settings

Refer to the following section for details.

☞ *5.16 Electronic Gear Settings on page 200*

With fully-closed loop control, the same setting as for a linear servomotor is used.

10.3.8 Alarm Detection Settings

This section describes the parameters related to alarm detection settings (Pn51B and Pn52A).

(1) Pn51B (Motor-Load Position Deviation Overflow Detection Level)

This setting is used to detect the difference between the feedback position of the servomotor encoder and the feedback load position of the external encoder for fully-closed loop control. If the detected difference exceeds the setting, an A.d10 alarm (Motor-Load Position Deviation Overflow) will be output.

Pn51B	Motor-Load Position Deviation Overflow Detection Level			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 1073741824	1 reference unit	1000	Immediately

Note:

If you set this parameter to 0, A.d10 alarms will not be output and the machine may be damaged.

(2) Pn52A (Multiplier per Fully-closed Rotation)

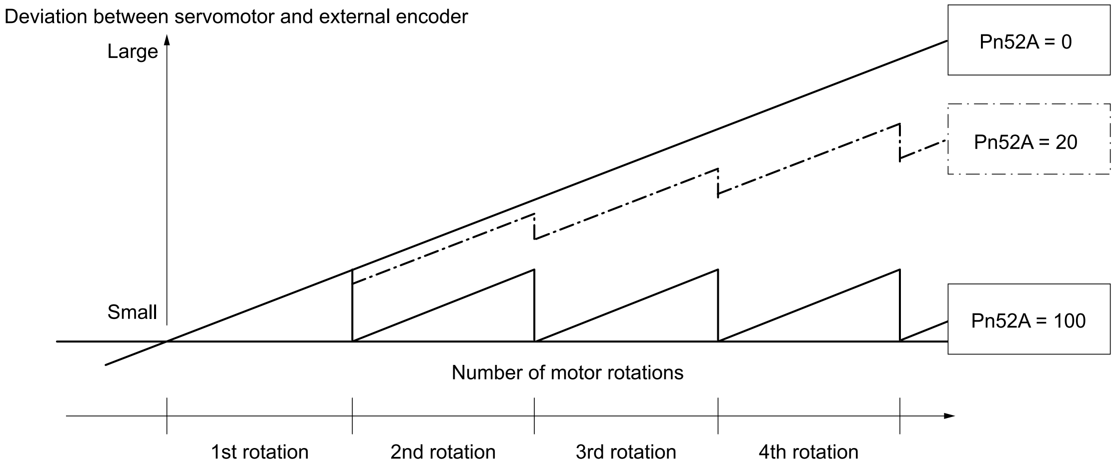
Set the coefficient of the deviation between the servomotor and the external encoder per servomotor rotation. This setting can be used to prevent the servomotor from running out of control due to damage to the external encoder or to detect belt slippage.

(a) Setting Example

Increase the value if the belt slips or is twisted excessively.

If this parameter is set to 0, the external encoder value will be read as it is.

If you use the default setting of 20, the second rotation will start with the deviation for the first motor rotation multiplied by 0.8.



(b) Related Parameters

Pn52A	Multiplier per Fully-closed Rotation			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0 to 100	1%	20	Immediately

10.3.9 Analog Monitor Signal Settings

You can monitor the position deviation between the servomotor and load with an analog monitor.

Pn006	n.□□XX	Analog Monitor 1 Signal Selection Speed Pos Trq		When Enabled
		00	Motor speed (1 V/1000 min^{-1}) Motor speed (1 V/1000 mm/s)	Immediately
		01	Speed reference (1 V/1000 min^{-1}) Speed reference (1 V/1000 mm/s)	
		02 Default	Torque reference (1 V/100% rated torque) Force reference (1 V/100% rated force)	
		03	Position deviation (0.05 V/reference unit)	
		04	Position amplifier deviation (after electronic gear) (0.05 V/encoder pulse unit) Position amplifier deviation (after electronic gear) (0.05 V/linear encoder pulse unit)	
		05	Position reference speed (1 V/1000 min^{-1}) Position reference speed (1 V/1000 mm/s)	
		06	Reserved (Do not use.)	
		07	Position deviation between motor and load (0.01 V/reference unit)	
		08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)	
		09	Speed feedforward (1 V/1000 min^{-1}) Speed feedforward (1 V/1000 mm/s)	
		0A	Torque feedforward (1 V/100% rated torque) Force feedforward (1 V/100% rated force)	
		0B	Active gain (gain 1: 1 V, gain 2: 2 V) 2 V)	
		0C	Completion of position reference distribution (completed: 5 V, not completed: 0 V)	
		0D	External encoder speed (1 V/1000 min^{-1}: value at the motor shaft)	
		0E	Reserved (Do not use.)	
		0F	Reserved (Do not use.)	
		10	Main circuit DC voltage	
		11 to 5F	Reserved (Do not use.)	

		Analog Monitor 2 Signal Selection Speed Pos Trq		When Enabled
Pn007	n.□□XX	00 Default	Motor speed (1 V/1000 min^{-1}) Motor speed (1 V/1000 mm/s)	Immediately
		01	Speed reference (1 V/1000 min^{-1}) Speed reference (1 V/1000 mm/s)	
		02	Torque reference (1 V/100% rated torque) Force reference (1 V/100% rated force)	
		03	Position deviation (0.05 V/reference unit)	
		04	Position amplifier deviation (after electronic gear) (0.05 V/encoder pulse unit) Position amplifier deviation (after electronic gear) (0.05 V/linear encoder pulse unit)	
		05	Position reference speed (1 V/1000 min^{-1}) Position reference speed (1 V/1000 mm/s)	
		06	Reserved (Do not use.)	
		07	Position deviation between motor and load (0.01 V/reference unit)	
		08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)	
		09	Speed feedforward (1 V/1000 min^{-1}) Speed feedforward (1 V/1000 mm/s)	
		0A	Torque feedforward (1 V/100% rated torque) Force feedforward (1 V/100% rated force)	
		0B	Active gain (gain 1: 1 V, gain 2: 2 V) 2 V)	
		0C	Completion of position reference distribution (completed: 5 V, not completed: 0 V)	
		0D	External encoder speed (1 V/1000 min^{-1}: value at the motor shaft)	
		0E	Reserved (Do not use.)	
		0F	Reserved (Do not use.)	
		10	Main circuit DC voltage	
		11 to 5F	Reserved (Do not use.)	

10.3.10 Setting to Use an External Encoder for Speed Feedback

For fully-closed loop control, you normally set Pn22A to n.0□□□ (use motor encoder speed). If you will use a direct drive servomotor and a high-resolution external encoder, set Pn22A to n.1□□□ (use external encoder speed).

		Fully-closed Control Speed Feedback Selection Speed Pos Trq		When Enabled
Pn22A	n.X□□□	0 Default	Use motor encoder speed.	After restart
		1	Use external encoder speed.	

Note:

This parameter cannot be used if Pn002 is set to n.0□□□ (do not use external encoder).

11

Σ-LINK II Function

Provides detailed information on the Σ-LINK II functions of the SERVOPACK.

11.1 Outline

Σ-LINK II is a protocol used for communications between the SERVOPACK and encoder.

The Σ-X Series now allows you to connect multiple devices to the SERVOPACK.

In addition to the encoder, you can also connected sensors and I/O devices installed on the machine end. You can also use a Yaskawa sensor hub (model number: JUSP-SL2H□) to connect devices that do not support Σ-LINK II to the SERVOPACK.

The SERVOPACK collects data from the devices. This collected data can be monitored by the host controller and allocated to signals and used for SERVOPACK functions.

You may need to perform configuration using the SigmaWin+ to enable Σ-LINK II. You may also need to configure settings to monitor the data of connected devices and to configure settings to allocate signals to SERVOPACK functions.

11.2 Devices That Support Σ-LINK II

The following table lists devices that support Σ-LINK II.

Classification	Product	Product Name	Model
Encoder	Servomotor (Semi-closed encoder)	Σ-X-series rotary servomotors Ancillary specification: Standard	SGMX□-□□□□□□□□1
	External Encoder *1 (Fully-closed encoder)	–	–
I/O Device	Sensor hub	Σ-LINK II sensor hub	JUSP-SL2H□

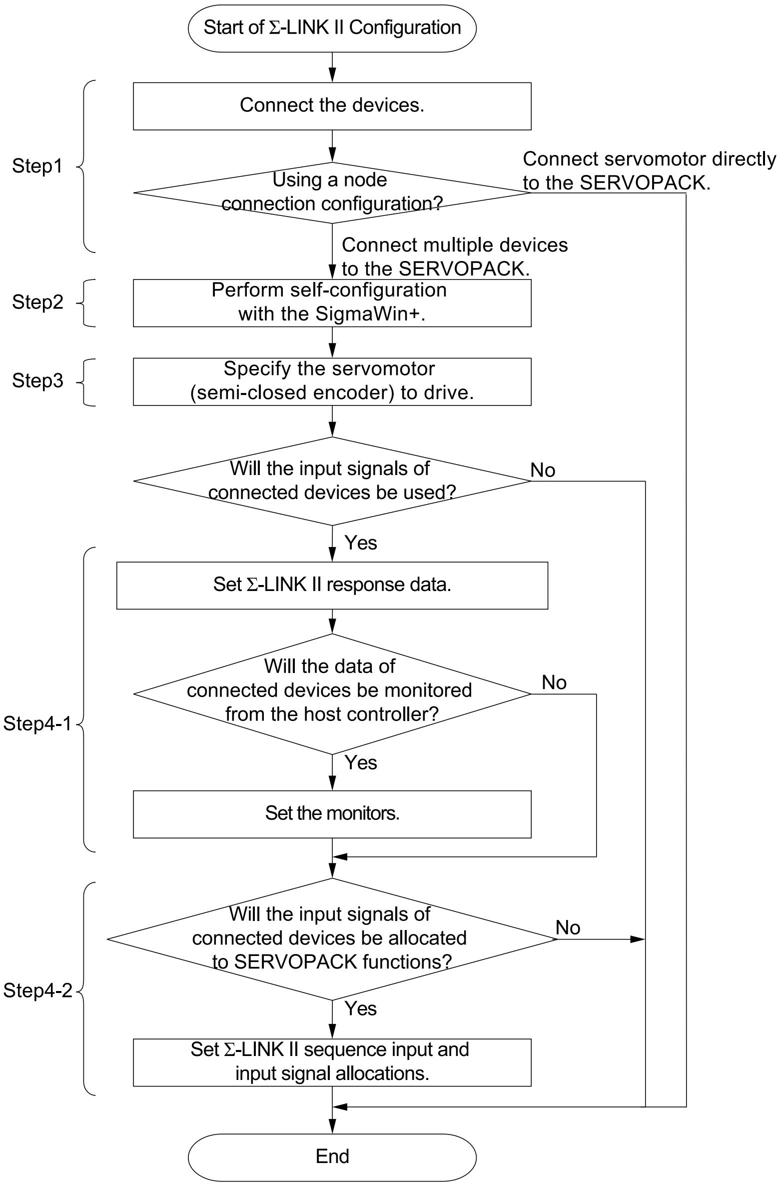
*1 Currently in development

Important

Σ-X-series rotary servomotors (model: SGMX□-□□□□□□□□2) with Σ-7 compatibility cannot use Σ-LINK II.

11.3 Procedure to Use Σ-LINK II

The following table gives the flow and references to use Σ-LINK II.



Step		Item	Reference
1		Connecting Devices to the SERVOPACK	☞ *11.2 Devices That Support Σ-LINK II on page 543* ☞ *11.4 Connecting Devices to the SERVOPACK on page 546*
2		Performing Self-Configuration with the SigmaWin+	☞ *11.5 Performing Self-Configuration on page 547*
3		Specifying the Servomotor (Semi-Closed Encoder) to Drive	☞ *11.6 Specifying the Servomotor (Semi-Closed Encoder) to Drive on page 552*
4		Configuring the Σ-LINK II Data Settings	–
	4-1	Monitoring the Input Signals of Connected Devices	☞ *11.7.1 Monitoring the Input Signals of Connected Devices with the SigmaWin+ on page 554*
	4-2	Allocating Input Signals of Connected Devices to SERVOPACK Functions and Using those Signals **Information** This function can be used only when a digital I/O type sensor hub is connected.	☞ *11.7.2 Allocating Input Signals of Connected Devices to SERVOPACK Functions and Using those Signals on page 557*

Term

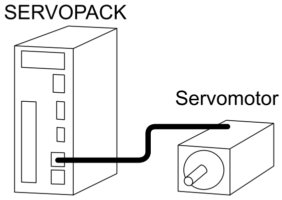
Self-configuration :

Self-configuration is a function that automatically identifies the devices connected over Σ-LINK II. Perform self-configuration from the SigmaWin+. You must perform self-configuration only when you connect multiple devices to the SERVOPACK.

11.4 Connecting Devices to the SERVOPACK

This section describes about when using a direction connection between the SERVOPACK and servomotor and when connecting multiple devices to the SERVOPACK.

11.4.1 Using a Direct Connection between the SERVOPACK and Servomotor

Equipment Configuration	Remarks
	Setup is not required to enable Σ-LINK II.

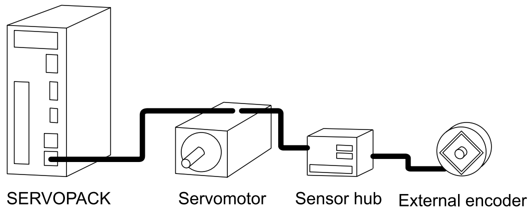
11.4.2 Connecting Multiple Devices to the SERVOPACK

You can connect a maximum of three Σ-LINK-II-compatible devices to the SERVOPACK, but only two of those connections can be devices that detect position (e.g., a servomotor and external encoder).

Important

There are limitations on the maximum cable length when connecting multiple devices to the SERVOPACK. Refer to the following manual for details.

📖 Σ-X-Series Peripheral Device Selection Manual (Manual No.: SIEP C710812 12)

Equipment Configuration	Remarks
	• Setup is required to enable Σ-LINK II. Refer to the following section for details on the settings. ☞ *11.5 Performing Self-Configuration on page 547* • Devices can be connected in any order.

11.5 Performing Self-Configuration

Perform self-configuration to identify the devices connected over Σ-LINK II. Use the SigmaWin+ to perform self-configuration. When you perform self-configuration, the connected devices will be automatically identified and those results will be saved in the SERVOPACK.

If a node or connection configuration is detected after restart that differs from the saved results, A.Cd4 (Sigma-LINK II Node Change Detected) will occur.

Information
- If you change the configuration of devices connected over Σ-LINK II after the self-configuration results are saved, execute self-configuration again or discard the self-configuration data. To discard the self-configuration data, click the [Discard Settings] button on the [SigmaLINK II Settings] window.
- If you use a direct connection between the SERVOPACK and servomotor, self-configuration is not required. However, if you switch to a direct connection between the SERVOPACK and servomotor after the self-configuration results are saved, execute self-configuration again or discard the self-configuration results data.
- When you connect a sensor hub, additional setup procedures are required. After you configure these settings, perform procedures shown in the following section.
  ☞ *11.7.2 Allocating Input Signals of Connected Devices to SERVOPACK Functions and Using those Signals on page 557*
- If the node detection time is short, a timeout may occur and the correct results may not be obtained. In this case, increase the setting of Pn589 (SigmaLINK II Node Detection Time).

11.5.1 Preparations

Always check the following before you perform Σ-LINK II configuration.

- Utility functions must not be running.
  Refer to the following section for details on utility functions.
  ☞ *16.2.1 Corresponding SERVOPACK Utility Function Names on page 741*
- The servo must not be ON.

11.5.2 Applicable Tools

The following table lists the tools that you can use to perform Σ-LINK II configuration.

Tool	Fn No./Function Name	Reference
Panel Operator	You cannot perform Σ-LINK II configuration from the panel operator.	
Digital Operator	You cannot perform Σ-LINK II configuration from the digital operator.	
SigmaWin+	[Σ-LINK II Setting]	📖 Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

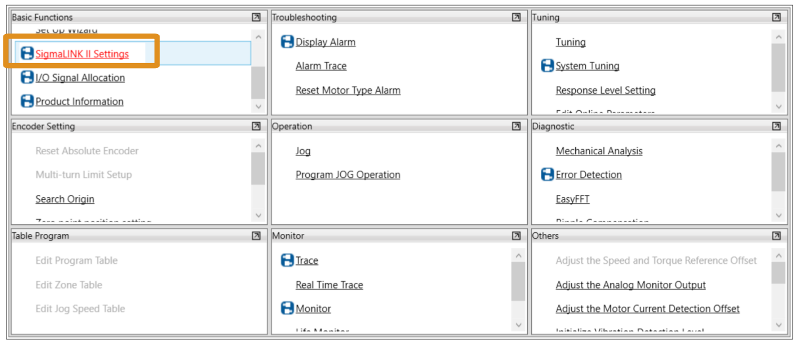
11.5.3 Operating Procedure

This section gives the operation procedure for Σ-LINK II self-configuration.

1. **First connect all Σ-LINK II devices, and then start an online connection to the SERVOPACK with the SigmaWin+.**
2. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

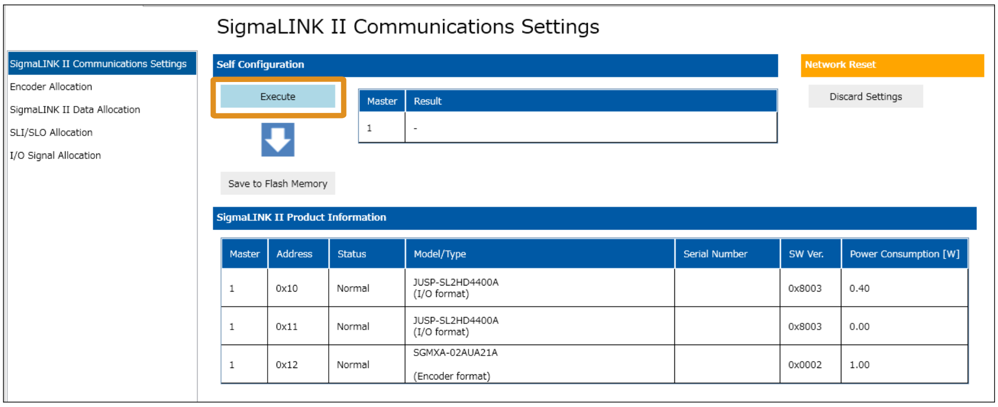
   The [Menu] window will be displayed.

3. **Click [SigmaLINK II Setting] in the [Basic Functions] area.**



The [SigmaLINK II Communications Settings] window will be displayed.

4. **Click the [Execute] button.**



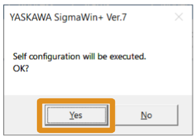
Master	Result
1	-

Master	Address	Status	Model/Type	Serial Number	SW Ver.	Power Consumption [W]
1	0x10	Normal	JUSP-SL2HD4400A (I/O format)		0x8003	0.40
1	0x11	Normal	JUSP-SL2HD4400A (I/O format)		0x8003	0.00
1	0x12	Normal	SGMXA-02AUA21A (Encoder format)		0x0002	1.00

Information
- Click the [Discard Settings] button to discard the self-configuration results.
- If an error code is displayed, refer to the following section.
  ☞ *11.5.4 Troubleshooting If an Error Code Is Displayed on page 549*

The message dialog box will be displayed.

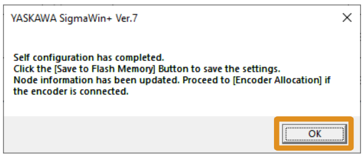
5. **Click the [Yes] button.**



Self configuration will be executed.
OK?

Another dialog box will be displayed.

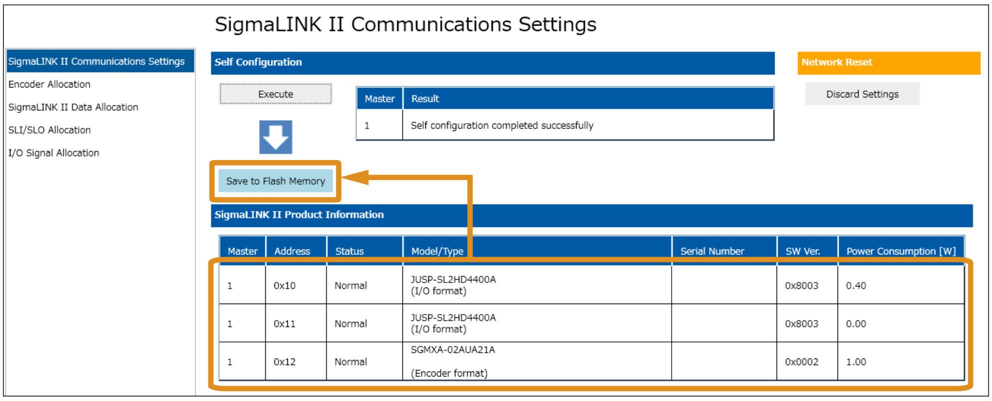
6. **Click the [OK] button.**



Self configuration has completed.
Click the [Save to Flash Memory] Button to save the settings.
Node information has been updated. Proceed to [Encoder Allocation] if the encoder is connected.

The devices connected to CN2 will be automatically detected, and the connected device information will be displayed at the bottom of the window.

7. **Check the information that was automatically detected. If there are no problems with the information, click the [Save to Flash Memory] button.**

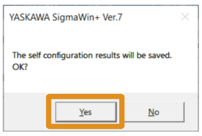


Master	Result
1	Self configuration completed successfully

Master	Address	Status	Model/Type	Serial Number	SW Ver.	Power Consumption [W]
1	0x10	Normal	JUSP-SL2HD4400A (I/O format)		0x8003	0.40
1	0x11	Normal	JUSP-SL2HD4400A (I/O format)		0x8003	0.00
1	0x12	Normal	SGMXA-02AUA21A (Encoder format)		0x0002	1.00

The message dialog box will be displayed.

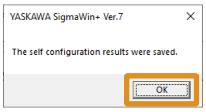
8. **Click the [Yes] button.**



The self configuration results will be saved.
OK?

Another dialog box will be displayed.

9. **Click the [OK] button.**



The self configuration results were saved.

The self-configuration results will be saved in the SERVOPACK.

This concludes the procedure.

11.5.4 Troubleshooting If an Error Code Is Displayed

If an error code is displayed when starting the [SigmaLINK II Communications Settings] window in the Sigma-Win+ or when Σ-LINK II self-configuration was executed, resolve the error based on the following information.

Error Code	Item	Possible Cause	Confirmation	Correction
0x0011	Node Combination Error	The SERVOPACK exceeded the upper limit of Σ-LINK II nodes that can be connected.	Check the number of nodes that can be connected. For the number of nodes that can be connected, refer to Peripheral Device Selection Manual (Manual No.: SIEP C710812 12).	Review the device configuration and set it to the number of nodes that can be connected.
		The content saved in the configuration and the content detected in node detection are different.	Check the content that was saved with self-configuration and the actual device connections.	If the actual device configuration is correct, execute self-configuration again. If the content that was saved with self-configuration is correct, change the actual device configuration to match the saved content.
		A sensor hub is connected that exceeds the number of connections supported by the SERVOPACK.	Check the total number of sensor hub connections.	Keep the total number of sensor hub connections to within two nodes.
0x0013	Excessive Total Power Consumption	The total power consumption of the nodes connected to one connector exceeded 3.5 W.	Check the total power consumption of the nodes connected to one connector.	• Use a booster unit. • Review the connection configuration so that total power consumption does not exceed the specified value. For the connection configuration, refer to Peripheral Device Selection Manual (Manual No.: SIEP C710812 12).

Continued on next page.

Continued from previous page.

Error Code	Item	Possible Cause	Confirmation	Correction
0x0070	Slave Communications Error	A timeout occurred while detecting nodes.	Compare the number of detected nodes displayed on the window and the actual number of connected nodes.	If the number of detected nodes displayed on the window is lower than the actual number of connected nodes, make the set value for Pn589 (Σ-LINK II Node Detection Time) larger, turn the power OFF and ON, and execute self-configuration again.
		There is a faulty contact in the connector or the connector is not wired correctly for the encoder cable.	Check the condition of the connector for encoder cable.	Reconnect the connector for encoder cable and check the encoder wiring.
		There is a cable disconnection or shortcircuit in the encoder. Or, the cable impedance is outside the specified values.	Check the condition of the encoder cable.	Use the encoder cable within the specified specifications.
		The power supplied to nodes is insufficient due to the voltage drop from the length of the cable.	Check if the length of each cable is within the specified cable length. For the specified cable lengths, refer to Peripheral Device Selection Manual (Manual No.: SIEP C710812 12).	• Use a booster unit. • Change the length of each cable to the specified cable length.
		One of the following has occurred: corrosion caused by improper temperature, humidity, or gas, a short-circuit caused by entry of water drops or cutting oil, or faulty contact in connector caused by vibration.	Check the operating environment.	Improve the operating environment, and replace the cable. If the alarm still occurs, replace the SERVOPACK.
		A malfunction was caused by noise.	–	Correct the wiring around the encoder by separating the encoder cable from the servomotor main circuit cable or by grounding the encoder.
		A failure occurred in the SERVOPACK.	–	If normal communications are possible after replacing the SERVOPACK with a different SERVOPACK, the SERVOPACK may be faulty. Replace the SERVOPACK.
0xFFFF	System Error	A system error occurred in the SERVOPACK.	–	If normal communications are possible after replacing the SERVOPACK with a different SERVOPACK, the SERVOPACK may be faulty. Replace the SERVOPACK.

11.6 Specifying the Servomotor (Semi-Closed Encoder) to Drive

The SERVOPACK cannot determine which device at what node address to drive by executing self-configuration only. For this reason, you must specify the node address of the servomotor for the SERVOPACK to drive and save that node address in the SERVOPACK.

You will use the SigmaWin+ to configure these settings.

Term

Node Address :

A node address is a unique number that identifies a device connected over Σ-LINK II.

Important

If you do not set the node address of the servomotor (semi-closed encoder) to drive correctly, an A.C90 alarm (Encoder Communications Error) will occur.

Information

You can also use parameters to specify the servomotor (semi-closed encoder) to drive. The following table lists the related parameters.

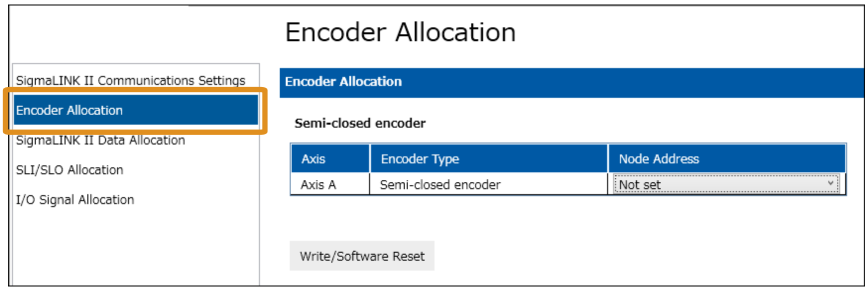
Pn0DA	n.□□XX	Node Address **Speed** **Pos** **Trq**		When Enabled
		00 to 1E	Select an encoder with a node address between 00h and 1Eh.	After restart

For example, set Pn0DA to 0012h for Node 3.

11.6.1 Operating Procedure

Use the following procedure to specify the motor (semi-closed encoder) to drive.

1. **Click [Encoder Allocation] on the [SigmaLINK II Settings] window.**



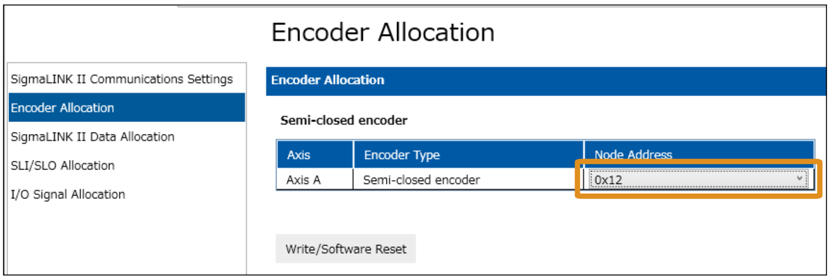
Axis	Encoder Type	Node Address
Axis A	Semi-closed encoder	Not set

The display of the [SigmaLINK II Communications Settings] area will be changed.

2. **Set the node address of the servomotor to be driven by the SERVOPACK.**

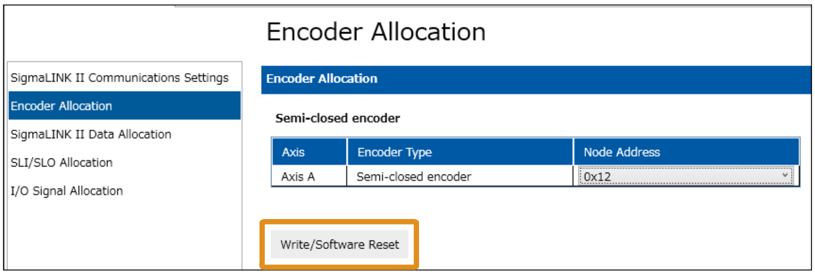
Refer to the following section for details on node address.

☞ *11.6 Specifying the Servomotor (Semi-Closed Encoder) to Drive on page 552*



Axis	Encoder Type	Node Address
Axis A	Semi-closed encoder	0x12

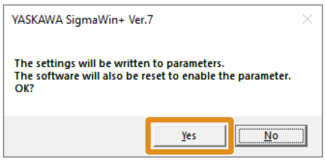
3. **Click the [Write/Software Reset] button.**



Axis	Encoder Type	Node Address
Axis A	Semi-closed encoder	0x12

The message dialog box will be displayed.

4. **Click the [Yes] button.**



The settings will be written to parameters.
The software will also be reset to enable the parameter.
OK?

After the software is reset, the node address of the motor to be driven by the SERVOPACK will be saved to the SERVOPACK and another message dialog box will be displayed.

5. **Click the [OK] button.**

Writing the settings to parameters has been completed.

This concludes the procedure.

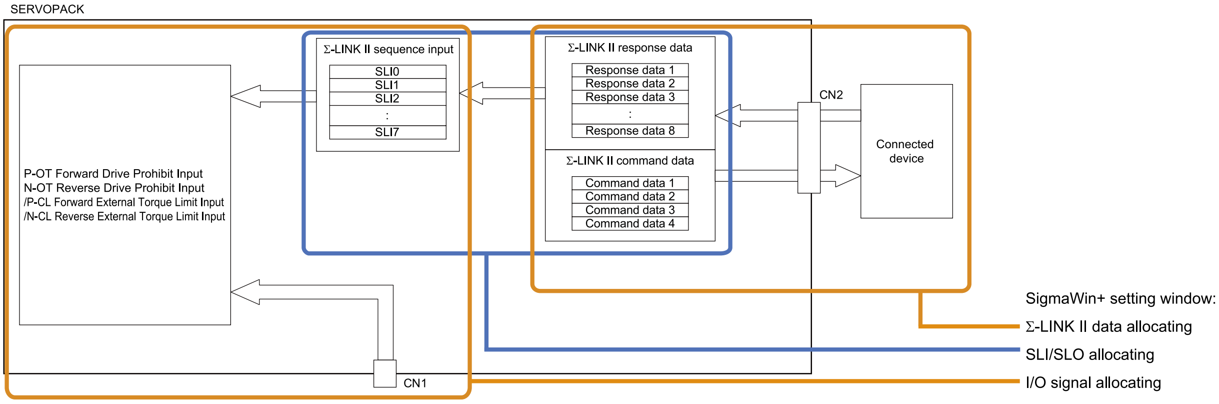
11.7 Configuring the Σ-LINK II Data Settings

You can accomplish the following by using Σ-LINK II functions.

- Monitoring the Input Signals of Connected Devices
- Allocating Input Signals of Connected Devices to SERVOPACK Functions and Using those Signals

To accomplish this, the Σ-LINK II data input from Σ-LINK II peripheral devices or output to Σ-LINK II peripheral devices must be associated with data inside the SERVOPACK. You will use the SigmaWin+ to configure these settings.

The following figure shows an image of the content to set.



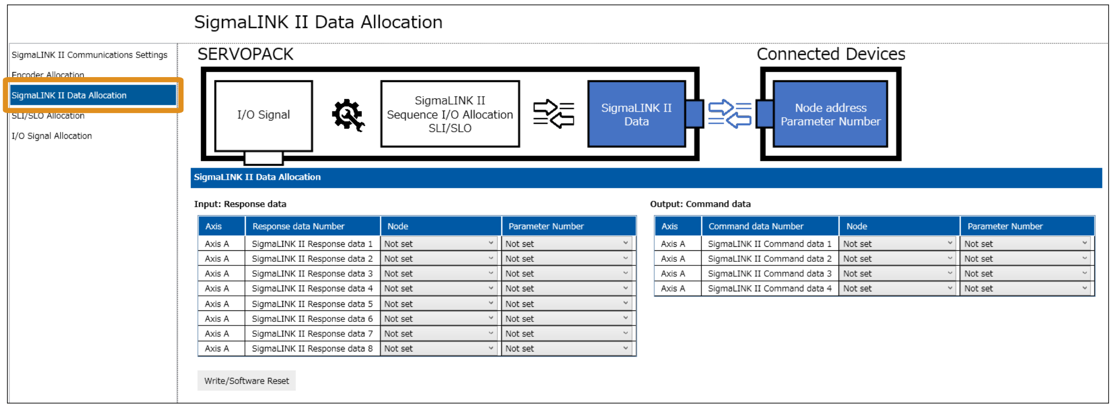
11.7.1 Monitoring the Input Signals of Connected Devices with the SigmaWin+

This section describes how to monitor the signals input to devices connected over Σ-LINK II with the SigmaWin +.

You can check the signals input to devices connected over Σ-LINK II as Σ-LINK II Response Data 1 to 8 with the monitor and trace functions in the SigmaWin+.

Use the SigmaWin+ to configure monitor settings for the input signals of devices connected over Σ-LINK II.

1. **Click [SigmaLINK II Data Allocation] on the [SigmaLINK II Settings] window.**



Input: Response data

Axis	Response data Number	Node	Parameter Number
Axis A	SigmaLINK II Response data 1	Not set	Not set
Axis A	SigmaLINK II Response data 2	Not set	Not set
Axis A	SigmaLINK II Response data 3	Not set	Not set
Axis A	SigmaLINK II Response data 4	Not set	Not set
Axis A	SigmaLINK II Response data 5	Not set	Not set
Axis A	SigmaLINK II Response data 6	Not set	Not set
Axis A	SigmaLINK II Response data 7	Not set	Not set
Axis A	SigmaLINK II Response data 8	Not set	Not set

Output: Command data

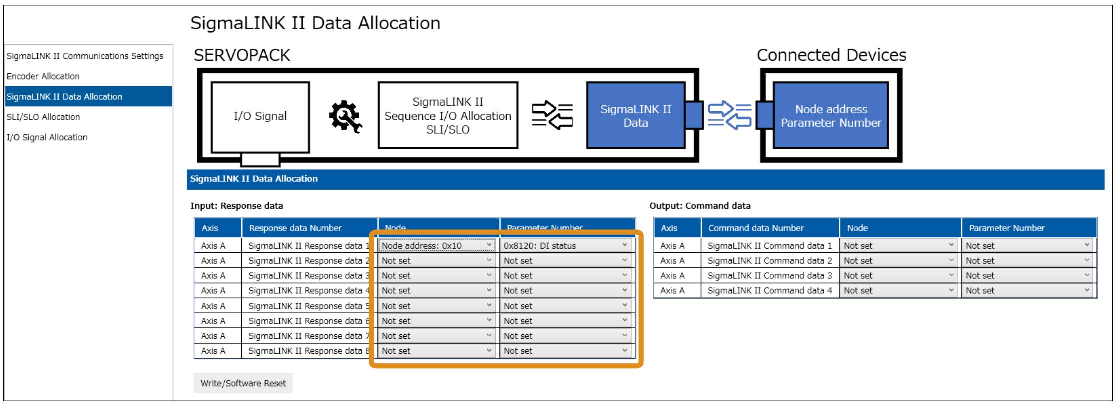
Axis	Command data Number	Node	Parameter Number
Axis A	SigmaLINK II Command data 1	Not set	Not set
Axis A	SigmaLINK II Command data 2	Not set	Not set
Axis A	SigmaLINK II Command data 3	Not set	Not set
Axis A	SigmaLINK II Command data 4	Not set	Not set

The display of the [SigmaLINK II Communications Settings] area will be changed.

2. **Under [Input: Response Data], set [Node] and [Parameter Number] for the [Response Data Number] to allocate.**

Information For the parameter number, refer to the device documentation. Refer to the following manual if you use a Yaskawa sensor hub.

Σ-X-Series Σ-LINK II Sensor Hub Instructions (Manual No.: TOMP C710812 06)



SigmaLINK II Data Allocation

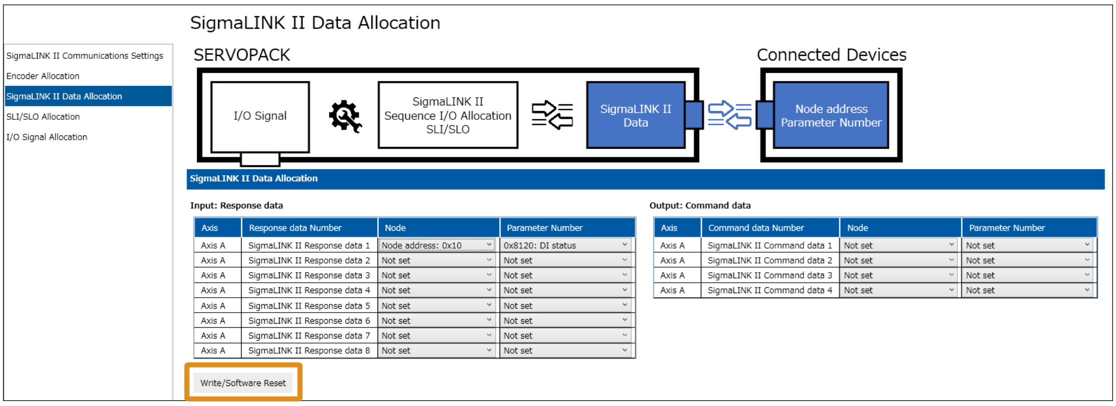
Input: Response data

Axis	Response data Number	Node	Parameter Number
Axis A	SigmaLINK II Response data 1	Node address: 0x10	0x8120: DI status
Axis A	SigmaLINK II Response data 2	Not set	Not set
Axis A	SigmaLINK II Response data 3	Not set	Not set
Axis A	SigmaLINK II Response data 4	Not set	Not set
Axis A	SigmaLINK II Response data 5	Not set	Not set
Axis A	SigmaLINK II Response data 6	Not set	Not set
Axis A	SigmaLINK II Response data 7	Not set	Not set
Axis A	SigmaLINK II Response data 8	Not set	Not set

Output: Command data

Axis	Command data Number	Node	Parameter Number
Axis A	SigmaLINK II Command data 1	Not set	Not set
Axis A	SigmaLINK II Command data 2	Not set	Not set
Axis A	SigmaLINK II Command data 3	Not set	Not set
Axis A	SigmaLINK II Command data 4	Not set	Not set

3. **Click the [Write/Software Reset] button.**



SigmaLINK II Data Allocation

Input: Response data

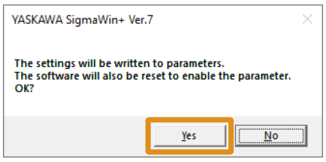
Axis	Response data Number	Node	Parameter Number
Axis A	SigmaLINK II Response data 1	Node address: 0x10	0x8120: DI status
Axis A	SigmaLINK II Response data 2	Not set	Not set
Axis A	SigmaLINK II Response data 3	Not set	Not set
Axis A	SigmaLINK II Response data 4	Not set	Not set
Axis A	SigmaLINK II Response data 5	Not set	Not set
Axis A	SigmaLINK II Response data 6	Not set	Not set
Axis A	SigmaLINK II Response data 7	Not set	Not set
Axis A	SigmaLINK II Response data 8	Not set	Not set

Output: Command data

Axis	Command data Number	Node	Parameter Number
Axis A	SigmaLINK II Command data 1	Not set	Not set
Axis A	SigmaLINK II Command data 2	Not set	Not set
Axis A	SigmaLINK II Command data 3	Not set	Not set
Axis A	SigmaLINK II Command data 4	Not set	Not set

The message dialog box will be displayed.

4. **Click the [Yes] button.**



The settings will be written to parameters.
The software will also be reset to enable the parameter.
OK?

After the software is reset, the content that was set will be saved to the SERVOPACK and another message dialog box will be displayed.

5. **Click the [OK] button.**

Writing the settings to parameters has been completed.

This concludes the procedure.

(1) Related Parameters

You can also use parameters to configure the settings to monitor the signals input to devices connected over Σ-LINK II with the SigmaWin+. The related parameters are shown next.

Information If you use the SigmaWin+ to configure the settings, these parameters will be automatically set.

To use parameters, set Pn050 to Pn05E. The settings of Pn050 to Pn05E are shown below.

Digit	Description	Remarks
n.□□□□XXXX	Parameter number (0000h to FFFFh)	This setting determines the breakdown of the response data (32 bits). The values are determined by each device.
n. XXXX□□□□	Node address (0010h to 001Eh)	A unique number assigned to each connected device. This value is automatically set during self-configuration.

Example: To Check the Input Signals of the Yaskawa Sensor Hub DI Signals (Parameter Number: 8120) in Σ-LINK II Response Data 1

- In Pn050 = n.□□□□XXXX (SigmaLINK II Response Data Selections 1 = Parameter Number), set the parameter number of the sensor hub DI signals to 8120.
- In Pn050 = n.XXXX□□□□ (SigmaLINK II Response Data Selections 1 = Node Address), set the node address of the sensor hub that was assigned in self-configuration.

Information For the parameter number, refer to the device documentation. Refer to the following manual if you use a Yaskawa sensor hub.

Σ-X-Series Σ-LINK II Sensor Hub Instructions (Manual No.: TOMP C710812 06)

When you configure the above settings, you can check the input signals of the sensor hub with bit 8 to 11 in Σ-LINK II Response Data 1.

Bit	Bit 31 to Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7 to Bit 0
Bit Information	Reserved	Information of sensor hub channel 4	Information of sensor hub channel 3	Information of sensor hub channel 2	Information of sensor hub channel 1	Reserved

The following table gives details on the related parameters.

Pn050	SigmaLINK II Response Data Selection 1			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	00000000h to FF7EFFFFh	–	00000000h	After restart
Pn052	SigmaLINK II Response Data Selection 2			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	00000000h to FF7EFFFFh	–	00000000h	After restart
Pn054	SigmaLINK II Response Data Selection 3			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	00000000h to FF7EFFFFh	–	00000000h	After restart
Pn056	SigmaLINK II Response Data Selection 4			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	00000000h to FF7EFFFFh	–	00000000h	After restart
Pn058	SigmaLINK II Response Data Selection 5			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	00000000h to FF7EFFFFh	–	00000000h	After restart
Pn05A	SigmaLINK II Response Data Selection 6			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	00000000h to FF7EFFFFh	–	00000000h	After restart
Pn05C	SigmaLINK II Response Data Selection 7			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	00000000h to FF7EFFFFh	–	00000000h	After restart
Pn05E	SigmaLINK II Response Data Selection 8			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	00000000h to FF7EFFFFh	–	00000000h	After restart

11.7.2 Allocating Input Signals of Connected Devices to SERVOPACK Functions and Using those Signals

The signals input to devices connected over Σ-LINK II can be used by allocating them to functions related to SERVOPACK input signals. The signals that can be allocated are given in the following table.

Information This function can be used only when a digital I/O type sensor hub is connected.

Signal	
P-OT	Forward Drive Prohibit Input Signal
N-OT	Reverse Drive Prohibit iInput Signal
/P-CL	Forward External Torque Limit Input Signal
/N-CL	Reverse External Torque Limit Input Signal

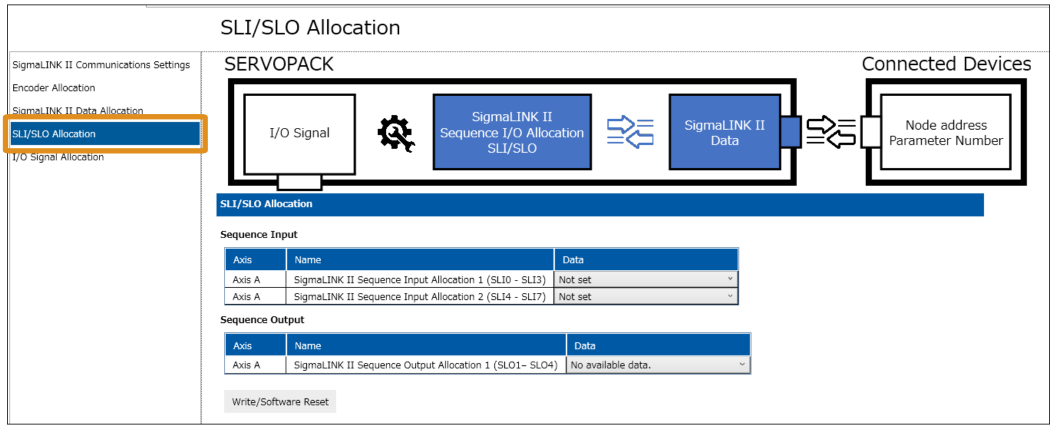
The setting procedure for the SigmaWin+ is shown next.

1. **Check if the Σ-LINK II data allocation settings have been completed.**

   Refer to the following section for details.

   ☞ *11.7.1 Monitoring the Input Signals of Connected Devices with the SigmaWin+ on page 554*

2. **Click [SLI/SLO Allocation] on the [SigmaLINK II Settings] window.**



Sequence Input

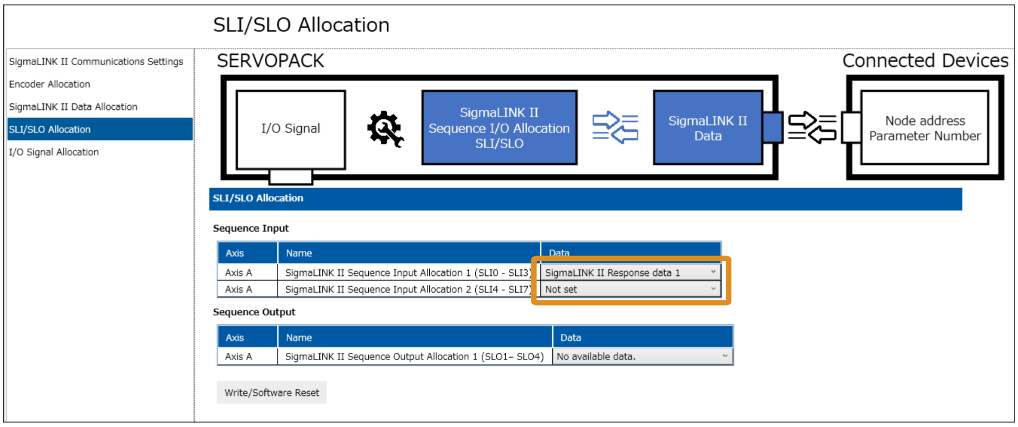
Axis	Name	Data
Axis A	SigmaLINK II Sequence Input Allocation 1 (SLI0 - SLI3)	Not set
Axis A	SigmaLINK II Sequence Input Allocation 2 (SLI4 - SLI7)	Not set

Sequence Output

Axis	Name	Data
Axis A	SigmaLINK II Sequence Output Allocation 1 (SLO1– SLO4)	No available data.

   The display of the [SigmaLINK II Communications Settings] area will be changed.

3. **Under [Sequence Input], select the Σ-LINK II data to allocate.**



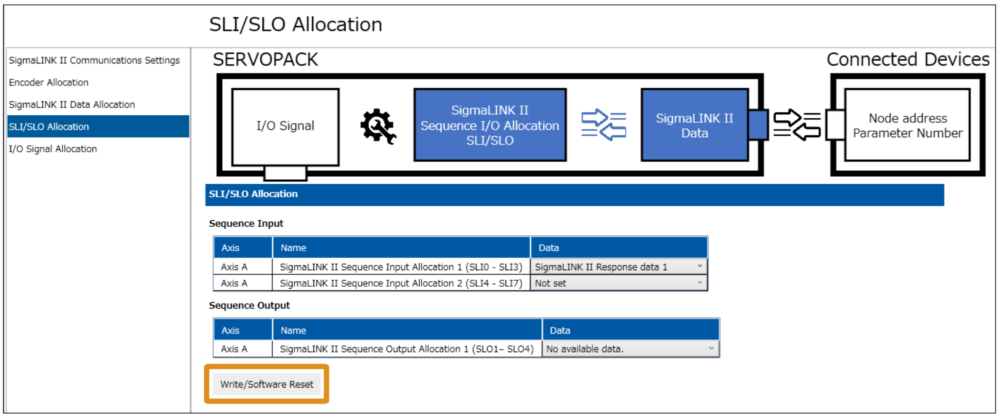
Sequence Input

Axis	Name	Data
Axis A	SigmaLINK II Sequence Input Allocation 1 (SLI0 - SLI3)	SigmaLINK II Response data 1
Axis A	SigmaLINK II Sequence Input Allocation 2 (SLI4 - SLI7)	Not set

Sequence Output

Axis	Name	Data
Axis A	SigmaLINK II Sequence Output Allocation 1 (SLO1– SLO4)	No available data.

4. **Click the [Write/Software Reset] button.**



Sequence Input

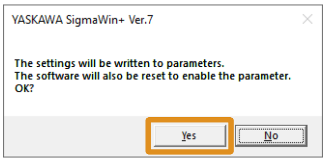
Axis	Name	Data
Axis A	SigmaLINK II Sequence Input Allocation 1 (SLI0 - SLI3)	SigmaLINK II Response data 1
Axis A	SigmaLINK II Sequence Input Allocation 2 (SLI4 - SLI7)	Not set

Sequence Output

Axis	Name	Data
Axis A	SigmaLINK II Sequence Output Allocation 1 (SLO1– SLO4)	No available data.

The message dialog box will be displayed.

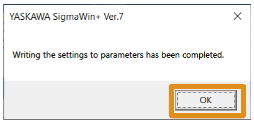
5. **Click the [Yes] button.**



The settings will be written to parameters.
The software will also be reset to enable the parameter.
OK?

After the software is reset, the content that was set will be saved to the SERVOPACK and another message dialog box will be displayed.

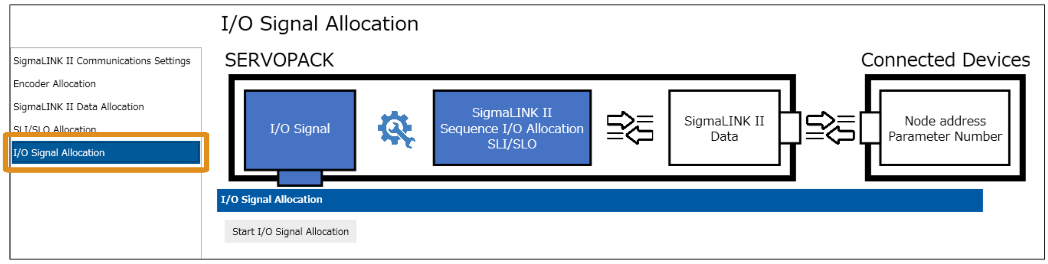
6. **Click the [OK] button.**



Writing the settings to parameters has been completed.

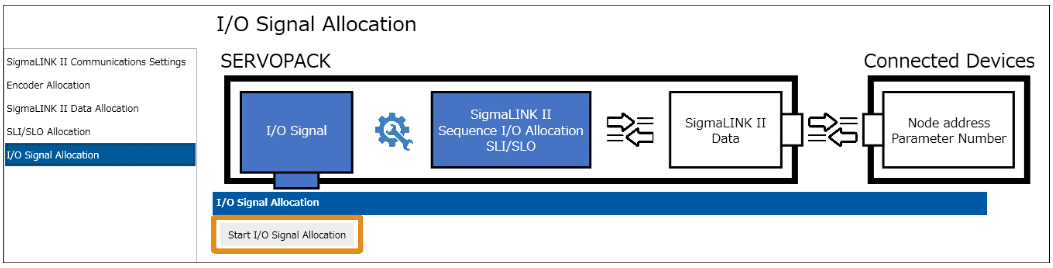
Close the message dialog box. You will return to the [SigmaLINK II Settings] window.

7. **Click [I/O Signal Allocation] on the [SigmaLINK II Settings] window.**



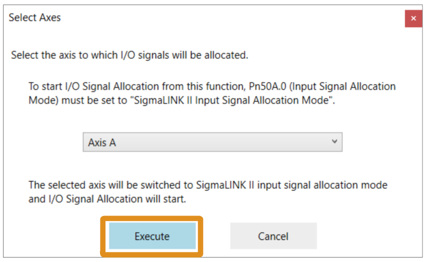
The display of the [SigmaLINK II Communications Settings] area will be changed.

8. **Click the [Start I/O Signal Allocation] button.**



The [Select Axis] window will be displayed.

9. **Click the [Execute] button.**



Select Axes

Select the axis to which I/O signals will be allocated.

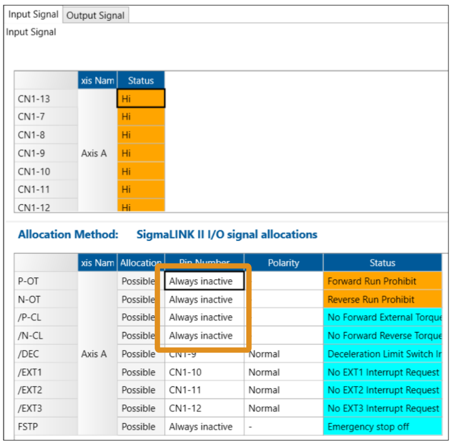
To start I/O Signal Allocation from this function, Pn50A.0 (Input Signal Allocation Mode) must be set to "SigmaLINK II Input Signal Allocation Mode".

Axis A

The selected axis will be switched to SigmaLINK II input signal allocation mode and I/O Signal Allocation will start.

The [I/O Signal Allocation] window will be displayed.

10. **Double-click the [Pin Number] cell of the signal to allocate, select sequence input number that was allocated in step 3, and then press the [Enter] key.**



Input Signal

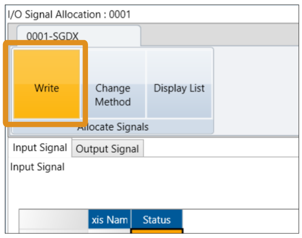
	xis Nam	Status
CN1-13	Axis A	Hi
CN1-7		Hi
CN1-8		Hi
CN1-9		Hi
CN1-10		Hi
CN1-11		Hi
CN1-12		Hi

Allocation Method: SigmaLINK II I/O signal allocations

	xis Nam	Allocation	Pin Number	Polarity	Status
P-OT	Axis A	Possible	Always inactive		Forward Run Prohibit
N-OT		Possible	Always inactive		Reverse Run Prohibit
/P-CL		Possible	Always inactive		No Forward External Torque
/N-CL		Possible	Always inactive		No Forward Reverse Torque
/DEC		Possible	CN1-9	Normal	Deceleration Limit Switch Ir
/EXT1		Possible	CN1-10	Normal	No EXT1 Interrupt Request
/EXT2		Possible	CN1-11	Normal	No EXT2 Interrupt Request
/EXT3		Possible	CN1-12	Normal	No EXT3 Interrupt Request
FSTP		Possible	Always inactive	-	Emergency stop off

11. **Use the same operation to set [Polarity] as required.**

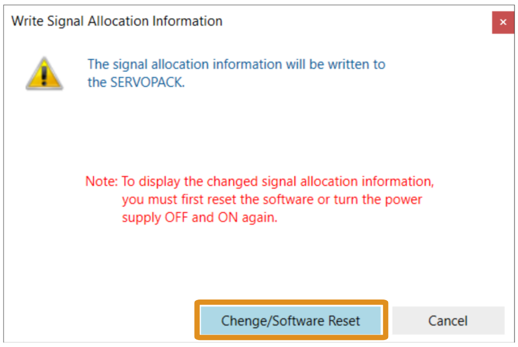
12. **Click [Write].**



I/O Signal Allocation : 0001

The [Write Signal Allocation Information] dialog box will be displayed.

13. **Click the [Change/Software Reset] button.**



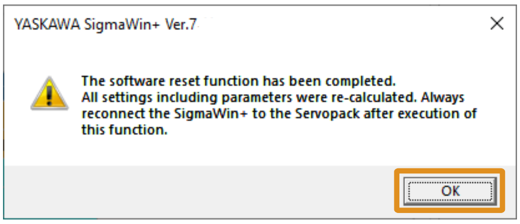
Write Signal Allocation Information

The signal allocation information will be written to the SERVOPACK.

Note: To display the changed signal allocation information, you must first reset the software or turn the power supply OFF and ON again.

The software will be reset, the content that was set will be applied, and another message dialog box will be displayed.

14. **Click the [OK] button.**



The software reset function has been completed.
All settings including parameters were re-calculated. Always reconnect the SigmaWin+ to the Servopack after execution of this function.

This concludes the procedure.

(1) Related Parameters

You can also use parameters to configure the settings to allocate input signals of connected devices to SERVOPACK functions and to use those signals. The related parameters are shown next.

Information If you use the SigmaWin+ to configure the settings, these parameters will be automatically set.

(a) SLI Allocations

To set the SLI allocations using parameters, allocate Σ-LINK II Response Data 1 to 8 to Pn0B1 (SigmaLINK II Sequence Allocation 1) and Pn0B2 (SigmaLINK II Sequence Allocation 2).

Four bits of continuous data from the bit specified by Pn0B1 = n.XX□□ are allocated as SLI0 to SLI3. Pn0B2 is also allocated as SLI4 to SLI7 in the same manner.

- Pn0B1: Σ-LINK II Sequence Input Allocation 1

Pn0B1	n.□□XX	SigmaLINK II Response Data Selection **Speed** **Pos** **Trq**		When Enabled
		00 Default	Disable (data is not set to the SigmaLINK II sequence input).	After restart
		01	Allocate SigmaLINK II Response Data 1 to the SigmaLINK II sequence input.	
		02	Allocate SigmaLINK II Response Data 2 to the SigmaLINK II sequence input.	
		03	Allocate SigmaLINK II Response Data 3 to the SigmaLINK II sequence input.	
		04	Allocate SigmaLINK II Response Data 4 to the SigmaLINK II sequence input.	
		05	Allocate SigmaLINK II Response Data 5 to the SigmaLINK II sequence input.	
		06	Allocate SigmaLINK II Response Data 6 to the SigmaLINK II sequence input.	
		07	Allocate SigmaLINK II Response Data 7 to the SigmaLINK II sequence input.	
		08	Allocate SigmaLINK II Response Data 8 to the SigmaLINK II sequence input.	
Pn0B1	n.XX□□	SigmaLINK II Sequence Input Allocation Start Position Selection **Speed** **Pos** **Trq**		When Enabled
		00 to 20	Specify the allocation start bit to the SigmaLINK II sequence input.	After restart

- Pn0B2: Σ-LINK II Sequence Input Allocation 2
  The setting procedure is the same as Pn0B1.

> **Important** If you allocated Σ-LINK II response data to Σ-LINK II sequence inputs, A.Cd7 (SigmaLINK II I/O Device Communications Error) and A.Cd8 (SigmaLINK II I/O Device Status Error) will occur regardless of the setting of Pn0DD (SigmaLINK II I/O Device Error Detection Selection).

(b) I/O Signal Allocation

To set the I/O signal allocations using parameters, allocate the Σ-LINK II sequence inputs (SLI0 to SLI7) to SERVOPACK functions.

First, set Pn50A to n.□□□2 (use Pn50A to Pn517, Pn590, Pn591, Pn598, Pn599 (SigmaLINK II input signal allocation mode)).

		Input Signal Allocation Mode **Speed** **Pos** **Trq**		When Enabled
Pn50A	n.□□□X	0 Default	Use the sequence input signal terminals with the default allocations.	After restart
		1	Use Pn50A to Pn517 (Sigma-7S-compatible I/O signal allocation mode).	
		2	Use Pn50A to Pn517, Pn590, Pn591, Pn598, Pn599 (SigmaLINK II input signal allocation mode).	

Next, set the settings of the signals to input from the Σ-LINK II connected device to □1□□□ (allocate the signal to SIgmaLINK II Sequence Input □).

Set the settings of the signals to input from the I/O signal connector (CN1) to □0□□ (allocate signal to CN1-□).

Refer to the following section for the parameters and settings used to set the signals.

☞ *(3) Σ-LINK II Input Signal Allocations on page 222*

Finally, set the signals to output from the I/O signal connector (CN1).

Refer to the following section for the parameters and settings used to set the signals.

☞ *6.1.4 Output Signal Allocations on page 224*

11.8 Changing Detection Conditions of Alarms Related to Σ-LINK II

You can change the detection conditions for certain alarms related to Σ-LINK II by setting the relevant parameters.

11.8.1 Connected Node Change Detection Condition

When a node or connection configuration is detected after restart that differs from the saved self-configuration results, A.Cd4 (SigmaLINK II Node Change Detected) will occur.

Set the detection conditions at this time with Pn0DC = n.□□□X.

Pn0DC	n.□□□X	Connected Node Change Detection Condition	Speed Pos Trq	When Enabled
		0 Default	Set vendor ID and product ID as conditions.	After restart
		1	Set vendor ID, product ID, and serial number as conditions.	
		2	Set vendor ID, product ID, and product version as conditions.	
		3	Set vendor ID, product ID, product version, and serial number as conditions.	

11.8.2 Σ-LINK II I/O Device Error Detection Selection

You can select the detection method for Σ-LINK II I/O device errors by setting Pn0DD (SigmaLINK II I/O Device Error Detection Selection).

Pn0DD	n.□□□X	SigmaLINK II I/O Device Communications Check Mask	Speed Pos Trq	When Enabled
		0 Default	Set SigmaLINK II slave communications error as an alarm (A.Cd7).	After restart
		1	Set SigmaLINK II slave communications error as a warning (A.932).	
		2	Do not detect the SigmaLINK II slave communications error.	
Pn0DD	n.□X□□	SigmaLINK II I/O Device Status Check Mask	Speed Pos Trq	When Enabled
		0	A.Cd8 occurs when the alarm or warning signal is received from the SigmaLINK II slave.	After restart
		1 Default	A.Cd8 occurs when the alarm signal is received from the SigmaLINK II slave and A.933 occurs when the warning signal is received.	
		2	A.933 occurs when the alarm or warning signal is received from the SigmaLINK II slave.	
		3	Do not detect the SigmaLINK II slave status error.	

Note:

If you allocated Σ-LINK II I/O response data to Σ-LINK II sequence inputs, A.Cd7 (SigmaLINK II I/O Device Communications Error) and A.Cd8 (SigmaLINK II I/O Device Status Error) will occur regardless of the setting of Pn0DD.

12

Safety Functions

This chapter provides detailed information on the Safety Functions of the SERVOPACK.

12.1 Introduction to the Safety Functions

12.1.1 Safety Functions

Safety Functions are built into the SERVOPACK to reduce the risks associated with using the machine by protecting workers from the hazards of moving machine parts and otherwise increasing the safety of machine operation. Especially when working in hazardous areas inside guards, such as for machine maintenance, the Safety Function can be used to avoid hazardous moving machine parts.

Refer to the following section for information on the Safety Function and safety parameters.

☞ *i.8.4 Safety Standards on page 44*

Important

Products that display the TÜV mark on the nameplate have met the safety standards.

12.1.2 Precautions for Safety Functions

⚠ WARNING

To confirm that the HWBB function satisfies the safety requirements of the system, you must conduct a risk assessment of the system.

Incorrect use of the Safety Function may cause injury.

The servomotor will move if there is an external force (e.g., gravity on a vertical axis) even when the HWBB function is operating. Use a separate means, such as a mechanical brake, that satisfies the safety requirements.

Incorrect use of the Safety Function may cause injury.

While the HWBB function is operating, the motor may move within an electric angle of 180° or less as a result of a SERVOPACK failure. Use the HWBB function for an application only after confirming that movement of the motor will not result in a hazardous condition.

Incorrect use of the Safety Function may cause injury.

The dynamic brake and the brake signal are not safety-related elements. You must design the system so that SERVOPACK failures will not cause a hazardous condition while the HWBB function is operating.

Incorrect use of the Safety Function may cause injury.

Connect devices that satisfy the safety standards for the signals for Safety Functions.

Incorrect use of the Safety Function may cause injury.

The HWBB function does not shut OFF the power to the SERVOPACK or electrically isolate it. Implement measures to shut OFF the power to the SERVOPACK before you perform maintenance on it.

There is a risk of electric shock.

12.2 Hard Wire Base Block (HWBB)

A hard wire base block (abbreviated as HWBB) is a Safety Function that is designed to shut OFF the current to the servomotor with a hardwired circuit.

The drive signals to the power module that controls the motor current are controlled by the circuits that are independently connected to the two input signal channels to turn OFF the power module and shut OFF the motor current.

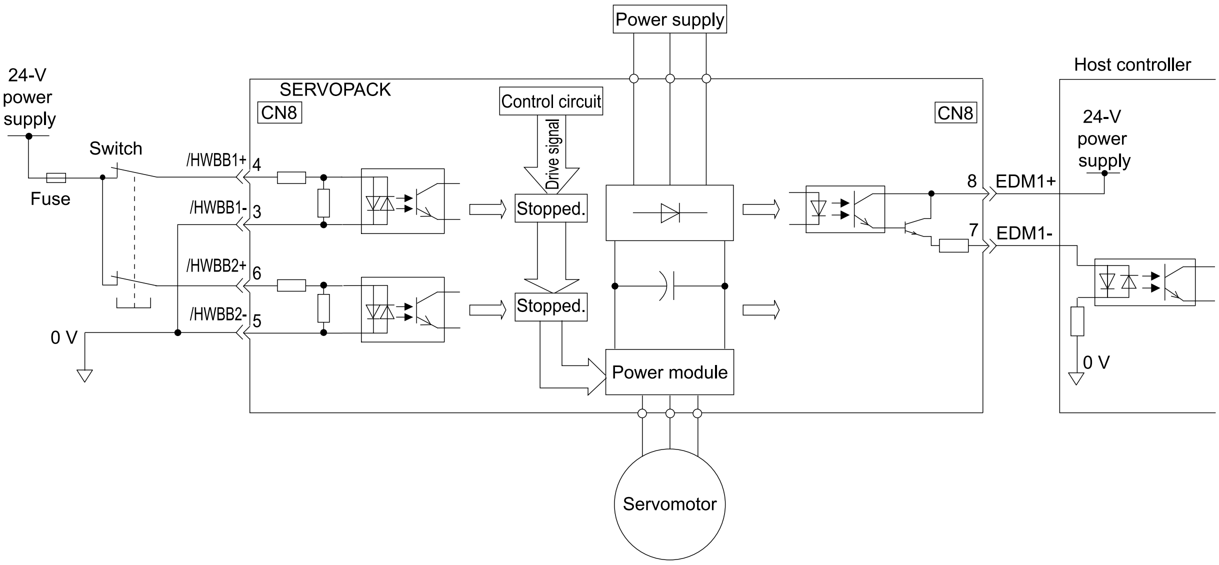
Refer to the following section for connection specification for signals.

☞ *4.6 Connecting Safety Function Signals on page 148*

Important

- Connect the Safety Function input signals (/HWBB1 and /HWBB2) as sink inputs when viewed from the SERVOPACK side. Make the connections this way because a safe failure will occur if the /HWBB1 and /HWBB2 signals are connected to 0 V. This differs from the wiring example for other input signals described in "*4.5.3 I/O Signal Wiring Examples on page 139*".
  The ON and OFF status of signals for the Safety Function are also defined as follows:
  - ON: The state in which the relay contacts are closed or the transistor is ON and current flows into the signal line.
  - OFF: The state in which the relay contacts are open or the transistor is OFF and no current flows into the signal line.
- For the 24-V power supply, use an SELV power supply.

The following figure shows a connection example.



Whether or not you use the EDM1 signal does not affect the performance level of safety parameters.

You can use the EDM1 signal if the system requires it, such as when a Σ-X SERVOPACK is replacing a Σ-7 SERVOPACK in the system.

12.2.1 Risk Assessment

When using the HWBB, you must perform a risk assessment of the servo system in advance to confirm that the safety level of the standards is satisfied. Refer to the following section for details on the standards.

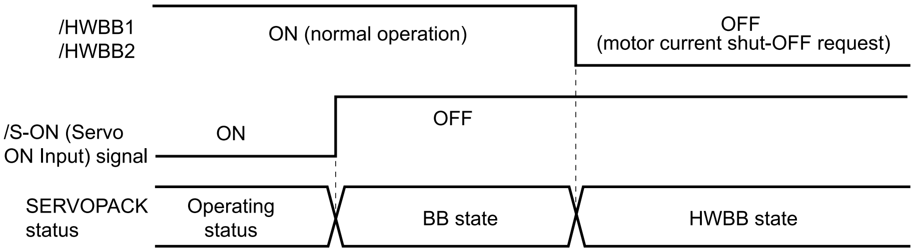
☞ *i.8 Compliance with UL Standards, EU Directives, and Other Safety Standards on page 43*

The following hazards exist even when the HWBB is operating. These hazards must be included in the risk assessment.

- The servomotor will move if an external force is applied to it (for example, gravity on a vertical axis). Implement measures to hold the servomotor, such as installing a separate mechanical brake.
- If a failure occurs such as a power module failure, the servomotor may move within an electric angle of 180°. Ensure safety even if the servomotor moves.
  The rotational angle or travel distance depends on the type of servomotor as follows:
  - Rotary servomotor: 1/6 rotation max. (rotational angle calculated at the motor shaft)
  - Direct drive servomotor: 1/20 rotation max. (rotational angle calculated at the motor shaft)
  - Linear servomotor: 50 mm max.
- The HWBB does not shut OFF the power to the SERVOPACK or electrically isolate it. Implement measures to shut OFF the power to the SERVOPACK before you perform maintenance on it.

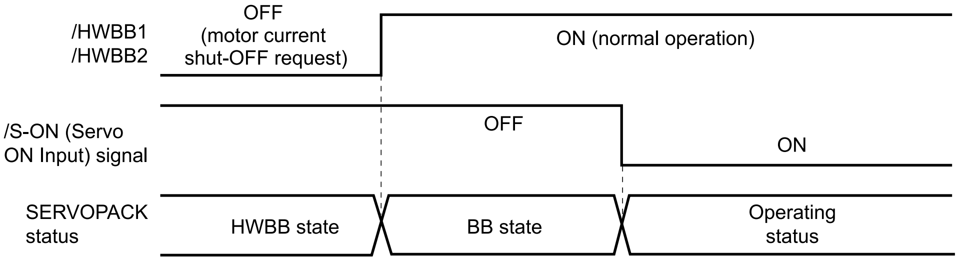
12.2.2 Hard Wire Base Block (HWBB) State

The SERVOPACK will be in the following state if the HWBB operates. If the /HWBB1 or /HWBB2 signal turns OFF, the HWBB will operate and the SERVOPACK will enter a HWBB state.

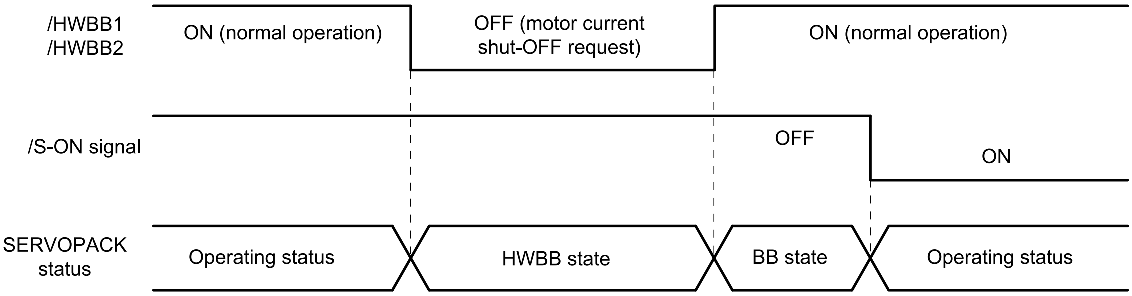


12.2.3 Resetting the HWBB State

Normally, after the /S-ON (Servo ON Input) signal is turned OFF and power is no longer supplied to the servomotor, the /HWBB1 and /HWBB2 signals will turn OFF and the SERVOPACK will enter the HWBB state. If you turn ON the /HWBB1 and /HWBB2 signals in this state, the SERVOPACK will enter a base block (BB) state and will be ready to acknowledge the /S-ON signal.



If the SERVOPACK enters the HWBB state while power is supplied to the motor, turn ON the /HWBB1 and /HWBB2 signals, and then turn ON the /S-ON (Servo ON Input) signal to restore the normal operating status.



If the SERVOPACK enters the HWBB state while the /S-ON signal is ON, turn ON the /HWBB1 and /HWBB2 signals, and then turn OFF the /S-ON signal. Next turn ON the /S-ON signal again to restore the normal operating status.

12.2.4 Detecting Errors in HWBB Signal

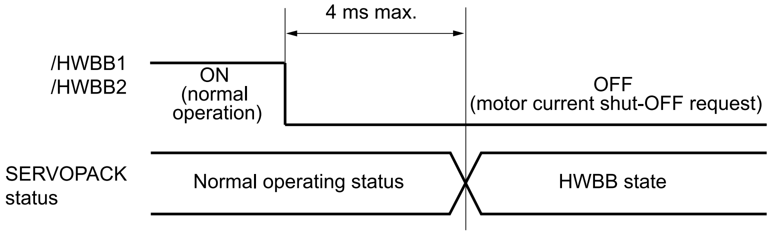
If only the /HWBB1 or the /HWBB2 signal is input, an A.Eb1 alarm (Safety Function Signal Input Timing Error) will occur unless the other signal is input within 10 seconds. This makes it possible to detect failures, such as disconnection of an HWBB signal. If the A.Eb1 alarm occurs, check the wiring.

⚠ CAUTION

The A.Eb1 alarm (Safety Function Signal Input Timing Error) is not a safety-related element. Keep this in mind when you design the system.

12.2.5 HWBB Input Signal Specifications

If an HWBB is requested by turning OFF the two HWBB input signal channels (/HWBB1 and /HWBB2), the power to the servomotor will be turned OFF within 4 ms.



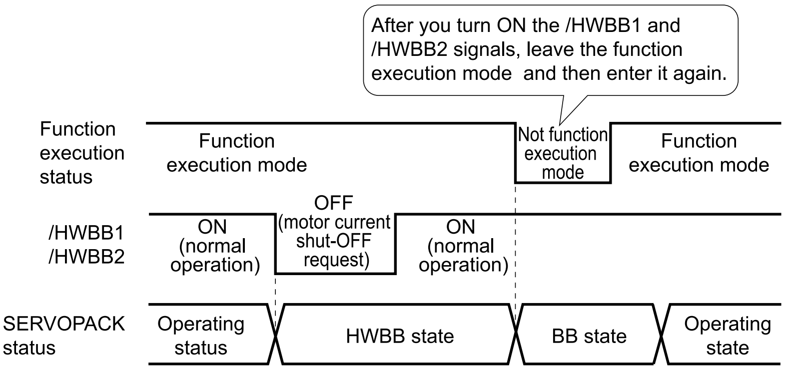
Note:

- The OFF status is not recognized if the OFF interval of the /HWBB1 or /HWBB2 signal is 0.5 ms or shorter. However, in certain situations, such as when you input test pulses and you do not want the HWBB function to respond, make the interval between OFF intervals (i.e., the ON interval) 0.5 ms or longer. The reason for this is that the OFF status may be recognized if a signal repeatedly turns OFF even though the OFF interval is 0.5 ms or shorter.
- You can check the status of the input signals by using monitor displays.

12.2.6 Operation without a Host Controller

The HWBB will operate even for operation without a host controller.

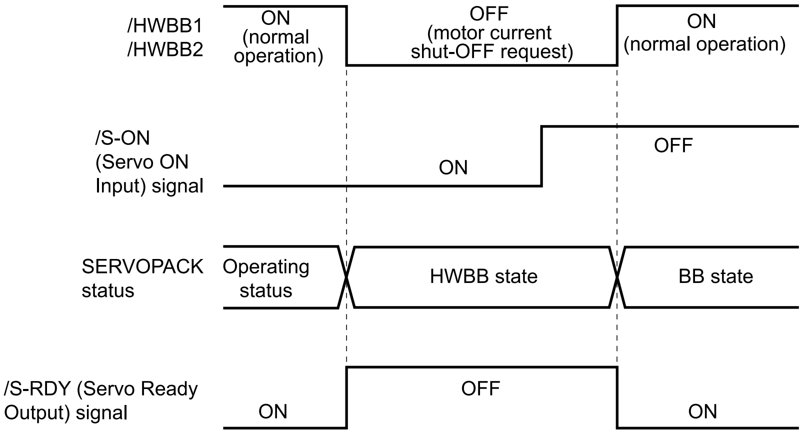
However, if the HWBB operates during execution of the following functions, leave the execution mode for the function and then enter it again to restart operation. Operation will not be restarted simply by turning ON the /HWBB1 and /HWBB2 signals.

Applicable Functions	Resetting the HWBB State
• Jog • Origin Search • Jog Program • Autotuning without Host Reference • Easy FFT • Adjust the Motor Current Detection Signal Offsets	 After you turn ON the /HWBB1 and /HWBB2 signals, leave the function execution mode and then enter it again.

12.2.7 /S-RDY (Servo Ready Output) Signal

The /S-ON (Servo ON Input) signal will not be acknowledged in the HWBB state. Therefore, the Servo Ready Output Signal will turn OFF. The Servo Ready Output Signal will turn ON if both the /HWBB1 and /HWBB2 signals are ON and the /S-ON signal is turned OFF (BB state).

An example is provided below for when the main circuit power is ON and the SEN signal turns ON when there is no servo alarm. (An absolute encoder is used in this example.)



12.2.8 /BK (Brake Output) Signal

If the HWBB operates when the /HWBB1 or /HWBB2 signal is OFF, the /BK (Brake) signal will turn OFF. At that time, the setting in Pn506 (Brake Reference - Servo OFF Delay Time) will be disabled. Therefore, the servomotor may be moved by external force until the actual brake becomes effective after the /BK signal turns OFF.

⚠ **CAUTION**

The brake signal is not a safety-related element. You must design the system so that a hazardous condition does not occur even if the brake signal fails in the HWBB state. Also, if a servomotor with a brake is used, keep in mind that the brake in the servomotor is used only to prevent the moving part from being moved by gravity or an external force and it cannot be used to stop the servomotor.

12.2.9 Stopping Methods

If the /HWBB1 or /HWBB2 signal turns OFF and the HWBB operates, the servomotor will stop according to the stop mode that is set for Pn001 = n.□□□X (Motor Stopping Method for Servo OFF). However, if you set Pn001 = n.□□□0 or n.□□□1 (stop the motor by applying the dynamic brake), observe the following precautions.

⚠ **CAUTION**

The dynamic brake is not a safety-related element. You must design the system so that a hazardous condition does not occur even if the servomotor coasts to a stop in the HWBB state. Normally, we recommend that you use a sequence that returns to the HWBB state after stopping for a reference.

If the application frequently uses the HWBB, stopping with the dynamic brake may result in the deterioration of elements in the SERVOPACK. To prevent internal elements from deteriorating, use a sequence in which the HWBB state is returned to after the servomotor has come to a stop.

12.2.10 Settings to Clear the Position Deviation

A position deviation in the HWBB state is cleared according to the setting of Pn200 = n.□X□□ (Clear Operation).

If you set Pn200 to n.□1□□ (do not clear position error) during position control, the position deviation will accumulate unless the position reference from the host controller is canceled in the HWBB state. The following conditions may result.

- An A.d00 alarm (Position Deviation Overflow) may occur.
- If you turn ON the servo after changing from HWBB state to BB state, the servomotor may move for the accumulated position deviation.

Therefore, stop the position reference from the host controller while in the HWBB state. If you set Pn200 to n.□1□□ (do not clear position error) during position control, input the CLR (Position Deviation Clear) signal during the HWBB or BB state to clear the position deviation.

12.2.11 ALM (Servo Alarm) Signal and ALO1, ALO2, and ALO3 (Alarm Code Output) Signals

The ALM (Servo Alarm) signal is not output in the HWBB state. The ALO1, ALO2, and ALO3 (Alarm Code Output) signals are not output in the HWBB state.

12.3 EDM1 (External Device Monitor)

The EDM1 (External Device Monitor) signal is used to monitor failures in the HWBB. Connect the monitor signal as a feedback signal, e.g., to the safety unit.

Whether or not you use the EDM1 signal does not affect the performance level of safety parameters.

You can use the EDM1 signal if the system requires it, such as when a Σ-X SERVOPACK is replacing a Σ-7 SERVOPACK in the system.

- Failure Detection Signal for EDM1 Signal
  The relationship between the EDM1, /HWBB1, and /HWBB2 signals is shown below.
  Detection of failures in the EDM1 signal circuit can be achieved by using the status of the /HWBB1, /HWBB2, and EDM1 signals in the following table. A failure can be detected by checking the failure status, e.g., when the power is turned ON.

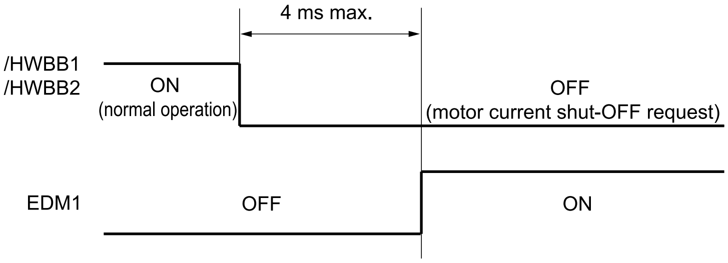
Signal	Logic			
/HWBB1	ON	ON	OFF	OFF
/HWBB2	ON	OFF	ON	OFF
EDM1	OFF	OFF	OFF	ON

⚠ WARNING

The EDM1 signal is not a safety output. Use it only for monitoring for failures.

12.3.1 EDM1 Output Signal Specifications

If an HWBB is requested by turning OFF the two HWBB input signal channels (/HWBB1 and /HWBB2) when the Safety Function is operating normally, the EDM1 output signal will be turned ON within 4 ms.

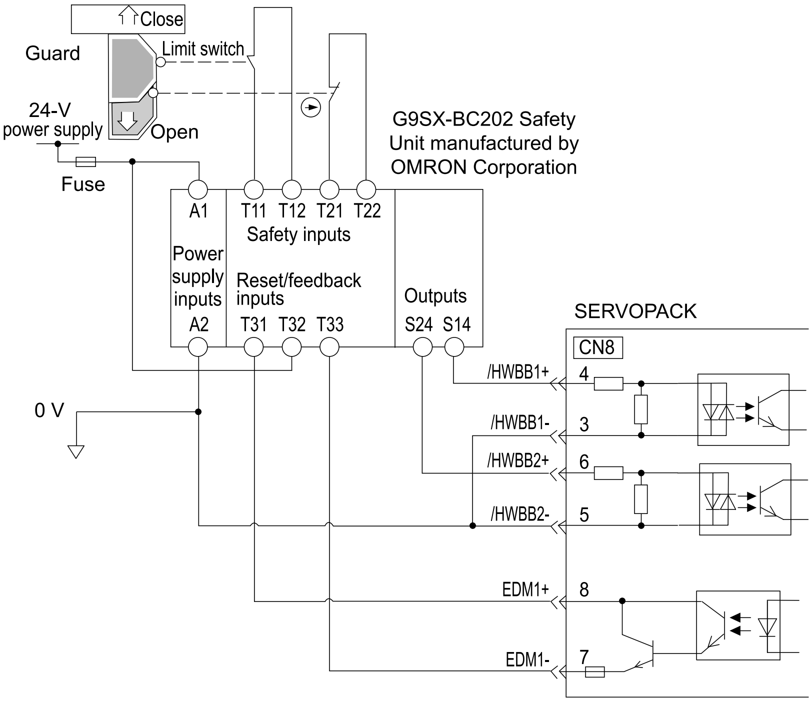


12.4 Applications Examples for Safety Functions

This section provides examples of using the Safety Functions.

12.4.1 Connection Example

In the following example, a safety unit is used and the HWBB operates when the guard is opened.



When the guard is opened, both the /HWBB1 and /HWBB2 signals turn OFF and the EDM1 signal turns ON, and this turns ON the feedback inputs and resets the safety unit. When the guard is closed from this state, the /HWBB1 and /HWBB2 signals turn ON and the SERVOPACK can be reset from the HWBB state.

Note:

The EDM1 signal is used as a source output. Refer to the following section for information on making the connection to the host controller.

☞ *(2) Diagnostic Output Circuits on page 149*

12.4.2 Failure Detection Method

If a failure occurs (e.g., the /HWBB1 or the /HWBB2 signal remains ON), the safety unit is not reset when the guard is closed because the EDM1 signal remains OFF. Therefore starting is not possible and an error is detected.

In this case the following must be considered: an error in the external device, disconnection of the external wiring, short-circuiting in the external wiring, or a failure in the SERVOPACK. Find the cause and correct the problem.

12.4.3 Procedure

1 Request is received to open the guard.

2 If the servomotor is operating, a stop command is received from the host controller, the servomotor stops, and the servo is turned OFF.

3 The guard is opened.

4 The /HWBB1 and /HWBB2 signals turn OFF and the HWBB operates. (Working inside the guard is enabled.)

5 The worker leaves the guarded area after completing work.

6 The guard is closed.

7 The servo is turned ON by the host controller.

12.5 Validating Safety Functions

When you commission the system or perform maintenance or SERVOPACK replacement, you must always perform the following validation test on the HWBB function after completing the wiring. (It is recommended that you keep the confirmation results as a record.)

- When the /HWBB1 and /HWBB2 signals turn OFF, confirm that the panel display or digital operator displays Hbb and that the servomotor does not operate.
  If the display does not show Hbb, check the ON/OFF status of the /HWBB1 and /HWBB2 signals.
- Monitor the ON/OFF status of the /HWBB1 and /HWBB2 signals.
  If the ON/OFF status of the signals do not coincide with the display, the following must be considered: an error in the external device, disconnection of the external wiring, short-circuiting in the external wiring, or a failure in the SERVOPACK. Find the cause and correct the problem.
- If you use the EDM1 signal, confirm that the EDM1 signal is OFF while in normal operation by using the feedback circuit input display of the connected device.
  (Whether or not you use the EDM1 signal does not affect the performance level of safety parameters.)

Information You can use the [Status] monitor in the SigmaWin+ or the panel operator of the SERVOPACK to check the ON/OFF status of the /HWBB1 and /HWBB2 signals. Refer to the following sections for details.

☞ *9.2.2 Operation Monitor, Status Monitor, and I/O Monitor on page 504*

☞ *14.3.4 Safety Input Signal Monitor (Un015) on page 642*

The /HWBB1 and /HWBB2 signals can also be traced using the trace function in the SigmaWin+. Refer to the following sections for details.

☞ *9.3 Monitoring Machine Operation Status and Signal Waveforms on page 511*

Based on chapter 7.3.3.4 in IEC 62061:2021, conducting a periodic validation test and keeping records of the test results is recommended to prevent the loss of the HWBB function due to cumulative failures. The recommended intervals for conducting the periodic validation test are as follows:

- If the system safety level is SIL 3: Once or more per month
- If the system safety level is lower than SIL 3: Once or more per year

Important

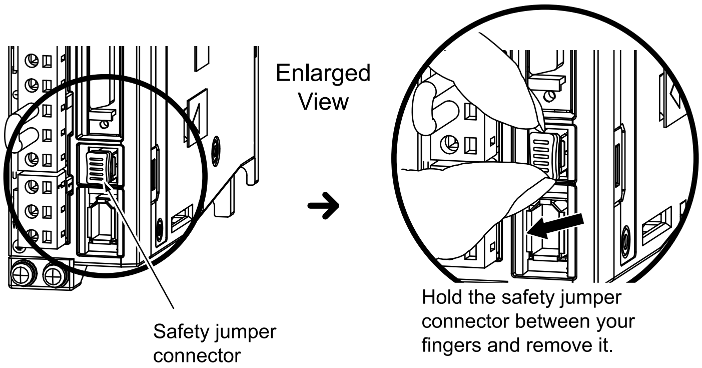
If the following states occur, check if the cause is on the SERVOPACK end.
- When the /HWBB1 and /HWBB2 signals are turned OFF, the panel display or digital operator does not display Hbb.
- When the /HWBB1 and /HWBB2 signals are turned OFF, the EDM1 signal does not turn ON.

If the cause is found on the SERVOPACK end, the SERVOPACK may be faulty.

12.6 Connecting a Safety Function Device

Use the following procedure to connect a Safety Function device.

1. **Remove the safety jumper connector from the connector for the Safety Function device (CN8).**



2. **Connect the Safety Function device to the connector for the Safety Function device (CN8).**

Note:

If you do not connect a Safety Function device, leave the safety jumper connector connected to the connector for the Safety Function device (CN8). If the SERVOPACK is used without the safety jumper connector connected to CN8, no current will be supplied to the servomotor and no motor torque will be output.

In this case, Hbb will be displayed on the panel display or digital operator.

13

Maintenance

This chapter provides information on the meaning of, causes of, and corrections for alarms and warnings.

13.1 Inspections and Part Replacement

This section describes inspections and part replacement for SERVOPACKs.

13.1.1 Inspections

Perform the inspections given in the following table at least once every year for the SERVOPACK. Daily inspections are not required.

Item	Frequency	Inspection	Correction
Exterior	At least once a year	Check for dust, dirt, and oil on the surfaces.	Clean with pressurized air or a cloth.
Loose Screws		Check for loose terminal block and connector mounting screws and for other loose parts.	Tighten any loose screws or other loose parts.

We recommend that you perform periodic inspections of the Safety Functions in the SERVOPACK. For information on the periodic validation test, refer to the following section.

☞ *12.5 Validating Safety Functions on page 573*

13.1.2 Guidelines for Part Replacement

The following electric or electronic parts are subject to mechanical wear or deterioration over time. Use one of the following methods to check the standard replacement period.

- Use the service life prediction function of the SERVOPACK.
  Refer to the following section for information on service life predictions.
  ☞ *9.4 Monitoring Product Life on page 518*
- Use the following table.

Part	Standard Replacement Period	Remarks
Cooling Fan	4 years to 5 years	The standard replacement periods given on the left are for the following operating conditions. – Surrounding air temperature: Annual average of 30°C – Load factor: 80% max. – Operation rate: 20 hours/day max.
Electrolytic Capacitor	10 years	
Relays	100000 power ON operations	Power ON frequency: Once an hour
Battery	3 years without power supplied	Surrounding temperature without power supplied: 20°C

When any standard replacement period is close to expiring, contact your Yaskawa representative. After an examination of the part in question, we will determine whether the part should be replaced.

Important

The parameters of any SERVOPACKs that are sent to Yaskawa for part replacement are reset to the factory settings before they are returned to you. Always keep a record of the parameter settings. And, always confirm that the parameters are properly set before starting operation.

13.1.3 Replacing the Battery

If the battery voltage drops to approximately 2.7 V or less, an A.830 alarm (Encoder Battery Alarm) or an A.930 warning (Absolute Encoder Battery Error) will be displayed.

If this alarm or warning is displayed, the battery must be replaced. Refer to the following section for the battery replacement procedure.

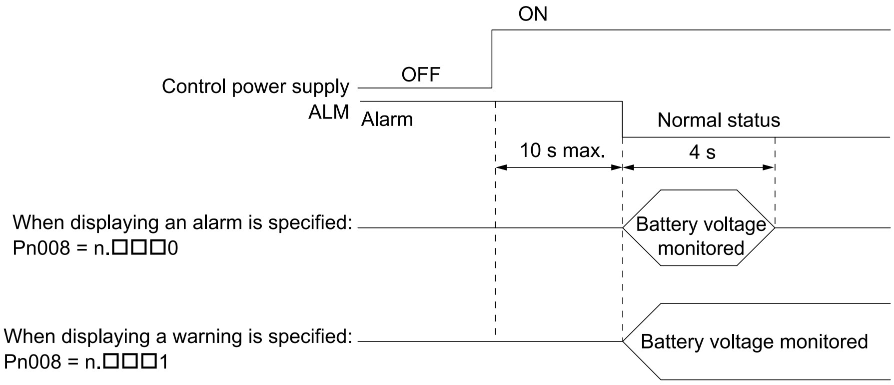
☞ *(2) Battery Replacement Procedure on page 578*

(1) Battery Alarm/Warning Selection

Whether to display an alarm or a warning is determined by the setting of Pn008 = n.□□□X (Low Battery Voltage Alarm/Warning Selection).

Pn008	n.□□□X	Low Battery Voltage Alarm/Warning Selection	Speed Pos Trq	When Enabled
		0 Default	Output alarm (A.830) for low battery voltage.	After restart
		1	Output warning (A.930) for low battery voltage.	

- Pn008 = n.□□□0
  The ALM (Servo Alarm Output) signal is output for up to 10 seconds when the control power is turned ON, and then the battery voltage is monitored for four seconds.
  No alarm will be displayed even if the battery voltage drops below the specified value after these four seconds.
- Pn008 = n.□□□1
  The ALM (Servo Alarm Output) signal is output for up to 10 seconds when the control power is turned ON, and then the battery voltage is monitored continuously.



(2) Battery Replacement Procedure

(a) When Installing a Battery on the Host Controller

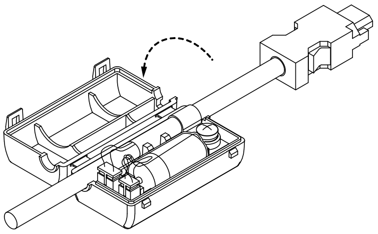
1. **Turn ON only the control power to the SERVOPACK.**
2. **Remove the old battery and mount a new battery.**
3. **Turn OFF the control power to the SERVOPACK to clear the A.830 alarm (Encoder Battery Alarm).**
4. **Turn ON the control power to the SERVOPACK again.**
5. **Make sure that the alarm has been cleared and that the SERVOPACK operates normally.**

(b) When Using an Encoder Cable with a Battery Unit

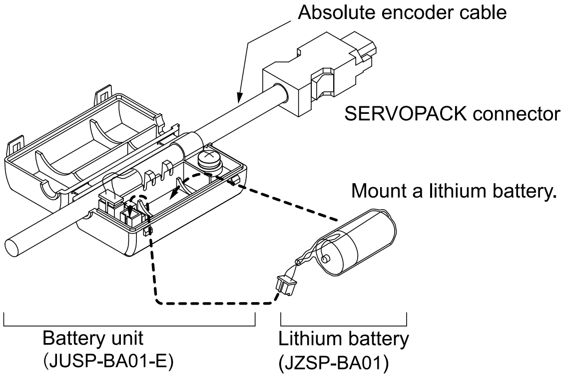
1. **Turn ON only the control power to the SERVOPACK.**

> Important
>
> If you remove the battery or disconnect the encoder cable while the control power to the SERVOPACK is OFF, the absolute encoder data will be lost.

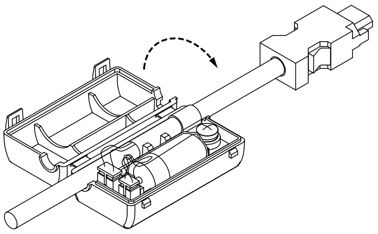
2. **Open the cover of the battery unit.**



3. **Remove the old battery and mount a new battery.**



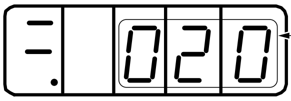
4. **Close the cover of the battery unit.**



5. **Turn OFF the power to the SERVOPACK to clear the A.830 alarm (Encoder Battery Alarm).**
6. **Turn ON the power to the SERVOPACK.**
7. **Make sure that the alarm has been cleared and that the SERVOPACK operates normally.**

13.2 Alarm Displays

If an error occurs in the SERVOPACK, an alarm number will be displayed on the panel display. However, if only "–" appears on the panel display, this indicates a SERVOPACK system error. Replace the SERVOPACK.



Example: If an A.020 alarm occurs, "020" will flash on the display.

This section provides a list of the alarms that may occur and the causes of and corrections for those alarms.

13.2.1 List of Alarms

The list of alarms gives the alarm name, alarm meaning, alarm stopping method, alarm reset possibility, and alarm code output in order of the alarm numbers.

(1) Servomotor Stopping Method for Alarms

Refer to the following section for information on the stopping method for alarms.

☞ *5.14.2 Servomotor Stopping Method for Alarms on page 196*

(2) Alarm Reset Possibility

Yes: You can use an alarm reset to clear the alarm. However, this assumes that the cause of the alarm has been removed.

No: You cannot clear the alarm.

(3) List of Alarms

The following table lists the alarms.

Information Alarm numbers FL-1 to FL-6 are not stored in the alarm history. They are only displayed on the panel display.

Alarm Number	Alarm Name	Alarm Meaning	Servomotor Stopping Method	Alarm Reset Possibility	Alarm Code Output		
					ALO1	ALO2	ALO3
A.020	Parameter Checksum Error	There is an error in the parameter data in the SERVOPACK.	Gr.1	No	H	H	H
A.021	Parameter Format Error	There is an error in the parameter data in the SERVOPACK.	Gr.1	No	H	H	H
A.022	System Checksum Error	There is an error in the parameter data in the SERVOPACK.	Gr.1	No	H	H	H
A.024	System Alarm	An internal program error occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.025	System Alarm	An internal program error occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.030	Main Circuit Detector Error	There is an error in the detection data for the main circuit.	Gr.1	Yes	H	H	H
A.040	Parameter Setting Error	A parameter setting is outside of the setting range.	Gr.1	No	H	H	H
A.041	Encoder Output Pulse Setting Error	The setting of Pn212 (Number of Encoder Output Pulses) or Pn281 (Encoder Output Resolution) is outside of the setting range or does not satisfy the setting conditions.	Gr.1	No	H	H	H
A.042	Parameter Combination Error	The combination of some parameters exceeds the setting range.	Gr.1	No	H	H	H

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Alarm Number	Alarm Name	Alarm Meaning	Servomotor Stopping Method	Alarm Reset Possibility	Alarm Code Output		
					ALO1	ALO2	ALO3
A.044	Semi-Closed/Fully-Closed Loop Control Parameter Setting Error	The settings of parameters related to semi-closed/fully-closed loop control do not match.	Gr.1	No	H	H	H
A.046	SigmaLINK II Command/ Response Parameter Setting Error	An error was detected in the SigmaLINK II response data or SigmaLINK II command data settings.	Gr.1	No	H	H	H
A.050	Combination Error	The capacities of the SERVOPACK and servomotor do not match.	Gr.1	Yes	H	H	H
A.051	Unsupported Device Alarm	An unsupported device was connected.	Gr.1	No	H	H	H
A.070	Motor Type Change Detected	The connected motor is a different type of motor from the previously connected motor.	Gr.1	No	H	H	H
A.080	Linear Encoder Pitch Setting Error	The setting of Pn282 (Linear Encoder Scale Pitch) has not been changed from the default setting.	Gr.1	No	H	H	H
A.0b0	Invalid Servo ON Command Alarm	The /S-ON (Servo ON Input) signal was input from the host controller after a utility function that turns ON the servomotor was executed.	Gr.1	Yes	H	H	H
A.100	Overcurrent Detected	An overcurrent flowed through the power transistor or the heat sink overheated.	Gr.1	No	L	H	H
A.101	Motor Overcurrent Detected	The current to the motor exceeded the allowable current.	Gr.1	No	L	H	H
A.300	Regeneration Error	There is an error related to regeneration.	Gr.1	Yes	L	L	H
A.320	Regenerative Overload	A regenerative overload occurred.	Gr.2	Yes	L	L	H
A.330	Main Circuit Power Supply Wiring Error	• The AC power supply input setting or DC power supply input setting is not correct. • The power supply wiring is not correct.	Gr.1	Yes	L	L	H
A.400	Overvoltage	The main circuit DC voltage is too high.	Gr.1	Yes	H	H	L
A.410	Undervoltage	The main circuit DC voltage is too low.	Gr.2	Yes	H	H	L
A.510	Overspeed	The motor exceeded the maximum speed.	Gr.1	Yes	L	H	L
A.511	Encoder Output Pulse Overspeed	• The pulse output speed for the setting of Pn212 (Number of Encoder Output Pulses) was exceeded. (Rotary Servomotor) • The motor speed upper limit for the setting of Pn281 (Encoder Output Resolution) was exceeded. (Linear Servomotor)	Gr.1	Yes	L	H	L
A.520	Vibration Alarm	Abnormal oscillation was detected in the motor speed.	Gr.1	Yes	L	H	L
A.521	Autotuning Alarm	Vibration was detected during autotuning for the tuning- less function.	Gr.1	Yes	L	H	L
A.550	Maximum Motor Speed Setting Error	The setting of Pn385 (Maximum Motor Speed) is greater than the maximum motor speed.	Gr.1	Yes	L	H	L

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Alarm Number	Alarm Name	Alarm Meaning	Servomotor Stopping Method	Alarm Reset Possibility	Alarm Code Output		
					ALO1	ALO2	ALO3
A.710	Instantaneous Overload	The servomotor was operating for several seconds to several tens of seconds under a torque that largely exceeded the rating.	Gr.2	Yes	L	L	L
A.720	Continuous Overload	The servomotor was operating continuously under a torque that exceeded the rating.	Gr.1	Yes	L	L	L
A.730	Dynamic Brake Overload	When the dynamic brake was applied, the rotational or linear kinetic energy exceeded the capacity of the dynamic brake resistor.	Gr.1	Yes	L	L	L
A.731	Dynamic Brake Overload	When the dynamic brake was applied, the rotational or linear kinetic energy exceeded the capacity of the dynamic brake resistor.	Gr.1	Yes	L	L	L
A.740	Inrush Current Limiting Resistor Overload	The main circuit power was frequently turned ON and OFF.	Gr.1	Yes	L	L	L
A.7A1	Internal Temperature Error 1 (Control Board Temperature Error)	The surrounding temperature of the control board is abnormal.	Gr.2	Yes	L	L	L
A.7A2	Internal Temperature Error 2 (Power Board Temperature Error)	The surrounding temperature of the power board is abnormal.	Gr.2	Yes	L	L	L
A.7A3	Internal Temperature Sensor Error	An error occurred in the temperature sensor circuit.	Gr.2	No	L	L	L
A.7Ab	SERVOPACK Built-in Fan Stopped	The fan inside the SERVOPACK stopped.	Gr.1	Yes	L	L	L
A.810	Encoder Backup Alarm	The power supplies to the encoder all failed and the position data was lost.	Gr.1	No	H	H	H
A.820	Encoder Checksum Alarm	There is an error in the checksum results for encoder memory.	Gr.1	No	H	H	H
A.830	Encoder Battery Alarm	The battery voltage was lower than the specified level after the control power was turned ON.	Gr.1	Yes	H	H	H
A.840	Encoder Data Alarm	There is an internal data error in the encoder.	Gr.1	No	H	H	H
A.850	Encoder Overspeed	The encoder was operating at high speed when the power was turned ON.	Gr.1	No	H	H	H
A.860	Encoder Overheated	The internal temperature of encoder is too high.	Gr.1	No	H	H	H
A.861	Motor Overheated	The internal temperature of motor is too high.	Gr.1	No	H	H	H
A.862	Overheat Alarm	The input voltage (temperature) for the overheat protection input (TH) signal exceeded the setting of Pn61B (Overheat Alarm Level).	Gr.1	Yes	H	H	H
A.890	Encoder Scale Error	A failure occurred in the linear encoder.	Gr.1	No	H	H	H
A.891	Encoder Module Error	An error occurred in the linear encoder.	Gr.1	No	H	H	H
A.8A0	External Encoder Error	An error occurred in the external encoder.	Gr.1	Yes	H	H	H

Continued on next page.

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Alarm Number	Alarm Name	Alarm Meaning	Servomotor Stopping Method	Alarm Reset Possibility	Alarm Code Output		
					ALO1	ALO2	ALO3
A.8A1	External Encoder Module Error	An error occurred in the serial converter unit.	Gr.1	Yes	H	H	H
A.8A2	External Incremental Encoder Sensor Error	An error occurred in the external encoder.	Gr.1	Yes	H	H	H
A.8A3	External Absolute Encoder Position Error	An error occurred in the position data of the external encoder.	Gr.1	Yes	H	H	H
A.8A5	External Encoder Overspeed	An overspeed error occurred in the external encoder.	Gr.1	Yes	H	H	H
A.8A6	External Encoder Overheated	An overheating error occurred in the external encoder.	Gr.1	Yes	H	H	H
A.b10	Speed Reference A/D Error	An error occurred in the A/D converter for the speed reference input.	Gr.2	Yes	H	H	H
A.b11	Speed Reference A/D Data Error	An error occurred in the A/D conversion data for the speed reference.	Gr.2	Yes	H	H	H
A.b20	Torque Reference A/D Error	An error occurred in the A/D converter for the torque reference input.	Gr.2	Yes	H	H	H
A.b21	Torque Reference A/D Conversion Data Error	An error occurred in the A/D conversion data for the torque reference.	Gr.2	Yes	H	H	H
A.b33	Current Detection Error 3	An error occurred in the current detection circuit.	Gr.1	No	H	H	H
A.bE2	Firmware error	A firmware error occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.bF0	System Alarm 0	Internal program error 0 occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.bF1	System Alarm 1	Internal program error 1 occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.bF2	System Alarm 2	Internal program error 2 occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.bF3	System Alarm 3	Internal program error 3 occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.bF4	System Alarm 4	Internal program error 4 occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.bF5	System Alarm 5	Internal program error 5 occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.bF6	System Alarm 6	Internal program error 6 occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.bF7	System Alarm 7	Internal program error 7 occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.bF8	System Alarm 8	Internal program error 8 occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.bFd	System Alarm D	An internal program error D occurred in the SERVOPACK.	Gr.1	No	H	H	H
A.C10	Servomotor Out of Control	The servomotor ran out of control.	Gr.1	Yes	L	H	L
A.C20	Phase Detection Error	The detection of the phase is not correct.	Gr.1	No	L	H	L
A.C21	Polarity Sensor Error	An error occurred in the polarity sensor.	Gr.1	No	L	H	L
A.C22	Phase Information Disagreement	The phase information does not match.	Gr.1	No	L	H	L
A.C50	Polarity Detection Failure	The polarity detection failed.	Gr.1	No	L	H	L

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Alarm Number	Alarm Name	Alarm Meaning	Servomotor Stopping Method	Alarm Reset Possibility	Alarm Code Output		
					ALO1	ALO2	ALO3
A.C51	Overtravel Detected during Polarity Detection	The overtravel signal was detected during polarity detection.	Gr.1	Yes	L	H	L
A.C52	Polarity Detection Not Completed	The servo was turned ON before the polarity was detected.	Gr.1	Yes	L	H	L
A.C53	Out of Range of Motion for Polarity Detection	The travel distance exceeded the setting of Pn48E (Polarity Detection Range).	Gr.1	No	L	H	L
A.C54	Polarity Detection Failure 2	The polarity detection failed.	Gr.1	No	L	H	L
A.C80	Encoder Clear Error or Multiturn Limit Setting Error	The multiturn data for the absolute encoder was not correctly cleared or set.	Gr.1	No	L	H	L
A.C90	Encoder Communications Error	Communications between the encoder and SERVOPACK is not possible.	Gr.1	No	L	H	L
A.C91	Encoder Communications Position Data Acceleration Rate Error	An error occurred in calculating the position data of the encoder.	Gr.1	No	L	H	L
A.C92	Encoder Communications Timer Error	An error occurred in the communications timer between the encoder and SERVOPACK.	Gr.1	No	L	H	L
A.CA0	Encoder Parameter Error	The parameters in the encoder are corrupted.	Gr.1	No	L	H	L
A.Cb0	Encoder Echoback Error	The contents of communications with the encoder are incorrect.	Gr.1	No	L	H	L
A.CC0	Multiturn Limit Disagreement	Different multiturn limits have been set in the encoder and the SERVOPACK.	Gr.1	No	L	H	L
A.Cd1	SigmaLINK II Node Configuration Error	A configuration that cannot be connected with SigmaLINK II was detected.	Gr.1	No	L	H	L
A.Cd2	SigmaLINK II Power Supply Short-Circuit Detected	An error occurred in the power system of the SigmaLINK II connection.	Gr.1	No	L	H	L
A.Cd3	SigmaLINK II Configuration Data Checksum Error	Saving the configuration data failed.	Gr.1	No	L	H	L
A.Cd4	SigmaLINK II Node Change Detected	The content saved in the configuration and the content detected in node detection are different.	Gr.1	No	L	H	L
A.Cd7	SigmaLINK II I/O Device Communications Error	An error occurred in communications with the SigmaLINK II I/O device.	Gr.2	No	L	H	L
A.Cd8	SigmaLINK II I/O Device Status Error	The SigmaLINK II I/O device detected an error.	Gr.2	No	L	H	L
A.CF1	Reception Failed Error in External Encoder	Communications between the external encoder and SERVOPACK is not possible.	Gr.1	No	L	H	L
A.CF2	Timer Stopped Error in External Encoder	An error occurred in the communications timer between the external encoder and SERVOPACK.	Gr.1	No	L	H	L
A.d00	Position Deviation Overflow	The setting of Pn520 (Position Deviation Overflow Alarm Level) was exceeded by the position deviation.	Gr.1	Yes	L	L	H

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Alarm Number	Alarm Name	Alarm Meaning	Servomotor Stopping Method	Alarm Reset Possibility	Alarm Code Output		
					ALO1	ALO2	ALO3
A.d01	Position Deviation Overflow Alarm at Servo ON	The servo was turned ON after the position deviation exceeded the setting of Pn526 (Position Deviation Overflow Alarm Level at Servo ON) while the servo was OFF.	Gr.1	Yes	L	L	H
A.d02	Position Deviation Overflow Alarm for Speed Limit at Servo ON	If position deviation remains in the deviation counter, the setting of Pn529 or Pn584 (Speed Limit Level at Servo ON) limits the speed when the servo is turned ON. This alarm occurs if reference pulses are input and the setting of Pn520 (Position Deviation Overflow Alarm Level) is exceeded before the limit is cleared.	Gr.2	Yes	L	L	H
A.d04	Overtravel Alarm	Overtravel was detected while the servo was ON.	Gr.1	Yes	L	L	H
A.d10	Motor-Load Position Deviation Overflow	There was too much position deviation between the motor and load during fully-closed loop control.	Gr.2	Yes	L	L	H
A.d30	Position Data Overflow	The position feedback data exceeded ±1879048192.	Gr.1	No	L	L	H
A.E72	Feedback Option Module Detection Failure	Detection of the feedback option module failed.	Gr.1	No	H	L	L
A.Eb1	Safety Function Signal Input Timing Error	An error occurred in the input timing of the safety function signal.	Gr.1	No	H	L	L
A.EC8	Gate Drive Error 1	An error occurred in the gate drive circuit.	Gr.1	No	H	L	L
A.EC9	Gate Drive Error 2	An error occurred in the gate drive circuit.	Gr.1	No	H	L	L
A.F10	Power Supply Line Open Phase	The voltage was low for more than one second for phase R, S, or T when the main power was ON.	Gr.2	Yes	H	L	H
FL-1	System Alarm	An internal program error occurred in the SERVOPACK.	-	No	Undefined.	Undefined.	Undefined.
FL-2	System Alarm	An internal program error occurred in the SERVOPACK.	-	No	Undefined.	Undefined.	Undefined.
FL-3	System Alarm	An internal program error occurred in the SERVOPACK.	-	No	Undefined.	Undefined.	Undefined.
FL-4	System Alarm	An internal program error occurred in the SERVOPACK.	-	No	Undefined.	Undefined.	Undefined.
FL-5	System Alarm	An internal program error occurred in the SERVOPACK.	-	No	Undefined.	Undefined.	Undefined.
FL-6	System Alarm	An internal program error occurred in the SERVOPACK.	-	No	Undefined.	Undefined.	Undefined.
CPF00	Digital Operator Communications Error 1	Communications were not possible between the digital operator and the SERVOPACK.	-	No	Undefined.	Undefined.	Undefined.
CPF01	Digital Operator Communications Error 2	Communications were not possible between the digital operator and the SERVOPACK.	-	No	Undefined.	Undefined.	Undefined.

13.2.2 Troubleshooting Alarms

The causes of and corrections for the alarms are given in the following table. Contact your Yaskawa representative if you cannot solve a problem with the correction given in the table.

◆ A.020:Parameter Checksum Error

Possible Cause	Confirmation	Correction	Reference
The power supply voltage suddenly dropped.	Measure the power supply voltage.	Set the power supply voltage within the specified range, and initialize the parameter settings.	164
The power was shut OFF while writing parameter settings.	Check the timing of shutting OFF the power.	Initialize the parameter settings and then set the parameters again.	164
The number of times that parameters were written exceeded the limit.	Check to see if the parameters were frequently changed from the host controller.	The SERVOPACK may be faulty. Replace the SERVOPACK. Reconsider the method for writing the parameters.	–
A malfunction was caused by noise from the AC power supply, ground, static electricity, or other source.	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, noise may be the cause.	Implement countermeasures against noise.	107
Gas, water drops, or cutting oil entered the SERVOPACK and caused failure of the internal components.	Check the installation conditions.	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A failure occurred in the SERVOPACK.	Turn the power 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

Possible Cause	Confirmation	Correction	Reference
The software version of the SERVOPACK that caused the alarm is older than the software version of the parameters specified to write.	Read the product information to see if the software versions are the same. If they are different, it could be the cause of the alarm.	Write the parameters from another SERVOPACK with the same model and the same software version, and then turn the power OFF and ON again.	502
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.022:System Checksum Error

Possible Cause	Confirmation	Correction	Reference
The power supply voltage suddenly dropped.	Measure the power supply voltage.	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
The power was shut OFF while setting a utility function.	Check the timing of shutting OFF the power.	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
A failure occurred in the SERVOPACK.	Turn the power 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.024:System Alarm
A.025:System Alarm
A.030:Main Circuit Detector Error

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.040:Parameter Setting Error

Possible Cause	Confirmation	Correction	Reference
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.	55
The motor parameter file was not written to the linear encoder. (This applies only when not using a serial converter unit.)	Check to see if the motor parameter file was written to the linear encoder.	Write the motor parameter file to the linear encoder.	175
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.	212
The electronic gear ratio is outside of the setting range.	Check the electronic gear ratio. The ratio must be within the following range: 0.001 < (Pn20E/Pn210) < 64000.	Set the electronic gear ratio in the following range: 0.001 < (Pn20E/ Pn210) < 64000.	200
A pin number or sequence input number that does not exist on the SERVOPACK was allocated in Pn590 to Pn599 = n.□XXX (Allocated Pin Number). (An alarm will not occur, however, if the signal is disabled.)	Check the setting of Pn590 to Pn599 = n.□XXX.	Set a pin number or sequence input number that exists in Pn590 to Pn599 = n.□XXX.	222

◆ A.041:Encoder Output Pulse Setting Error

Possible Cause	Confirmation	Correction	Reference
The setting of Pn212 (Number of Encoder Output Pulses) or Pn281 (Encoder Output Resolution) is outside of the setting range or does not satisfy the setting conditions.	Check the setting of Pn212 or Pn281.	Set Pn212 or Pn281 to an appropriate value.	267

◆ A.042:Parameter Combination Error

Possible Cause	Confirmation	Correction	Reference
The speed of program jogging went below the setting range when the electronic gear ratio (Pn20E/ Pn210) or the servomotor was changed.	Check if the setting of the electronic gear ratio (Pn20E/Pn210) satisfies the conditions given in the preparations for program jogging.	Decrease the setting of the electronic gear ratio (Pn20E/Pn210).	344
The speed of program jogging went below the setting range when Pn533 or Pn585 (Program Jogging Movement Speed) was changed.	Check if the setting of Pn533 or Pn585 satisfies the conditions given in the preparations for program jogging.	Increase the setting of Pn533 or Pn585.	344
The travel speed during autotuning without a host reference went below the setting range when the electronic gear ratio (Pn20E/ Pn210) or the servomotor was changed.	Check if the setting of the electronic gear ratio (Pn20E/Pn210) satisfies the conditions given in the preparations for autotuning without a host reference.	Decrease the setting of the electronic gear ratio (Pn20E/Pn210).	396

◆ A.044:Semi-Closed/Fully-Closed Loop Control Parameter Setting Error

Possible Cause	Confirmation	Correction	Reference
The node specified by Pn0DA or Pn0DB does not exist.	Check if the setting for Pn0DA or Pn0DB is the node address of the connected device.	Set Pn0DA and Pn0DB to appropriate values.	552
An unsupported serial converter unit, encoder, or external encoder was specified by Pn0DA.	Check if the connected serial converter unit, encoder, or external encoder is a supported model.	Connect a supported serial converter unit, encoder, or external encoder.	552
A serial converter unit, encoder, or external encoder was specified by Pn0DA.	Check the node address set in Pn0DA.	Set the node address of a servomotor in Pn0DA.	552
A servomotor was specified by Pn0DB.	Check the node address set in Pn0DB.	Set the node address of a serial converter unit, encoder, or external encoder in Pn0DB (a servomotor cannot be used as an external encoder).	552
An I/O device was specified by Pn0DA or Pn0DB.	Check the node address set in Pn0DA and Pn0DB.	Set the node address of a servomotor in Pn0DA, and set the node address of a serial converter unit, encoder, or external encoder in Pn0DB.	552
The same node was specified in Pn0DA and Pn0DB.	Check if Pn0DA and Pn0DB are the same value.	Set Pn0DA and Pn0DB to different values.	552
The setting of Pn002 = n.X□□□ (External Encoder Usage) and the device status do not match.	Check the setting of Pn002 = n.X□□□.	Make sure that the setting of Pn002 = n.X□□□ agrees with the device status.	534

◆ A.046:SigmaLINK II Command/Response Parameter Setting Error

Possible Cause	Confirmation	Correction	Reference
Slave parameters specified by and Pn050 to Pn05E (SigmaLINK II Response Data Selection 1 to 8) do not exist.	Check the parameter numbers set in and Pn050 to Pn05E.	Refer to the I/O device manual and set the correct values.	–

◆ A.050:Combination Error

Possible Cause	Confirmation	Correction	Reference
The SERVOPACK and servomotor capacities do not match each other.	Confirm that the following condition is met: 1/4 ≤ (Servomotor capacity/SERVOPACK capacity) ≤ 4	Select a proper combination of the SERVOPACK and servomotor capacities.	55
A failure occurred in the encoder.	Replace the encoder and check to see if the alarm still occurs.	Replace the servomotor or encoder.	–
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.051:Unsupported Device Alarm

Possible Cause	Confirmation	Correction	Reference
The motor parameter file was not written to the linear encoder. (This applies only when not using a serial converter unit.)	Check to see if the motor parameter file was written to the linear encoder.	Write the motor parameter file to the linear encoder.	175
An unsupported serial converter unit or encoder (e.g., an external encoder) is connected to the SERVOPACK.	Check the product combination specifications.	Change to a correct combination of models.	–

◆ A.070:Motor Type Change Detected

Possible Cause	Confirmation	Correction	Reference
A rotary servomotor was removed and a linear servomotor was connected.	–	Set the parameters for a linear servomotor and reset the motor type alarm. Then, turn the power to the SERVOPACK OFF and ON again.	616
A linear servomotor was removed and a rotary servomotor was connected.	–	Set the parameters for a rotary servomotor and reset the motor type alarm. Then, turn the power to the SERVOPACK OFF and ON again.	616
The node specified by Pn0DA was changed from rotary servomotor to linear servomotor.	Check the setting of Pn0DA.	Change Pn0DA to the setting for a linear servomotor and reset the motor type alarm. Then, turn the power to the SERVOPACK OFF and ON again.	552, 616
The node specified by Pn0DA was changed from linear servomotor to rotary servomotor.	Check the setting of Pn0DA.	Change Pn0DA to the setting for a rotary servomotor and reset the motor type alarm. Then, turn the power to the SERVOPACK OFF and ON again.	552, 616

◆ A.080:Linear Encoder Pitch Setting Error

Possible Cause	Confirmation	Correction	Reference
The setting of Pn282 (Linear Encoder Scale Pitch) has not been changed from the default setting.	Check the setting of Pn282.	Correct the setting of Pn282.	174

◆ A.0b0:Invalid Servo ON Command Alarm

Possible Cause	Confirmation	Correction	Reference
The /S-ON (Servo ON Input) signal was input from the host controller after a utility function that turns ON the servomotor was executed.	–	Turn the power to the SERVOPACK OFF and ON again. Or, execute a software reset.	312

◆ A.100:Overcurrent Detected

Possible Cause	Confirmation	Correction	Reference
The main circuit cable is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	125
There is a short-circuit or ground fault in a main circuit cable.	Check for short-circuits across servomotor phases U, V, and W, or between the ground and servomotor phases U, V, and W.	The cable may be shortcircuited. Replace the cable.	125
There is a short-circuit or ground fault inside the servomotor.	Check for short-circuits across servomotor phases U, V, and W, or between the ground and servomotor phases U, V, or W.	The servomotor may be faulty. Replace the servomotor.	125
There is a short-circuit or ground fault inside the SERVOPACK.	Check for short-circuits across the servomotor connection terminals U, V, and W on the SERVOPACK, or between the ground and terminals U, V, or W.	The SERVOPACK may be faulty. Replace the SERVOPACK.	125
The regenerative resistor is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	125
The dynamic brake (DB, emergency stop executed from the SERVOPACK) was frequently activated, or a DB overload alarm occurred.	Check the power consumed by the DB resistor to see how frequently the DB is being used. Or, check the alarm display to see if an A.730 or A.731 alarm (Dynamic Brake Overload) has occurred.	Change the SERVOPACK model, operating methods, or the mechanisms so that the dynamic brake does not need to be used so frequently.	–
The regenerative processing capacity was exceeded.	Check the regenerative load ratio in the operation monitor of the SigmaWin+ to see how frequently the regenerative resistor is being used.	Recheck the operating conditions and load.	212
The SERVOPACK regenerative resistance is too small.	Check the regenerative load ratio in the operation monitor of the SigmaWin+ to see how frequently the regenerative resistor is being used.	Change the regenerative resistance to a value larger than the SERVOPACK minimum allowable resistance.	212
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. Use an FG wire size equivalent to the SERVOPACK's main circuit wire size.	–
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.101:Motor Overcurrent Detected

Possible Cause	Confirmation	Correction	Reference
The main circuit cable is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	125
There is a short-circuit or ground fault in a main circuit cable.	Check for short-circuits across servomotor phases U, V, and W, or between the ground and servomotor phases U, V, and W.	The cable may be shortcircuited. Replace the cable.	125
There is a short-circuit or ground fault inside the servomotor.	Check for short-circuits across servomotor phases U, V, and W, or between the ground and servomotor phases U, V, or W.	The servomotor may be faulty. Replace the servomotor.	125
There is a short-circuit or ground fault inside the SERVOPACK.	Check for short-circuits across the servomotor connection terminals U, V, and W on the SERVOPACK, or between the ground and terminals U, V, or W.	The SERVOPACK may be faulty. Replace the SERVOPACK.	125
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. Use an FG wire size equivalent to the SERVOPACK's main circuit wire size.	–
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.300:Regeneration Error

Possible Cause	Confirmation	Correction	Reference
When using the built-in regenerative resistor, the jumper between the regenerative resistor terminals (B2 and B3) was removed from one of the following SERVOPACKs: SGDXS-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, or -330A.	Confirm to see if the jumper is connected between main circuit terminals B2 and B3.	Correctly connect a jumper.	121
The external regenerative resistor or regenerative resistor unit is not wired correctly, or was removed or disconnected.	Check the wiring of the external regenerative resistor or regenerative resistor unit.	Remove the jumper between B2 and B3, and correctly wire the external regenerative resistor or regenerative resistor unit.	121
Pn600 (Regenerative Resistor Capacity) is not set to 0 and an external regenerative resistor is not connected to one of the following SERVOPACKs: SGDXS-R70A, -R90A,-1R6A, or -2R8A.	Check to see if an external regenerative resistor is connected and check the setting of Pn600.	Connect an external regenerative resistor, or set Pn600 (Regenerative Resistor Capacity) to 0 (setting unit: ×10 W) if no regenerative resistor is required.	212
An external regenerative resistor is not connected to one of the following SERVOPACKs: SGDXS-470A, -550A, -590A, or -780A.	Check to see if an external regenerative resistor or regenerative resistor unit is connected and check the setting of Pn600.	Connect an external regenerative resistor and set Pn600 to an appropriate value. Or connect a regenerative resistor unit and set Pn600 (Regenerative Resistor Capacity) to 0 (setting unit: 10 W).	212
A failure occurred in the SERVOPACK.	–	While the main circuit power is OFF, turn the control power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.320:Regenerative Overload

Possible Cause	Confirmation	Correction	Reference
The power supply voltage exceeded the specified range.	Measure the power supply voltage.	Set the power supply voltage within the specified range.	–
The external regenerative resistance value or regenerative resistor capacity is too small, or there has been a continuous regeneration state.	Check the operating conditions or the capacity.	Change the regenerative resistance value or capacity. Reconsider the operating conditions.	212
There was a continuous regeneration state because a negative load was continuously applied.	Check the load applied to the servomotor during operation.	Reconsider the system including the servo, machine, and operating conditions.	–
The setting of Pn600 (Regenerative Resistor Capacity) is smaller than the capacity of the external regenerative resistor.	Check to see if a regenerative resistor is connected and check the setting of Pn600.	Correct the setting of Pn600.	212
The setting of Pn603 (Regenerative Resistance) is smaller than the capacity of the external regenerative resistor.	Check to see if a regenerative resistor is connected and check the setting of Pn603.	Correct the setting of Pn603.	212
The external regenerative resistance is too high.	Check the regenerative resistance.	Change the regenerative resistance to a correct value or use an external regenerative resistor of an appropriate capacity.	212
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.330:Main Circuit Power Supply Wiring Error

Possible Cause	Confirmation	Correction	Reference
The regenerative resistor was disconnected when the SERVOPACK power supply voltage was high.	Measure the resistance of the regenerative resistor using a measuring instrument.	If you are using the regenerative resistor built into the SERVOPACK, replace the SERVOPACK. If you are using an external regenerative resistor, replace the external regenerative resistor.	–
DC power was supplied when an AC power supply input was specified in the settings.	Check the power supply to see if it is a DC power supply.	Correct the power supply setting to match the actual power supply.	167
AC power was supplied when a DC power supply input was specified in the settings.	Check the power supply to see if it is an AC power supply.	Correct the power supply setting to match the actual power supply.	167
Pn600 (Regenerative Resistor Capacity) is not set to 0 and an external regenerative resistor is not connected to one of the following SERVOPACKs: SGDXS-R70A, -R90A,-1R6A, or -2R8A.	Check to see if an external regenerative resistor is connected and check the setting of Pn600.	Connect an external regenerative resistor, or if an external regenerative resistor is not required, set Pn600 to 0.	121 , 212
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.400:Overvoltage

Possible Cause	Confirmation	Correction	Reference
The power supply voltage exceeded the specified range.	Measure the power supply voltage.	Set the AC/DC power supply voltage within the specified range.	–
The power supply is not stable or was influenced by a lightning surge.	Measure the power supply voltage.	Improve the power supply conditions, install a surge absorber, and then turn the power OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–
The voltage for AC power supply was too high during acceleration or deceleration.	Check the power supply voltage and the speed and torque during operation.	Set the AC power supply voltage within the specified range.	–
The external regenerative resistance is too high for the operating conditions.	Check the operating conditions and the regenerative resistance.	Select a regenerative resistance value that is appropriate for the operating conditions and load.	212
The load moment of inertia ratio or mass ratio exceeded the allowable value.	Check to see if the moment of inertia ratio or mass ratio is within the allowable range.	Increase the deceleration time, or reduce the load.	–
A failure occurred in the SERVOPACK.	–	While the main circuit power is OFF, turn the control power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.410:Undervoltage

Possible Cause	Confirmation	Correction	Reference
The power supply voltage went below the specified range.	Measure the power supply voltage.	Set the power supply voltage within the specified range.	–
The power supply voltage dropped during operation.	Measure the power supply voltage.	Increase the power supply capacity.	–
A momentary power interruption occurred.	Measure the power supply voltage.	If you have changed the setting of Pn509 (Momentary Power Interruption Hold Time), decrease the setting.	229
The SERVOPACK fuse is blown out.	–	Replace the SERVOPACK and connect a reactor to the DC reactor terminals (⊖1, ⊖2) on the SERVOPACK.	–
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.510:Overspeed

Possible Cause	Confirmation	Correction	Reference
The order of phases U, V, and W in the motor wiring is not correct.	Check the wiring of the servomotor.	Make sure that the servomotor is correctly wired.	–
A reference value that exceeded the overspeed detection level was input.	Check the input reference.	Reduce the reference value. Or, adjust the gain.	233
The motor exceeded the maximum speed.	Check the waveform of the motor speed.	Reduce the speed reference input gain. Adjust the servo gains. Or, reconsider the operating conditions.	233
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.511:Encoder Output Pulse Overspeed

Possible Cause	Confirmation	Correction	Reference
The encoder output pulse frequency exceeded the limit.	Check the encoder output pulse setting.	Decrease the setting of Pn212 (Number of Encoder Output Pulses) or Pn281 (Encoder Output Resolution).	267
The encoder output pulse frequency exceeded the limit because the motor speed was too high.	Check the encoder output pulse setting and the motor speed.	Reduce the motor speed.	–

◆ A.520:Vibration Alarm

Possible Cause	Confirmation	Correction	Reference
Abnormal oscillation was detected in the motor speed.	Check for abnormal motor noise, and check the speed and torque waveforms during operation.	Reduce the motor speed. Or, reduce the setting of Pn100 (Speed Loop Gain).	478
The setting of Pn103 (Moment of Inertia Ratio) is greater than the actual moment of inertia or was greatly changed.	Check the moment of inertia ratio or mass ratio.	Set Pn103 (Moment of Inertia Ratio) to an appropriate value.	373
The setting of Pn312 or Pn384 (Vibration Detection Level) is not suitable.	Check that the setting of Pn312 or Pn384 (Vibration Detection Level) is suitable.	Set Pn312 or Pn384 (Vibration Detection Level) to an appropriate value.	314

◆ A.521:Autotuning Alarm

Possible Cause	Confirmation	Correction	Reference
The servomotor vibrated considerably while performing the tuning-less function.	Check the waveform of the motor speed.	Reduce the load so that the load moment of inertia ratio is within the allowable value. Or increase the load level or reduce the response level in the tuning-less level settings.	369
The servomotor vibrated considerably while performing custom tuning or Easy FFT.	Check the waveform of the motor speed.	Check the operating procedure of corresponding function and implement corrections.	422 , 495

◆ A.550:Maximum Motor Speed Setting Error

Possible Cause	Confirmation	Correction	Reference
The setting of Pn385 (Maximum Motor Speed) is greater than the maximum speed.	Check the setting of Pn385, and the upper limits of the maximum motor speed setting and the encoder output resolution setting.	Set Pn385 to a value that does not exceed the maximum motor speed.	232

◆ A.710:Instantaneous Overload
A.720:Continuous Overload

Possible Cause	Confirmation	Correction	Reference
The wiring is not correct or there is a faulty connection in the motor or encoder wiring.	Check the wiring.	Make sure that the servomotor and encoder are correctly wired.	125
Operation was performed that exceeded the overload protection characteristics.	Check the motor overload characteristics and operation reference.	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.	Remove the mechanical problem.	–
There is an error in the setting of Pn282 (Linear Encoder Scale Pitch).	Check the setting of Pn282.	Set Pn282 to an appropriate value.	174
There is an error in the setting of Pn080 = n.□□X□ (Motor Phase Sequence Selection).	Check the setting of Pn080 = n.□□X□.	Set Pn080 = n.□□X□ to an appropriate value.	179
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.730:Dynamic Brake Overload
A.731:Dynamic Brake Overload

Possible Cause	Confirmation	Correction	Reference
The servomotor was rotated by an external force.	Check the operation status.	Implement measures to ensure that the motor will not be rotated by an external force.	–
When the servomotor was stopped with the dynamic brake, the rotational or linear kinetic energy exceeded the capacity of the dynamic brake resistor.	Check the power consumed by the DB resistor to see how frequently the DB is being used.	Reconsider the following: • Reduce the servomotor command speed. • Decrease the moment of inertia ratio or mass ratio. • Reduce the frequency of stopping with the dynamic brake.	–
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.740:Inrush Current Limiting Resistor Overload

Possible Cause	Confirmation	Correction	Reference
The allowable frequency of the inrush current limiting resistor was exceeded when the main circuit power was turned ON and OFF.	–	Reduce the frequency of turning the main circuit power ON and OFF.	–
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.7A1:Internal Temperature Error 1 (Control Board Temperature Error) A.7A2:Internal Temperature Error 2 (Power Board Temperature Error)

Possible Cause	Confirmation	Correction	Reference
The surrounding temperature is too high.	Check the surrounding temperature using a thermometer. Or, check the operating status with the SERVOPACK installation environment monitor.	Decrease the surrounding temperature by improving the SERVOPACK installation conditions.	98
An overload alarm was reset by turning OFF the power too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	–
There was an excessive load or operation was performed that exceeded the regenerative processing capacity.	Check the load during operation with [Cumulative Load] and check the regenerative capacity with [Regenerative Load] on the operation monitor of the SigmaWin+.	Reconsider the load and operating conditions.	–
The SERVOPACK installation orientation is not correct or there is insufficient space around the SERVOPACK.	Check the SERVOPACK installation conditions.	Install the SERVOPACK according to specifications.	95 , 97
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.7A3:Internal Temperature Sensor Error

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.7Ab:SERVOPACK Built-in Fan Stopped

Possible Cause	Confirmation	Correction	Reference
The fan inside the SERVOPACK stopped.	Check for foreign matter inside the SERVOPACK.	Remove foreign matter from the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.810:Encoder Backup Alarm

Possible Cause	Confirmation	Correction	Reference
The power to the absolute encoder was turned ON for the first time.	Check to see if the power was turned ON for the first time.	Set up the encoder.	206
The encoder cable was disconnected and then connected again.	Check to see if the power was turned ON for the first time.	Check the encoder connection and set up the encoder.	206
Power is not being supplied both from the control power supply (+5 V) from the SERVOPACK and from the battery power supply.	Check the encoder connector battery and the connector status.	Replace the battery or implement similar measures to supply power to the encoder, and set up the encoder.	206
A failure occurred in the absolute encoder.	–	If the alarm still occurs after setting up the encoder again, replace the servomotor.	–
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.820:Encoder Checksum Alarm

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the encoder.	–	• When Using an Absolute Encoder Set up the encoder again. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. • When Using a Singleturn Absolute Encoder or Incremental Encoder – The servomotor may be faulty. Replace the servomotor. – The linear encoder may be faulty. Replace the linear encoder.	206
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.830:Encoder Battery Alarm

Possible Cause	Confirmation	Correction	Reference
The battery connection is faulty or a battery is not connected.	Check the battery connection.	Correct the battery connection.	126
The battery voltage is lower than the specified value (2.7 V).	Measure the battery voltage.	Replace the battery.	577
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.840:Encoder Data Alarm

Possible Cause	Confirmation	Correction	Reference
The encoder malfunctioned.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the servomotor or linear encoder may be faulty. Replace the servomotor or linear encoder.	–
An error occurred in reading data from the linear encoder.	–	The linear encoder is not mounted within an appropriate tolerance. Correct the mounting of the linear encoder.	–
Excessive speed occurred in the linear encoder.	–	Control the motor speed within the range specified by the linear encoder manufacturer and then turn ON the control power.	–
The encoder malfunctioned due to noise.	–	Correct the wiring around the encoder by separating the encoder cable from the servomotor main circuit cable or by grounding the encoder.	–
The polarity sensor is not wired correctly.	Check the wiring of the polarity sensor.	Correct the wiring of the polarity sensor.	–
The polarity sensor failed.	–	Replace the polarity sensor.	–

◆ A.850:Encoder Overspeed

Possible Cause	Confirmation	Correction	Reference
Rotary Servomotor: The servomotor speed was 200 min^{-1} or higher when the control power was turned ON.	Check the motor speed when the power is turned ON.	Reduce the servomotor speed to a value less than 200 min^{-1}, and turn ON the control power.	–
Linear Servomotor: The servomotor exceeded the specified speed when the control power was turned ON.	Check the motor speed when the power is turned ON.	Control the motor speed within the range specified by the linear encoder manufacturer and then turn ON the control power.	–
A failure occurred in the encoder.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the servomotor or linear encoder may be faulty. Replace the servomotor or linear encoder.	–
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.860:Encoder Overheated

Possible Cause	Confirmation	Correction	Reference
The surrounding temperature around the servomotor is too high.	Measure the surrounding temperature around the servomotor.	Reduce the surrounding temperature of the servomotor to 40°C or less.	–
The servomotor load is greater than the rated load.	Check the load with the [Cumulative Load] on the operation monitor of the SigmaWin+.	Operate the servo drive so that the motor load remains within the specified range.	504
A failure occurred in the encoder.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the servomotor or absolute linear encoder may be faulty. Replace the servomotor or absolute linear encoder.	–
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.861:Motor Overheated

Possible Cause	Confirmation	Correction	Reference
The surrounding temperature around the servomotor is too high.	Measure the surrounding temperature around the servomotor.	Reduce the surrounding temperature of the servomotor to 40°C or less.	–
The servomotor load is greater than the rated load.	Check the load with the [Cumulative Load] on the operation monitor of the SigmaWin+.	Operate the servo drive so that the motor load remains within the specified range.	504
A failure occurred in the serial converter unit.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the serial converter unit may be faulty. Replace the serial converter unit.	–
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.862:Overheat Alarm

Possible Cause	Confirmation	Correction	Reference
The surrounding temperature is too high.	Check the surrounding temperature using a thermometer.	Lower the surrounding temperature by improving the installation conditions of the linear servomotor or the machine.	–
The overheat protection input signal line is disconnected or short-circuited.	Check the input voltage with the overheat protection input information on the operation monitor of the SigmaWin+.	Repair the line for the overheat protection input signal.	–
An overload alarm was reset by turning OFF the power too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	–
Operation was performed under an excessive load.	Check the load with the [Cumulative Load] on the operation monitor of the SigmaWin+.	Reconsider the load and operating conditions.	–
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
The temperature detection circuit in the linear servomotor is faulty or the sensor attached to the machine is faulty.	–	The temperature detection circuit in the linear servomotor may be faulty or the sensor attached to the machine may be faulty. Replace the linear servomotor or repair the sensor attached to the machine.	–

◆ A.890:Encoder Scale Error

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the linear encoder.	–	The linear encoder may be faulty. Replace the linear encoder.	–

◆ A.891:Encoder Module Error

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the linear encoder.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the linear encoder may be faulty. Replace the linear encoder.	–

◆ A.8A0:External Encoder Error

Possible Cause	Confirmation	Correction	Reference
Setting the origin of the absolute linear encoder failed because the motor moved.	Before you set the origin, use the fully-closed feedback pulse counter to confirm that the motor is not moving.	The motor must be stopped while setting the origin position.	209
A failure occurred in the external encoder.	–	Replace the external encoder.	–

◆ A.8A1:External Encoder Module Error

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the external encoder.	–	Replace the external encoder.	–
A failure occurred in the serial converter unit.	–	Replace the serial converter unit.	–

◆ A.8A2:External Incremental Encoder Sensor Error

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the external encoder.	–	Replace the external encoder.	–

◆ A.8A3:External Absolute Encoder Position Error

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the external absolute encoder.	–	The external absolute encoder may be faulty. Refer to the encoder manufacturer’s instruction manual for corrections.	–

◆ A.8A5:External Encoder Overspeed

Possible Cause	Confirmation	Correction	Reference
An overspeed error was detected in the external encoder.	Check the maximum speed of the external encoder.	Keep the external encoder below its maximum speed.	–

◆ A.8A6:External Encoder Overheated

Possible Cause	Confirmation	Correction	Reference
An overheating error was detected in the external encoder.	–	Replace the external encoder.	–

◆ A.b10:Speed Reference A/D Error
A.b11:Speed Reference A/D Data Error

Possible Cause	Confirmation	Correction	Reference
A malfunction occurred in the speed reference input section.	–	Reset the alarm and restart operation.	610
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.b20:Torque Reference A/D Error

Possible Cause	Confirmation	Correction	Reference
A malfunction occurred in the reading section for the torque reference input.	–	Reset the alarm and restart operation.	610
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.b21:Torque Reference A/D Conversion Data Error

Possible Cause	Confirmation	Correction	Reference
A malfunction occurred in the torque reference input section.	–	Reset the alarm and restart operation.	610
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.b33:Current Detection Error 3

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the current detection circuit.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.bE2:Firmware error A.bF0:System Alarm 0 A.bF1:System Alarm 1 A.bF2:System Alarm 2 A.bF3:System Alarm 3 A.bF4:System Alarm 4 A.bF5:System Alarm 5 A.bF6:System Alarm 6 A.bF7:System Alarm 7 A.bF8:System Alarm 8 A.bFd:System Alarm D

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.C10:Servomotor Out of Control

Possible Cause	Confirmation	Correction	Reference
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.	–
There is an error in the setting of Pn080 = n.□□X□ (Motor Phase Sequence Selection).	Check the setting of Pn080 = n.□□X□.	Set Pn080 = n.□□X□ to an appropriate value.	179
When using an absolute encoder, the setting of Pn080 = n.□□X□ (Motor Phase Sequence Selection) was changed after polarity detection was executed.	–	Execute polarity detection again.	182
A failure occurred in the encoder.	–	If the motor wiring is correct and an alarm still occurs after turning the power OFF and ON again, the servomotor or linear encoder may be faulty. Replace the servomotor or linear encoder.	–
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.C20:Phase Detection Error

Possible Cause	Confirmation	Correction	Reference
The linear encoder signal level is too low.	Check the voltage of the linear encoder signal.	Fine-tune the mounting of the scale sensor head. Or, replace the linear encoder.	–
The count-up direction of the linear encoder does not match the forward direction of the moving coil in the motor.	Check the setting of Pn080 = n.□□X□ (Motor Phase Sequence Selection). Check the installation orientation for the linear encoder and moving coil.	Change the setting of Pn080 = n.□□X□. Correctly reinstall the linear encoder or moving coil.	179
The polarity sensor signal is being affected by noise.	–	Correct the FG wiring. Implement countermeasures against noise for the polarity sensor wiring.	–
The setting of Pn282 (Linear Encoder Scale Pitch) is not correct.	Check the setting of Pn282 (Linear Encoder Scale Pitch).	Check the specifications of the linear encoder and set a correct value.	174

◆ A.C21:Polarity Sensor Error

Possible Cause	Confirmation	Correction	Reference
The polarity sensor is protruding from the magnetic way of the motor.	Check the polarity sensor.	Correctly reinstall the moving coil or magnetic way of the motor.	–
The polarity sensor is not wired correctly.	Check the wiring of the polarity sensor.	Correct the wiring of the polarity sensor.	–
The polarity sensor failed.	–	Replace the polarity sensor.	–

◆ A.C22:Phase Information Disagreement

Possible Cause	Confirmation	Correction	Reference
The SERVOPACK phase information is different from the linear encoder phase information.	–	Perform polarity detection.	184

◆ A.C50:Polarity Detection Failure

Possible Cause	Confirmation	Correction	Reference
The parameter settings are not correct.	Check the linear encoder specifications and feedback signal status.	The settings of Pn282 (Linear Encoder Scale Pitch) and Pn080 = n.□□X□ (Motor Phase Sequence Selection) may not match the installation. Set the parameters to correct values.	174,179
There is noise on the scale signal.	Check to make sure that the frame grounds of the serial converter unit and servomotor are connected to the FG terminal on the SERVOPACK and that the FG terminal on the SERVOPACK is connected to the frame ground on the power supply. And, confirm that the shield is properly processed on the linear encoder cable. Check to see if the detection reference is repeatedly output in one direction.	Implement appropriate countermeasures against noise for the linear encoder cable.	–
An external force was applied to the moving coil of the motor.	–	The polarity cannot be properly detected if the detection reference is 0 and the speed feedback is not 0 because of an external force, such as cable tension, applied to the moving coil. Implement measures to reduce the external force so that the speed feedback goes to 0. If the external force cannot be reduced, increase the setting of Pn481 (Polarity Detection Speed Loop Gain).	–
The linear encoder resolution is too low.	Check the linear encoder scale pitch to see if it is within 100 μm.	If the linear encoder scale pitch is 100 μm or higher, the SERVOPACK cannot detect the correct speed feedback. Use a linear encoder scale pitch with higher resolution. (We recommend a pitch of 40 μm or less.) Or, increase the setting of Pn485 (Polarity Detection Reference Speed). However, increasing the setting of Pn485 will increase the servomotor movement range that is required for polarity detection.	–

◆ A.C51:Overtravel Detected during Polarity Detection

Possible Cause	Confirmation	Correction	Reference
The overtravel signal was detected during polarity detection.	Check the overtravel position.	Wire the overtravel signals. Execute polarity detection at a position where an overtravel signal would not be detected.	139

◆ A.C52:Polarity Detection Not Completed

Possible Cause	Confirmation	Correction	Reference
The servo was turned ON under the following circumstances. • Before polarity detection was completed • Before /P-DET was input	–	Input the /P-DET signal.	183

◆ A.C53:Out of Range of Motion for Polarity Detection

Possible Cause	Confirmation	Correction	Reference
The travel distance exceeded the setting of Pn48E (Polarity Detection Range) in the middle of detection.	–	Increase the setting of Pn48E (Polarity Detection Range). Or, increase the setting of Pn481 (Polarity Detection Speed Loop Gain).	–

◆ A.C54:Polarity Detection Failure 2

Possible Cause	Confirmation	Correction	Reference
An external force was applied to the servomotor.	–	Increase the setting of Pn495 (Polarity Detection Confirmation Force Reference). Increase the setting of Pn498 (Polarity Detection Allowable Error Range). Increasing the allowable error will also increase the motor temperature.	–

◆ A.C80:Encoder Clear Error or Multiturn Limit Setting Error

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the encoder.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the servomotor or linear encoder may be faulty. Replace the servomotor or linear encoder.	–
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.C90:Encoder Communications Error

Possible Cause	Confirmation	Correction	Reference
The content saved in the configuration and the content detected in node detection are different when SigmaLINK II was used.	Check the content that was saved with self-configuration and the actual device connections.	If the actual device configuration is correct, execute self-configuration again. If the content that was saved with self-configuration is correct, change the actual device configuration to match the saved content.	547
There is a faulty contact in the connector or the connector is not wired correctly for the encoder cable.	Check the condition of the connector for encoder cable.	Reconnect the connector for encoder cable and check the encoder wiring.	125
There is a cable disconnection or short-circuit in the encoder. Or, the cable impedance is outside the specified values.	Check the condition of the encoder cable.	Use the encoder cable within the specified specifications.	–
One of the following has occurred: corrosion caused by improper temperature, humidity, or gas, a short-circuit caused by entry of water drops or cutting oil, or faulty contact in connector caused by vibration.	Check the operating environment.	Improve the operating environment, and replace the cable. If the alarm still occurs, replace the SERVOPACK.	94
A malfunction was caused by noise.	–	Correct the wiring around the encoder by separating the encoder cable from the servomotor main circuit cable or by grounding the encoder.	107
A failure occurred in the SERVOPACK.	–	If the alarm does not occur when the servomotor is connected to a different SERVOPACK and the control power is supplied, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.C91:Encoder Communications Position Data Acceleration Rate Error

Possible Cause	Confirmation	Correction	Reference
Noise entered on the signal lines because the encoder cable is bent or the sheath is damaged.	Check the condition of the encoder cable and connectors.	Check the encoder cable to see if it is installed correctly.	109
The encoder cable is bundled with a high-current line or installed near a high-current line.	Check the installation condition of the encoder cable.	Confirm that there is no surge voltage on the encoder cable.	–
There is variation in the FG potential because of the influence of machines on the servomotor side, such as a welder.	Check the installation condition of the encoder cable.	Properly ground the machine to separate it from the FG of the encoder.	–

◆ A.C92:Encoder Communications Timer Error

Possible Cause	Confirmation	Correction	Reference
Noise entered on the signal line from the encoder.	–	Implement countermeasures against noise for the encoder wiring.	107
Excessive vibration or shock was applied to the encoder.	Check the operating conditions.	Reduce machine vibration. Correctly install the servomotor or linear encoder.	–
A failure occurred in the encoder.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the servomotor or linear encoder may be faulty. Replace the servomotor or linear encoder.	–
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.CA0:Encoder Parameter Error

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the encoder.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the servomotor or linear encoder may be faulty. Replace the servomotor or linear encoder.	–
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.Cb0:Encoder Echoback Error

Possible Cause	Confirmation	Correction	Reference
The encoder is wired incorrectly or there is faulty contact.	Check the wiring of the encoder.	Make sure that the encoder is correctly wired.	125
The specifications of the encoder cable are not correct and noise entered on it.	–	Use a shielded twisted-pair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm ^{2}.	–
The encoder cable is too long and noise entered on it.	–	• Rotary Servomotors: The encoder cable wiring distance must be 50 m max. • Linear Servomotors: The encoder cable wiring distance must be 20 m max.	–
There is variation in the FG potential because of the influence of machines on the servomotor side, such as a welder.	Check the condition of the encoder cable and connectors.	Properly ground the machine to separate it from the FG of the encoder.	–
Excessive vibration or shock was applied to the encoder.	Check the operating conditions.	Reduce machine vibration. Correctly install the servomotor or linear encoder.	–
A failure occurred in the encoder.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the servomotor or linear encoder may be faulty. Replace the servomotor or linear encoder.	–
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.CC0:Multiturn Limit Disagreement

Possible Cause	Confirmation	Correction	Reference
When using a direct drive servomotor, the setting of Pn205 (Multiturn Limit) does not agree with the encoder.	Check the setting of Pn205.	Correct the setting of Pn205 (0 to 65535).	301
The multiturn limit of the encoder is different from that of the SERVOPACK. Or, the multiturn limit of the SERVOPACK has been changed.	Check the setting of Pn205 (Multiturn Limit).	Change the setting if the alarm occurs.	301
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.Cd1:SigmaLINK II Node Configuration Error

Possible Cause	Confirmation	Correction	Reference
Nodes that are compatible and incompatible with SigmaLINK II are connected.	Check if nodes that are compatible and incompatible with SigmaLINK II are connected.	Make all of the connected nodes either compatible or incompatible with SigmaLINK II.	546
Four or more nodes are connected.	Check the number of connected servomotors, external encoders, and I/O devices.	Connect no more than a total of three servomotors, external encoders, and I/O devices.	546
Two or more servomotors are connected.	Check the number of servomotors that are connected.	Connect one servomotor.	546
Two or more external encoders are connected.	Check the number of external encoders that are connected.	Connect one external encoder.	546

◆ A.Cd2:SigmaLINK II Power Supply Short-Circuit Detected

Possible Cause	Confirmation	Correction	Reference
The CN2 power supply is short-circuited.	Check the condition of the encoder cable.	Disconnect the connected node and check if the alarm occurs. If the alarm occurs even when the connected node is disconnected, replace the encoder cable. If the alarm still occurs, replace the connected node or SERVOPACK.	–

◆ A.Cd3:SigmaLINK II Configuration Data Checksum Error

Possible Cause	Confirmation	Correction	Reference
Saving the configuration data failed.	–	Execute SigmaLINK II self-configuration again and save the settings.	547
The SigmaLINK II configuration data saved in nonvolatile memory is damaged.	–	Execute SigmaLINK II self-configuration again and save the settings.	547

◆ A.Cd4:SigmaLINK II Node Change Detected

Possible Cause	Confirmation	Correction	Reference
The content saved in the configuration and the content detected in node detection are different.	Check the content that was saved with self-configuration and the actual device connections.	If the actual device configuration is correct, execute self-configuration again. If the content that was saved with self-configuration is correct, change the actual device configuration to match the saved content.	547
Detection of the node failed.	–	Execute SigmaLINK II self-configuration again and save the settings.	547

◆ A.Cd7:SigmaLINK II I/O Device Communications Error

Possible Cause	Confirmation	Correction	Reference
There is a faulty contact in the connector or the connector is not wired correctly for the encoder cable.	Check the connection and condition of the encoder cable.	• Correctly connect the encoder cable. • Replace the encoder cable.	–
There is a cable disconnection or short-circuit in the encoder. Or, the cable impedance is outside the specified values.	Check the condition of the encoder cable.	Use the encoder cable within the specified specifications.	–
One of the following has occurred: corrosion caused by improper temperature, humidity, or gas, a short-circuit caused by entry of water drops or cutting oil, or faulty contact in connector caused by vibration.	Check the operating environment.	Improve the operating environment, and replace the cable. If the alarm still occurs, replace the SERVOPACK.	94
A malfunction was caused by noise.	–	Correct the wiring around the encoder by separating the encoder cable from the servomotor main circuit cable or by grounding the encoder.	107
A failure occurred in the SERVOPACK.	–	If the alarm does not occur when the I/O device is connected to a different SERVOPACK and the control power is supplied, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.Cd8:SigmaLINK II I/O Device Status Error

Possible Cause	Confirmation	Correction	Reference
The I/O device detected a warning.	Check the alarm code by reading the I/O device alarm in the SigmaWin+.	Take corrective action according to the I/O device manual.	–

◆ A.CF1:Reception Failed Error in External Encoder

Possible Cause	Confirmation	Correction	Reference
The content saved in the configuration and the content detected in node detection are different when SigmaLINK II was used.	Check the content that was saved with self-configuration and the actual device connections.	If the actual device configuration is correct, execute self-configuration again. If the content that was saved with self-configuration is correct, change the actual device configuration to match the saved content.	547
The cable between the serial converter unit and SERVOPACK is not wired correctly or there is a faulty contact.	Check the wiring of the external encoder.	Correctly wire the cable between the serial converter unit and SERVOPACK.	131
A specified cable is not being used between serial converter unit and SERVOPACK.	Check the wiring specifications of the external encoder.	Use a specified cable.	–
The cable between the serial converter unit and SERVOPACK is too long.	Measure the length of the cable that connects the serial converter unit.	The length of the cable between the serial converter unit and SERVOPACK must be 20 m or less.	–
The sheath on cable between the serial converter unit and SERVOPACK is broken.	Check the cable that connects the serial converter unit.	Replace the cable between the serial converter unit and SERVOPACK.	–

◆ A.CF2:Timer Stopped Error in External Encoder

Possible Cause	Confirmation	Correction	Reference
Noise entered the cable between the serial converter unit and SERVOPACK.	–	Correct the wiring around the serial converter unit, e.g., separate I/O signal lines from the main circuit cables or ground.	–
A failure occurred in the serial converter unit.	–	Replace the serial converter unit.	–
A failure occurred in the SERVOPACK.	–	Replace the SERVOPACK.	–

◆ A.d00:Position Deviation Overflow

Possible Cause	Confirmation	Correction	Reference
The servomotor U, V, and W wiring is not correct.	Check the wiring of the servomotor main circuit cables.	Make sure that there are no faulty contacts in the wiring for the servomotor and encoder.	–
The frequency of the position reference pulse is too high.	Reduce the reference pulse frequency and try operating the SERVOPACK.	Reduce the position reference pulse frequency or the reference acceleration rate, or reconsider the electronic gear ratio.	200
The acceleration of the position reference is too high.	Reduce the reference acceleration and try operating the SERVOPACK.	Apply smoothing, i.e., by using Pn216 (Position Reference Acceleration/ Deceleration Time Constant).	251
The setting of Pn520 (Position Deviation Overflow Alarm Level) is too low for the operating conditions.	Check the setting of Pn520 (Position Deviation Overflow Alarm Level) to see if it is set to an appropriate value.	Optimize the setting of Pn520.	364
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.d01:Position Deviation Overflow Alarm at Servo ON

Possible Cause	Confirmation	Correction	Reference
The servo was turned ON after the position deviation exceeded the setting of Pn526 (Position Deviation Overflow Alarm Level at Servo ON) while the servo was OFF.	Check the position deviation while the servo is OFF.	Set the position deviation to be cleared while the servo is OFF.	364

◆ A.d02:Position Deviation Overflow Alarm for Speed Limit at Servo ON

Possible Cause	Confirmation	Correction	Reference
If position deviation remains in the deviation counter, the setting of Pn529 or Pn584 (Speed Limit Level at Servo ON) limits the speed when the servo is turned ON. This alarm occurs if reference pulses are input and the setting of Pn520 (Position Deviation Overflow Alarm Level) is exceeded.	–	Set the position deviation to be cleared while the servo is OFF. Optimize the setting of Pn520 (Position Deviation Overflow Alarm Level). Or, set Pn529 or Pn584 (Speed Limit Level at Servo ON) to an appropriate value.	364

◆ A.d04:Overtravel Alarm

Possible Cause	Confirmation	Correction	Reference
Overtravel was detected while the servo was ON.	Check the status of the overtravel signals on the input signal monitor.	• Review the references from the host controller so that the moving parts of the machine do not exceed the overtravel range and software limits. • Check the wiring of the overtravel signals. • Implement countermeasures against noise.	188

◆ A.d10:Motor-Load Position Deviation Overflow

Possible Cause	Confirmation	Correction	Reference
The motor direction and external encoder installation orientation are backward.	Check the motor direction and the external encoder installation orientation.	Install the external encoder in the opposite direction, or change the setting of Pn002 = n.X□□□ (External Encoder Usage) to reverse the direction.	534
There is an error in the connection between the load (e.g., stage) and external encoder coupling.	Check the coupling of the external encoder.	Check the mechanical coupling.	–

◆ A.d30:Position Data Overflow

Possible Cause	Confirmation	Correction	Reference
The position data exceeded ±1879048192.	Check the input reference pulse counter.	Reconsider the operating specifications.	–

◆ A.E72:Feedback Option Module Detection Failure

Possible Cause	Confirmation	Correction	Reference
There is a faulty connection between the SERVOPACK and the feedback option module.	Check the connection between the SERVOPACK and the feedback option module.	Correctly connect the feedback option module.	–
The feedback option module was disconnected.	–	Reset the option module configuration error and turn the power to the SERVOPACK OFF and ON again.	614
A failure occurred in the feedback option module.	–	Replace the feedback option module.	–
A failure occurred in the SERVOPACK.	–	Replace the SERVOPACK.	–

◆ A.Eb1:Safety Function Signal Input Timing Error

Possible Cause	Confirmation	Correction	Reference
The delay between activation of the /HWBB1 and /HWBB2 input signals for the HWBB was ten second or longer.	Measure the time delay between the /HWBB1 and /HWBB2 signals.	The output signal circuits or devices for /HWBB1 and /HWBB2 or the SERVOPACK input signal circuits may be faulty. Alternatively, the input signal cables may be disconnected. Check to see if any of these items are faulty or have been disconnected.	–
A failure occurred in the SERVOPACK.	–	Replace the SERVOPACK.	–

◆ A.EC8:Gate Drive Error 1
A.EC9:Gate Drive Error 2

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.F10:Power Supply Line Open Phase

Possible Cause	Confirmation	Correction	Reference
The three-phase power supply wiring is not correct.	Check the power supply wiring.	Make sure that the power supply is correctly wired.	113
The three-phase power supply is unbalanced.	Measure the voltage for each phase of the three-phase power supply.	Balance the power supply by changing phases.	–
A single-phase AC power supply was input without specifying Pn00B = n.□1□□ (Single-phase AC Power Supply Input).	Check the power supply and the parameter setting.	Match the parameter setting to the power supply.	113
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ FL-1:System Alarm
FL-2:System Alarm
FL-3:System Alarm
FL-4:System Alarm
FL-5:System Alarm
FL-6:System Alarm

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ CPF00:Digital Operator Communications Error 1

Possible Cause	Confirmation	Correction	Reference
There is a faulty connection between the digital operator and the SERVOPACK.	Check the connector contact.	Disconnect the connector and insert it again. Or, replace the cable.	–
A malfunction was caused by noise.	–	Keep the digital operator or the cable away from sources of noise.	–

◆ CPF01:Digital Operator Communications Error 2

Possible Cause	Confirmation	Correction	Reference
A failure occurred in the digital operator.	–	Disconnect the digital operator and then connect it again. If the alarm still occurs, the digital operator may be faulty. Replace the digital operator.	–
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–
A malfunction was caused by noise.	–	Keep the digital operator or the cable away from sources of noise.	–

13.2.3 Alarm Reset

If there is an ALM (Servo Alarm Output) signal, use one of the following methods to reset the alarm after eliminating the cause of the alarm.

The /ALM-RST (Alarm Reset Input) signal will not always reset encoder-related alarms. If you cannot reset an alarm with the /ALM-RST signal, turn OFF the control power to reset it.

Important

Be sure to eliminate the cause of an alarm before you reset the alarm.

If you reset the alarm and continue operation without eliminating the cause of the alarm, it may result in damage to the equipment or fire.

(1) Resetting Alarms with the /ALM-RST (Alarm Reset Input) Signal

Type	Signal	Connector Pin No.	Name
Input	/ALM-RST	CN1-44	Alarm Reset

Note:

Use Pn50B = n.□□X□ (/ALM-RST (Alarm Reset Input) Signal Allocation) to allocate the /ALM-RST signal to other connector pins. Refer to the following section for details.

☞ *6.1.3 Input Signal Allocations on page 220*

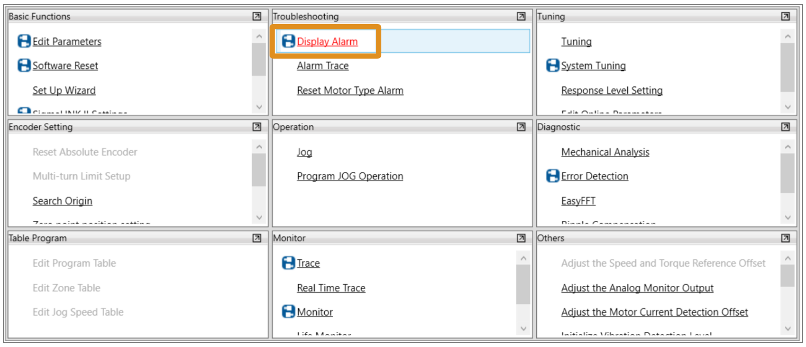
(2) Resetting Alarms with the SigmaWin+

Use the following procedure to reset alarms with the SigmaWin+.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

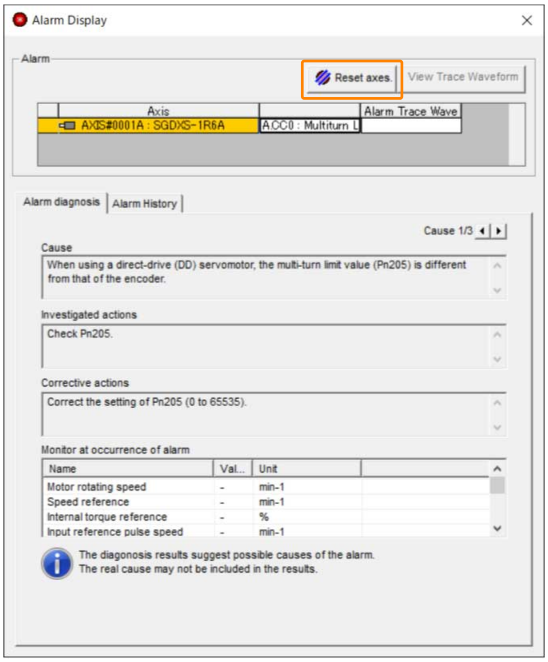
   The [Menu] window will be displayed.

2. **Click [Display Alarm] in the [Troubleshooting] area.**



   The [Alarm Display] window will be displayed.

3. **Click the [Reset axes] button.**



Cause

When using a direct-drive (DD) servomotor, the multi-turn limit value (Pn205) is different from that of the encoder.

Investigated actions

Check Pn205.

Corrective actions

Correct the setting of Pn205 (0 to 65535).

Monitor at occurrence of alarm

Name	Val...	Unit
Motor rotating speed	-	min-1
Speed reference	-	min-1
Internal torque reference	-	%
Input reference pulse speed	-	min-1

The diagonosis results suggest possible causes of the alarm.
The real cause may not be included in the results.

   The alarm will be reset, and the alarm display will be cleared.

This concludes the procedure to reset alarms.

(3) Resetting Alarms Using the Panel Operator

Simultaneously press the [UP] and the [DOWN] keys on the panel operator.

(4) Resetting Alarms Using the Digital Operator

Press the [ALARM RESET] key on the digital operator. Refer to the following manual for details on resetting alarms.

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

13.2.4 Displaying the Alarm History

The alarm history displays up to the last ten alarms that have occurred in the SERVOPACK.

Note:

(1) Preparations

No preparations are required.

(2) Applicable Tools

The following table lists the tools that you can use to display the alarm history.

Tool	Fn No./Function Name	Reference
Panel Operator	Fn000	☞ *14.4.1 Display Alarm History (Fn000) on page 644*
Digital Operator	Fn000	📖 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Troubleshooting] – [Display Alarm]	☞ *(3) Operating Procedure on page 612*

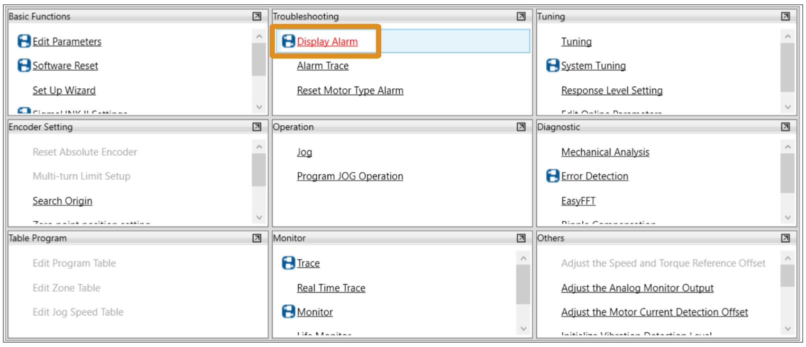
(3) Operating Procedure

Use the following procedure to display the alarm history.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

   The [Menu] window will be displayed.

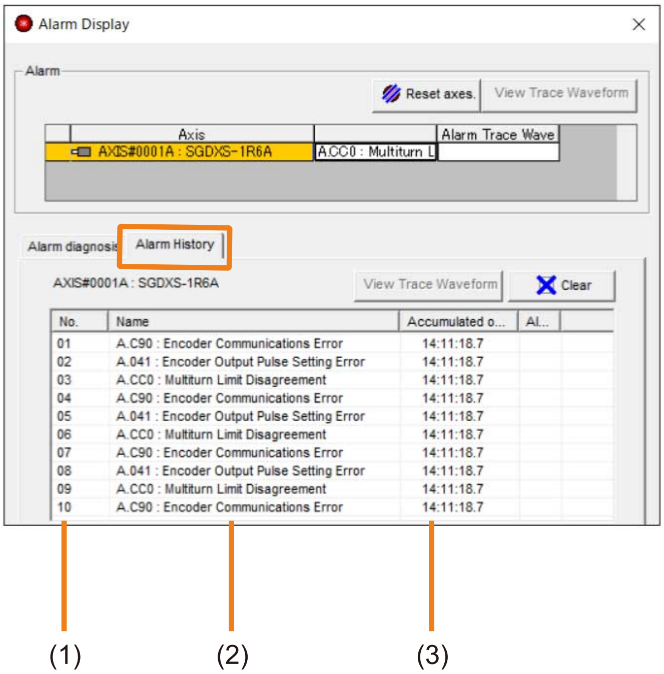
2. **Click [Display Alarm] in the [Troubleshooting] area.**



   The [Alarm Display] window will be displayed.

3. **Click the [Alarm History] tab.**

   The following window will appear and you can check the alarms that occurred in the past.



	Axis		Alarm Trace Wave
	AXIS#0001A : SGDXS-1R6A	A.CC0 : Multiturn L	

AXIS#0001A : SGDXS-1R6A

No.	Name	Accumulated o...	Al...
01	A.C90 : Encoder Communications Error	14:11:18.7	
02	A.041 : Encoder Output Pulse Setting Error	14:11:18.7	
03	A.CC0 : Multiturn Limit Disagreement	14:11:18.7	
04	A.C90 : Encoder Communications Error	14:11:18.7	
05	A.041 : Encoder Output Pulse Setting Error	14:11:18.7	
06	A.CC0 : Multiturn Limit Disagreement	14:11:18.7	
07	A.C90 : Encoder Communications Error	14:11:18.7	
08	A.041 : Encoder Output Pulse Setting Error	14:11:18.7	
09	A.CC0 : Multiturn Limit Disagreement	14:11:18.7	
10	A.C90 : Encoder Communications Error	14:11:18.7	

Code	Item	Meaning
(1)	No.	Alarms in order of occurrence (Older alarms have higher numbers.)
(2)	Name	Alarm number, alarm name
(3)	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 and main circuit power turned ON. For 24-hour, 365-day operation, measurements are possible for approximately 13 years.

Information
- 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.
- You can clear the alarm history by clicking the [Clear] button. The alarm history is not cleared when alarms are reset or when the SERVOPACK main circuit power is turned OFF.

This concludes the procedure to display the alarm history.

13.2.5 Clearing the Alarm History

You can clear the alarm history that is recorded in the SERVOPACK.

The alarm history is not cleared when alarms are reset or when the SERVOPACK main circuit power is turned OFF. You must perform the following procedure.

(1) Preparations

Always check the following before you clear the alarm history.

- The parameters must not be write prohibited.

(2) Applicable Tools

The following table lists the tools that you can use to clear the alarm history.

Tool	Fn No./Function Name	Reference
Panel Operator	Fn006	☞ *14.4.6 Clear Alarm History (Fn006) on page 647*
Digital Operator	Fn006	🕮 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Troubleshooting] – [Display Alarm]	☞ *(3) Operating Procedure on page 614*

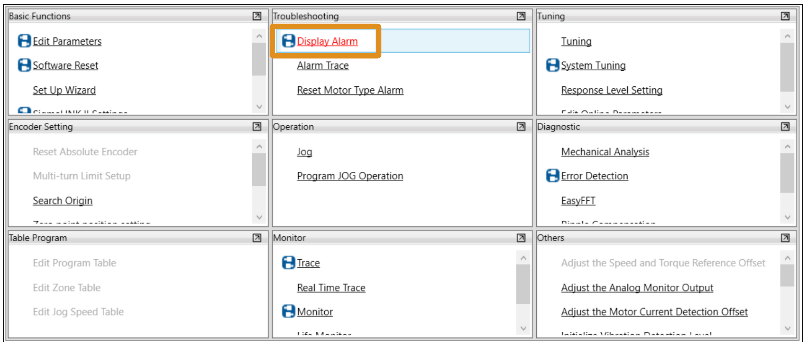
(3) Operating Procedure

Use the following procedure to clear the alarm history.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

   The [Menu] window will be displayed.

2. **Click [Display Alarm] in the [Troubleshooting] area.**

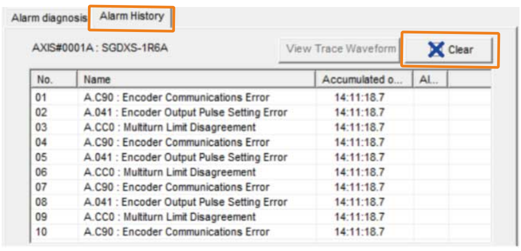


   The [Alarm Display] window will be displayed.

3. **Click the [Alarm History] tab.**

4. **Click the [Clear] button.**

   The alarm history will be cleared.



AXIS#0001A : SGDXS-1R6A

No.	Name	Accumulated o...	Al...
01	A.C90 : Encoder Communications Error	14:11:18.7	
02	A.041 : Encoder Output Pulse Setting Error	14:11:18.7	
03	A.CC0 : Multiturn Limit Disagreement	14:11:18.7	
04	A.C90 : Encoder Communications Error	14:11:18.7	
05	A.041 : Encoder Output Pulse Setting Error	14:11:18.7	
06	A.CC0 : Multiturn Limit Disagreement	14:11:18.7	
07	A.C90 : Encoder Communications Error	14:11:18.7	
08	A.041 : Encoder Output Pulse Setting Error	14:11:18.7	
09	A.CC0 : Multiturn Limit Disagreement	14:11:18.7	
10	A.C90 : Encoder Communications Error	14:11:18.7	

This concludes the procedure to clear the alarm history.

13.2.6 Resetting Option Module Configuration Error

If any option modules are attached to the SERVOPACK, the SERVOPACK detects the presence and models of the connected option modules. If it finds any errors, it outputs alarms.

You can delete those alarms with this operation.

Information This operation is the only way to reset alarms for option modules. The alarms are not reset when you reset other alarms or when you turn OFF the power to the SERVOPACK.

Always remove the cause of an alarm before you reset the alarm.

(1) Preparations

Always check the following before you clear an alarm detected in an option module.

- The parameters must not be write prohibited.

(2) Applicable Tools

The following table lists the tools that you can use to reset option module configuration errors.

Tool	Fn No./Function Name	Reference
Panel Operator	Fn014	☞ *14.4.19 Reset Option Module Configuration Error (Fn014) on page 656*
Digital Operator	Fn014	📖 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Troubleshooting] – [Display Alarm]	☞ *(3) Operating Procedure on page 615*

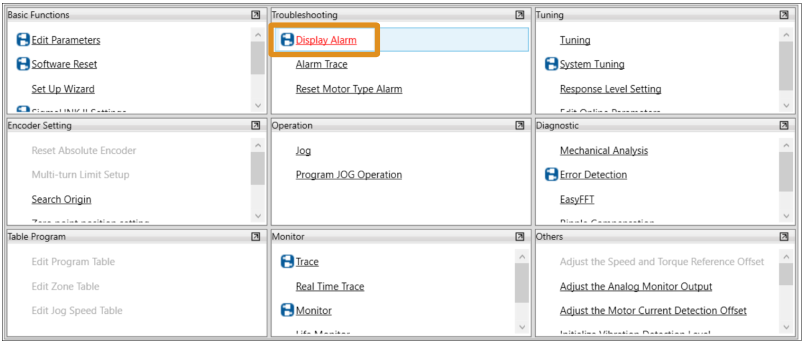
(3) Operating Procedure

Use the following procedure to reset alarms detected in option modules.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**

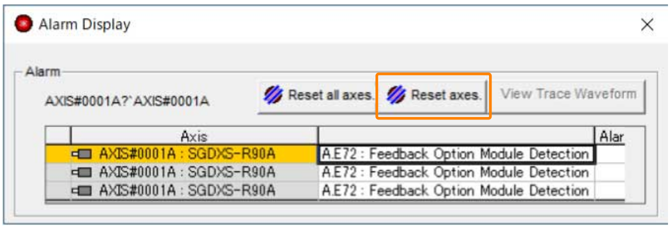
   The [Menu] window will be displayed.

2. **Click [Display Alarm] in the [Troubleshooting] area.**



   The [Alarm Display] window will be displayed.

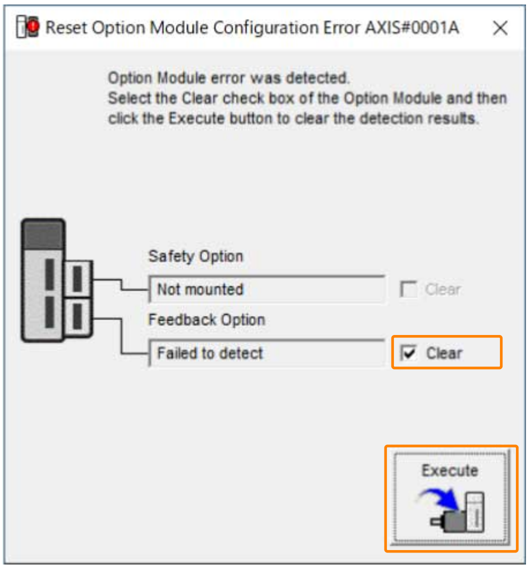
3. **Click the [Reset axes] button.**



Axis	Alar
AXIS#0001A : SGDXS-R90A	A.E72 : Feedback Option Module Detection
AXIS#0001A : SGDXS-R90A	A.E72 : Feedback Option Module Detection
AXIS#0001A : SGDXS-R90A	A.E72 : Feedback Option Module Detection

   The [Reset Option Module Configuration Error] window will be displayed.

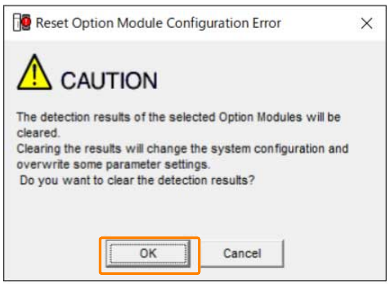
4. **Select the [Clear] check box for the option module for which to reset the alarm and then click the [Execute] button.**



Option Module error was detected.
Select the Clear check box of the Option Module and then click the Execute button to clear the detection results.

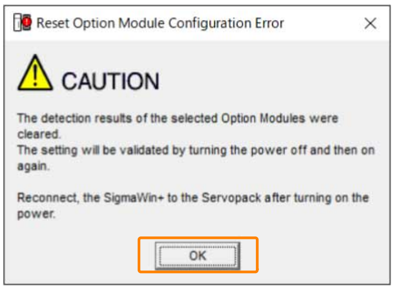
Safety Option: Not mounted ☐ Clear
Feedback Option: Failed to detect ☑ Clear

5. **Read the precaution and then click the [OK] button.**



The detection results of the selected Option Modules will be cleared.
Clearing the results will change the system configuration and overwrite some parameter settings.
Do you want to clear the detection results?

6. **Read the precaution and then click the [OK] button.**



The detection results of the selected Option Modules were cleared.
The setting will be validated by turning the power off and then on again.

Reconnect, the SigmaWin+ to the Servopack after turning on the power.

7. **Turn the power to the SERVOPACK OFF and ON again.**

This concludes the procedure to reset alarms detected in option modules.

13.2.7 Resetting Motor Type Alarms

The SERVOPACK automatically determines the type of servomotor that is connected to it. If the type of servomotor that is connected is changed, A.070 alarm (Motor Type Change Detected) will occur the next time the SERVOPACK is started. If an A.070 alarm occurs, you must set the parameters to match the new type of servomotor.

An A.070 alarm is reset by executing the Reset Motor Type Alarm utility function.

Information
- This utility function is the only way to reset an A.070 alarm (Motor Type Change Detected). The errors are not reset when you reset alarms or turn OFF the power to the SERVOPACK.
- If an A.070 alarm occurs, first set the parameters according to the newly connected servomotor type and then execute the Reset Motor Type Alarm utility function.

(1) Preparations

Always check the following before you reset a motor type alarm.

- The parameters must not be write prohibited.

(2) Applicable Tools

The following table lists the tools that you can use to reset the motor type alarms.

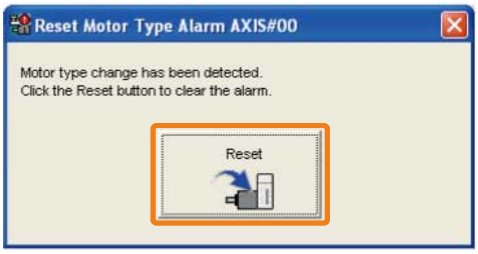
Tool	Fn No./Function Name	Reference
Panel Operator	Fn021	☞ *14.4.24 Resetting Motor Type Alarms (Fn021) on page 658*
Digital Operator	Fn021	🕮 Σ-7/Σ-X-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	[Troubleshooting] - [Reset Motor Type Alarm]	☞ *(3) Operating Procedure on page 616*

(3) Operating Procedure

Use the following procedure to reset motor type alarm.

1. **Click the [ ] button for the servo drive in the workspace of the Main Window of the SigmaWin+.**
2. **Click the [Reset Motor Type Alarm] in the [Menu] window.**

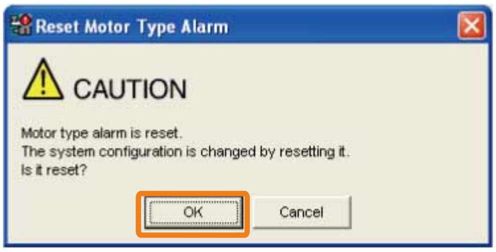
   The [Reset Motor Type Alarm] window will be displayed.
3. **Click the [Reset] button.**



Reset Motor Type Alarm AXIS#00

Motor type change has been detected.
Click the Reset button to clear the alarm.

4. **Read the precaution and then click the [OK] button.**

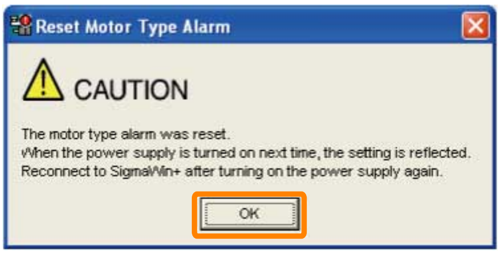


Reset Motor Type Alarm

CAUTION

Motor type alarm is reset.
The system configuration is changed by resetting it.
Is it reset?

5. **Read the precaution and then click the [OK] button.**



Reset Motor Type Alarm

CAUTION

The motor type alarm was reset.
When the power supply is turned on next time, the setting is reflected.
Reconnect to SigmaWin+ after turning on the power supply again.

6. **Turn the power to the SERVOPACK OFF and ON again.**

This concludes the procedure to reset motor type alarms.

13.3 Warning Displays

If a warning occurs in the SERVOPACK, a warning number will be displayed on the panel display. Warnings are displayed to warn you before an alarm occurs.

If a warning occurs, eliminate the cause and then reset it with the SigmaWin+. Refer to the following section for the reset procedure.

☞ *(2) Resetting Alarms with the SigmaWin+ on page 611*

This section provides a list of warnings and the causes of and corrections for warnings.

13.3.1 Warnings Table

The list of warnings gives the warning name, warning meaning, and warning code output in order of the warning numbers.

Note:

- A warning code is output only when you set Pn001 to n.1□□□ (output both alarm codes and warning codes).
- Use Pn008 = n.□X□□ (Warning Detection Selection) to control warning detection. However, the following warnings are not affected by the setting of Pn008 = n.□X□□ and other parameter settings are required in addition to Pn008 = n.□X□□.

Warning Number	Parameters That Must Be Set to Select Warning Detection	Reference
A.911	Pn310 = n.□□□X (Vibration Detection Selection)	314
A.923	– (Not affected by the setting of Pn008 = n.□X□□.)	–
A.930	Pn008 = n.□□□X (Low Battery Voltage Alarm/Warning Selection)	577
A.932	Pn0DD = n.□□□X (SigmaLINK II I/O Device Communications Check Mask)	562
A.933	Pn0DD = n.□X□□ (SigmaLINK II I/O Device Status Check Mask)	562
A.971	Pn008 = n.□□X□ (Function Selection for Undervoltage) (Not affected by the setting of Pn008 = n.□X□□.)	230
A.9A0	Pn00D = n.X□□□ (Overtravel Warning Detection Selection) (Not affected by the setting of Pn008 = n.□X□□.)	189
A.9b0	Pn00F = n.□□□X (SERVOPACK Preventative Maintenance Warning Selection)	519
A.9b1	Pn00F = n.□□X□ (Servomotor Preventative Maintenance Warning Selection)	

Warning Number	Warning Name	Warning Meaning	Warning Code Output		
			ALO1	ALO2	ALO3
A.900	Position Deviation Overflow	The position deviation exceeded the percentage set with the following formula: (Pn520 × Pn51E/100)	H	H	H
A.901	Position Deviation Overflow Alarm at Servo ON	The position deviation when the servo was turned ON exceeded the percentage set with the following formula: (Pn526 × Pn528/100)	H	H	H
A.905	Error Detection Warning	An error was detected in error detection.	H	H	H
A.910	Overload	This warning occurs before an A.710 or A.720 alarm (overload) occurs. If the warning is ignored and operation is continued, an alarm may occur.	L	H	H
A.911	Vibration	Abnormal vibration was detected during motor operation. The detection level is the same as A.520. Set whether to output an alarm or a warning by setting Pn310 (Vibration Detection Selections).	L	H	H
A.912	Internal Temperature Warning 1 (Control Board Temperature Error)	The surrounding temperature of the control board is abnormal.	H	L	H

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Warning Number	Warning Name	Warning Meaning	Warning Code Output		
			ALO1	ALO2	ALO3
A.913	Internal Temperature Warning 2 (Power Board Temperature Error)	The surrounding temperature of the power board is abnormal.	H	L	H
A.920	Regenerative Overload	This warning occurs before an A.320 alarm (Regenerative Overload) occurs. If the warning is ignored and operation is continued, an alarm may occur.	H	L	H
A.923	SERVOPACK Built- Fan Stopped	The fan inside the SERVOPACK stopped.	H	L	H
A.930	Absolute Encoder Battery Error	This warning occurs when the voltage of absolute encoder's battery is low.	L	L	H
A.93b	Overheat Warning	The input voltage (temperature) of the overheat protection input (TH) signal exceeded the setting of Pn61C (Overheat Warning Level).	L	L	H
A.941	Change of Parameters Requires Restart	Parameters have been changed that require the power to be turned OFF and ON again.	H	H	L
A.942	Speed Ripple Compensation Information Disagreement	The speed ripple compensation information stored in the encoder does not agree with the speed ripple compensation information stored in the SERVOPACK.	L	L	L
A.971	Undervoltage	This warning occurs before an A.410 alarm (Undervoltage) occurs. If the warning is ignored and operation is continued, an alarm may occur.	L	L	L
A.9A0	Overtravel	Overtravel was detected while the servo was ON.	H	L	L
A.9b0	SERVOPACK Preventative Maintenance Warning	One of the consumable parts of the SERVOPACK has reached the end of its service life.	H	L	H
A.9b1	Servomotor Preventative Maintenance Warning	One of the consumable parts of the servomotor has reached the time when maintenance is needed.	H	L	H

13.3.2 Troubleshooting Warnings

The causes of and corrections for the warnings are given in the following table. Contact your Yaskawa representative if you cannot solve a problem with the correction given in the table.

◆ A.900:Position Deviation Overflow

Possible Cause	Confirmation	Correction	Reference
The servomotor U, V, and W wiring is not correct.	Check the wiring of the servomotor main circuit cables.	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 gain, e.g., by using autotuning without a host reference.	394
The frequency of the position reference pulse is too high.	Reduce the reference pulse frequency and try operating the SERVOPACK.	Reduce the position reference pulse frequency or the reference acceleration rate, or reconsider the electronic gear ratio.	200
The acceleration of the position reference is too high.	Reduce the reference acceleration and try operating the SERVOPACK.	Apply smoothing, i.e., by using Pn216 (Position Reference Acceleration/ Deceleration Time Constant).	246
The excessive position deviation alarm level (Pn520 × Pn51E/100) is too low for the operating conditions.	Check excessive position deviation alarm level (Pn520 × Pn51E/100) to see if it is set to an appropriate value.	Optimize the settings of Pn520 and Pn51E.	364
A failure occurred in the SERVOPACK.	–	Turn the power to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.901:Position Deviation Overflow Alarm at Servo ON

Possible Cause	Confirmation	Correction	Reference
The position deviation when the servo was turned ON exceeded the percentage set with the following formula: (Pn526 × Pn528/100)	–	Set the position deviation to be cleared while the servo is OFF. Optimize the setting of Pn528 (Position Deviation Overflow Warning Level at Servo ON).	366

◆ A.905:Error Detection Warning

Possible Cause	Confirmation	Correction	Reference
A behavior was detected that differs greatly from the sample data in error detection tracing.	Check the error detection tracing waveform and error rate.	Check if an error has occurred on the equipment. Reconsider Pn5C4 (Error Detection Sample Data Set 1 Warning Level 1) and Pn5C5 (Error Detection Sample Data Set 1 Judgment Level 1).	–
The correct sample data is not saved.	Check if the SigmaWin+ is Ver. 7.42 or higher.	First upgrade to the SigmaWin+ Ver. 7.42 or higher, and then create the sample data again.	522

◆ A.910:Overload

Possible Cause	Confirmation	Correction	Reference
The wiring is not correct or there is a faulty connection in the motor or encoder wiring.	Check the wiring.	Make sure that the servomotor and encoder are correctly wired.	–
Operation was performed that exceeded the overload protection characteristics.	Check the motor overload characteristics and operation reference.	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.	Remove the mechanical problem.	–
The setting of Pn52B (Overload Warning Level) is not suitable.	Check that the setting of Pn52B (Overload Warning Level) is suitable.	Set Pn52B (Overload Warning Level) to an appropriate value.	198
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.911:Vibration

Possible Cause	Confirmation	Correction	Reference
Abnormal vibration was detected during motor operation.	Check for abnormal motor noise, and check the speed and torque waveforms during operation.	Reduce the motor speed. Or, reduce the servo gain with custom tuning.	422
The setting of Pn103 (Moment of Inertia Ratio) is greater than the actual moment of inertia or was greatly changed.	Check the moment of inertia ratio or mass ratio.	Set Pn103 (Moment of Inertia Ratio) to an appropriate value.	373
The setting of Pn312 or Pn384 (Vibration Detection Level) is not suitable.	Check that the setting of Pn312 or Pn384 (Vibration Detection Level) is suitable.	Set Pn312 or Pn384 (Vibration Detection Level) to an appropriate value.	314

◆ A.912:Internal Temperature Warning 1 (Control Board Temperature Error) A.913:Internal Temperature Warning 2 (Power Board Temperature Error)

Possible Cause	Confirmation	Correction	Reference
The surrounding temperature is too high.	Check the surrounding temperature using a thermometer. Or, check the operating status with the SERVOPACK installation environment monitor.	Decrease the surrounding temperature by improving the SERVOPACK installation conditions.	98
An overload alarm was reset by turning OFF the power too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	–
There was an excessive load or operation was performed that exceeded the regenerative processing capacity.	Check the load during operation with [Cumulative Load] and check the regenerative capacity with [Regenerative Load] on the operation monitor of the SigmaWin+.	Reconsider the load and operating conditions.	–
The SERVOPACK installation orientation is not correct or there is insufficient space around the SERVOPACK.	Check the SERVOPACK installation conditions.	Install the SERVOPACK according to specifications.	95, 97
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.920:Regenerative Overload

Possible Cause	Confirmation	Correction	Reference
The power supply voltage exceeded the specified range.	Measure the power supply voltage.	Set the power supply voltage within the specified range.	–
There is insufficient external regenerative resistance, regenerative resistor capacity, or SERVOPACK capacity, or there has been a continuous regeneration state.	Check the operating conditions or the capacity.	Change the regenerative resistance value, regenerative resistance capacity, or SERVOPACK capacity. Reconsider the operating conditions.	–
There was a continuous regeneration state because a negative load was continuously applied.	Check the load applied to the servomotor during operation.	Reconsider the system including the servo, machine, and operating conditions.	–

◆ A.923:SERVOPACK Built- Fan Stopped

Possible Cause	Confirmation	Correction	Reference
The fan inside the SERVOPACK stopped.	Check for foreign matter inside the SERVOPACK.	Remove foreign matter from the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.930:Absolute Encoder Battery Error

Possible Cause	Confirmation	Correction	Reference
The battery connection is faulty or a battery is not connected.	Check the battery connection.	Correct the battery connection.	126
The battery voltage is lower than the specified value (2.7 V).	Measure the battery voltage.	Replace the battery.	577
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.93b:Overheat Warning

Possible Cause	Confirmation	Correction	Reference
The surrounding temperature is too high.	Check the surrounding temperature using a thermometer.	Lower the surrounding temperature by improving the installation conditions of the linear servomotor or the machine.	–
Operation was performed under an excessive load.	Check the load with the [Cumulative Load] on the operation monitor of the SigmaWin+.	Reconsider the load and operating conditions.	–
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–
The temperature detection circuit in the linear servomotor is faulty or the sensor attached to the machine is faulty.	–	The temperature detection circuit in the linear servomotor may be faulty or the sensor attached to the machine may be faulty. Replace the linear servomotor or repair the sensor attached to the machine.	–

◆ A.941:Change of Parameters Requires Restart

Possible Cause	Confirmation	Correction	Reference
Parameters have been changed that require the power to be turned OFF and ON again.	–	Turn the power to the SERVOPACK OFF and ON again.	–

◆ A.942:Speed Ripple Compensation Information Disagreement

Possible Cause	Confirmation	Correction	Reference
The speed ripple compensation information stored in the encoder does not agree with the speed ripple compensation information stored in the SERVOPACK.	–	Reset the speed ripple compensation value on the SigmaWin+.	443
The speed ripple compensation information stored in the encoder does not agree with the speed ripple compensation information stored in the SERVOPACK.	–	Set Pn423 to n.□□□2 (execute speed ripple compensation using the default adjustment value). However, changing this setting may increase the speed ripple when using a Σ-X rotary servomotor.	443
The speed ripple compensation information stored in the encoder does not agree with the speed ripple compensation information stored in the SERVOPACK.	–	Set Pn423 to n.□□1□ (do not detect A.942 alarms) . However, changing this setting may increase the speed ripple.	443
The speed ripple compensation information stored in the encoder does not agree with the speed ripple compensation information stored in the SERVOPACK.	–	Set Pn423 to n.□□□0 (disable speed ripple compensation). However, changing this setting may increase the speed ripple.	443

◆ A.971:Undervoltage

Possible Cause	Confirmation	Correction	Reference
For a 200-V SERVOPACK, the AC power supply voltage dropped below 140 V.	Measure the power supply voltage.	Set the power supply voltage within the specified range.	–
The power supply voltage dropped during operation.	Measure the power supply voltage.	Increase the power supply capacity.	–
A momentary power interruption occurred.	Measure the power supply voltage.	If you have changed the setting of Pn509 (Momentary Power Interruption Hold Time), decrease the setting.	229
The SERVOPACK fuse is blown out.	–	Replace the SERVOPACK and connect a reactor.	123
A failure occurred in the SERVOPACK.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.	–

◆ A.9A0:Overtravel

Possible Cause	Confirmation	Correction	Reference
Overtravel was detected while the servo was ON.	Check the status of the overtravel signals on the input signal monitor.	Even if an overtravel signal is not shown by the input signal monitor, momentary overtravel may have been detected. Take the following precautions. • Do not specify movements that would cause overtravel from the host controller. • Check the wiring of the overtravel signals. • Implement countermeasures against noise.	189

◆ A.9b0:SERVOPACK Preventative Maintenance Warning

Possible Cause	Confirmation	Correction	Reference
One of the consumable parts of the SERVOPACK has reached the end of its service life.	–	Replace the part. Contact your Yaskawa representative for replacement.	519

◆ A.9b1:Servomotor Preventative Maintenance Warning

Possible Cause	Confirmation	Correction	Reference
One of the consumable parts of the servomotor has reached the time when maintenance is needed.	–	Replace the part. Contact your Yaskawa representative for replacement.	519

13.4 Troubleshooting Based on the Operation and Conditions of the Servomotor

This section provides troubleshooting based on the operation and conditions of the servomotor, including causes and corrections.

13.4.1 Servomotor Does Not Start

Possible Cause	Confirmation	Correction	Reference
The control power is not turned ON.	Measure the voltage between control power supply terminals.	Turn OFF the power to the servo system. Correct the wiring so that the control power is turned ON.	–
The main circuit power is not turned ON.	Measure the voltage between the main circuit power input terminals.	Turn OFF the power to the servo system. Correct the wiring so that the main circuit power is turned ON.	–
The I/O signal connector (CN1) pins are not wired correctly or are disconnected.	Turn OFF the power to the servo system. Check the wiring condition of the I/O signal connector (CN1) pins.	Correct the wiring of the I/O signal connector (CN1) pins.	135,509
The wiring servomotor main circuit cables or encoder cable is disconnected.	Check the wiring conditions.	Turn OFF the power to the servo system. Wire the cable correctly.	–
There is an overload on the servomotor.	Operate the servomotor with no load and check the load status.	Turn OFF the power to the servo system. Reduce the load or replace the servomotor with a servomotor with a larger capacity.	–
The type of encoder that is being used does not agree with the setting of Pn002 = n.□X□□ (Encoder Usage).	Check the type of the encoder that is being used and the setting of Pn002 = n.□X□□.	Set Pn002 = n.□X□□ according to the type of the encoder that is being used.	292
No speed or position reference is input.	Turn OFF the power to the servo system. Check the allocation status of the input signals.	Allocate an input signal so that the speed and position references are input correctly.	135,509
There is a mistake in the input signal allocations.	Check the allocations of the input signals.	Correctly allocate the input signals.	220,509
The /S-ON (Servo ON Input) signal is OFF.	Check the settings of Pn50A = n.□□□X (Input Signal Allocation Mode) and Pn50A = n.□□X□ (/S-ON (Servo ON Input) Signal Allocation).	Set Pn50A = n.□□XX correctly and turn ON the /S-ON signal.	–
The function setting of the /P-CON (Proportional Control Input) signal is not correct.	Check the setting of Pn000 = n.□□X□ (Control Method Selection).	Set the parameter to match the application.	170
The SEN input is OFF.	Check the ON/OFF status of the SEN input.	If you are using an absolute encoder, turn ON the SEN signal.	292,509
The reference pulse mode selection is not correct.	Check the setting of Pn200 = n.□□□X (Reference Pulse Form) and the reference pulse form.	Set Pn200 = n.□□□X so that is agrees with the reference pulse form.	247
Speed control: The speed reference input is not appropriate.	Check between the speed reference input (V-REF) and signal ground (SG) to see if the control method and the input agree.	Correctly set the control method and input method.	509
Torque control: The torque reference input is not appropriate.	Check between the torque reference input (T-REF) and signal ground (SG) to see if the control method and the input agree.	Correctly set the control method and input method.	509
Position control: The reference pulse input is not appropriate.	Check the setting of Pn200 = n.□□□X (Reference Pulse Form) and the sign and pulse signals.	Correctly set the control method and input method.	247

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Possible Cause	Confirmation	Correction	Reference
The /CLR (Position Deviation Clear Input) signal is still ON.	Check the /CLR signal (CN1-14 and CN1-15).	Turn OFF the /CLR signal.	509
The P-OT (Forward Drive Prohibit Input) or N-OT (Reverse Drive Prohibit Input) signal is still OFF.	Check the P-OT and N-OT signals.	Turn ON the P-OT and N-OT signals.	509
The safety input signals (/HWBB1 or /HWBB2) are still OFF.	Check the /HWBB1 and /HWBB2 input signals.	Turn ON the /HWBB1 and /HWBB2 input signals. If you are not using the safety function, connect the safety jumper connector (provided as an accessory) to CN8.	509
		Validate the safety functions.	573
The FSTP (Forced Stop Input) signal is still OFF.	Check the FSTP signal.	• Turn ON the FSTP signal. • If you will not use the function to force the motor to stop, set Pn516 = n.□□□X (FSTP (Forced Stop Input) Signal Allocation) to disable the signal.	509
A failure occurred in the SERVOPACK.	–	Turn OFF the power to the servo system. Replace the SERVOPACK.	–
The polarity detection was not executed.	Check the setting of Pn080 = n.□□□X (Polarity Sensor Selection).	Correct the parameter setting.	181
	Check the /S-ON (Servo ON Input) or /P-DET (Polarity Detection Input) signal.	• If you are using an incremental linear encoder, turn ON the /S-ON or /P-DET signal. • If you are using an absolute linear encoder, turn OFF the external /S-ON signal and execute polarity detection.	182

13.4.2 Servomotor Moves Instantaneously, and Then Stops

Possible Cause	Confirmation	Correction	Reference
There is a mistake in the servomotor wiring.	Turn OFF the power to the servo system. Check the wiring.	Wire the cable correctly.	–
There is a mistake in the wiring of the encoder or serial converter unit.	Turn OFF the power to the servo system. Check the wiring.	Wire the cable correctly.	–
There is a mistake in the linear encoder wiring.	Turn OFF the power to the servo system. Check the wiring.	Wire the cable correctly.	–
The setting of Pn282 (Linear Encoder Scale Pitch) is not correct.	Check the setting of Pn282.	Correct the setting of Pn282.	174
The count-up direction of the linear encoder does not match the forward direction of the moving coil in the motor.	Check the directions.	Change the setting of Pn080 = n.□□X□ (Motor Phase Sequence Selection). Place the linear encoder and motor in the same direction.	179
Polarity detection was not performed correctly.	Check to see if electrical angle 2 (electrical angle from polarity origin) at any position is between ±10°.	Correct the settings for the polarity detection-related parameters.	–

13.4.3 Servomotor Speed Is Unstable

Possible Cause	Confirmation	Correction	Reference
There is a faulty connection in the servomotor wiring.	The connector connections for the power line (U, V, and W phases) and the encoder or serial converter unit may be unstable. Turn OFF the power to the servo system. Check the wiring.	Tighten any loose terminals or connectors and correct the wiring.	–

13.4.4 Servomotor Moves without a Reference Input

Possible Cause	Confirmation	Correction	Reference
Speed control: The speed reference input is not appropriate.	Check between the speed reference input (V-REF) and signal ground (SG) to see if the control method and the input agree.	Correctly set the control method and input method.	509
Torque control: The torque reference input is not appropriate.	Check between the torque reference input (T-REF) and signal ground (SG) to see if the control method and the input agree.	Correctly set the control method and input method.	509
The speed reference offset is not correct.	The SERVOPACK offset is adjusted incorrectly.	Adjust the SERVOPACK offset.	235
Position control: The reference pulse input is not appropriate.	Check the setting of Pn200 = n.□□□X (Reference Pulse Form) and the sign and pulse signals.	Correctly set the control method and input method.	–
A failure occurred in the SERVOPACK.	–	Turn OFF the power to the servo system. Replace the SERVOPACK.	–
The count-up direction of the linear encoder does not match the forward direction of the moving coil in the motor.	Check the directions.	Change the setting of Pn080 = n.□□X□ (Motor Phase Sequence Selection). Match the linear encoder direction and servomotor direction.	179
Polarity detection was not performed correctly.	Check to see if electrical angle 2 (electrical angle from polarity origin) at any position is between ±10°.	Correct the settings for the polarity detection-related parameters.	–

13.4.5 Dynamic Brake Does Not Operate

Possible Cause	Confirmation	Correction	Reference
The setting of Pn001 = n.□□□X (Motor Stopping Method for Servo OFF and Group 1 Alarms) is not suitable.	Check the setting of Pn001 = n.□□□X.	Correct the setting of Pn001 = n.□□□X.	–
The dynamic brake resistor is disconnected.	Check the moment of inertia, motor speed, and dynamic brake frequency of use. If the moment of inertia, motor speed, or dynamic brake frequency of use is excessive, the dynamic brake resistor may be disconnected.	Turn OFF the power to the servo system. Replace the SERVOPACK. To prevent disconnection, reduce the load.	–
There was a failure in the dynamic brake drive circuit.	–	There is a defective component in the dynamic brake circuit. Turn OFF the power to the servo system. Replace the SERVOPACK.	–

13.4.6 Abnormal Noise from Servomotor

Possible Cause	Confirmation	Correction	Reference
The servomotor vibrated considerably while performing the tuning-less function with the default settings.	Check the waveform of the motor speed.	Reduce the load so that the load moment of inertia ratio or mass ratio is within the allowable value, or increase the load level or reduce the response level in the tuning-less level settings. If the situation is not improved, set Pn170 = n.□□□0 (disable the tuning-less function) and execute autotuning either with or without a host reference.	368
The machine mounting is not secure.	Turn OFF the power to the servo system. Check the servomotor installation.	Tighten the mounting screws.	–
	Turn OFF the power to the servo system. Check to see if there is misalignment in the coupling.	Align the coupling.	–
	Turn OFF the power to the servo system. Check to see if the coupling is balanced.	Balance the coupling.	–
The bearings are defective.	Turn OFF the power to the servo system. Check for noise and vibration around the bearings.	Replace the servomotor.	–
There is a vibration source at the driven machine.	Turn OFF the power to the servo system. Check for any foreign matter, damage, or deformation in the machine's moving parts.	Consult with the machine manufacturer.	–
Noise interference occurred because of incorrect I/O signal cable specifications.	Turn OFF the power to the servo system. Check the I/O signal cables to see if they satisfy specifications. Use a shielded twisted-pair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm^2.	Use cables that satisfy the specifications.	–
Noise interference occurred because an I/O signal cable is too long.	Turn OFF the power to the servo system. Check the lengths of the I/O signal cables.	The I/O signal cables must be no longer than 3 m.	–
Noise interference occurred because of incorrect encoder cable specifications.	Turn OFF the power to the servo system. Check the encoder cable to see if it satisfies specifications. Use a shielded twisted-pair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm^2.	Use cables that satisfy the specifications.	–
Noise interference occurred because the encoder cable is too long.	Turn OFF the power to the servo system. Check the length of the encoder cable.	• Rotary servomotors: The encoder cable length must be 50 m max. • Linear servomotors: Make sure that the serial converter unit cable is no longer than 20 m and that the linear encoder cable and the sensor cable are no longer than 15 m each.	–
Noise interference occurred because the encoder cable is damaged.	Turn OFF the power to the servo system. Check the encoder cable to see if it is pinched or the sheath is damaged.	Replace the encoder cable and correct the cable installation environment.	–
The encoder cable was subjected to excessive noise interference.	Turn OFF the power to the servo system. Check to see if the encoder cable is bundled with a power line or installed near a power line.	Correct the cable layout so that no surge is applied by power line.	–
There is variation in the FG potential because of the influence of machines on the servomotor side, such as a welder.	Turn OFF the power to the servo system. Check to see if the machines are correctly grounded.	Properly ground the machines to separate them from the FG of the encoder.	–

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Possible Cause	Confirmation	Correction	Reference
There is a SERVOPACK pulse counting error due to noise.	Check to see if there is noise interference on the signal line from the encoder.	Turn OFF the power to the servo system. Implement countermeasures against noise for the encoder wiring.	–
The encoder was subjected to excessive vibration or shock.	Turn OFF the power to the servo system. Check to see if vibration from the machine occurred. Check the servomotor installation (mounting surface precision, securing state, and alignment). Check the linear encoder installation (mounting surface precision and securing method).	Reduce machine vibration. Improve the mounting state of the servomotor or linear encoder.	–
A failure occurred in the encoder.	–	Turn OFF the power to the servo system. Replace the servomotor.	–
A failure occurred in the serial converter unit.	–	Turn OFF the power to the servo system. Replace the serial converter unit.	–
A failure occurred in the linear encoder.	–	Turn OFF the power to the servo system. Replace the linear encoder.	–

13.4.7 Servomotor Vibrates at Frequency of Approx. 200 to 400 Hz.

Possible Cause	Confirmation	Correction	Reference
The servo gains are not balanced.	Check to see if the servo gains have been correctly tuned.	Perform autotuning without a host reference.	394
The setting of Pn100 (Speed Loop Gain) is too high.	Check the setting of Pn100 (Speed Loop Gain). The default setting is Kv = 40.0 Hz.	Set Pn100 (Speed Loop Gain) to an appropriate value.	–
The setting of Pn102 (Position Loop Gain) is too high.	Check the setting of Pn102 (Position Loop Gain). The default setting is Kp = 40.0/s.	Set Pn102 (Position Loop Gain) to an appropriate value.	–
The setting of Pn101 (Speed Loop Integral Time Constant) is not appropriate.	Check the setting of Pn101 (Speed Loop Integral Time Constant). The default setting is Ti = 20.0 ms.	Set Pn101 (Speed Loop Integral Time Constant) to an appropriate value.	–
The setting of Pn103 (Moment of Inertia Ratio) is not appropriate.	Check the setting of Pn103 (Moment of Inertia Ratio).	Set Pn103 (Moment of Inertia Ratio) to an appropriate value.	–

13.4.8 Large Motor Speed on Starting and Stopping

Possible Cause	Confirmation	Correction	Reference
The servo gains are not balanced.	Check to see if the servo gains have been correctly tuned.	Perform autotuning without a host reference.	394
The setting of Pn100 (Speed Loop Gain) is too high.	Check the setting of Pn100 (Speed Loop Gain). The default setting is Kv = 40.0 Hz.	Set Pn100 (Speed Loop Gain) to an appropriate value.	–
The setting of Pn102 (Position Loop Gain) is too high.	Check the setting of Pn102 (Position Loop Gain). The default setting is Kp = 40.0/s.	Set Pn102 (Position Loop Gain) to an appropriate value.	–
The setting of Pn101 (Speed Loop Integral Time Constant) is not appropriate.	Check the setting of Pn101 (Speed Loop Integral Time Constant). The default setting is Ti = 20.0 ms.	Set Pn101 (Speed Loop Integral Time Constant) to an appropriate value.	–

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Possible Cause	Confirmation	Correction	Reference
The setting of Pn103 (Moment of Inertia Ratio) is not appropriate.	Check the setting of Pn103 (Moment of Inertia Ratio).	Set Pn103 (Moment of Inertia Ratio) to an appropriate value.	–
The torque reference is saturated.	Check the waveform of the torque reference.	Use the mode switching.	–
Pn483 (Forward Force Limit) and Pn484 (Reverse Force Limit) are set to the default values.	Force limits: Default settings Pn483 = 30% Pn484 = 30%	Set Pn483 (Forward Force Limit) and Pn484 (Reverse Force Limit) to appropriate values.	281

13.4.9 Absolute Encoder Position Deviation Error (The position that was saved in the host controller when the power was turned OFF is different from the position when the power was next turned ON.)

Possible Cause	Confirmation	Correction	Reference
Noise interference occurred because of incorrect encoder cable specifications.	Turn OFF the power to the servo system. Check the encoder cable to see if it satisfies specifications. Use a shielded twisted-pair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm^2.	Use cables that satisfy the specifications.	–
Noise interference occurred because the encoder cable is too long.	Turn OFF the power to the servo system. Check the length of the encoder cable.	• Rotary servomotors: The encoder cable length must be 50 m max. • Linear servomotors: Make sure that the serial converter unit cable is no longer than 20 m and that the linear encoder cable and the sensor cable are no longer than 15 m each.	–
Noise interference occurred because the encoder cable is damaged.	Turn OFF the power to the servo system. Check the encoder cable to see if it is pinched or the sheath is damaged.	Replace the encoder cable and correct the cable installation environment.	–
The encoder cable was subjected to excessive noise interference.	Turn OFF the power to the servo system. Check to see if the encoder cable is bundled with a power line or installed near a power line.	Correct the cable layout so that no surge is applied by power line.	–
There is variation in the FG potential because of the influence of machines on the servomotor side, such as a welder.	Turn OFF the power to the servo system. Check to see if the machines are correctly grounded.	Properly ground the machines to separate them from the FG of the encoder.	–
There is a SERVOPACK pulse counting error due to noise.	Turn OFF the power to the servo system. Check to see if there is noise interference on the signal line from the encoder or serial converter unit.	Implement countermeasures against noise for the encoder or serial converter unit wiring.	–
The encoder was subjected to excessive vibration or shock.	Turn OFF the power to the servo system. Check to see if vibration from the machine occurred. Check the servomotor installation (mounting surface precision, securing state, and alignment). Check the linear encoder installation (mounting surface precision and securing method).	Reduce machine vibration. Improve the mounting state of the servomotor or linear encoder.	–
A failure occurred in the encoder.	–	Turn OFF the power to the servo system. Replace the servomotor or linear encoder.	–
A failure occurred in the SERVOPACK.	–	Turn OFF the power to the servo system. Replace the SERVOPACK.	–

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Possible Cause	Confirmation	Correction	Reference
Host controller multiturn data or absolute encoder position data reading error	Check the error detection section of the host controller.	Correct the error detection section of the host controller.	–
	Check to see if the host controller is executing data parity checks.	Perform parity checks for the multiturn data or absolute encoder position data.	–
	Check for noise interference in the cable between the SERVOPACK and the host controller.	Implement countermeasures against noise and then perform parity checks again for the multiturn data or absolute encoder position data.	–

13.4.10 Overtravel Occurred

Possible Cause	Confirmation	Correction	Reference
The P-OT/N-OT (Forward Drive Prohibit Input or Reverse Drive Prohibit Input) signal was input.	Check the external power supply (+24 V) voltage for the input signals.	Correct the external power supply (+24 V) voltage for the input signals.	–
	Check the operating condition of the overtravel limit switches.	Make sure that the overtravel limit switches operate correctly.	–
	Check the wiring of the overtravel limit switches.	Correct the wiring of the overtravel limit switches.	186
	Check the settings of the overtravel input signal allocation (Pn50A/Pn50B or Pn590/Pn591).	Set the parameters to correct values.	186
The P-OT/N-OT (Forward Drive Prohibit Input or Reverse Drive Prohibit Input) signal malfunctioned.	Check for fluctuation in the external power supply (+24 V) voltage for the input signals.	Eliminate fluctuation from the external power supply (+24 V) voltage for the input signals.	–
	Check to see if the operation of the overtravel limit switches is unstable.	Stabilize the operating condition of the overtravel limit switches.	–
	Check the wiring of the overtravel limit switches (e.g., check for cable damage and loose screws).	Correct the wiring of the overtravel limit switches.	–
There is a mistake in the allocation of the P-OT/N-OT (Forward Drive Prohibit Input or Reverse Drive Prohibit Input).	Check if the SERVOPACK is configured in one of the following ways: • Pn50A = n.□□□1 (use Sigma-7S-compatible I/O signal allocations) and the P-OT signal is allocated to CN1 with Pn50A = n.X□□□. • Pn50A = n.□□□2 (use SigmaLINK II input signal allocation) and the P-OT signal is allocated to CN1 with Pn590.	Set the parameters to correct values.	186
	Check if the SERVOPACK is configured in one of the following ways: • Pn50A = n.□□□1 (use Sigma-7S-compatible I/O signal allocations) and the N-OT signal is allocated to CN1 with Pn50B = n.□□□X. • Pn50A = n.□□□2 (use SigmaLINK II input signal allocation) and the N-OT signal is allocated to CN1 with Pn591.	Set the parameters to correct values.	
The selection of the servomotor stopping method is not correct.	Check the servo OFF stopping method set in Pn001 = n.□□□X or Pn001 = n.□□X□.	Select a servomotor stopping method other than coasting to a stop.	187
	Check the torque control stopping method set in Pn001 = n.□□□X or Pn001 = n.□□X□.	Select a servomotor stopping method other than coasting to a stop.	

13.4.11 Improper Stop Position for Overtravel (OT) Signal

Possible Cause	Confirmation	Correction	Reference
The limit switch position and dog length are not appropriate.	–	Install the limit switch at the appropriate position.	–
The overtravel limit switch position is too close for the coasting distance.	–	Install the overtravel limit switch at the appropriate position.	–

13.4.12 Position Deviation (without Alarm)

Possible Cause	Confirmation	Correction	Reference
Noise interference occurred because of incorrect encoder cable specifications.	Turn OFF the power to the servo system. Check the encoder cable to see if it satisfies specifications. Use a shielded twisted-pair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm^2.	Use cables that satisfy the specifications.	–
Noise interference occurred because the encoder cable is too long.	Turn OFF the power to the servo system. Check the length of the encoder cable.	• Rotary servomotors: The encoder cable length must be 50 m max. • Linear servomotors: Make sure that the serial converter unit cable is no longer than 20 m and that the linear encoder cable and the sensor cable are no longer than 15 m each.	–
Noise interference occurred because the encoder cable is damaged.	Turn OFF the power to the servo system. Check the encoder cable to see if it is pinched or the sheath is damaged.	Replace the encoder cable and correct the cable installation environment.	–
The encoder cable was subjected to excessive noise interference.	Turn OFF the power to the servo system. Check to see if the encoder cable is bundled with a power line or installed near a power line.	Correct the cable layout so that no surge is applied by power line.	–
There is variation in the FG potential because of the influence of machines on the servomotor side, such as a welder.	Turn OFF the power to the servo system. Check to see if the machines are correctly grounded.	Properly ground the machines to separate them from the FG of the encoder.	–
There is a SERVOPACK pulse counting error due to noise.	Turn OFF the power to the servo system. Check to see if there is noise interference on the signal line from the encoder or serial converter unit.	Implement countermeasures against noise for the encoder wiring or serial converter unit wiring.	–
The encoder was subjected to excessive vibration or shock.	Turn OFF the power to the servo system. Check to see if vibration from the machine occurred. Check the servomotor installation (mounting surface precision, securing state, and alignment). Check the linear encoder installation (mounting surface precision and securing method).	Reduce machine vibration. Improve the mounting state of the servomotor or linear encoder.	–
The coupling between the machine and servomotor not suitable.	Turn OFF the power to the servo system. Check to see if position offset occurs at the coupling between machine and servomotor.	Correctly secure the coupling between the machine and servomotor.	–
Noise interference occurred because of incorrect I/O signal cable specifications.	Turn OFF the power to the servo system. Check the I/O signal cables to see if they satisfy specifications. Use a shielded twisted-pair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm^2.	Use cables that satisfy the specifications.	–

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Possible Cause	Confirmation	Correction	Reference
If reference pulse input multiplication switching is being used, noise may be causing the I/O signals used for this function (/PSEL and /PSELA) to be falsely detected.	Turn OFF the power to the servo system. Check the I/O signal cables to see if they satisfy specifications. Use a shielded twisted-pair wire cable or a screened twisted-pair cable with conductors of at least 0.12 mm^2.	Use cables that satisfy the specifications.	–
Pulses are being lost because the filter for the reference pulse input is not appropriate.	Check the setting of Pn200 = n.X□□□ (Filter Selection).	Set the parameters to correct values.	248
Noise interference occurred because an I/O signal cable is too long.	Turn OFF the power to the servo system. Check the lengths of the I/O signal cables.	The I/O signal cables must be no longer than 3 m.	–
An encoder fault occurred. (The pulse count does not change.)	–	Turn OFF the power to the servo system. Replace the servomotor or linear encoder.	–
A failure occurred in the SERVOPACK.	–	Turn OFF the power to the servo system. Replace the SERVOPACK.	–

13.4.13 Servomotor Overheated

Possible Cause	Confirmation	Correction	Reference
The surrounding temperature is too high.	Measure the surrounding temperature around the servomotor.	Reduce the surrounding temperature to 40°C or less.	–
The surface of the servomotor is dirty.	Turn OFF the power to the servo system. Visually check the surface for dirt.	Clean dirt, dust, and oil from the surface.	–
There is an overload on the servomotor.	Check the load status with a monitor.	If the servomotor is overloaded, reduce the load or replace the servo drive with a SERVOPACK and servomotor with larger capacities.	–
Polarity detection was not performed correctly.	Check to see if electrical angle 2 (electrical angle from polarity origin) at any position is between ±10°.	Correct the settings for the polarity detection-related parameters.	–

14

Panel Displays and Panel Operator Procedures

Describes how to interpret panel displays and the operation of the panel operator.

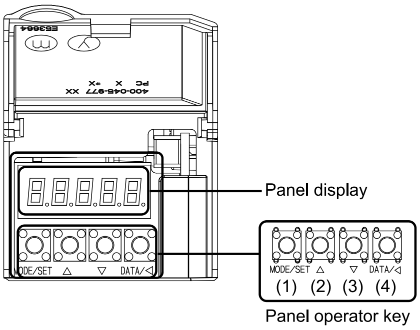
14.1 Panel Operator

14.1.1 Panel Operator Key Names and Functions

The panel operator consists of a panel display and panel operator keys.

You can use the panel operator to set parameters, display status, execute utility functions, and monitor SERVOPACK operation.

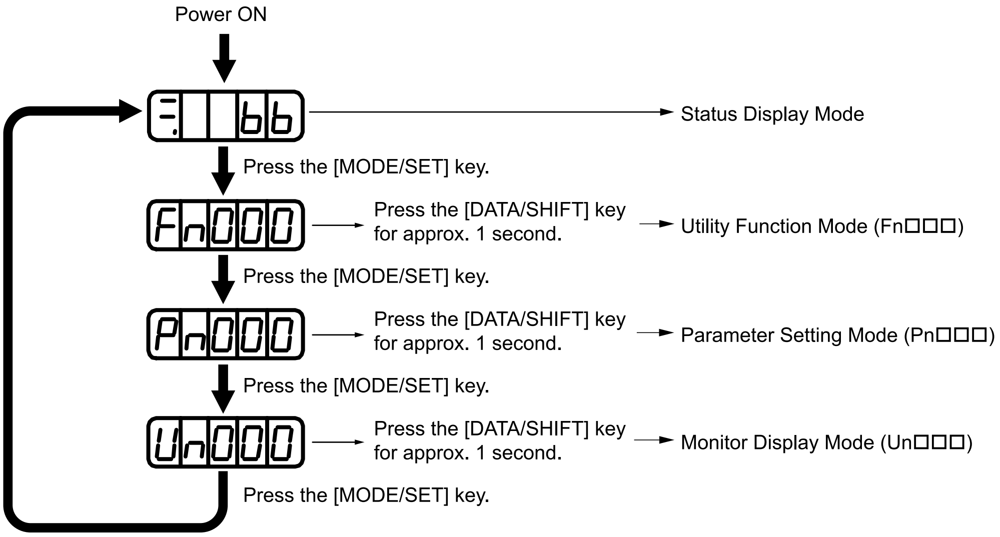
The panel operator key names and functions are given below.



Code	Key Name	Function
(1)	[MODE/SET] key	• Changes the display. • Confirms settings.
(2)	[UP] key	Increases the setting.
(3)	[DOWN] key	Decreases the setting.
(4)	[DATA/SHIFT] key	• Displays the setting. To display the setting, press the [DATA/SHIFT] key for approximately one second. • Moves to the next digit on the left when a digit is flashing.

14.1.2 Changing Modes

Press the [MODE/SET] key to change between the modes as shown below.



Item	Reference
Status Display	*14.1.3 Status Display on page 636*
Utility Function (Fn□□□)	*14.4 Utility Function (Fn□□□) Operations on the Panel Operator on page 644*
Parameter Setting (Pn□□□)	*14.2 Parameter (Pn□□□) Operations on the Panel Operator on page 638*
Monitor Display (Un□□□)	*14.3 Monitor Display (Un□□□) Operations on the Panel Operator on page 640*

Information

You can change the setting of Pn52F (Monitor Display at Startup) to display the Monitor Display Mode instead of the Status Display Mode after the power is turned ON.

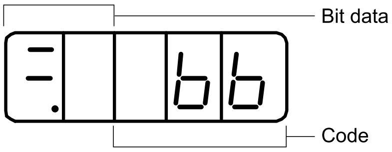
Set Pn52F to the Un number of the monitor display to display after the power is turned ON.

Pn52F	Monitor Display at Startup			Speed Pos Trq
	Setting Range	Setting Unit	Default Setting	When Enabled
	0000h ~ 0FFFh	-	0FFFh	Immediately

If 0FFF is set (default setting), the SERVOPACK will enter the Status Display Mode after the power is turned ON.

14.1.3 Status Display

The status is displayed as described below.



Important

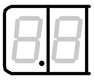
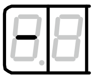
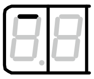
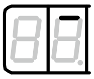
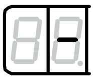
If the displayed characters cannot be recognized, turn the SERVOPACK power OFF and ON again.

If this does not resolve the problem, check the items shown below.

- Check the input signals on the [Status] monitor of the SigmaWin+.
  Refer to the following section for details.
  ☞ *(1) Operating Procedure on page 504*
- Check if anything around the SERVOPACK is generating noise.

If the problem is still not resolved after checking the above items, the SERVOPACK may be faulty.

(1) Interpreting Bit Data

Display	Meaning
	**Control Power ON Display** Lit while the SERVOPACK control power is ON. Not lit if the SERVOPACK control power is OFF.
	**Base Block Display** Lit if the servo is OFF. Not lit while the servo is ON.
	**During Speed Control: /V-CMP (Speed Coincidence Output) Signal Display** Lit if the difference between the servomotor speed and the reference speed is the same as or less than the setting of Pn503 or Pn582. (The default setting is 10 min^{-1} or 10 mm/s.) Always lit during torque control. Additional Information If there is noise in the reference voltage during speed control, the horizontal segment (-) on the top of the leftmost digit on the panel operator display may flash. Refer to the following section and implement countermeasures against noise. *4.1.2 Countermeasures against Noise on page 107* **During Position Control: /COIN (Positioning Completion) Signal Display** Lit if the deviation between the position reference and actual motor position is equal to or less than the setting of Pn522. (The default setting is 7 reference units.) Not lit it the deviation exceeds the setting.
	**/TGON (Rotation Detection Output) Signal Display** Lit if the servomotor speed is higher than the setting of Pn502 or Pn581 and not lit if the speed is lower than the setting. (The default setting is 20 min^{-1} or 20 mm/s.)
	**During Speed Control: Speed Reference Input Display** Lit if the current input speed reference is larger than the setting of Pn502 or Pn581 and not lit if the reference is smaller than the setting. (The default setting is 20 min^{-1} or 20 mm/s.) **During Position Control: Reference Pulse Input Display** Lit while reference pulses are being input. Not lit if reference pulses are not being input.

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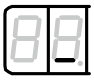
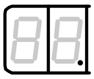
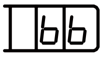
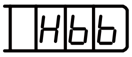
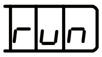
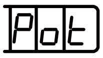
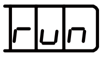
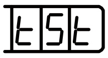
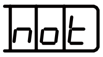
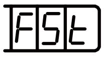
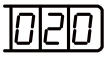
Display	Meaning
	**During Torque Control: Torque Reference Input Display** Lit if the current input torque reference is larger than the specified value (10% of the rated torque) and not lit if the reference is smaller than the specified value. **During Position Control: Clear Signal Input Display** Lit while the clear signal is being input. Not lit if the clear signal is not being input.
	**Power Ready Display** Lit while the main circuit power is ON. Not lit if the main circuit power is OFF.

(2) Interpreting Codes

Display	Meaning	Display	Meaning
	**Base Block Active** Indicates that the servo is OFF.		**Safety Function** Indicates that the SERVOPACK is in the hard wire base block state due to a safety function.
	**Operation in Progress** Indicates that the servo is ON.		
	**Forward Drive Prohibited** Indicates that the P-OT (Forward Drive Prohibit) signal is open.	(Example: Operation in Progress Status)  	**Test without Motor in Progress** Indicates that the test without a motor is in progress. The status display changes according to the status of servomotor and SERVOPACK. However, “tSt” will not be displayed during a test without a motor even if an alarm occurs.
	**Reverse Drive Prohibited** Indicates that the N-OT (Reverse Drive Prohibit Input) signal is open.		
	**Forced Stop Status** Indicates that the FSTP (Force Stop Input) signal forced the servomotor to stop.		**Alarm Status** Flashes the alarm number.

14.2 Parameter (Pn□□□) Operations on the Panel Operator

This section describes the procedures for setting the parameters that are used in this manual.

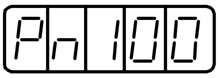
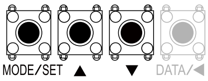
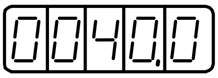
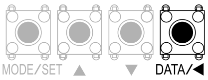
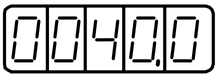
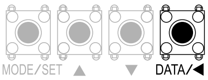
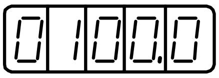
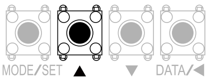
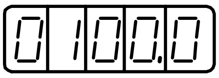
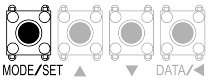
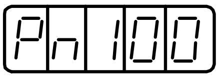
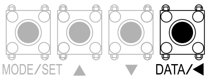
Refer to the following sections for details on parameter classifications and notation.

☞ *5.1.1 Parameter Classification on page 158*

☞ *5.1.2 Notation for Parameters on page 159*

14.2.1 Setting Parameters That Require Numeric Settings

The following procedure shows how to change the setting of Pn100 (Speed Loop Gain) from 40.0 to 100.0 as an example of a parameter for numeric setting.

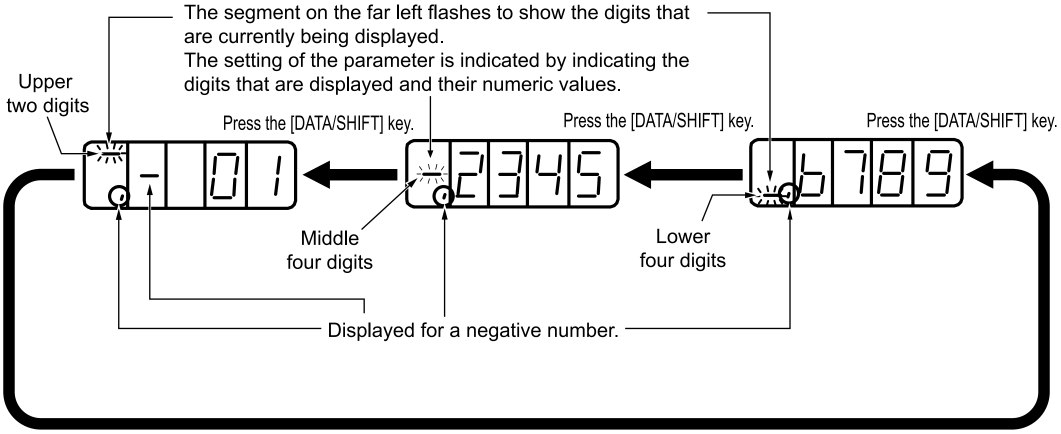
Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Parameter Setting Mode. If Pn100 is not displayed, press the [UP] key or [DOWN] key to display “Pn100”.
2			Press the [DATA/SHIFT] key for approximately one second. The current setting of Pn100 will be displayed.
3			Press the [DATA/SHIFT] key to move the digit that is flashing to “4”. (You can change the value of the digit that is flashing.)
4			Press the [UP] key six times to change the setting to 100.0. Refer to the following section for the operating procedure for settings with more than five digits. ☞ *(1) Parameters with Settings of More Than Five Digits on page 638*
5	 (Flashing)		Press the [MODE/SET] key. The display will flash. The setting has now been changed from 40.0 to 100.0.
6			Press the [DATA/SHIFT] key for approximately one second to return the display to “Pn100”.

Information Setting Negative Numbers

- For parameters that accept a negative setting, display “00000” and then press the [DOWN] key to set a negative number.
- For a negative number, the value increases when the [DOWN] key is pressed and decreases when the [UP] key is pressed.

(1) Parameters with Settings of More Than Five Digits

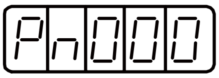
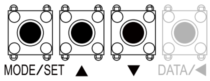
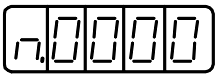
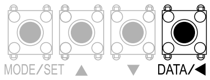
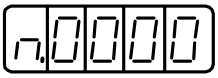
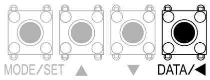
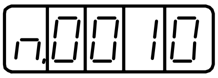
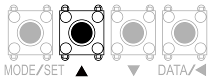
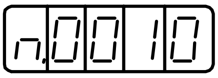
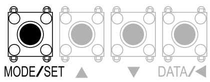
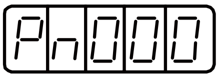
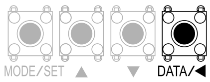
The panel operator displays five digits. Settings of more than five digits are displayed as shown in the following figure.



14.2.2 Setting Parameters That Require Selection of Functions

For parameters that require selection of functions, you can select the individual digits of the numbers displayed on the panel operator to set the functions assigned to them.

The following example shows how to change the setting of Pn000 = n.□□X□ (Control Method Selection) in Pn000 (Basic Function Selections 0) from speed control to position control.

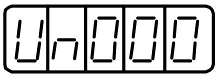
Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Parameter Setting Mode. If Pn000 is not displayed, press the [UP] key or [DOWN] key to display “Pn000”.
2			Press the [DATA/SHIFT] key for approximately one second. The current setting of Pn000 will be displayed.
3			Press the [DATA/SHIFT] key to move the digit that is flashing. (You can change the value of the digit that is flashing.)
4			Press the [UP] key once to change the display to “n.0010”. (This changes the control method from speed control to position control.)
5	 (Flashing)		Press the [MODE/SET] key. The display will flash. The control method has now been changed from speed control to position control.
6			Press the [DATA/SHIFT] key for approximately one second to return the display to “Pn000”.
7	To enable the change to the setting, turn the power to the SERVOPACK OFF and ON again.		

14.3 Monitor Display (Un□□□) Operations on the Panel Operator

You can monitor the status of the reference values and I/O signals that are set in the SERVOPACK and the internal status of the SERVOPACK with monitor displays.

The panel operator displays numbers beginning with “Un.”

Display Example for Motor Speed



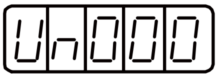
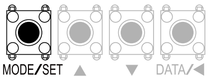
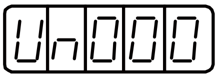
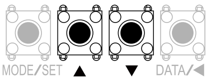
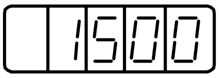
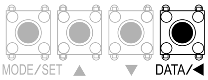
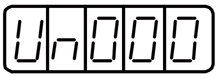
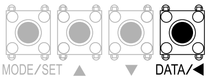
This section describes the basic operations for monitor displays and how to interpret some special monitor displays.

Refer to the following section for details on the contents of the monitor display.

☞ *16.2.2 Corresponding SERVOPACK Monitor Display Function Names on page 742*

14.3.1 Basic Monitor Display Operations

The procedure for Un000 (Motor Speed) is described here as an example.

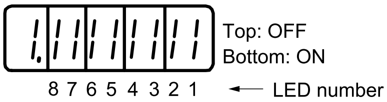
Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Monitor Display Mode.
2			Press the [UP] key or [DOWN] key to select the Un number of the item that you want to monitor.
3			Press the [DATA/SHIFT] key for approximately one second. The contents of the monitor display for the specified Un number will appear. Refer to the following section for the operating procedure for displays with more than five digits. ☞ *(1) Parameters with Settings of More Than Five Digits on page 638*
4			Press the [DATA/SHIFT] key for approximately one second. The display shown for step 1 will appear again.

14.3.2 Input Signal Monitor (Un005)

You can use Un005 to display the status of allocated signals on the LED segments of the panel operator.

(1) Interpreting the Display

LED Segments



- If the input signal that corresponds to the display digit number is OFF, the top LED segment will be lit.
- If the input signal that corresponds to the display digit number is ON, the bottom LED segment will be lit.

The allocations are given in the following table.

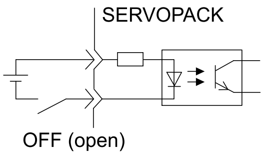
Display LED Number	Input Pin Number	Signal Name (Default Setting)
1	CN1-40	/SI0 (/S-ON)
2	CN1-41	/SI3 (/P-CON)
3	CN1-42	/SI1 (P-OT)
4	CN1-43	/SI2 (N-OT)
5	CN1-44	/SI4 (/ALM-RST)
6	CN1-45	/SI5 (/P-CL)
7	CN1-46	/SI6 (/N-CL)
8	CN1-4	SEN

Information The configuration of the input circuits is shown below.

OFF: Open

ON: Closed

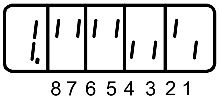
Example:



(2) Display Examples

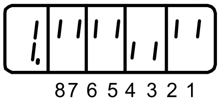
Display examples for input signals are shown below.

- When the /S-ON (Servo ON Input) Signal Is ON



The bottom segment of digit 1 is lit.

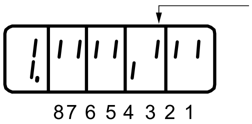
- When the /S-ON (Servo ON Input) Signal Is OFF



The top segment of digit 1 is lit.

- When the P-OT (Forward Drive Prohibit Input) Signal Is Active

The top segment of digit 3 is lit.

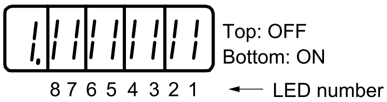


14.3.3 Output Signal Monitor (Un006)

You can use Un006 to display the status of allocated signals on the LED segments of the panel operator.

(1) Interpreting the Display

LED Segments



- If the output signal that corresponds to the display digit number is OFF, the top LED segment will be lit.
- If the output signal that corresponds to the display digit number is ON, the bottom LED segment will be lit.

The allocations are given in the following table.

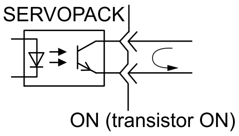
Display LED Number	Input Pin Number	Signal Name (Default Setting)
1	CN1-31, -32	ALM+, ALM-
2	CN1-25, -26	/SO1+ (/COIN+ or /V-CMP+) and /SO1- (/COIN- or /V-CMP-)
3	CN1-27, -28	/SO2+ (/TGON+) and /SO2- (/TGON-)
4	CN1-29, -30	/SO3+ (/S-RDY+) and /SO3- (/S-RDY-)
5	CN1-37	ALO1
6	CN1-38	ALO2
7	CN1-39	ALO3
8	–	Reserved.

Information The configuration of the output circuits is shown below.

OFF: Transistor OFF

ON: Transistor ON

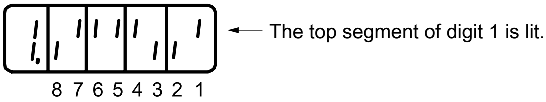
Example:



(2) Display Examples

A display example for output signals is shown below.

- When the ALM (Servo Alarm Output) Signal Is OFF

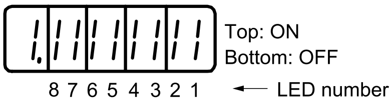


14.3.4 Safety Input Signal Monitor (Un015)

(1) Interpreting the Display

You can display the status of allocated signals on the LED segments of the panel operator.

LED Segments



- If the signal that corresponds to the display digit number is ON, the top LED segment will be lit.
- If the signal that corresponds to the display digit number is OFF, the bottom LED segment will be lit.

The allocations are given in the following table.

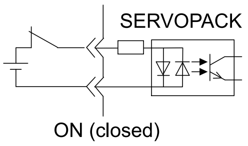
Display LED Number	Input Pin Number	Signal Name (Default Setting)
1	CN8-3, -4	/HWBB1
2	CN8-5, -6	/HWBB2
3	–	Reserved.
4	–	Reserved.
5	–	Reserved.
6	–	Reserved.
7	–	Reserved.
8	–	Reserved.

Information The configuration of the input circuits is shown below.

OFF: Open

ON: Closed

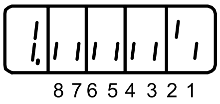
Example:



(2) Display Examples

A display example for safety input signals is shown below.

- When the /HWBB1 Signal Turns OFF to Activate a HWBB



The bottom segment of digit 1 is lit.

14.3.5 Upper Limit Setting Monitor for Maximum Motor Speed/ Upper Limit Setting for Encoder Output Resolution (Un010)

You can use Un010 to monitor the upper limit setting for the maximum motor speed or the upper limit setting for the encoder output resolution.

You can monitor the upper limit of Pn281 (Encoder Output Resolution) for the current Pn385 (Maximum Motor Speed), or you can monitor the upper limit of the maximum motor speed setting for the current encoder output resolution setting.

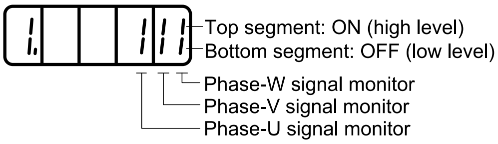
Select which signal to monitor with Pn080 = n.X□□□ (Calculation Method for Maximum Speed or Encoder Output Pulses).

- If Pn080 = n.0□□□, Pn281 (Encoder Output Resolution) that can be set is displayed.
- If Pn080 = n.1□□□, Pn385 (Maximum Motor Speed) that can be set is displayed in mm/s.

14.3.6 Polarity Sensor Signal Monitor (Un011)

You can use Un011 to monitor the signal pattern of the polarity sensor.

Press the [DATA/SHIFT] key for approximately one second to display the polarity sensor signal pattern.



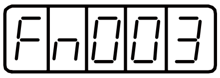
Polarity Sensor Signal Pattern	Signal Monitor		
	Phase U	Phase V	Phase W
0	L	L	L
1	L	L	H
2	L	H	L
3	L	H	H
4	H	L	L
5	H	L	H
6	H	H	L
7	H	H	H

14.4 Utility Function (Fn□□□) Operations on the Panel Operator

Utility functions are used to set up and tune the SERVOPACK.

The panel operator displays numbers beginning with “Fn.”

Display Example: Origin Search



The operating procedures from the panel operator are described here. Refer to the descriptions of individual utility functions for preparations and related parameters.

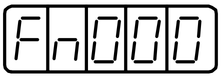
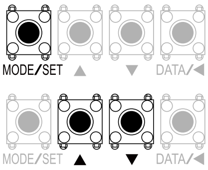
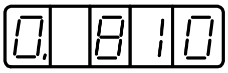
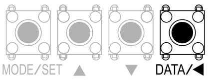
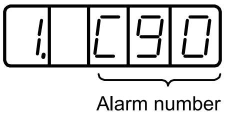
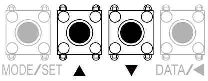
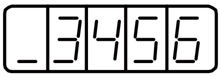
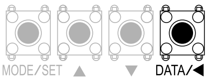
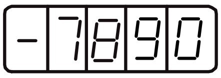
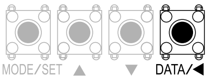
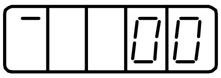
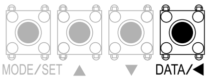
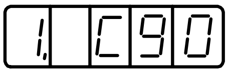
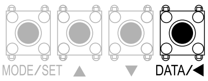
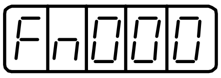
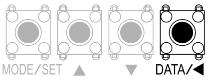
Refer to the following section for details on utility functions.

☞ *16.2.1 Corresponding SERVOPACK Utility Function Names on page 741*

14.4.1 Display Alarm History (Fn000)

Refer to the following section for information on this utility function other than the procedure.

☞ *13.2.4 Displaying the Alarm History on page 612*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode. If “Fn000” is not displayed, press the [UP] key or [DOWN] key to display “Fn000”.
2			Press the [DATA/SHIFT] key for approximately one second. The most recent alarm will be displayed.
3			Press the [DOWN] key to display the next older alarm. Press the [UP] key to display the next newer alarm. The higher the far-left segment is, the older the alarm is. Refer to the following section for information on alarms. ☞ *13.2.1 List of Alarms on page 580*
4			Press the [DATA/SHIFT] key. The lower four digits of the time stamp will be displayed.
5			Press the [DATA/SHIFT] key. The middle four digits of the time stamp will be displayed.
6			Press the [DATA/SHIFT] key. The upper two digits of the time stamp will be displayed.
7			Press the [DATA/SHIFT] key. The alarm number will flash on the display.
8			Press the [DATA/SHIFT] key again for approximately one second to return the display to “Fn000”.

Information **Time Stamp**

A time stamp gives the total operating time to the point at which the alarm occurred in increments of 100 ms from when the control power and main circuit power were turned ON. For 24-hour, 365-day operation, measurements are possible for approximately 13 years.

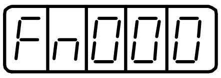
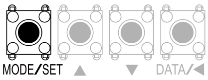
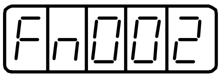
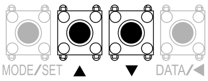
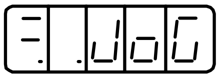
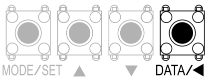
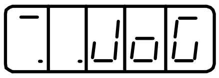
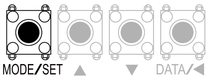
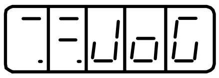
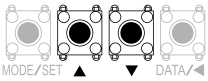
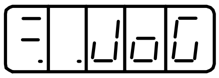
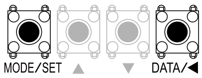
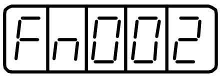
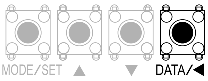
Time Stamp Display Example

If 36000 is displayed, 3600000 ms = 3600 s = 60 min = 1 h. Therefore, the total operating time in hours is 1 hour.

14.4.2 Jog (Fn002)

Refer to the following section for information on this utility function other than the procedure.

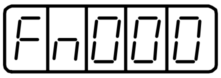
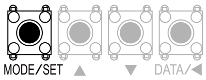
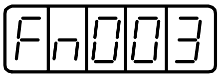
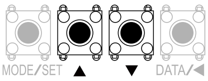
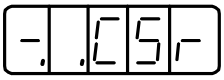
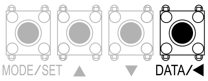
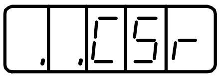
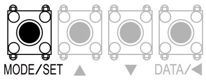
☞ *7.3 Trial Operation for the Servomotor without a Load on page 333*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display “Fn002”.
3			Press the [DATA/SHIFT] key for approximately one second. The display shown at the left will appear.
4			Press the [MODE/SET] key to turn ON the servo.
5			The servomotor will operate at the speed set in Pn304 or Pn383 while the [UP] key (for forward operation) or [DOWN] key (for reverse operation) is pressed.
6			Press the [MODE/SET] key to turn OFF the servo. Additional Information You can turn OFF the servo by pressing the [DATA/SHIFT] key for approximately one second.
7			Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn002”.
8	After you finish jogging operation, turn the power to the SERVOPACK OFF and ON again.		

14.4.3 Origin Search (Fn003)

Refer to the following section for information on this utility function other than the procedure.

☞ *7.6.2 Origin Search on page 349*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display “Fn003.”
3			Press the [DATA/SHIFT] key for approximately one second. The display shown on the left will appear.
4			Press the [MODE/SET] key to turn ON the servo. The display shown on the left will appear.

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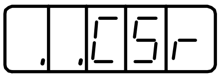
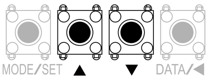
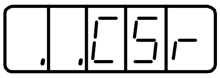
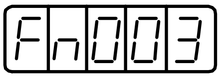
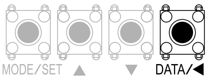
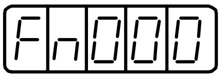
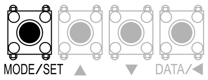
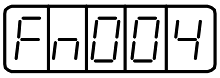
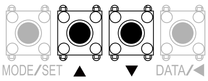
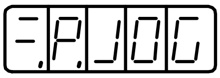
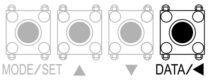
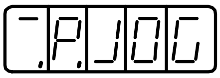
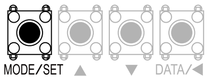
Step	Panel Display after Operation	Keys	Operation
5			Press the [UP] key to operate the servomotor in the forward direction. Press the [DOWN] key to operate the servomotor in the reverse direction. The rotation direction of the servomotor changes according to the setting of Pn000 = n.□□□X as follows. Rotary Servomotors • n.□□□0 [UP] key: CCW, [DOWN] key: CW • n.□□□1 [UP] key: CW, [DOWN] key: CCW **Note:** This is the direction when viewed from the load side of the servomotor. Linear Servomotors • n.□□□0 [UP] key: Linear encoder counts up, [DOWN] key: Linear encoder counts down • n.□□□1 [UP] key: Linear encoder counts down, [DOWN] key: Linear encoder counts up **Note:** The direction in which the linear encoder counts up is the forward direction. Refer to the following sections for details. ☞ *5.6 Motor Direction Setting on page 172*
6	 (Flashing)	–	When the servomotor origin search has been completed, the display will flash. At this time, the servomotor is servo-locked at the origin within one encoder rotation.
7			Press the [DATA/SHIFT] key for approximately one second to return the display to "Fn003".
8	Turn the power to the SERVOPACK OFF and ON again after you finish the origin search.		

14.4.4 Jog Program (Fn004)

Refer to the following section for information on this utility function other than the procedure.

☞ *7.6.1 Program Jogging on page 344*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display "Fn004".
3			Press the [DATA/SHIFT] key for approximately one second. The display shown on the left will appear.
4			Press the [MODE/SET] key to turn ON the servo. The display shown on the left will appear.

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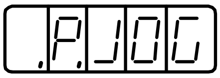
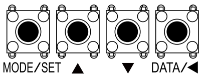
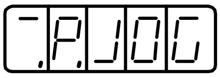
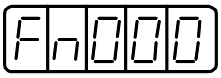
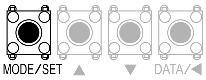
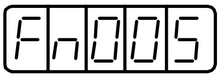
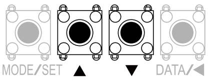
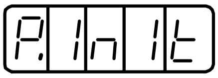
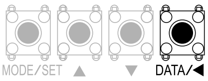
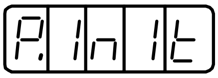
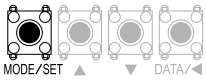
Step	Panel Display after Operation	Keys	Operation
5			Press the [UP] key or [DOWN] key according to the initial movement direction of the operation pattern. The operation will start after the preset waiting time. Additional Information • Press the [MODE/SET] key during operation. The servo will turn OFF and the servomotor will stop. • Press the [DATA/SHIFT] key for approximately one second during operation to return to the display shown for step 2.
6		–	When program jogging has been completed, "End" will flash on the display, and then the display shown on the left will appear again. Additional Information • Press the [MODE/SET] key during operation to turn OFF the servo and return to the display shown for step 3. • Press the [DATA/SHIFT] key for approximately one second during operation to return to the display shown for step 2.
7	Turn the power to the SERVOPACK OFF and ON again after you finish program jogging.		

14.4.5 Initialize Parameters (Fn005)

Refer to the following section for information on this utility function other than the procedure.

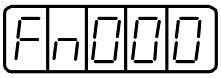
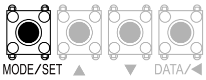
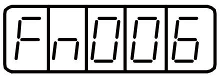
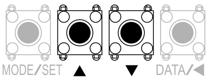
☞ *5.1.5 Initialize Parameters on page 164*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display "Fn005."
3			Press the [DATA/SHIFT] key for approximately one second. The display shown on the left will appear.
4			Press the [MODE/SET] key to initialize the parameters. When the initialization has been completed, "donE" will flash on the display, and then the display shown on the left will appear again.
5	To enable the change to the setting, turn the power to the SERVOPACK OFF and ON again after the initialization of the parameter settings has been completed.		

14.4.6 Clear Alarm History (Fn006)

Refer to the following section for information on this utility function other than the procedure.

☞ *13.2.5 Clearing the Alarm History on page 613*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display "Fn006".

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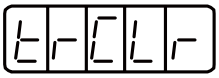
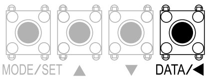
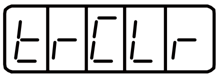
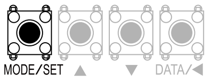
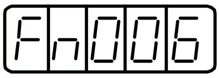
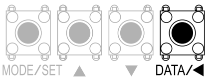
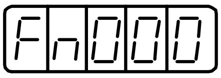
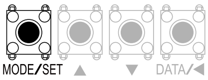
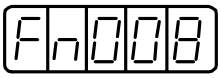
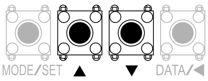
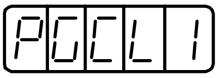
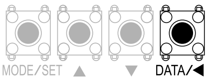
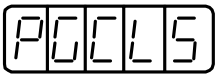
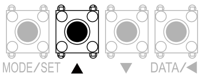
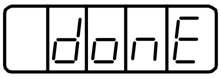
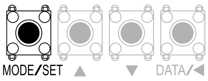
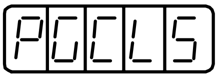
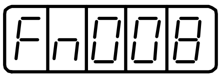
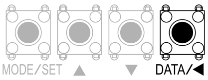
Step	Panel Display after Operation	Keys	Operation
3			Press the [DATA/SHIFT] key for approximately one second. The display shown at the left will appear.
4			Press the [MODE/SET] key to clear the alarm history. When deleting the alarms has been completed, “donE” will flash on the display, and then the display shown on the left will appear again.
5			Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn006”.

14.4.7 Reset Absolute Encoder (Fn008)

Refer to the following section for information on this utility function other than the procedure.

☞ *5.17 Resetting the Absolute Encoder on page 206*

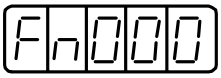
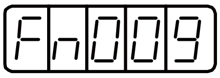
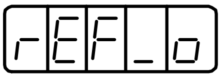
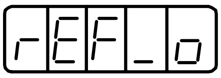
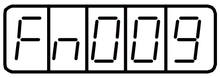
Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display “Fn008”.
3			Press the [DATA/SHIFT] key for approximately one second. “PGCL1” will be displayed.
4			Continue pressing the [UP] key until “PGCL5” is displayed. **Note:** If you press the wrong key, “no-oP” will flash on the display for approximately one second and the display will return to the original Utility Function Mode display. Repeat the operation from the beginning.
5			Press the [MODE/SET] key. The absolute encoder will be initialized. When initialization has been completed, “donE” will flash on the display for approximately one second.
6		–	After displaying “donE”, the display will return to the “PGCL5” display.
7			Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn008”.
8	To enable changes to the settings, turn the power to the SERVOPACK OFF and ON again.		

14.4.8 Autotune Analog (Speed/Torque) Reference Offset (Fn009)

Refer to the following section for information on this utility function other than the procedure.

☞ *(5) Adjusting the Speed Reference Offset on page 235*

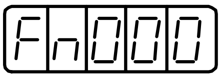
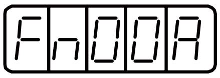
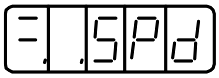
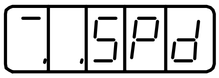
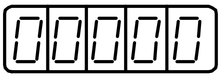
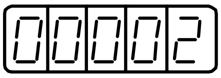
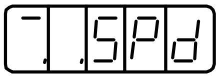
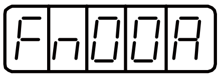
☞ *6.7.2 Adjusting the Torque Reference Offset on page 257*

Step	Panel Display after Operation	Keys	Operation
1	–	–	Turn OFF the servo, and input a 0-V reference voltage from the host controller or an external circuit.
2		MODE/SET	Press the [MODE/SET] key to enter Utility Function Mode.
3		▲ ▼	Press the [UP] key or [DOWN] key to display “Fn009.”
4		DATA/◀	Press the [DATA/SHIFT] key for approximately one second. “ rEF_o” will be displayed.
5		MODE/SET	Press the [MODE/SET] key. “donE” will flash on the display for approximately one second, and then the display shown on the left will appear.
6		DATA/◀	Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn009.” .

14.4.9 Manually Adjust Speed Reference Offset (Fn00A)

Refer to the following section for information on this utility function other than the procedure.

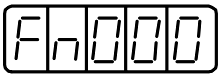
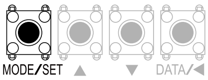
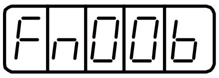
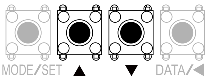
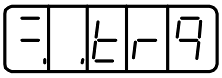
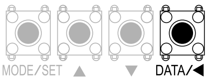
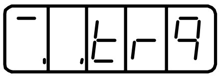
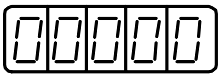
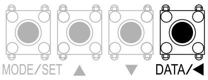
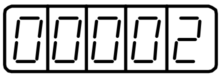
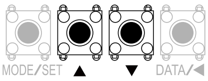
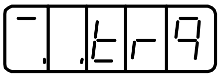
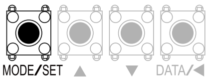
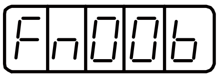
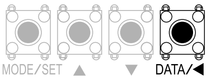
☞ *(b) Manually Adjusting the Speed Reference Offset on page 237*

Step	Panel Display after Operation	Keys	Operation
1		MODE/SET	Press the [MODE/SET] key to enter Utility Function Mode.
2		▲ ▼	Press the [UP] key or [DOWN] key to display “Fn00A.”
3		DATA/◀	Press the [DATA/SHIFT] key for approximately one second. The display shown on the left will appear. **Note:** If write protection is set, “no_oP” will flash on the display for approximately one second. Change the setting of Fn010 to enable writing.
4		–	Turn ON the servo from an external device. The display shown on the left will appear.
5		DATA/◀	Press the [DATA/SHIFT] key for approximately one second. The current amount of offset will be displayed.
6	 Example:	▲ ▼	Press the [UP] key or [DOWN] key to adjust the offset until the servomotor stops. The displayed value is the amount of the offset.
7		MODE/SET	Press the [MODE/SET] key. “donE” will flash on the display, and then the display shown on the left will appear.
8		DATA/◀	Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn00A.”

14.4.10 Manually Adjust Torque Reference Offset (Fn00B)

Refer to the following section for information on this utility function other than the procedure.

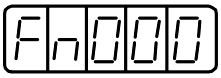
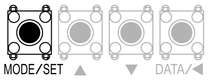
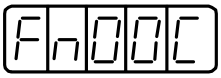
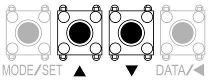
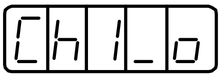
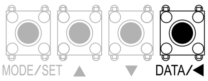
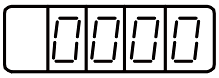
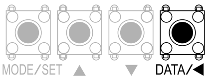
☞ *(2) Manually Adjusting the Torque Reference Offset on page 259*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display “Fn00b”.
3			Press the [DATA/SHIFT] key for approximately one second. The display shown on the left will appear. **Note:** If write protection is set, “no_oP” will flash on the display for approximately one second. Change the setting of Fn010 to enable writing.
4		–	Turn ON the servo. The display shown on the left will appear.
5			Press the [DATA/SHIFT] key for approximately one second. The current amount of offset will be displayed.
6	 Example:		Press the [UP] key or [DOWN] key to adjust the amount of offset.
7			Press the [MODE/SET] key. “donE” will flash on the display, and then the display shown on the left will appear.
8			Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn00b”.

14.4.11 Adjust Analog Monitor Output Offset (Fn00C)

Refer to the following section for information on this utility function other than the procedure.

☞ *(3) Adjusting the Analog Monitor Output on page 515*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display “Fn00C”.
3			Press the [DATA/SHIFT] key for approximately one second. The display shown at the left will appear.
4			Press the [DATA/SHIFT] key. The offset will be displayed as shown on the left.

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Step	Panel Display after Operation	Keys	Operation
5	-0001	▲ ▼	Press the [UP] key or [DOWN] key to adjust the offset.
6	Ch1_o	DATA/◀	Press the [DATA/SHIFT] key for to return the display shown on the left.
7	Ch2_o	MODE/SET	Press the [MODE/SET] key. The display will change to the monitor output for CH2 (analog monitor 2 output).
8	0000	DATA/◀	Press the [DATA/SHIFT] key. The offset will be displayed as shown on the left.
9	-0001	▲ ▼	Press the [UP] key or [DOWN] key to adjust the offset.
10	Fn00C	DATA/◀	Press the [DATA/SHIFT] key for approximately one second. "Ch2-o" will be displayed, and then "Fn00C" will be displayed again.

14.4.12 Adjust Analog Monitor Output Gain (Fn00D)

Refer to the following section for information on this utility function other than the procedure.

☞ *(3) Adjusting the Analog Monitor Output on page 515*

Step	Panel Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the [MODE/SET] key to enter Utility Function Mode.
2	Fn00d	▲ ▼	Press the [UP] key or [DOWN] key to display "Fn00D".
3	Ch1_G	DATA/◀	Press the [DATA/SHIFT] key for approximately one second. The display shown at the left will appear.
4	0000	DATA/◀	Press the [DATA/SHIFT] key. The gain adjustment will be displayed as shown on the left.
5	-0001	▲ ▼	Press the [UP] key or [DOWN] key to adjust the gain.
6	Ch1_G	DATA/◀	Press the [DATA/SHIFT] key for to return the display shown on the left.
7	Ch2_G	MODE/SET	Press the [MODE/SET] key. The display will change from the monitor output for CH1 to the monitor output for CH2.
8	0000	DATA/◀	Press the [DATA/SHIFT] key. The gain adjustment will be displayed as shown on the left.

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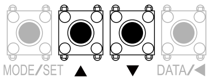
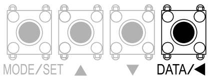
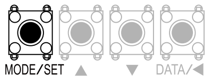
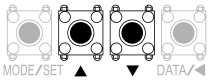
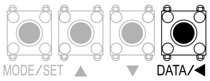
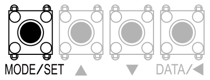
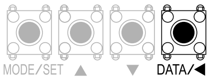
Step	Panel Display after Operation	Keys	Operation
9	-0001		Press the [UP] key or [DOWN] key to adjust the gain.
10	Fn00d		Press the [DATA/SHIFT] key for approximately one second. “Ch2-G” will be displayed, and then “Fn00D” will be displayed again.

14.4.13 Autotune Motor Current Detection Signal Offset (Fn00E)

Refer to the following section for information on this utility function other than the procedure.

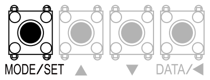
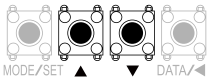
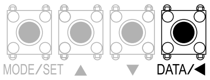
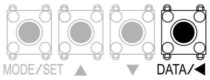
☞ *6.16.1 Automatic Adjustment on page 317*

Step	Panel Display after Operation	Keys	Operation
1	Fn000		Press the [MODE/SET] key to enter Utility Function Mode.
2	Fn00E		Press the [UP] key or [DOWN] key to display “Fn00E.”
3	Cur_o		Press the [DATA/SHIFT] key for approximately one second. The display shown on the left will appear.
4	Cur_o		Press the [MODE/SET] key to perform automatic offset- signal adjustment. When the adjustment has been completed, “donE” will flash on the display, and then the display shown on the left will appear again.
5	Fn00E		Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn00E.”

14.4.14 Manually Adjust Motor Current Detection Signal Offset (Fn00F)

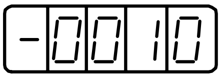
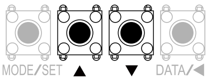
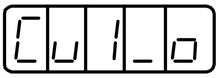
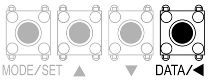
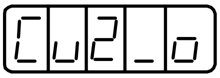
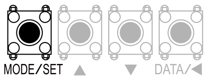
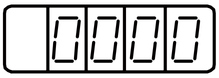
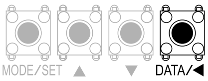
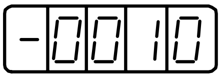
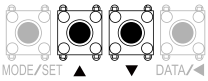
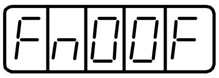
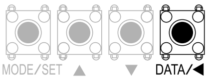
Refer to the following section for information on this utility function other than the procedure.

☞ *6.16.2 Manual Adjustment on page 319*

Step	Panel Display after Operation	Keys	Operation
1	Fn000		Press the [MODE/SET] key to enter Utility Function Mode.
2	Fn00F		Press the [UP] key or [DOWN] key to display “Fn00F.”
3	Cu1_o		First you adjust the offset for phase U (Cu1-o). Press the [DATA/SHIFT] key for approximately one second. The display shown at the left will appear.
4	0000		Press the [DATA/SHIFT] key. The amount of offset for phase U will be displayed.

Continued on next page.

Continued from previous page.

Step	Panel Display after Operation	Keys	Operation
5			Press the [UP] key or [DOWN] key to change the amount of offset. Change the setting by approximately 10 units at a time in the direction that reduces the torque ripple to find the value that minimizes the torque ripple, and set that value. Adjustment range: -512 to +511
6			Press the [DATA/SHIFT] key. The display shown on the left will appear again.
7			Next you adjust the offset for phase V (Cu2-o). Press the [MODE/SET] key for approximately one second. The display shown at the left will appear.
8			Press the [DATA/SHIFT] key. The amount of offset for phase V will be displayed.
9			Press the [UP] key or [DOWN] key to change the amount of offset. In the same way as for the phase-U adjustment, change the setting by approximately 10 units at a time in the direction that reduces the torque ripple to find the value that minimizes the torque ripple, and set that value. Adjustment range: -512 to +511
10			Press the [DATA/SHIFT] key for approximately one second. “Cu2-o” will be displayed, and then “Fn00F” will be displayed again.
11	Reduce the amount by which you change the offsets each time and repeat steps 3 to 10 *1 to fine-tune the amounts of offset.		

*1 Examples of the Amount of Change to Adjust Offsets

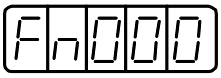
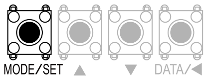
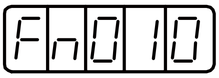
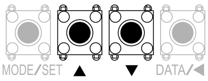
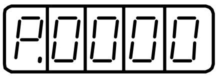
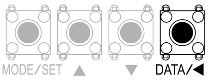
- First time: 10 units at a time
- Second time: 5 units at a time
- Third time: 1 unit at a time

The above values are guidelines. Vary the amount of change and the number of repetitions according to your system.

14.4.15 Write Prohibition Setting (Fn010)

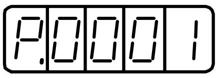
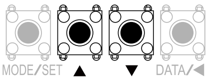
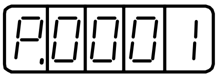
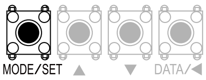
Refer to the following section for information on this utility function other than the procedure.

☞ *5.1.4 Write Prohibition Setting on page 161*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display “Fn010”.
3			Press the [DATA/SHIFT] key for approximately one second. The display shown on the left will appear.

Continued on next page.

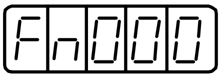
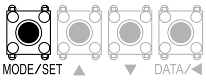
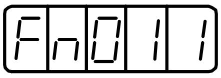
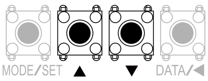
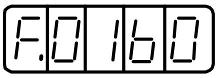
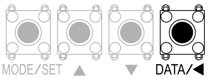
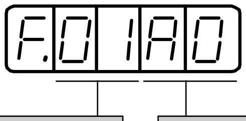
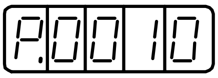
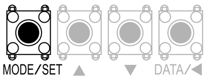
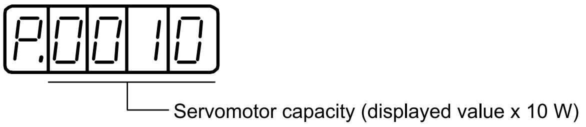
Continued from previous page.

<table>
<tr><th>Step</th><th>Panel Display after Operation</th><th>Keys</th><th>Operation</th></tr>
<tr><td>4</td><td> </td><td> </td><td>Press the [UP] key or [DOWN] key and set one of the following.
P.0000: Write permitted (default setting)
P.0001: Write prohibited</td></tr>
<tr><td>5</td><td> </td><td> </td><td>Press the [MODE/SET] key to enter the value.
When the setting has been completed, “donE” will flash on the display, and then the display shown on the left will appear again.
Note:
If you set any value other than “P.0000” or “P.0001”, “Error” will be displayed.</td></tr>
</table>

14.4.16 Display Servomotor Model (Fn011)

Refer to the following section for information on this utility function other than the procedure.

☞ *9.1 Monitoring Product Information on page 502*

<table>
<tr><th>Step</th><th>Panel Display after Operation</th><th>Keys</th><th>Operation</th></tr>
<tr><td>1</td><td> </td><td> </td><td>Press the [MODE/SET] key to enter Utility Function Mode.</td></tr>
<tr><td>2</td><td> </td><td> </td><td>Press the [UP] key or [DOWN] key to display “Fn011”.</td></tr>
<tr><td>3</td><td>Example
 </td><td> </td><td>Press the [DATA/SHIFT] key for approximately one second to display the servomotor voltage and model codes.

<table>
<tr><th colspan="2">Servomotor voltage</th></tr>
<tr><th>No.</th><th>Type</th></tr>
<tr><td>01</td><td>AC200 V</td></tr>
</table>
<table>
<tr><th colspan="2">Servomotor model</th></tr>
<tr><th>No.</th><th>Type</th></tr>
<tr><td>D0</td><td>SGMXA</td></tr>
<tr><td>D1</td><td>SGMXP</td></tr>
<tr><td>D3</td><td>SGMXG</td></tr>
<tr><td>DD</td><td>SGMXJ</td></tr>
<tr><td>A7</td><td>SGM7M</td></tr>
<tr><td>AC</td><td>SGM7D</td></tr>
<tr><td>AE</td><td>SGM7E</td></tr>
<tr><td>AF</td><td>SGM7F</td></tr>
<tr><td>40</td><td>Linear servomotor</td></tr>
</table></td></tr>
<tr><td>4</td><td>Example
 </td><td> </td><td>Press the [MODE/SET] key. The servomotor capacity will be displayed.

The above example indicates 100 W.</td></tr>
</table>

Continued on next page.

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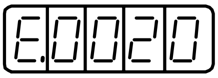
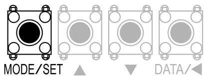
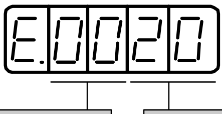
<table>
<tr><th>Step</th><th>Panel Display after Operation</th><th>Keys</th><th>Operation</th></tr>
<tr><td>5</td><td>Example
 </td><td> </td><td>

- Rotary Servomotors
Press the [MODE/SET] key. The encoder type and resolution codes will be displayed.

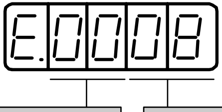


<table>
<tr><th colspan="2">Encoder type</th></tr>
<tr><th>No.</th><th>Type</th></tr>
<tr><td>00</td><td>Incremental</td></tr>
<tr><td>01</td><td>Multi-turn absolute</td></tr>
<tr><td>02</td><td>Single-turn absolute*1</td></tr>
</table>

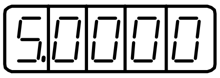
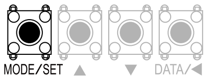
<table>
<tr><th colspan="2">Encoder resolution</th></tr>
<tr><th>No.</th><th>Resolution</th></tr>
<tr><td>20</td><td>20 bits</td></tr>
<tr><td>22</td><td>22 bits</td></tr>
<tr><td>24</td><td>24 bits</td></tr>
<tr><td>26</td><td>26 bits</td></tr>
</table>

*1 A single-turn absolute encoder is used only for a direct drive servomotor.

- Linear Servomotors
Press the [MODE/SET] key. The encoder type and linear encoder scale pitch resolution codes will be displayed.

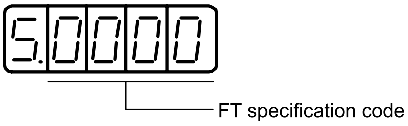
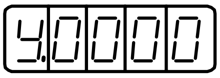
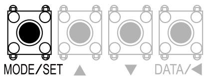


<table>
<tr><th colspan="2">Encoder type</th></tr>
<tr><th>No.</th><th>Type</th></tr>
<tr><td>00</td><td>Incremental</td></tr>
<tr><td>01</td><td>Absolute value</td></tr>
</table>

<table>
<tr><th colspan="2">Number of divisions of linear encoder scale pitch</th></tr>
<tr><th>No.</th><th>Number of divisions</th></tr>
<tr><td>8</td><td>256</td></tr>
<tr><td>12</td><td>4096</td></tr>
</table>
</td></tr>
<tr><td>6</td><td> </td><td> </td><td>

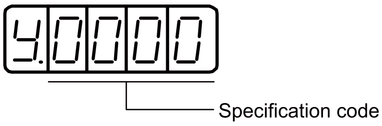
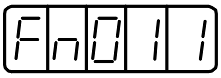
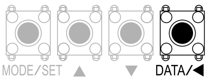
Press the [MODE/SET] Key. The FT specification code for the SERVOPACK will be displayed. s.0000 indicates a standard model.

If a specification code other than s.0000 is displayed, a SERVOPACK with FT specification is being used.


</td></tr>
<tr><td>7</td><td> </td><td> </td><td>

Press the [MODE/SET] key. The code for custom SERVOPACK specifications will be displayed. y.0000 indicates a standard model.

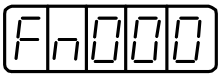
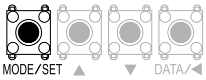
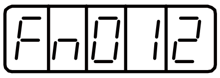
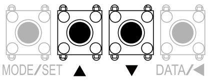
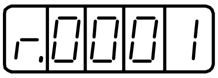
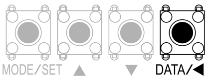
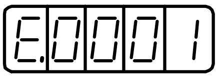
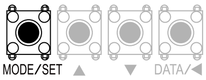
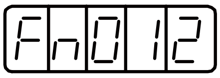
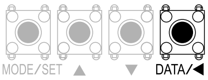
If a specification code other than y.0000 is displayed, a customized SERVOPACK is being used.


</td></tr>
<tr><td>8</td><td> </td><td> </td><td>Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn011”.</td></tr>
</table>

14.4.17 Display Software Version (Fn012)

Refer to the following section for information on this utility function other than the procedure.

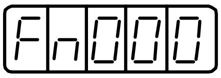
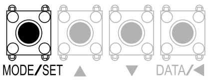
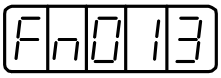
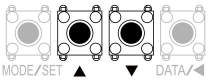
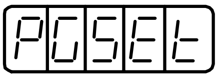
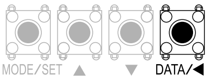
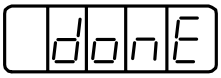
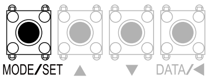
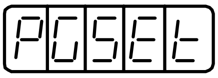
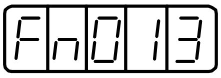
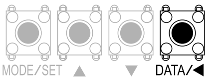
☞ *9.1 Monitoring Product Information on page 502*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display “Fn012”.
3			Press the [DATA/SHIFT] key for approximately one second. The software version of the SERVOPACK will be displayed.
4			Press the [MODE/SET] key. The software version of the encoder will be displayed. Additional Information If you press the [MODE/SET] key again, a pre-programmed display will appear. The display will change as follows: “0.0000” → “S.FFFF” → “F. FFFF”.
5			Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn012”.

14.4.18 Multiturn Limit Setting after A.CC0 (Multiturn Limit Disagreement) Alarm (Fn013)

Refer to the following section for information on this utility function other than the procedure.

☞ *6.12.9 A.CC0 (Multiturn Limit Disagreement Alarm) on page 301*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display “Fn013.”
3			Press the [DATA/SHIFT] key for approximately one second. “PGSEt” will be displayed.
4			Press the [MODE/SET] key. The value of the multiturn limit setting in the absolute encoder will be made the same as the setting of Pn205. When unifying the values has been completed, “donE” will flash on the display for approximately one second.
5		–	After displaying “donE”, the display will return to the “PGSEt” display.
6			Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn013.”
7	To enable changes to the settings, turn the power to the SERVOPACK OFF and ON again.		

14.4.19 Reset Option Module Configuration Error (Fn014)

Refer to the following section for information on this utility function other than the procedure.

☞ *13.2.6 Resetting Option Module Configuration Error on page 614*

Step	Panel Display after Operation	Keys	Operation
1	Fn000	**MODE/SET** ▲ ▼ DATA/◀	Press the [MODE/SET] key to enter Utility Function Mode.
2	Fn014	MODE/SET **▲** **▼** DATA/◀	Press the [UP] key or [DOWN] key to display “Fn014”.
3	o.SAFE	MODE/SET ▲ ▼ **DATA/◀**	Press the [DATA/SHIFT] key for approximately one second. The display shown at the left will appear.
4	o.FEEd	MODE/SET **▲** **▼** DATA/◀	Press the [UP] key or [DOWN] key to select the option module to be cleared.
5	o.Init	**MODE/SET** ▲ ▼ DATA/◀	Press the [MODE/SET] key for approximately one second. The display shown at the left will appear.
6	o.FEEd	**MODE/SET** ▲ ▼ DATA/◀	Press the [MODE/SET] key again. The alarms in the option module will be cleared. “donE” will flash on the display and the display shown on the left will appear again.
7	Fn014	MODE/SET ▲ ▼ **DATA/◀**	Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn014”.
8	To enable the change to the setting, turn the power to the SERVOPACK OFF and ON again after clearing detected option module alarms has been completed.		

14.4.20 Initialize Vibration Detection Level (Fn01B)

Refer to the following section for information on this utility function other than the procedure.

☞ *6.15 Vibration Detection Level Initialization on page 314*

Step	Panel Display after Operation	Keys	Operation
1	Fn000	**MODE/SET** ▲ ▼ DATA/◀	Press the [MODE/SET] key to enter Utility Function Mode.
2	Fn01b	MODE/SET **▲** **▼** DATA/◀	Press the [UP] key or [DOWN] key to display “Fn01b.”
3	d.Init	MODE/SET ▲ ▼ **DATA/◀**	Press the [DATA/SHIFT] key for approximately one second. The display shown at the left will appear.
4	d.Init (Flashing)	**MODE/SET** ▲ ▼ DATA/◀	Press the [MODE/SET] key for approximately one second. The display shown on the left will flash and the vibration level will be detected and updated. **Note:** 1. Operate the SERVOPACK with the references that will be used for actual operation. 2. If the servomotor operates at 10% or less of the maximum speed, “Error” will be displayed.
5	donE	**MODE/SET** ▲ ▼ DATA/◀	Wait for a period of time and then press the [MODE/SET] key again to complete vibration detection and updating the setting. This will enable the setting. If the setting is completed normally, “donE” will be displayed. If there was an error in making the setting, “Error” will be displayed.
6	Fn01b	MODE/SET ▲ ▼ **DATA/◀**	Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn01b.”

14.4.21 Display SERVOPACK and Servomotor IDs (Fn01E)

This function cannot be executed from the panel operator on the SERVOPACK.

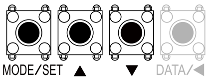
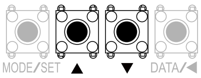
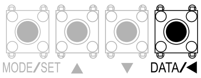
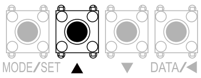
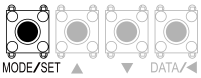
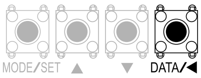
14.4.22 Display Servomotor ID from Feedback Option Module (Fn01F)

This function cannot be executed from the panel operator on the SERVOPACK.

14.4.23 Set Absolute Linear Encoder Origin (Fn020)

Refer to the following section for information on this utility function other than the procedure.

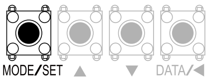
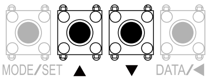
☞ *5.18.1 Setting the Origin of the Absolute Linear Encoder on page 209*

Step	Panel Display after Operation	Keys	Operation
1	Fn000		Press the [MODE/SET] key to enter Utility Function Mode.
2	Fn020		Press the [UP] key or [DOWN] key to display “Fn020.”
3	0SEt1		Press the [DATA/SHIFT] key for approximately one second. The display shown at the left will appear.
4	0SEt5		Continue pressing the [UP] key until “0SET5” is displayed. **Note:** If you make a mistake during key operations, “no_oP” will flash on the display for approximately one second and then “Fn000” will be displayed again.
5	0SEt5		Press the [MODE/SET] key to set the origin of the absolute linear encoder. When the setting has been completed, “donE” will flash on the display, and then the display shown on the left will appear again.
6	Fn020		Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn020.”
7	To enable changes to the settings, turn the power to the SERVOPACK OFF and ON again.		

14.4.24 Resetting Motor Type Alarms (Fn021)

Refer to the following section for information on this utility function other than the procedure.

☞ *13.2.7 Resetting Motor Type Alarms on page 616*

Step	Panel Display after Operation	Keys	Operation
1	Fn000		Press the [MODE/SET] key to enter Utility Function Mode.
2	Fn021		Press the [UP] key or [DOWN] key to display “Fn021”.

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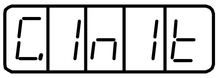
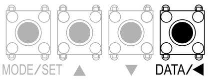
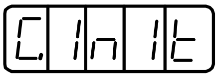
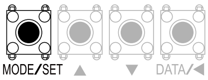
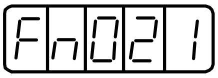
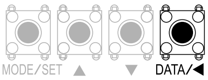
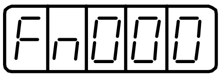
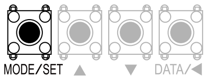
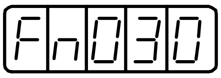
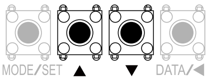
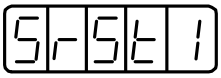
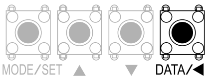
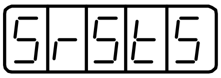
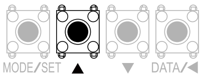
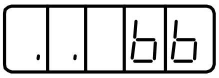
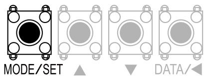
Step	Panel Display after Operation	Keys	Operation
3			Press the [DATA/SHIFT] key for approximately one second. The display shown at the left will appear.
4			Press the [MODE/SET] key to reset the motor type alarm. “donE” will flash on the display and the display shown on the left will appear again.
5			Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn021”.
6	To enable changes to the settings, turn the power to the SERVOPACK OFF and ON again.		

14.4.25 Software Reset (Fn030)

Refer to the following section for information on this utility function other than the procedure.

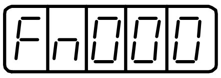
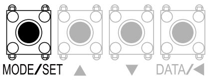
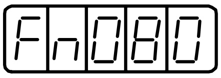
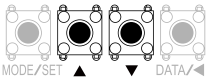
☞ *6.14 Software Reset on page 312*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display “Fn030.”
3			Press the [DATA/SHIFT] key for approximately one second. The display shown on the left will appear.
4			Continue pressing the [UP] key until the display shown on the left appears. **Note:** If you make a mistake during key operations, “no_oP” will flash on the display for approximately one second.
5			Press the [MODE/SET] key. The panel display will go blank and then will change to the same initial status display as when the power is turned ON.

14.4.26 Polarity Detection (Fn080)

Refer to the following section for information on this utility function other than the procedure.

☞ *5.11 Polarity Detection on page 182*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display “Fn080”.

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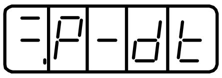
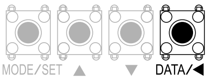
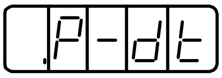
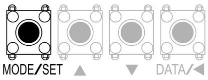
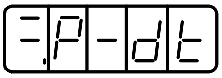
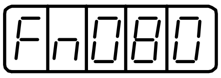
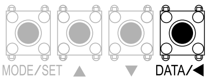
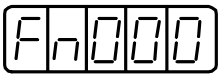
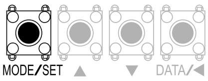
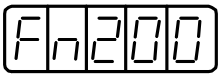
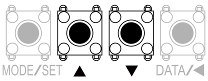
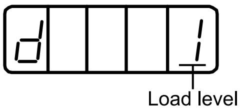
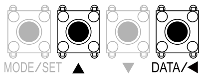
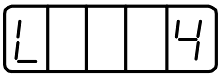
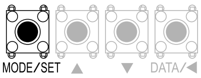
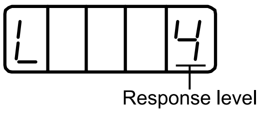
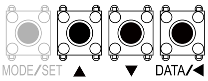
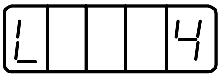
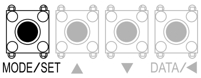
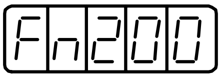
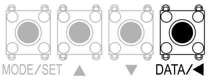
Step	Panel Display after Operation	Keys	Operation
3			Press the [DATA/SHIFT] key for approximately one second. The display shown at the left will appear.
4			Press the [MODE/SET] key to start polarity detection.
5		–	After polarity detection has been completed, the display shown on the left will appear. The servomotor will enter the servo OFF state.
6			Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn080”.

14.4.27 Tuning-less Level Setting (Fn200)

Refer to the following section for information on this utility function other than the procedure.

☞ *8.4 Tuning-less Function on page 368*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display “Fn200.”
3			Press the [DATA/SHIFT] key for approximately one second. The load level setting display for the tuning-less levels will appear. **Note:** If the response waveform shows overshooting, if the load moment of inertia exceeds the allowable level (i.e., outside the scope of product warranty), or if the mass ratio is 30 or higher (i.e., outside the scope of product warranty), press the [UP] key and change the load level to 2.
4			Press the [MODE/SET] key. The response level setting display for the tuning-less levels will appear.
5			Press the [UP] key or [DOWN] key to set the response level. Set the response level to between 0 and 7. The larger the value is, the higher the gain is and the better response performance will be. (The default setting is 4.) **Note:** Vibration may occur if the response level is too high. Lower the response level if vibration occurs. If high-frequency noise is generated, press the [DATA/SHIFT] key to automatically set a notch filter for the vibration frequency.
6			Press the [MODE/SET] key. “donE” will flash for approximately one second and then “L 4” will be displayed.
7			Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn200”.

14.4.28 Advanced Autotuning without Reference (Fn201)

This function cannot be executed from the panel operator on the SERVOPACK.

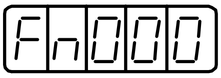
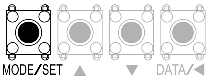
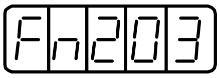
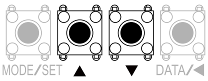
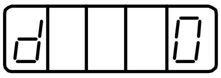
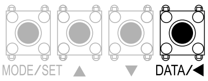
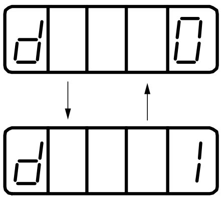
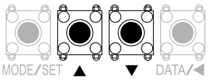
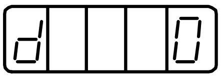
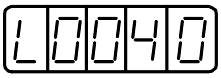
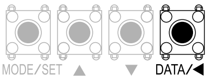
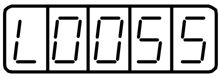
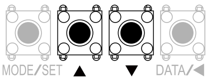
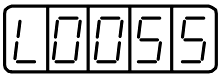
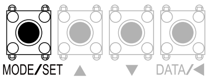
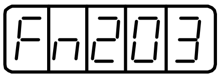
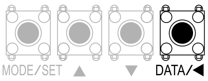
14.4.29 Advanced Autotuning with Reference (Fn202)

This function cannot be executed from the panel operator on the SERVOPACK.

14.4.30 One-Parameter Tuning (Fn203)

Refer to the following section for information on this utility function other than the procedure.

☞ *8.9 Custom Tuning on page 422*

Step	Panel Display after Operation	Keys	Operation
1			Press the [MODE/SET] key to enter Utility Function Mode.
2			Press the [UP] key or [DOWN] key to display “Fn203”.
3			Press the [DATA/SHIFT] key for approximately one second. The display shown at the left will appear.
4			Press the [UP] key or [DOWN] key to enter Tuning Mode. Tuning Mode (Strength of Tuning Setting) 0: Performs tuning giving priority to stability. 1: Performs tuning giving priority to response. **Note:** The rigidity type is always 2.
5		–	If the servo is OFF (i.e., if power is not supplied to the servomotor), input the /S-ON (Servo ON) from the host controller. If the servo is ON, go to step 6.
6			Press the [DATA/SHIFT] key for less than one second. The one-parameter gain will be displayed as shown on the left.
7			Press the [UP] key or [DOWN] key to change the one-parameter gain value and change the actual servo gains (Pn100, Pn101, Pn102, and Pn401) at the same time. You end this tuning function when you decide that the response is satisfactory.
8			Press the [MODE/SET] key to save the four calculated gains to the parameters. When tuning has been completed, “donE” will flash on the display, and then the display shown on the left will appear again. **Note:** To end operation without saving the calculated gains, go to step 9.
9			Press the [DATA/SHIFT] key for approximately one second to return the display to “Fn203”.

14.4.31 Adjust Anti-resonance Control (Fn204)

This function cannot be executed from the panel operator on the SERVOPACK.

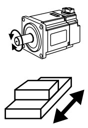
14.4.32 Vibration Suppression (Fn205)

This function cannot be executed from the panel operator on the SERVOPACK.

14.4.33 Easy FFT (Fn206)

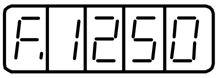
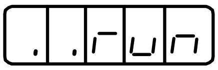
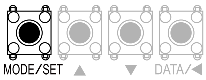
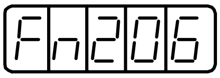
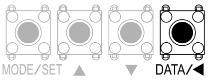
Refer to the following section for information on this utility function other than the procedure.

☞ *8.16.2 Easy FFT on page 495*

Step	Panel Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the [MODE/SET] key to enter Utility Function Mode.
2	Fn206	▲ ▼	Press the [UP] key or [DOWN] key to display Fn206.
3	1n. 15 (Reference amplitude setting)	DATA/◀	Press the [DATA/SHIFT] key for approximately one second. The display shown on the left will appear and the panel operator will enter Reference Amplitude Setting Mode.
4	1n. 16	▲ ▼	Press the [UP] key or [DOWN] key to set the reference amplitude. Reference amplitude setting range: 1 to 800 **Note:** 1. If you are setting Easy FFT for the first time, do not change the reference amplitude setting, but rather start from the default value of 15. Although increasing the reference amplitude will increase the detection accuracy, the vibration and noise in the machine will increase momentarily. Increase the reference amplitude a little at a time and observe the results. 2. The set reference amplitude will be stored in Pn456.
5	F. (Ready to operate status)	DATA/◀	Press the [DATA/SHIFT] key for approximately one second. The ready to operate status will be entered.
6	. .run	MODE/SET	Press the [MODE/SET] key to turn ON the servo. Additional Information Press the [MODE/SET] key again to turn OFF the servo. Return to step 5.
7	E_FFt (Flashing)  Slight movement in servomotor	▲ ▼	While the servo is ON, press the [UP] (forward) key or the [DOWN] (reverse) key. The servomotor will automatically perform round-trip operation, moving in forward and reverse several times for 1/4th of a rotation for a rotary servomotor and 10 mm or less for a linear servomotor. The servomotor performs this operation for approximately 2 seconds. During this operation, the display shown on the left will flash. **Note:** 1. Press the [MODE/SET] key to cancel the operation. Return to step 5. 2. The servomotor will move slightly. Also at the same time, the servomotor will emit noise. To ensure safety, do not approach or enter the range of machine motion.

Continued on next page.

Continued from previous page.

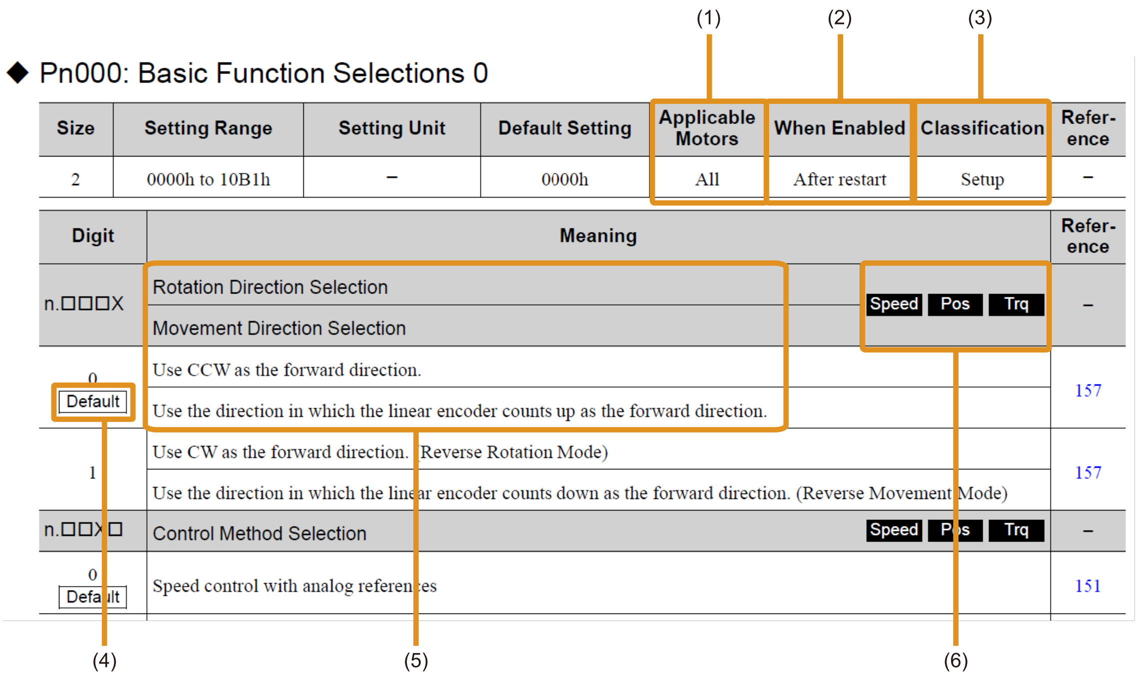
Step	Panel Display after Operation	Keys	Operation
8	 (Detection result display example)	–	If detection is completed normally, “E_FFt” will stop flashing and the detected resonance frequency will be displayed. If detection fails, “F——” will be displayed. To set the results, go to step 9. To monitor the resonance frequency without setting the detection result, press the [DATA/SHIFT] key for approximately one second and return to step 2. IMPORTANT If the operation ended normally but it took two seconds or longer, the detection accuracy may not be sufficient. Increase the reference amplitude to a value higher than 15 to increase the detection accuracy. Although increasing the reference amplitude will increase the detection accuracy, the vibration and noise in the machine will increase momentarily. Increase the reference amplitude a little at a time and observe the results.
9			Press the [MODE/SET] key. The optimum notch filter for the detected resonance frequency will automatically be set. If the notch filter is set correctly, “donE” will flash on the display, and then the display shown on the left will appear. When Pn408 is set to n.□□□1 (enable first stage notch filter), Pn40C (Second Stage Notch Filter Frequency) is set automatically. Press the [MODE/SET] key to return to step 5. **Note:** 1. When Pn408 is set to n.□1□1 (enable first and second stage notch filters), notch filter frequencies are not set. 2. If the frequency detected by this function is not to be used, set Pn408 to n.□□□0 (disable notch filter).
10			Press the [DATA/SHIFT] key for approximately one second to return the display to Fn206.
11	Turn the power to the SERVOPACK OFF and ON again after you finish executing Easy FFT.		

15

Parameter Lists

Provides information on the parameters.

15.1 Interpreting the Parameter Lists



◆ Pn000: Basic Function Selections 0

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 10B1h	–	0000h	All	After restart	Setup	–

Digit	Meaning		Reference
n.□□□X	Rotation Direction Selection Movement Direction Selection	Speed Pos Trq	–
0 Default	Use CCW as the forward direction. Use the direction in which the linear encoder counts up as the forward direction.		157
1	Use CW as the forward direction. (Reverse Rotation Mode) Use the direction in which the linear encoder counts down as the forward direction. (Reverse Movement Mode)		157
n.□□X□	Control Method Selection	Speed Pos Trq	–
0 Default	Speed control with analog references		151

No.	Item	Meaning
(1)	Applicable Motors	Indicates the types of servomotors to which the parameter applies. • All: The parameter is used for both rotary servomotors and linear servomotors. • Rotary: The parameter is used for only rotary servomotors. • Linear: The parameter is used for only linear servomotors. If this item differs by digit, it is added to the digit table. Rotary servomotor terms are used for parameters that are applicable to all servomotors. If you are using a linear servomotor, you need to interpret the terms accordingly. Refer to the following sections for details. ☞ *i.5.2 Differences in Terms for Rotary Servomotors and Linear Servomotors on page 28*
(2)	When Enabled	Indicates when a change to the parameter will be effective. “After restart” indicates parameters that will be effective after one of the following is executed. • The power is turned OFF and ON again. • A software reset is executed. If this item differs by digit, it is added to the digit table.
(3)	Classification	There are the following two classifications. • Setup • Tuning Refer to the following sections for details. ☞ *5.1.1 Parameter Classification on page 158*
(4)	Default Setting	The default setting.
(5)	Digit Name	If there are differences in the parameters for rotary servomotor and linear servomotor, information is provided for both. • Top row: For rotary servomotors • Bottom row: For linear servomotors
(6)	Control Mode	Speed: A parameter that can be used in speed control. Pos: A parameter that can be used in position control. Trq: A parameter that can be used in torque control. "Torque" is used even for linear servomotor parameters. Grayed-out icons (Speed, Speed, Speed) indicate parameters that cannot be used in the corresponding control method. For parameters for numeric settings, this item is added next to the parameter name. For parameters for selecting functions, this item is added to each digit in the table.

15.2 List of Parameters

The following table lists the parameters.

Note:

Do not change the following parameters from their default settings.

- Reserved parameters
- Parameters not given in this manual
- Parameters that are not valid for the servomotor that you are using, as given in the parameter table

◆ Pn000: Basic Function Selections 0

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 10B1h	–	0000h	All	After restart	Setup	–

Digit	Meaning		Reference
n.□□□X	Rotation Direction Selection Movement Direction Selection	Speed Pos Trq	–
0 Default	Use CCW as the forward direction. Use the direction in which the linear encoder counts up as the forward direction.		172
1	Use CW as the forward direction. (Reverse Rotation Mode) Use the direction in which the linear encoder counts down as the forward direction. (Reverse Movement Mode)		172
n.□□X□	Control Method Selection	Speed Pos Trq	–
0 Default	Speed control with analog references		166
1	Position control with pulse train references		166
2	Torque control with analog references		166
3	Internal set speed control with contact commands		166
4	Switching between internal set speed control with contact references and speed control with analog references		166
5	Switching between internal set speed control with contact references and position control with pulse train references		166
6	Switching between internal set speed control with contact references and torque control with analog references		166
7	Switching between position control with pulse train references and speed control with analog references		166
8	Switching between position control with pulse train references and torque control with analog references		166
9	Switching between torque control with analog references and speed control with analog references		166
A	Switching between speed control with analog references and speed control with zero clamping		166
B	Switching between position control with pulse train references and position control with reference pulse inhibition		166
n.□X□□	Reserved (Do not change.)		–
n.X□□□	Rotary/Linear Servomotor Startup Selection When Encoder Is Not Connected	Speed Pos Trq	–
0 Default	When an encoder is not connected, start as SERVOPACK for rotary servomotor.		169
1	When an encoder is not connected, start as SERVOPACK for linear servomotor.		169

◆ Pn001: Application Function Selections 1

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 1142h	–	0000h	All	After restart	Setup	–

Digit	Meaning	Reference
n.□□□X	Motor Stopping Method for Servo OFF and Group 1 Alarms Speed Pos Trq	–
0 Default	Stop the motor by applying the dynamic brake.	195
1	Stop the motor by the applying dynamic brake and then release the dynamic brake.	195
2	Coast the motor to a stop without the dynamic brake.	195
n.□□X□	Overtravel Stopping Method Speed Pos Trq	–
0 Default	Apply the dynamic brake or coast the motor to a stop (use the stopping method set in Pn001 = n.□□□X).	187
1	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then servo-lock the motor.	187
2	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then let the motor coast.	187
3	Decelerate the motor to a stop using the deceleration time set in Pn30A and then servo-lock the motor.	187
4	Decelerate the motor to a stop using the deceleration time set in Pn30A and then let the motor coast.	187
n.□X□□	Main Circuit Power Supply AC/DC Input Selection Speed Pos Trq	–
0 Default	Input AC power as the main circuit power supply using the L1, L2, and L3 terminals (do not use shared converter).	167
1	Input DC as the main circuit power supply using the B1/⊕, ⊖2 terminals or the B1 and ⊖2 terminals (use an external converter or the shared converter).	167
n.X□□□	Warning Code Output Selection Speed Pos Trq	–
0 Default	Output only alarm codes on the ALO1, ALO2, and ALO3 terminals.	226
1	Output both warning codes and alarm codes on the ALO1, ALO2, and ALO3 terminals. However, while an warning code is being output, the ALM (Servo Alarm Output) signal will remain ON (normal state).	226

◆ Pn002: Application Function Selections 2

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 4213h	–	0000h	–	After restart	Setup	–

Digit	Meaning	Applicable Motors	Reference
n.□□□X	Speed/Position Control Option (T-REF Input Allocation) Speed Pos Trq	–	–
0 Default	Do not use T-REF.	All	286, 488, 290
1	Use T-REF as an external torque limit input.	All	286, 488, 290
2	Use T-REF as a torque feedforward input.	All	286, 488, 290
3	Use T-REF as an external torque limit input when /P-CL or /N-CL is enabled.	All	286, 488, 290
n.□□X□	Torque Control Option (V-REF Input Allocation) Speed Pos Trq	–	–
0 Default	Use Pn407 or Pn480 as the speed limit. (Use internal speed limiting.)	All	262
1	Use V-REF (CN1-5 and CN1-6) as an external speed limit input signal and limit the speed with the V-REF input voltage and the setting of Pn300. (Use external speed limiting.)	All	262
n.□X□□	Encoder Usage Speed Pos Trq	–	–
0 Default	Use the encoder according to encoder specifications.	All	292
1	Use the encoder as an incremental encoder.	All	292
2	Use the encoder as a single-turn absolute encoder.	Rotary	292
n.X□□□	External Encoder Usage Speed Pos Trq	–	–
0 Default	Do not use an external encoder.	Rotary	535
1	The external encoder moves in the forward direction for CCW motor rotation.	Rotary	535
2	Reserved (Do not use.)	Rotary	535
3	The external encoder moves in the reverse direction for CCW motor rotation.	Rotary	535
4	Reserved (Do not use.)	Rotary	535

◆ Pn006: Application Function Selections 6

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 105Fh	–	0002h	All	Immediately	Setup	514

Digit	Meaning
n.□□XX	Analog Monitor 1 Signal Selection **Speed** **Pos** **Trq**
00	Motor speed (1 V/1000 min^{-1})
	Motor speed (1 V/1000 mm/s)
01	Speed reference (1 V/1000 min^{-1})
	Speed reference (1 V/1000 mm/s)
02 Default	Torque reference (1 V/100% rated torque)
	Force reference (1 V/100% rated force)
03	Position deviation (0.05 V/reference unit)
04	Position amplifier deviation (after electronic gear) (0.05 V/encoder pulse unit)
	Position amplifier deviation (after electronic gear) (0.05 V/linear encoder pulse unit)
05	Position reference speed (1 V/1000 min^{-1})
	Position reference speed (1 V/1000 mm/s)
06	Reserved (Do not use.)
07	Position deviation between motor and load (0.01 V/reference unit)
08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)
09	Speed feedforward (1 V/1000 min^{-1})
	Speed feedforward (1 V/1000 mm/s)
0A	Torque feedforward (1 V/100% rated torque)
	Force feedforward (1 V/100% rated force)
0B	Active gain (gain 1: 1 V, gain 2: 2 V) 2 V)
0C	Completion of position reference distribution (completed: 5 V, not completed: 0 V)
0D	External encoder speed (1 V/1000 min^{-1}: value at the motor shaft)
0E	Reserved (Do not use.)
0F	Reserved (Do not use.)
10	Main circuit DC voltage
11 to 5F	Reserved (Do not use.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn007: Application Function Selections 7

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 105Fh	–	0000h	All	Immediately	Setup	514

Digit	Meaning
n.□□XX	Analog Monitor 2 Signal Selection **Speed** **Pos** **Trq**
00 Default	Motor speed (1 V/1000 min^{-1})
	Motor speed (1 V/1000 mm/s)
01	Speed reference (1 V/1000 min^{-1})
	Speed reference (1 V/1000 mm/s)
02	Torque reference (1 V/100% rated torque)
	Force reference (1 V/100% rated force)
03	Position deviation (0.05 V/reference unit)
04	Position amplifier deviation (after electronic gear) (0.05 V/encoder pulse unit)
	Position amplifier deviation (after electronic gear) (0.05 V/linear encoder pulse unit)
05	Position reference speed (1 V/1000 min^{-1})
	Position reference speed (1 V/1000 mm/s)
06	Reserved (Do not use.)
07	Position deviation between motor and load (0.01 V/reference unit)
08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)
09	Speed feedforward (1 V/1000 min^{-1})
	Speed feedforward (1 V/1000 mm/s)
0A	Torque feedforward (1 V/100% rated torque)
	Force feedforward (1 V/100% rated force)
0B	Active gain (gain 1: 1 V, gain 2: 2 V) 2 V)
0C	Completion of position reference distribution (completed: 5 V, not completed: 0 V)
0D	External encoder speed (1 V/1000 min^{-1}: value at the motor shaft)
0E	Reserved (Do not use.)
0F	Reserved (Do not use.)
10	Main circuit DC voltage
11 to 5F	Reserved (Do not use.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn008: Application Function Selections 8

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 7121h	–	0000h	Rotary	After restart	Setup	–

Digit	Meaning	Reference
n.□□□X	Low Battery Voltage Alarm/Warning Selection Speed Pos Trq	–
0 Default	Output alarm (A.830) for low battery voltage.	578
1	Output warning (A.930) for low battery voltage.	578
n.□□X□	Function Selection for Undervoltage Speed Pos Trq	–
0 Default	Do not detect undervoltage.	230
1	Detect undervoltage warning and limit torque at host controller.	230
2	Detect undervoltage warning and limit torque with Pn424 and Pn425 (i.e., only in SERVOPACK).	230
n.□X□□	Warning Detection Selection Speed Pos Trq	–
0 Default	Detect warnings.	618
1	Do not detect warnings except for A.971.	618
n.X□□□	Reserved (Do not change.)	–

◆ Pn009: Application Function Selections 9

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0141h	–	0040h	All	After restart	Tuning	–

Digit	Meaning	Reference
n.□□□X	Reserved (Do not change.)	–
n.□□X□	Current Control Mode Selection Speed Pos Trq	–
0	Use current control mode 1.	475
1	• SERVOPACK Models SGDXS-R70A, -R90A, -1R6A, -2R8A, - 3R8A, -5R5A, -7R6A: Use current control mode 1. • SERVOPACK Models SGDXS-120A, -180A, -200A, -330A, -470A, -550A, -590A, -780A: Use current control mode 2. (For noise reduction when the motor is stopped)	475
2	Use current control mode 2. (For noise reduction when the motor is stopped)	475
3	Use current control mode 3. (For noise reduction when the motor is operating at high speed)	475
4 Default	Use current control mode 4. (For noise reduction when the motor is stopped and operating at high speed)	475
n.□X□□	Speed Detection Method Selection Speed Pos Trq	–
0 Default	Use speed detection 1.	475
1	Use speed detection 2.	475
n.X□□□	Reserved (Do not change.)	–

◆ Pn00A: Application Function Selections A

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 1044h	–	0001h	All	After restart	Setup	–

Digit	Meaning	Reference
n.□□□X	Motor Stopping Method for Group 2 Alarms Speed Pos Trq	–
0	Apply the dynamic brake or coast the motor to a stop (use the stopping method set in Pn001 = n.□□□X).	196
1 Default	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque. Use the setting of Pn001 = n.□□□X for the status after stopping.	196
2	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then let the motor coast.	196
3	Decelerate the motor to a stop using the deceleration time set in Pn30A. Use the setting of Pn001 = n.□□□X for the status after stopping.	196
4	Decelerate the motor to a stop using the deceleration time set in Pn30A and then let the motor coast.	196
n.□□X□	Stopping Method for Forced Stops Speed Pos Trq	–
0 Default	Apply the dynamic brake or coast the motor to a stop (use the stopping method set in Pn001 = n.□□□X).	322
1	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque. Use the setting of Pn001 = n.□□□X for the status after stopping.	322
2	Decelerate the motor to a stop using the torque set in Pn406 as the maximum torque and then let the motor coast.	322
3	Decelerate the motor to a stop using the deceleration time set in Pn30A. Use the setting of Pn001 = n.□□□X for the status after stopping.	322
4	Decelerate the motor to a stop using the deceleration time set in Pn30A and then let the motor coast.	322
n.□X□□	Reserved (Do not change.)	–
n.X□□□	Reserved (Do not change.)	–

◆ Pn00B: Application Function Selections B

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 1121h	–	0000h	All	After restart	Setup	–

Digit	Meaning	Reference
n.□□□X	Operator Parameter Display Selection Speed Pos Trq	–
0 Default	Display only setup parameters.	158
1	Display all parameters.	158
n.□□X□	Motor Stopping Method for Group 2 Alarms Speed Pos Trq	–
0 Default	Stop the motor by setting the speed reference to 0.	196
1	Apply the dynamic brake or coast the motor to a stop (use the stopping method set in Pn001 = n.□□□X).	196
2	Set the stopping method with Pn00A = n.□□□X.	196
n.□X□□	Power Input Selection for Three-phase SERVOPACK Speed Pos Trq	–
0 Default	Use a three-phase power supply input.	168
1	Use a three-phase power supply input as a single-phase power supply input.	168
n.X□□□	Reserved (Do not change.)	–

◆ Pn00C: Application Function Selections C

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0141h	–	0040h	–	After restart	Setup	351

Digit	Meaning	Applicable Motors
n.□□□X	**Function Selection for Test without a Motor** Speed Pos Trq	–
0 Default	Disable tests without a motor.	All
1	Enable tests without a motor.	All
n.□□X□	**Encoder Resolution for Tests without a Motor** Speed Pos Trq	–
0	Use 13 bits.	Rotary
1	Use 20 bits.	Rotary
2	Use 22 bits.	Rotary
3	Use 24 bits.	Rotary
4 Default	Use 26 bits.	Rotary
n.□X□□	**Encoder Type Selection for Tests without a Motor** Speed Pos Trq	–
0 Default	Use an incremental encoder.	All
1	Use an absolute encoder.	All
n.X□□□	**Reserved (Do not change.)**	–

◆ Pn00D: Application Function Selections D

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 2001h	–	0000h	All	After restart	Setup	189

Digit	Meaning
n.□□□X	**Reserved (Do not change.)**
n.□□X□	**Reserved (Do not change.)**
n.□X□□	**Reserved (Do not change.)**
n.X□□□	**Overtravel Warning Detection Selection** Speed Pos Trq
0 Default	Do not detect overtravel warnings.
1	Detect overtravel warnings.
2	Detect overtravel alarms.

◆ Pn00F: Application Function Selections F

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to 2021h	–	0000h	All	After restart	Setup	–

Digit	Meaning	Refer-ence
n.□□□X	SERVOPACK Preventative Maintenance Warning Selection Speed Pos Trq	–
0 Default	Do not detect SERVOPACK preventative maintenance warnings.	519
1	Detect SERVOPACK preventative maintenance warnings.	519
n.□□X□	Servomotor Preventative Maintenance Warning Selection Speed Pos Trq	–
0 Default	Do not detect servomotor preventative maintenance warnings.	520
1	Detect servomotor preventative maintenance warnings.	520
n.□X□□	Reserved (Do not change.)	–
n.X□□□	Reserved (Do not change.)	–

◆ Pn021: Reserved (Do not change.)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	–	–	0000h	All	–	–	–

◆ Pn022: Application Function Selections 22

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to 0011h	–	0000h	All	After restart	Setup	190

Digit	Meaning
n.□□□X	Overtravel Release Method Selection Speed Pos Trq
0 Default	Overtravel exists while the P-OT or N-OT signal is being input.
1	Overtravel exists while the P-OT or N-OT signal is input and the current position of the workpiece is separated from the P-OT signal or N-OT signal.
n.□□X□	Reserved (Do not change.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn02F: Application Function Selections 2F

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to 0002h	–	0000h	All	After restart	Setup	–

Digit	Meaning
n.□□□X	Selection of Capacitor Discharge Mode When Main Circuit Power OFF Speed Pos Trq
0 Default	• SGDXS-R70A to -200A : Do not perform rapid discharge. • SGDXS-330A to -780A : Perform rapid discharge.
1	Perform rapid discharge.
2	Reserved (Do not use.)
n.□□X□	Reserved (Do not change.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn040: Reserved (Do not change.)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	–	–	0000h	–	–	–	–

◆ Pn050: SigmaLINK II Response Data Selection 1

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	00000000h to FF7EFFFFh	–	00000000h	All	After restart	Setup	554

Digit	Meaning
n.□□□□XXXX	Parameter Number (0000h to FFFFh)
n.□□XX□□□□	Node Address (10h to 1Eh)
n.XX□□□□□□	Reserved.

◆ Pn052: SigmaLINK II Response Data Selection 2

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	00000000h to FF7EFFFFh	–	00000000h	All	After restart	Setup	554

Digit	Meaning
n.□□□□XXXX	Parameter Number (0000h to FFFFh)
n.□□XX□□□□	Node Address (10h to 1Eh)
n.XX□□□□□□	Reserved.

◆ Pn054: SigmaLINK II Response Data Selection 3

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
4	00000000h to FF7EFFFFh	–	00000000h	All	After restart	Setup	554

Digit	Meaning
n.□□□□XXXX	Parameter Number (0000h to FFFFh)
n.□□XX□□□□	Node Address (10h to 1Eh)
n.XX□□□□□□	Reserved.

◆ Pn056: SigmaLINK II Response Data Selection 4

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
4	00000000h to FF7EFFFFh	–	00000000h	All	After restart	Setup	554

Digit	Meaning
n.□□□□XXXX	Parameter Number (0000h to FFFFh)
n.□□XX□□□□	Node Address (10h to 1Eh)
n.XX□□□□□□	Reserved.

◆ Pn058: SigmaLINK II Response Data Selection 5

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
4	00000000h to FF7EFFFFh	–	00000000h	All	After restart	Setup	554

Digit	Meaning
n.□□□□XXXX	Parameter Number (0000h to FFFFh)
n.□□XX□□□□	Node Address (10h to 1Eh)
n.XX□□□□□□	Reserved.

◆ Pn05A: SigmaLINK II Response Data Selection 6

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
4	00000000h to FF7EFFFFh	–	00000000h	All	After restart	Setup	554

Digit	Meaning
n.□□□□XXXX	Parameter Number (0000h to FFFFh)
n.□□XX□□□□	Node Address (10h to 1Eh)
n.XX□□□□□□	Reserved.

◆ Pn05C: SigmaLINK II Response Data Selection 7

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	00000000h to FF7EFFFFh	–	00000000h	All	After restart	Setup	554

Digit	Meaning
n.□□□□XXXX	Parameter Number (0000h to FFFFh)
n.□□XX□□□□	Node Address (10h to 1Eh)
n.XX□□□□□□	Reserved.

◆ Pn05E: SigmaLINK II Response Data Selection 8

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	00000000h to FF7EFFFFh	–	00000000h	All	After restart	Setup	554

Digit	Meaning
n.□□□□XXXX	Parameter Number (0000h to FFFFh)
n.□□XX□□□□	Node Address (10h to 1Eh)
n.XX□□□□□□	Reserved.

◆ Pn080: Application Function Selections 80

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to 1111h	–	0000h	Linear	After restart	Setup	–

Digit	Meaning	Refer-ence
n.□□□X	Polarity Sensor Selection Speed Pos Trq	–
0 Default	Use polarity sensor.	181
1	Do not use polarity sensor.	181
n.□□X□	Motor Phase Sequence Selection Speed Pos Trq	–
0 Default	Set a phase-A lead as a phase sequence of U, V, and W.	179
1	Set a phase-B lead as a phase sequence of U, V, and W.	179
n.□X□□	Reserved (Do not change.)	–
n.X□□□	Calculation Method for Maximum Speed or Encoder Output Pulses Speed Pos Trq	–
0 Default	Calculate the encoder output pulse setting for a fixed maximum motor speed.	742
1	Calculate the maximum motor speed for a fixed encoder output pulse setting.	742

◆ Pn081: Application Function Selections 81

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to 1111h	–	0000h	All	After restart	Setup	265

Digit	Meaning
n.□□□X	Phase-C Pulse Output Selection Speed Pos Trq
0 Default	Output phase-C pulses only in the forward direction.
1	Output phase-C pulses in both the forward and reverse directions.
n.□□X□	Reserved (Do not change.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn0B1: SigmaLINK II Sequence Input Allocation 1

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to FFFFh	–	0000h	All	After restart	Setup	560

Digit	Meaning
n.□□XX	SigmaLINK II Response Data Selection Speed Pos Trq
00 Default	Disable (data is not set to the SigmaLINK II sequence input).
01	Allocate SigmaLINK II Response Data 1 to the SigmaLINK II sequence input.
02	Allocate SigmaLINK II Response Data 2 to the SigmaLINK II sequence input.
03	Allocate SigmaLINK II Response Data 3 to the SigmaLINK II sequence input.
04	Allocate SigmaLINK II Response Data 4 to the SigmaLINK II sequence input.
05	Allocate SigmaLINK II Response Data 5 to the SigmaLINK II sequence input.
06	Allocate SigmaLINK II Response Data 6 to the SigmaLINK II sequence input.
07	Allocate SigmaLINK II Response Data 7 to the SigmaLINK II sequence input.
08	Allocate SigmaLINK II Response Data 8 to the SigmaLINK II sequence input.
n.XX□□	SigmaLINK II Sequence Input Allocation Start Position Selection Speed Pos Trq
00 to 20	Specify the allocation start bit to the SigmaLINK II sequence input.

◆ Pn0B2: SigmaLINK II Sequence Input Allocation 2

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to FFFFh	–	0000h	All	After restart	Setup	560

Digit	Meaning
n.□□XX	SigmaLINK II Response Data Selection Speed Pos Trq
00 Default	Disable (data is not set to the SigmaLINK II sequence input).
01	Allocate SigmaLINK II Response Data 1 to the SigmaLINK II sequence input.
02	Allocate SigmaLINK II Response Data 2 to the SigmaLINK II sequence input.
03	Allocate SigmaLINK II Response Data 3 to the SigmaLINK II sequence input.
04	Allocate SigmaLINK II Response Data 4 to the SigmaLINK II sequence input.
05	Allocate SigmaLINK II Response Data 5 to the SigmaLINK II sequence input.
06	Allocate SigmaLINK II Response Data 6 to the SigmaLINK II sequence input.
07	Allocate SigmaLINK II Response Data 7 to the SigmaLINK II sequence input.
08	Allocate SigmaLINK II Response Data 8 to the SigmaLINK II sequence input.
n.XX□□	SigmaLINK II Sequence Input Allocation Start Position Selection Speed Pos Trq
00 to 20	Specify the allocation start bit to the SigmaLINK II sequence input.

◆ Pn0B5: SigmaLINK II Sequence Output Allocation 1

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to FFFFh	–	0000h	All	After restart	Setup	–

Digit	Meaning
n.□□XX	SigmaLINK II Command Data Selection Speed Pos Trq
00 Default	Disable (data is not set to the SigmaLINK II sequence output).
01	Allocate SigmaLINK II Command Data 1 to the SigmaLINK II sequence output.
02	Allocate SigmaLINK II Command Data 2 to the SigmaLINK II sequence output.
03	Allocate SigmaLINK II Command Data 3 to the SigmaLINK II sequence output.
04	Allocate SigmaLINK II Command Data 4 to the SigmaLINK II sequence output.
n.XX□□	SigmaLINK II Sequence Output Allocation Start Position Selection Speed Pos Trq
00 to 20	Specify the allocation start bit to the SigmaLINK II sequence output.

◆ Pn0D6: Reserved (Do not change.)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	–	–	0000h	All	–	–	–

◆ Pn0DA: SigmaLINK II Semi-closed Encoder Selection

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 011Eh	–	0000h	All	After restart	Setup	552

Digit	Meaning
n.□□XX	Node Address Speed Pos Trq
00 to 1E	Select an encoder with a node address between 00h and 1Eh.
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn0DB: SigmaLINK II Fully-closed Encoder Selection

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 011Eh	–	0101h	All	After restart	Setup	–

Digit	Meaning
n.□□XX	Node Address Speed Pos Trq
00 to 1E	Select an encoder with a node address between 00h and 1Eh.
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn0DC: SigmaLINK II Node Change Detection Condition Selection

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0003h	–	0000h	All	After restart	Setup	–

Digit	Meaning
n.□□□X	Connected Node Change Detection Condition Speed Pos Trq
0 Default	Set vendor ID and product ID as conditions.
1	Set vendor ID, product ID, and serial number as conditions.
2	Set vendor ID, product ID, and product version as conditions.
3	Set vendor ID, product ID, product version, and serial number as conditions.
n.□□X□	Reserved (Do not change.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn0DD: SigmaLINK II I/O Device Error Detection Selection

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to F4F2h	–	0130h	All	After restart	Setup	–

Digit	Meaning
n.□□□X	SigmaLINK II I/O Device Communications Check Mask Speed Pos Trq
0 Default	Set SigmaLINK II slave communications error as an alarm (A.Cd7).
1	Set SigmaLINK II slave communications error as a warning (A.932).
2	Do not detect the SigmaLINK II slave communications error.
n.□□X□	Reserved (Do not change.)
n.□X□□	SigmaLINK II I/O Device Status Check Mask Speed Pos Trq
0	A.Cd8 occurs when the alarm or warning signal is received from the SigmaLINK II slave.
1 Default	A.Cd8 occurs when the alarm signal is received from the SigmaLINK II slave and A.933 occurs when the warning signal is received.
2	A.933 occurs when the alarm or warning signal is received from the SigmaLINK II slave.
3	Do not detect the SigmaLINK II slave status error.
n.X□□□	Reserved (Do not change.)

◆ Pn100: Speed Loop Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 20000	0.1 Hz	400	All	Immediately	Tuning	478

◆ Pn101: Speed Loop Integral Time Constant

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	15 to 51200	0.01 ms	2000	All	Immediately	Tuning	478

◆ Pn102: Position Loop Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 20000	0.1/s	400	All	Immediately	Tuning	478

◆ Pn103: Moment of Inertia Ratio

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 65535	1%	100	All	Immediately	Tuning	478

◆ Pn104: Second Speed Loop Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 20000	0.1 Hz	400	All	Immediately	Tuning	468

◆ Pn105: Second Speed Loop Integral Time Constant

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	15 to 51200	0.01 ms	2000	All	Immediately	Tuning	468

◆ Pn106: Second Position Loop Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 20000	0.1/s	400	All	Immediately	Tuning	468

◆ Pn109: Feedforward

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 100	1%	0	All	Immediately	Tuning	488

◆ Pn10A: Feedforward Filter Time Constant

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 6400	0.01 ms	0	All	Immediately	Tuning	488

◆ Pn10B: Gain Application Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 5334h	–	0000h	All	–	Setup	–

Digit	Meaning	When Enabled	Reference
n.□□□X	Mode Switching Selection Speed Pos Trq	–	–
0 Default	Use the internal torque reference as the condition (level setting: Pn10C).	Immediately	490
1	Use the speed reference as the condition (level setting: Pn10D).	Immediately	490
	Use the speed reference as the condition (level setting: Pn181).		
2	Use the acceleration reference as the condition (level setting: Pn10E).	Immediately	490
	Use the acceleration reference as the condition (level setting: Pn182).		
3	Use the position deviation as the condition (level setting: Pn10F).	Immediately	490
4	Do not use mode switching.	Immediately	490
n.□□X□	Speed Loop Control Method Speed Pos Trq	–	–
0 Default	PI control	After restart	484
1	I-P control	After restart	484
2, 3	Reserved (Do not use.)	After restart	484
n.□X□□	Reserved (Do not change.)	–	–
n.X□□□	Reserved (Do not change.)	–	–

◆ Pn10C: Mode Switching Level for Torque Reference

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 800	1%	200	All	Immediately	Tuning	490

◆ Pn10D: Mode Switching Level for Speed Reference

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 min^{-1}	0	Rotary	Immediately	Tuning	490

◆ Pn10E: Mode Switching Level for Acceleration

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 30000	1 min^{-1}/s	0	Rotary	Immediately	Tuning	490

◆ Pn10F: Mode Switching Level for Position Deviation

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 reference unit	0	All	Immediately	Tuning	490

◆ Pn11F: Position Integral Time Constant

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 50000	0.1 ms	0	All	Immediately	Tuning	493

◆ Pn121: Friction Compensation Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 1000	1%	100	All	Immediately	Tuning	468, 404

◆ Pn122: Second Friction Compensation Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 1000	1%	100	All	Immediately	Tuning	468, 404

◆ Pn123: Friction Compensation Coefficient

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 100	1%	0	All	Immediately	Tuning	404

◆ Pn124: Friction Compensation Frequency Correction

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	-10000 to 10000	0.1 Hz	0	All	Immediately	Tuning	404

◆ Pn125: Friction Compensation Gain Correction

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	1 to 1000	1%	100	All	Immediately	Tuning	404

◆ Pn131: Gain Switching Time 1

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 65535	1 ms	0	All	Immediately	Tuning	468

◆ Pn132: Gain Switching Time 2

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 65535	1 ms	0	All	Immediately	Tuning	468

◆ Pn135: Gain Switching Waiting Time 1

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 65535	1 ms	0	All	Immediately	Tuning	468

◆ Pn136: Gain Switching Waiting Time 2

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 65535	1 ms	0	All	Immediately	Tuning	468

◆ Pn139: Automatic Gain Switching Selections 1

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0052h	–	0000h	All	Immediately	Tuning	468

Digit	Meaning
n.□□□X	Gain Switching Selection Speed Pos Trq
0 Default	Manual Gain Switching The gain is switched manually with the /G-SEL (Gain Selection Input) signal.
1	Reserved (Do not use.)
2	Use automatic gain switching pattern 1. The gain settings 1 switch automatically to 2 when switching condition A is satisfied. The gain settings 2 switch automatically to 1 when switching condition A is not satisfied.
n.□□X□	Gain Switching Condition A Speed Pos Trq
0 Default	/COIN (Positioning Completion Output) signal turns ON.
1	/COIN (Positioning Completion Output) signal turns OFF.
2	/NEAR (Near Output) signal turns ON.
3	/NEAR (Near Output) signal turns OFF.
4	Position reference filter output is 0 and reference pulse input is OFF.
5	Position reference pulse input is ON.
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn13D: Current Gain Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	100 to 2000	1%	2000	All	Immediately	Tuning	475

◆ Pn140: Model Following Control-Related Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 1121h	–	0100h	All	Immediately	Tuning	–

Digit	Meaning	Reference
n.□□□X	Model Following Control Selection Speed Pos Trq	–
0 Default	Do not use model following control.	485
1	Use model following control.	485
n.□□X□	Vibration Suppression Selection Speed Pos Trq	–
0 Default	Do not perform vibration suppression.	485
1	Perform vibration suppression for a specific frequency.	485
2	Perform vibration suppression for two specific frequencies.	485
n.□X□□	Vibration Suppression Adjustment Selection Speed Pos Trq	–
0	Do not adjust vibration suppression automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	404
1 Default	Adjust vibration suppression automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	404
n.X□□□	Speed Feedforward (VFF)/Torque Feedforward (TFF) Selection Speed Pos Trq	–
0 Default	Do not use model following control and speed/torque feedforward together.	404, 441
1	Use model following control and speed/torque feedforward together.	404, 441

◆ Pn141: Model Following Control Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 20000	0.1/s	500	All	Immediately	Tuning	485

◆ Pn142: Model Following Control Gain Correction

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	500 to 2000	0.1%	1000	All	Immediately	Tuning	468

◆ Pn143: Model Following Control Bias in the Forward Direction

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	0.1%	1000	All	Immediately	Tuning	485

◆ Pn144: Model Following Control Bias in the Reverse Direction

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	0.1%	1000	All	Immediately	Tuning	485

◆ Pn145: Vibration Suppression 1 Frequency A

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 2500	0.1 Hz	500	All	Immediately	Tuning	442

◆ Pn146: Vibration Suppression 1 Frequency B

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 2500	0.1 Hz	700	All	Immediately	Tuning	442

◆ Pn147: Model Following Control Speed Feedforward Compensation

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	0.1%	1000	All	Immediately	Tuning	485

◆ Pn148: Second Model Following Control Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 20000	0.1/s	500	All	Immediately	Tuning	468

◆ Pn149: Second Model Following Control Gain Correction

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	500 to 2000	0.1%	1000	All	Immediately	Tuning	468

◆ Pn14A: Vibration Suppression 2 Frequency

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 2000	0.1 Hz	800	All	Immediately	Tuning	442

◆ Pn14B: Vibration Suppression 2 Correction

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 1000	1%	100	All	Immediately	Tuning	442

◆ Pn14F: Control-Related Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0031h	–	0030h	All	After restart	Tuning	–

Digit	Meaning	Reference
n.□□□X	Model Following Control Type Selection Speed Pos Trq	–
0 Default	Use overshoot control type for model following control.	488
1	Use response emphasis type for model following control.	488
n.□□X□	Tuning-less Type Selection Speed Pos Trq	–
0	Use tuning-less type 1.	369
1	Use tuning-less type 2.	369
2	Use tuning-less type 3.	369
3 Default	Use tuning-less type 4.	369
n.□X□□	Reserved (Do not change.)	–
n.X□□□	Reserved (Do not change.)	–

◆ Pn160: Anti-Resonance Control-Related Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0011h	–	0010h	All	Immediately	Tuning	–

Digit	Meaning	Reference
n.□□□X	Anti-Resonance Control Selection Speed Pos Trq	–
0 Default	Do not use anti-resonance control.	431
1	Use anti-resonance control.	431
n.□□X□	Anti-Resonance Control Adjustment Selection Speed Pos Trq	–
0	Do not adjust anti-resonance control automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	403
1 Default	Adjust anti-resonance control automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	403
n.□X□□	Reserved (Do not change.)	–
n.X□□□	Reserved (Do not change.)	–

◆ Pn161: Anti-Resonance Frequency

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 20000	0.1 Hz	1000	All	Immediately	Tuning	431

◆ Pn162: Anti-Resonance Gain Correction

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	1 to 1000	1%	100	All	Immediately	Tuning	431

◆ Pn163: Anti-Resonance Damping Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 300	1%	0	All	Immediately	Tuning	431

◆ Pn164: Anti-Resonance Filter Time Constant 1 Correction

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	-1000 to 1000	0.01 ms	0	All	Immediately	Tuning	431

◆ Pn165: Anti-Resonance Filter Time Constant 2 Correction

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	-1000 to 1000	0.01 ms	0	All	Immediately	Tuning	431

◆ Pn166: Anti-Resonance Damping Gain 2

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 1000	1%	0	All	Immediately	Tuning	436

◆ Pn170: Tuning-less Function-Related Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 2711h	–	1401h	All	–	Setup	368

Digit	Meaning	When Enabled
n.□□□X	Tuning-less Selection Speed Pos Trq	–
0	Disable tuning-less function.	After restart
1 Default	Enable tuning-less function.	After restart
n.□□X□	Speed Control Method Speed Pos Trq	–
0 Default	Use for speed control.	After restart
1	Use for speed control and use host controller for position control.	After restart
n.□X□□	Tuning-less Level Speed Pos Trq	–
0	Set the tuning-less level to 0.	Immediately
1	Set the tuning-less level to 1.	Immediately
2	Set the tuning-less level to 2.	Immediately
3	Set the tuning-less level to 3.	Immediately
4 Default	Set the tuning-less level to 4.	Immediately
5	Set the tuning-less level to 5.	Immediately
6	Set the tuning-less level to 6.	Immediately
7	Set the tuning-less level to 7.	Immediately
n.X□□□	Tuning-less Load Level Speed Pos Trq	–
0	Set the tuning-less load level to 0.	Immediately
1 Default	Set the tuning-less load level to 1.	Immediately
2	Set the tuning-less load level to 2.	Immediately

◆ Pn173: Load Fluctuation Compensation Control-Related Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0001h	–	0000h	All	Immediately	Setup	465

Digit	Meaning
n.□□□X	Load Fluctuation Compensation Control Selection Speed Pos Trq
0 Default	Do not use load fluctuation compensation control.
1	Use load fluctuation compensation control.
n.□□X□	Reserved (Do not change.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn174: Load Fluctuation Compensation Control Response Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 20000	0.1	400	All	Immediately	Tuning	465

◆ Pn181: Mode Switching Level for Speed Reference

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 mm/s	0	Linear	Immediately	Tuning	490

◆ Pn182: Mode Switching Level for Acceleration

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 30000	1 mm/s^2	0	Linear	Immediately	Tuning	490

◆ Pn200: Position Control Reference Form Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 2236h	–	0000h	All	After restart	Setup	–

Digit	Meaning	Reference
n.□□□X	Reference Pulse Form Speed Pos Trq	–
0 Default	Sign and pulse train, positive logic.	247
1	CW and CCW pulse trains, positive logic	247
2	Two-phase pulse trains with 90° phase differential (phase A and phase B) ×1, positive logic	247
3	Two-phase pulse trains with 90° phase differential (phase A and phase B) ×2, positive logic	247
4	Two-phase pulse trains with 90° phase differential (phase A and phase B) ×4, positive logic	247
5	Sign and pulse train, negative logic.	247
6	CW and CCW pulse trains, negative logic	247
n.□□X□	Clear Signal Form Speed Pos Trq	–
0 Default	Clear position deviation when the signal is at high level.	249
1	Clear position deviation on the rising edge of the signal.	249
2	Clear position deviation when the signal is at low level.	249
3	Clear position deviation on the falling edge of the signal.	249
n.□X□□	Clear Operation Speed Pos Trq	–
0 Default	Clear position deviation at a base block (at servo OFF or when alarm occurs).	249
1	Do not clear position error (cleared only with CLR (Clear Position Deviation) signal).	249
2	Clear position deviation when an alarm occurs.	249
n.X□□□	Filter Selection Speed Pos Trq	–
0 Default	Use the reference input filter 1 for a line-driver signal. (1 Mpps max.)	247
1	Use the reference input filter for an open-collector signal. (200 kpps max.)	247
2	Use the reference input filter 2 for a line-driver signal. (1 to 4 Mpps)	247

◆ Pn205: Multiturn Limit

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 65535	1 rev	65535	Rotary	After restart	Setup	300

◆ Pn207: Position Control Function Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to 2210h	–	0000h	All	After restart	Setup	–

Digit	Meaning	Refer-ence
n.□□□X	Reserved (Do not change.)	–
n.□□X□	Position Control Option Speed Pos Trq	–
0 Default	Do not use V-REF.	490
1	Use V-REF as a speed feedforward input.	490
n.□X□□	Reserved (Do not change.)	–
n.X□□□	/COIN (Positioning Completion Output) Signal Output Timing Speed Pos Trq	–
0 Default	Output when the absolute value of the position deviation is the same or less than the setting of Pn522 (Positioning Completed Width).	253
1	Output when the absolute value of the position error is the same or less than the setting of Pn522 (Positioning Completed Width) and the reference after the position reference filter is 0.	253
2	Output when the absolute value of the position error is the same or less than the setting of Pn522 (Positioning Completed Width) and the reference input is 0.	253

◆ Pn20A: Number of External Encoder Scale Pitches

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	4 to 1048576	1 scale pitch/ revolution	32768	Rotary	After restart	Setup	535

◆ Pn20E: Electronic Gear Ratio (Numerator)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	1 to 1073741824	–	256	All	After restart	Setup	200

◆ Pn210: Electronic Gear Ratio (Denominator)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	1 to 1073741824	–	1	All	After restart	Setup	200

◆ Pn212: Number of Encoder Output Pulses

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	16 to 1073741824	1 P/Rev	2048	Rotary	After restart	Setup	267

◆ Pn216: Position Reference Acceleration/Deceleration Time Constant

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 65535	0.1 ms	0	All	Immediately after the motor stops	Setup	251

◆ Pn217: Average Position Reference Movement Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	0.1 ms	0	All	Immediately after the motor stops	Setup	251

◆ Pn218: Reference Pulse Input Multiplier

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	1 to 100	× 1	1	All	Immediately	Setup	250

◆ Pn21D: Encoder Resolution Setting

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 00A1h	–	0080h	Rotary	After restart	Setup	214

Digit	Meaning
n.□□□X	Encoder Resolution Compatibility Selection Speed Pos Trq
0 Default	Disable encoder resolution compatibility.
1	Enable encoder resolution compatibility.
n.□□X□	Encoder Resolution Compatibility: Resolution Selection Speed Pos Trq
4	Operate as 20-bit encoder.
6	Operate as 22-bit encoder.
8 Default	Operate as 24-bit encoder.
A	Operate as 26-bit encoder.
Other values	Reserved (Do not use.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn22A: Fully-closed Control Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 1003h	–	0000h	Rotary	After restart	Setup	539

Digit	Meaning
n.□□□X	Reserved (Do not change.)
n.□□X□	Reserved (Do not change.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Fully-closed Control Speed Feedback Selection Speed Pos Trq
0 Default	Use motor encoder speed.
1	Use external encoder speed.

◆ Pn281: Encoder Output Resolution

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	1 to 4096	1 edge/pitch	20	All	After restart	Setup	268

◆ Pn282: Linear Encoder Scale Pitch

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
4	0 to 6553600	0.01 μm	0	Linear	After restart	Setup	174

◆ Pn300: Speed Reference Input Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	150 to 3000	0.01 V/ Rated speed	600	All	Immediately	Setup	235, 263, 490

◆ Pn301: Internal Set Speed 1

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	Rotary: 1 min^{-1} Direct Drive: 0.1 min^{-1}	100	Rotary	Immediately	Setup	270

◆ Pn302: Internal Set Speed 2

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	Rotary: 1 min^{-1} Direct Drive: 0.1 min^{-1}	200	Rotary	Immediately	Setup	270

◆ Pn303: Internal Set Speed 3

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	Rotary: 1 min^{-1} Direct Drive: 0.1 min^{-1}	300	Rotary	Immediately	Setup	270

◆ Pn304: Jogging Speed

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	Rotary: 1 min^{-1} Direct Drive: 0.1 min^{-1}	500	Rotary	Immediately	Setup	333

◆ Pn305: Soft Start Acceleration Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 12000	1 ms	0	All	Immediately	Setup	239

◆ Pn306: Soft Start Deceleration Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 12000	1 ms	0	All	Immediately	Setup	239

◆ Pn307: Speed Reference Filter Time Constant

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 65535	0.01 ms	40	All	Immediately	Setup	240

◆ Pn308: Speed Feedback Filter Time Constant

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 65535	0.01 ms	0	All	Immediately	Setup	476

◆ Pn30A: Deceleration Time for Servo OFF and Forced Stops

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 12000	1 ms	0	All	Immediately	Setup	188

◆ Pn30C: Speed Feedforward Average Movement Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 5100	0.1 ms	0	All	Immediately	Setup	490

◆ Pn310: Vibration Detection Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to 0002h	–	0000h	All	Immediately	Setup	314

Digit	Meaning
n.□□□X	Vibration Detection Selection Speed Pos Trq
0 Default	Do not detect vibration.
1	Output a warning (A.911) if vibration is detected.
2	Output an alarm (A.520) if vibration is detected.
n.□□X□	Reserved (Do not change.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn311: Vibration Detection Sensitivity

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	50 to 500	1%	100	All	Immediately	Tuning	314

◆ Pn312: Vibration Detection Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 5000	1 min^{-1}	50	Rotary	Immediately	Tuning	314

◆ Pn316: Maximum Motor Speed

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 65535	1 min^{-1}	10000	Rotary	After restart	Setup	232

◆ Pn324: Moment of Inertia Calculation Starting Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 20000	1%	300	All	Immediately	Setup	402

◆ Pn380: Internal Set Speed 1

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 mm/s	10	Linear	Immediately	Setup	270

◆ Pn381: Internal Set Speed 2

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 mm/s	20	Linear	Immediately	Setup	270

◆ Pn382: Internal Set Speed 3

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 mm/s	30	Linear	Immediately	Setup	270

◆ Pn383: Jogging Speed

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 mm/s	50	Linear	Immediately	Setup	333

◆ Pn384: Vibration Detection Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 5000	1 mm/s	10	Linear	Immediately	Tuning	314

◆ Pn385: Maximum Motor Speed

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	1 to 100	100 mm/s	50	Linear	After restart	Setup	232

◆ Pn400: Torque Reference Input Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 100	0.1 V/ rated torque	30	All	Immediately	Setup	257, 489

◆ Pn401: First Stage First Torque Reference Filter Time Constant

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 65535	0.01 ms	100	All	Immediately	Tuning	480

◆ Pn402: Forward Torque Limit

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 800	1%	800	Rotary	Immediately	Setup	281

Note:

The setting is a percentage of the motor rated torque.

◆ Pn403: Reverse Torque Limit

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 800	1%	800	Rotary	Immediately	Setup	281

Note:

The setting is a percentage of the motor rated torque.

◆ Pn404: Forward External Torque Limit

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 800	1%	100	All	Immediately	Setup	287

Note:

The setting is a percentage of the motor rated torque.

◆ Pn405: Reverse External Torque Limit

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 800	1%	100	All	Immediately	Setup	287

Note:

The setting is a percentage of the motor rated torque.

◆ Pn406: Emergency Stop Torque

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 800	1%	800	All	Immediately	Setup	187

Note:

The setting is a percentage of the motor rated torque.

◆ Pn407: Speed Limit during Torque Control

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 10000	1 min^{-1}	10000	Rotary	Immediately	Setup	262

◆ Pn408: Torque-Related Function Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to 1111h	–	0000h	All	–	Setup	–

Digit	Meaning	When Enabled	Refer-ence
n.□□□X	Notch Filter Selection 1 Speed Pos Trq	–	–
0 Default	Disable first stage notch filter.	Immediately	480
1	Enable first stage notch filter.	Immediately	480
n.□□X□	Speed Limit Selection Speed Pos Trq	–	–
0 Default	Use the smaller of the maximum motor speed and the setting of Pn407 as the speed limit.	After restart	262
	Use the smaller of the maximum motor speed and the setting of Pn480 as the speed limit.		
1	Use the smaller of the overspeed alarm detection speed and the setting of Pn407 as the speed limit.	After restart	262
	Use the smaller of the overspeed alarm detection speed and the setting of Pn480 as the speed limit.		
n.□X□□	Notch Filter Selection 2 Speed Pos Trq	–	–
0 Default	Disable second stage notch filter.	Immediately	480
1	Enable second stage notch filter.	Immediately	480
n.X□□□	Friction Compensation Function Selection Speed Pos Trq	–	–
0 Default	Disable friction compensation.	Immediately	472
1	Enable friction compensation.	Immediately	472

◆ Pn409: First Stage Notch Filter Frequency

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	10 to 5000	1 Hz	5000	All	Immediately	Tuning	480

◆ Pn40A: First Stage Notch Filter Q Value

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	50 to 1000	0.01	70	All	Immediately	Tuning	480

◆ Pn40B: First Stage Notch Filter Depth

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 1000	0.001	0	All	Immediately	Tuning	480

◆ Pn40C: Second Stage Notch Filter Frequency

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	10 to 5000	1 Hz	5000	All	Immediately	Tuning	480

◆ Pn40D: Second Stage Notch Filter Q Value

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	50 to 1000	0.01	70	All	Immediately	Tuning	480

◆ Pn40E: Second Stage Notch Filter Depth

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 1000	0.001	0	All	Immediately	Tuning	480

◆ Pn40F: Second Stage Second Torque Reference Filter Frequency

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	100 to 5000	1 Hz	5000	All	Immediately	Tuning	480

◆ Pn410: Second Stage Second Torque Reference Filter Q Value

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	50 to 100	0.01	50	All	Immediately	Tuning	480

◆ Pn412: First Stage Second Torque Reference Filter Time Constant

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 65535	0.01 ms	100	All	Immediately	Tuning	468

◆ Pn415: T-REF Filter Time Constant

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 65535	0.01 ms	0	All	Immediately	Setup	261

◆ Pn416: Torque-Related Function Selections 2

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 1111h	–	0000h	All	Immediately	Setup	481

Digit	Meaning
n.□□□X	Notch Filter Selection 3 Speed Pos Trq
0 Default	Disable third stage notch filter.
1	Enable third stage notch filter.
n.□□X□	Notch Filter Selection 4 Speed Pos Trq
0 Default	Disable fourth stage notch filter.
1	Enable fourth stage notch filter.
n.□X□□	Notch Filter Selection 5 Speed Pos Trq
0 Default	Disable fifth stage notch filter.
1	Enable fifth stage notch filter.
n.X□□□	Reserved (Do not change.)

◆ Pn417: Third Stage Notch Filter Frequency

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 5000	1 Hz	5000	All	Immediately	Tuning	481

◆ Pn418: Third Stage Notch Filter Q Value

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	50 to 1000	0.01	70	All	Immediately	Tuning	481

◆ Pn419: Third Stage Notch Filter Depth

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 1000	0.001	0	All	Immediately	Tuning	481

◆ Pn41A: Fourth Stage Notch Filter Frequency

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	10 to 5000	1 Hz	5000	All	Immediately	Tuning	481

◆ Pn41B: Fourth Stage Notch Filter Q Value

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	50 to 1000	0.01	70	All	Immediately	Tuning	481

◆ Pn41C: Fourth Stage Notch Filter Depth

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 1000	0.001	0	All	Immediately	Tuning	481

◆ Pn41D: Fifth Stage Notch Filter Frequency

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	10 to 5000	1 Hz	5000	All	Immediately	Tuning	481

◆ Pn41E: Fifth Stage Notch Filter Q Value

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	50 to 1000	0.01	70	All	Immediately	Tuning	481

◆ Pn41F: Fifth Stage Notch Filter Depth

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 1000	0.001	0	All	Immediately	Tuning	481

◆ Pn423: Speed Ripple Compensation Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000H to 1112h	–	0002h	–	–	Setup	462

Digit	Meaning	Applicable Motors	When Enabled
n.□□□X	Speed Ripple Compensation Function Selection Speed Pos Trq	–	–
0	Do not execute speed ripple compensation.	Rotary	Immediately
1	Execute speed ripple compensation using the value adjusted by the user.	Rotary	Immediately
2 Default	Execute speed ripple compensation using the default adjustment value.	Rotary	Immediately
n.□□X□	Speed Ripple Compensation Information Disagreement Warning Detection Selection Speed Pos Trq	–	–
0 Default	Detect A.942 alarms.	Rotary	After restart
1	Do not detect A.942 alarms.	Rotary	After restart
n.□X□□	Speed Ripple Compensation Enable Condition Selection Speed Pos Trq	–	–
0 Default	Speed Reference	Rotary	After restart
1	Motor Speed	Rotary	After restart
n.X□□□	Speed Ripple Compensation Function Operation Mode Selection Speed Pos Trq	–	–
0 Default	Execute speed ripple compensation in normal mode.	All	After restart
1	Execute speed ripple compensation in press operation mode.	All	After restart
2	Reserved (Do not use.)	All	After restart
3	Reserved (Do not use.)	All	After restart

◆ Pn424: Torque Limit at Main Circuit Voltage Drop

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 100	1%	50	All	Immediately	Setup	231

Note:

The setting is a percentage of the motor rated torque.

◆ Pn425: Release Time for Torque Limit at Main Circuit Voltage Drop

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 1000	1 ms	100	All	Immediately	Setup	231

◆ Pn426: Torque Feedforward Average Movement Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 5100	0.1 ms	0	All	Immediately	Setup	489

◆ Pn427: Speed Ripple Compensation Enable Speed

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 min^{-1}	0	Rotary	Immediately	Tuning	462

◆ Pn428: Output Torque Compensation Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0001h	–	0001h	All	After restart	Setup	474

Digit	Meaning
n.□□□X	Output Torque Compensation Function Selection Speed Pos Trq
0	Disable output torque compensation.
1 Default	Enable output torque compensation.
n.□□X□	Reserved (Do not change.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn456: Sweep Torque Reference Amplitude

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	1 to 800	1%	15	All	Immediately	Tuning	499

◆ Pn460: Notch Filter Adjustment Selections 1

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0101h	–	0101h	All	Immediately	Tuning	371, 403

Digit	Meaning
n.□□□X	Notch Filter Adjustment Selection 1 Speed Pos Trq
0	Do not adjust the first stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.
1 Default	Adjust the first stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.
n.□□X□	Reserved (Do not change.)
n.□X□□	Notch Filter Adjustment Selection 2 Speed Pos Trq
0	Do not adjust the second stage notch filter automatically when the tuning-less function is enabled or during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.
1 Default	Adjust the second stage notch filter automatically when the tuning-less function is enabled or during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.
n.X□□□	Reserved (Do not change.)

◆ Pn475: Gravity Compensation-Related Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to 0001h	–	0000h	All	After restart	Setup	473

Digit	Meaning
n.□□□X	Gravity Compensation Selection Speed Pos Trq
0 Default	Disable gravity compensation.
1	Enable gravity compensation.
n.□□X□	Reserved (Do not change.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn476: Gravity Compensation Torque

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	-1000 to 1000	0.1%	0	All	Immediately	Tuning	473

◆ Pn480: Speed Limit during Force Control

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 10000	1 mm/s	10000	Linear	Immediately	Setup	262

◆ Pn481: Polarity Detection Speed Loop Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	10 to 20000	0.1 Hz	400	Linear	Immediately	Tuning	–

◆ Pn482: Polarity Detection Speed Loop Integral Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	15 to 51200	0.01 ms	3000	Linear	Immediately	Tuning	–

◆ Pn483: Forward Force Limit

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 800	1%	30	Linear	Immediately	Setup	281

Note:

The setting is a percentage of the motor rated torque.

◆ Pn484: Reverse Force Limit

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 800	1%	30	Linear	Immediately	Setup	281

Note:

The setting is a percentage of the motor rated torque.

◆ Pn485: Polarity Detection Reference Speed

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 100	1 mm/s	20	Linear	Immediately	Tuning	–

◆ Pn486: Polarity Detection Reference Acceleration/Deceleration Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 100	1 ms	25	Linear	Immediately	Tuning	–

◆ Pn487: Polarity Detection Constant Speed Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 300	1 ms	0	Linear	Immediately	Tuning	–

◆ Pn488: Polarity Detection Reference Waiting Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	50 to 500	1 ms	100	Linear	Immediately	Tuning	–

◆ Pn48E: Polarity Detection Range

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	1 to 65535	1 mm	10	Linear	Immediately	Tuning	–

◆ Pn490: Polarity Detection Load Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 20000	1%	100	Linear	Immediately	Tuning	–

◆ Pn495: Polarity Detection Confirmation Force Reference

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 200	1%	100	Linear	Immediately	Tuning	–

◆ Pn498: Polarity Detection Allowable Error Range

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 30	1 deg	10	Linear	Immediately	Tuning	–

◆ Pn49F: Speed Ripple Compensation Enable Speed (Linear)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 mm/s	0	Linear	Immediately	Tuning	462

◆ Pn501: Zero Clamping Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 min^{-1}	10	Rotary	Immediately	Setup	240

◆ Pn502: Rotation Detection Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	1 to 10000	1 min^{-1}	20	Rotary	Immediately	Setup	227

◆ Pn503: Speed Coincidence Detection Signal Output Width

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 100	1 min^{-1}	10	Rotary	Immediately	Setup	242

◆ Pn506: Brake Reference-Servo OFF Delay Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 50	10 ms	0	All	Immediately	Setup	191

◆ Pn507: Brake Reference Output Speed Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 10000	1 min^{-1}	100	Rotary	Immediately	Setup	191

◆ Pn508: Servo OFF-Brake Command Waiting Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	10 to 100	10 ms	50	All	Immediately	Setup	191

◆ Pn509: Momentary Power Interruption Hold Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	20 to 50000	1 ms	20	All	Immediately	Setup	229

◆ Pn50A: Input Signal Selections 1

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to FFF2h	–	2100h	All	After restart	Setup	–

Digit	Meaning	Reference
n.□□□X	Input Signal Allocation Mode Speed Pos Trq	–
0 Default	Use the sequence input signal terminals with the default allocations.	220
1	Use Pn50A to Pn517 (Sigma-7S-compatible I/O signal allocation mode).	220
2	Use Pn50A to Pn517, Pn590, Pn591, Pn598, Pn599 (SigmaLINK II input signal allocation mode).	220
n.□□X□	/S-ON (Servo ON Input) Signal Allocation Speed Pos Trq	–
0 Default	Active when CN1-40 input signal is ON (closed).	170
1	Active when CN1-41 input signal is ON (closed).	170
2	Active when CN1-42 input signal is ON (closed).	170
3	Active when CN1-43 input signal is ON (closed).	170
4	Active when CN1-44 input signal is ON (closed).	170
5	Active when CN1-45 input signal is ON (closed).	170
6	Active when CN1-46 input signal is ON (closed).	170
7	The signal is always active.	170
8	The signal is always inactive.	170
9	Active when CN1-40 input signal is OFF (open).	170
A	Active when CN1-41 input signal is OFF (open).	170
B	Active when CN1-42 input signal is OFF (open).	170
C	Active when CN1-43 input signal is OFF (open).	170
D	Active when CN1-44 input signal is OFF (open).	170
E	Active when CN1-45 input signal is OFF (open).	170
F	Active when CN1-46 input signal is OFF (open).	170
n.□X□□	/P-CON (Proportional Control Input) Signal Allocation Speed Pos Trq	–
0 to F	The allocations are the same as the /S-ON (Servo ON Input) signal allocations.	476
n.X□□□	P-OT (Forward Drive Prohibit Input) Signal Allocation Speed Pos Trq	–
0	Enable forward drive when CN1-40 input signal is ON (closed).	187
1	Enable forward drive when CN1-41 input signal is ON (closed).	187
2 Default	Enable forward drive when CN1-42 input signal is ON (closed).	187
3	Enable forward drive when CN1-43 input signal is ON (closed).	187
4	Enable forward drive when CN1-44 input signal is ON (closed).	187
5	Enable forward drive when CN1-45 input signal is ON (closed).	187
6	Enable forward drive when CN1-46 input signal is ON (closed).	187
7	Set the signal to always prohibit forward drive.	187
8	Set the signal to always enable forward drive.	187
9	Enable forward drive when CN1-40 input signal is OFF (open).	187
A	Enable forward drive when CN1-41 input signal is OFF (open).	187
B	Enable forward drive when CN1-42 input signal is OFF (open).	187

Digit	Meaning	Reference
C	Enable forward drive when CN1-43 input signal is OFF (open).	187
D	Enable forward drive when CN1-44 input signal is OFF (open).	187
E	Enable forward drive when CN1-45 input signal is OFF (open).	187
F	Enable forward drive when CN1-46 input signal is OFF (open).	187

◆ Pn50B: Input Signal Selections 2

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to FFFFh	–	6543h	All	After restart	Setup	–

Digit	Meaning	Refer-ence
n.□□□X	N-OT (Reverse Drive Prohibit Input) Signal Allocation Speed Pos Trq	–
0	Enable reverse drive when CN1-40 input signal is ON (closed).	187
1	Enable reverse drive when CN1-41 input signal is ON (closed).	187
2	Enable reverse drive when CN1-42 input signal is ON (closed).	187
3 Default	Enable reverse drive when CN1-43 input signal is ON (closed).	187
4	Enable reverse drive when CN1-44 input signal is ON (closed).	187
5	Enable reverse drive when CN1-45 input signal is ON (closed).	187
6	Enable reverse drive when CN1-46 input signal is ON (closed).	187
7	Set the signal to always prohibit reverse drive.	187
8	Set the signal to always enable reverse drive.	187
9	Enable reverse drive when CN1-40 input signal is OFF (open).	187
A	Enable reverse drive when CN1-41 input signal is OFF (open).	187
B	Enable reverse drive when CN1-42 input signal is OFF (open).	187
C	Enable reverse drive when CN1-43 input signal is OFF (open).	187
D	Enable reverse drive when CN1-44 input signal is OFF (open).	187
E	Enable reverse drive when CN1-45 input signal is OFF (open).	187
F	Enable reverse drive when CN1-46 input signal is OFF (open).	187
n.□□X□	/ALM-RST (Alarm Reset Input) Signal Allocation Speed Pos Trq	–
0	Active on signal edge when CN1-40 input signal changes from OFF (open) to ON (closed).	610
1	Active on signal edge when CN1-41 input signal changes from OFF (open) to ON (closed).	610
2	Active on signal edge when CN1-42 input signal changes from OFF (open) to ON (closed).	610
3	Active on signal edge when CN1-43 input signal changes from OFF (open) to ON (closed).	610
4 Default	Active on signal edge when CN1-44 input signal changes from OFF (open) to ON (closed).	610
5	Active on signal edge when CN1-45 input signal changes from OFF (open) to ON (closed).	610
6	Active on signal edge when CN1-46 input signal changes from OFF (open) to ON (closed).	610
7	Reserved (Do not use.)	610
8	The signal is always inactive.	610
9	Active on signal edge when CN1-40 input signal changes from ON (closed) to OFF (open).	610
A	Active on signal edge when CN1-41 input signal changes from ON (closed) to OFF (open).	610
B	Active on signal edge when CN1-42 input signal changes from ON (closed) to OFF (open).	610
C	Active on signal edge when CN1-43 input signal changes from ON (closed) to OFF (open).	610
D	Active on signal edge when CN1-44 input signal changes from ON (closed) to OFF (open).	610
E	Active on signal edge when CN1-45 input signal changes from ON (closed) to OFF (open).	610
F	Active on signal edge when CN1-46 input signal changes from ON (closed) to OFF (open).	610
n.□X□□	/P-CL (Forward External Torque Limit Input) Signal Allocation Speed Pos Trq	–
0 to F	The allocations are the same as the /S-ON (Servo ON Input) signal allocations.	282

Digit	Meaning	Refer-ence
n.X□□□	/N-CL (Reverse External Torque Limit Input) Signal Allocation Speed Pos Trq	–
0 to F	The allocations are the same as the /S-ON (Servo ON Input) signal allocations.	282

◆ Pn50C: Input Signal Selections 3

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to FFFFh	–	8888h	All	After restart	Setup	–

Digit	Meaning	Refer-ence
n.□□□X	/SPD-D (Motor Direction Input) Signal Allocation Speed Pos Trq	–
0	Active when CN1-40 input signal is ON (closed).	270
1	Active when CN1-41 input signal is ON (closed).	270
2	Active when CN1-42 input signal is ON (closed).	270
3	Active when CN1-43 input signal is ON (closed).	270
4	Active when CN1-44 input signal is ON (closed).	270
5	Active when CN1-45 input signal is ON (closed).	270
6	Active when CN1-46 input signal is ON (closed).	270
7	The signal is always active.	270
8 Default	The signal is always inactive.	270
9	Active when CN1-40 input signal is OFF (open).	270
A	Active when CN1-41 input signal is OFF (open).	270
B	Active when CN1-42 input signal is OFF (open).	270
C	Active when CN1-43 input signal is OFF (open).	270
D	Active when CN1-44 input signal is OFF (open).	270
E	Active when CN1-45 input signal is OFF (open).	270
F	Active when CN1-46 input signal is OFF (open).	270
n.□□X□	/SPD-A (Internal Set Speed Selection Input) Signal Allocation Speed Pos Trq	–
0 to F	The allocations are the same as the /SPD-D (Motor Direction Input) signal allocations.	270
n.□X□□	/SPD-B (Internal Set Speed Selection Input) Signal Allocation Speed Pos Trq	–
0 to F	The allocations are the same as the /SPD-D (Motor Direction Input) signal allocations.	270
n.X□□□	/C-SEL (Control Selection Input) Signal Allocation Speed Pos Trq	–
0 to F	The allocations are the same as the /SPD-D (Motor Direction Input) signal allocations.	279

◆ Pn50D: Input Signal Selections 4

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to FFFFh	–	8888h	All	After restart	Setup	–

Digit	Meaning	Reference
n.□□□X	/ZCLAMP (Zero Clamping Input) Signal Allocation Speed Pos Trq	–
0	Active when CN1-40 input signal is ON (closed).	241
1	Active when CN1-41 input signal is ON (closed).	241
2	Active when CN1-42 input signal is ON (closed).	241
3	Active when CN1-43 input signal is ON (closed).	241
4	Active when CN1-44 input signal is ON (closed).	241
5	Active when CN1-45 input signal is ON (closed).	241
6	Active when CN1-46 input signal is ON (closed).	241
7	The signal is always active.	241
8 Default	The signal is always inactive.	241
9	Active when CN1-40 input signal is OFF (open).	241
A	Active when CN1-41 input signal is OFF (open).	241
B	Active when CN1-42 input signal is OFF (open).	241
C	Active when CN1-43 input signal is OFF (open).	241
D	Active when CN1-44 input signal is OFF (open).	241
E	Active when CN1-45 input signal is OFF (open).	241
F	Active when CN1-46 input signal is OFF (open).	241
n.□□X□	/INHIBIT (Reference Pulse Inhibit Input) Signal Allocation Speed Pos Trq	–
0 to F	The allocations are the same as the /ZCLAMP (Zero Clamping Input) signal allocations.	254
n.□X□□	/G-SEL (Gain Selection Input) Signal Allocation Speed Pos Trq	–
0 to F	The allocations are the same as the /ZCLAMP (Zero Clamping Input) signal allocations.	469
n.X□□□	/P-DET (Polarity Detection Input) Signal Allocation Speed Pos Trq	–
0 to F	The allocations are the same as the /ZCLAMP (Zero Clamping Input) signal allocations.	183

◆ Pn50E: Output Signal Selections 1

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to 6666h	–	3211h	All	After restart	Setup	–

Digit	Meaning	Refer-ence
n.□□□X	/COIN (Positioning Completion Output) Signal Allocation Speed Pos Trq	–
0	Disabled (the above signal output is not used).	252
1 Default	Output the signal from the CN1-25 or CN1-26 output terminal.	252
2	Output the signal from the CN1-27 or CN1-28 output terminal.	252
3	Output the signal from the CN1-29 or CN1-30 output terminal.	252
4	Output the signal from the CN1-37 output terminal.	252
5	Output the signal from the CN1-38 output terminal.	252
6	Output the signal from the CN1-39 output terminal.	252
Other values	Disabled (the above signal output is not used).	252
n.□□X□	/V-CMP (Speed Coincidence Detection Output) Signal Allocation Speed Pos Trq	–
0 to 6	The allocations are the same as the /COIN (Positioning Completion Output) signal allocations.	242
n.□X□□	/TGON (Rotation Detection Output) Signal Allocation Speed Pos Trq	–
0 to 6	The allocations are the same as the /COIN (Positioning Completion Output) signal allocations.	227
n.X□□□	/S-RDY (Servo Ready Output) Signal Allocation Speed Pos Trq	–
0 to 6	The allocations are the same as the /COIN (Positioning Completion Output) signal allocations.	228

◆ Pn50F: Output Signal Selections 2

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to 6666h	–	0000h	All	After restart	Setup	–

Digit	Meaning	Refer-ence
n.□□□X	/CLT (Torque Limit Detection Output) Signal Allocation Speed Pos Trq	–
0 Default	Disabled (the above signal output is not used).	291
1	Output the signal from the CN1-25 or CN1-26 output terminal.	291
2	Output the signal from the CN1-27 or CN1-28 output terminal.	291
3	Output the signal from the CN1-29 or CN1-30 output terminal.	291
4	Output the signal from the CN1-37 output terminal.	291
5	Output the signal from the CN1-38 output terminal.	291
6	Output the signal from the CN1-39 output terminal.	291
Other values	Disabled (the above signal output is not used).	291
n.□□X□	/VLT (Speed Limit Detection Output) Signal Allocation Speed Pos Trq	–
0 to 6	The allocations are the same as the /CLT (Torque Limit Detection Output) signal allocations.	262
n.□X□□	/BK (Brake Output) Signal Allocation Speed Pos Trq	–
0 to 6	The allocations are the same as the /CLT (Torque Limit Detection Output) signal allocations.	192
n.X□□□	/WARN (Warning Output) Signal Allocation Speed Pos Trq	–
0 to 6	The allocations are the same as the /CLT (Torque Limit Detection Output) signal allocations.	226

◆ Pn510: Output Signal Selections 3

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0666h	–	0000h	All	After restart	Setup	–

Digit	Meaning	Reference
n.□□□X	/NEAR (Near Output) Signal Allocation Speed Pos Trq	–
0 Default	Disabled (the above signal output is not used).	253
1	Output the signal from the CN1-25 or CN1-26 output terminal.	253
2	Output the signal from the CN1-27 or CN1-28 output terminal.	253
3	Output the signal from the CN1-29 or CN1-30 output terminal.	253
4	Output the signal from the CN1-37 output terminal.	253
5	Output the signal from the CN1-38 output terminal.	253
6	Output the signal from the CN1-39 output terminal.	253
Other values	Disabled (the above signal output is not used).	253
n.□□X□	Reserved (Do not change.)	–
n.□X□□	/PSELA (Reference Pulse Input Multiplication Switching Output) Signal Allocation Speed Pos Trq	–
0 to 6	The allocations are the same as the /NEAR (Near Output) signal allocations.	250
n.X□□□	Reserved (Do not change.)	–

◆ Pn512: Output Signal Inverse Settings

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 1111h	–	0000h	All	After restart	Setup	224

Digit	Meaning
n.□□□X	Output Signal Inversion for CN1-25 and CN1-26 Terminals Speed Pos Trq
0 Default	The signal is not inverted.
1	The signal is inverted.
n.□□X□	Output Signal Inversion for CN1-27 and CN1-28 Terminals Speed Pos Trq
0 Default	The signal is not inverted.
1	The signal is inverted.
n.□X□□	Output Signal Inversion for CN1-29 and CN1-30 Terminals Speed Pos Trq
0 Default	The signal is not inverted.
1	The signal is inverted.
n.X□□□	Output Signal Inversion for CN1-37 Terminal Speed Pos Trq
0 Default	The signal is not inverted.
1	The signal is inverted.

◆ Pn513: Output Signal Inverse Settings 2

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0011h	–	0000h	All	After restart	Setup	224

Digit	Meaning
n.☐☐☐X	Output Signal Inversion for CN1-38 Terminal Speed Pos Trq
0 Default	The signal is not inverted.
1	The signal is inverted.
n.☐☐X☐	Output Signal Inversion for CN1-39 Terminal Speed Pos Trq
0 Default	The signal is not inverted.
1	The signal is inverted.
n.☐X☐☐	Reserved (Do not change.)
n.X☐☐☐	Reserved (Do not change.)

◆ Pn514: Output Signal Selections 4

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0666h	–	0000h	All	After restart	Setup	520

Digit	Meaning
n.☐☐☐X	Reserved (Do not change.)
n.☐☐X☐	Reserved (Do not change.)
n.☐X☐☐	/PM (Preventative Maintenance Output) Signal Allocation Speed Pos Trq
0 Default	Disabled (the above signal output is not used).
1	Output the signal from the CN1-25 or CN1-26 output terminal.
2	Output the signal from the CN1-27 or CN1-28 output terminal.
3	Output the signal from the CN1-29 or CN1-30 output terminal.
4	Output the signal from the CN1-37 output terminal.
5	Output the signal from the CN1-38 output terminal.
6	Output the signal from the CN1-39 output terminal.
Other values	Disabled (the above signal output is not used).
n.X☐☐☐	Reserved (Do not change.)

◆ Pn515: Input Signal Selections 6

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer- ence
2	0000h to FFFFh	–	8888h	All	After restart	Setup	–

Digit	Meaning	Refer- ence
n.□□□X	SEN (Absolute Data Request Input) Signal Allocation Speed Pos Trq	–
0	Active when CN1-40 input signal is ON (closed).	295, 306
1	Active when CN1-41 input signal is ON (closed).	295, 306
2	Active when CN1-42 input signal is ON (closed).	295, 306
3	Active when CN1-43 input signal is ON (closed).	295, 306
4	Active when CN1-44 input signal is ON (closed).	295, 306
5	Active when CN1-45 input signal is ON (closed).	295, 306
6	Active when CN1-46 input signal is ON (closed).	295, 306
7	The signal is always active.	295, 306
8 Default	Enable when 5 V is input to CN1-4.	295, 306
9	Active when CN1-40 input signal is OFF (open).	295, 306
A	Active when CN1-41 input signal is OFF (open).	295, 306
B	Active when CN1-42 input signal is OFF (open).	295, 306
C	Active when CN1-43 input signal is OFF (open).	295, 306
D	Active when CN1-44 input signal is OFF (open).	295, 306
E	Active when CN1-45 input signal is OFF (open).	295, 306
F	Active when CN1-46 input signal is OFF (open).	295, 306
n.□□X□	/PSEL (Reference Pulse Input Multiplication Switching Input) Signal Allocation Speed Pos Trq	–
0	Active when CN1-40 input signal is ON (closed).	250
1	Active when CN1-41 input signal is ON (closed).	250
2	Active when CN1-42 input signal is ON (closed).	250
3	Active when CN1-43 input signal is ON (closed).	250
4	Active when CN1-44 input signal is ON (closed).	250
5	Active when CN1-45 input signal is ON (closed).	250
6	Active when CN1-46 input signal is ON (closed).	250
7	The signal is always active.	250
8 Default	The signal is always inactive.	250
9	Active when CN1-40 input signal is OFF (open).	250

Digit	Meaning	Refer-ence
A	Active when CN1-41 input signal is OFF (open).	250
B	Active when CN1-42 input signal is OFF (open).	250
C	Active when CN1-43 input signal is OFF (open).	250
D	Active when CN1-44 input signal is OFF (open).	250
E	Active when CN1-45 input signal is OFF (open).	250
F	Active when CN1-46 input signal is OFF (open).	250
n.□X□□	Reserved (Do not change.)	–
n.X□□□	Reserved (Do not change.)	–

◆ Pn516: Input Signal Selections 7

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to FFFFh	–	8888h	All	After restart	Setup	322

Digit	Meaning
n.□□□X	FSTP (Forced Stop Input) Signal Allocation Speed Pos Trq
0	Enable drive when CN1-40 input signal is ON (closed).
1	Enable drive when CN1-41 input signal is ON (closed).
2	Enable drive when CN1-42 input signal is ON (closed).
3	Enable drive when CN1-43 input signal is ON (closed).
4	Enable drive when CN1-44 input signal is ON (closed).
5	Enable drive when CN1-45 input signal is ON (closed).
6	Enable drive when CN1-46 input signal is ON (closed).
7	Set the signal to always prohibit drive (always force the motor to stop).
8 Default	Set the signal to always enable drive (always disable forcing the motor to stop).
9	Enable drive when CN1-40 input signal is OFF (open).
A	Enable drive when CN1-41 input signal is OFF (open).
B	Enable drive when CN1-42 input signal is OFF (open).
C	Enable drive when CN1-43 input signal is OFF (open).
D	Enable drive when CN1-44 input signal is OFF (open).
E	Enable drive when CN1-45 input signal is OFF (open).
F	Enable drive when CN1-46 input signal is OFF (open).
n.□□X□	Reserved (Do not change.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn517: Output Signal Selections 5

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h to 0666h	–	0654h	All	After restart	Setup	224

Digit	Meaning
n.□□□X	ALO1 (Alarm Code Output) Signal Allocation Speed Pos Trq
0	Disabled (the above signal output is not used).
1	Output the signal from the CN1-25 or CN1-26 output terminal.
2	Output the signal from the CN1-27 or CN1-28 output terminal.
3	Output the signal from the CN1-29 or CN1-30 output terminal.
4 Default	Output the signal from the CN1-37 output terminal.
5	Output the signal from the CN1-38 output terminal.
6	Output the signal from the CN1-39 output terminal.
n.□□X□	ALO2 (Alarm Code Output) Signal Allocation Speed Pos Trq
0 to 6	The allocations are the same as the ALO1 (Alarm Code Output) signal allocations.
n.□X□□	ALO3 (Alarm Code Output) Signal Allocation Speed Pos Trq
0 to 6	The allocations are the same as the ALO1 (Alarm Code Output) signal allocations.
n.X□□□	Reserved (Do not change.)

◆ Pn518: Reserved (Do not change.)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
–	–	–	–	All	–	–	–

◆ Pn51B: Motor-Load Position Deviation Overflow Detection Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	0 to 1073741824	1 reference unit	1000	Rotary	Immediately	Setup	537

◆ Pn51E: Position Deviation Overflow Warning Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	10 to 100	1%	100	All	Immediately	Setup	365

◆ Pn520: Position Deviation Overflow Alarm Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	1 to 1073741823	1 reference unit	6116694	All	Immediately	Setup	364, 487

◆ Pn522: In-position Range

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	0 to 1073741824	1 reference unit	7	All	Immediately	Setup	252

◆ Pn524: Near Signal Width

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	1 to 1073741824	1 reference unit	1073741824	All	Immediately	Setup	254

◆ Pn526: Position Deviation Overflow Alarm Level at Servo ON

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
4	1 to 1073741823	1 reference unit	6116694	All	Immediately	Setup	366

◆ Pn528: Position Deviation Overflow Warning Level at Servo ON

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	10 to 100	1%	100	All	Immediately	Setup	366

◆ Pn529: Speed Limit Level at Servo ON

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 10000	1 min^{-1}	10000	Rotary	Immediately	Setup	366

◆ Pn52A: Multiplier per Fully-closed Rotation

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 100	1%	20	Rotary	Immediately	Tuning	537

◆ Pn52B: Overload Warning Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	1 to 100	1%	20	All	After restart	Setup	198

◆ Pn52C: Base Current Derating at Motor Overload Detection

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	10 to 100	1%	100	All	After restart	Setup	198

◆ Pn52F: Monitor Display at Startup

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0000h ~ 0FFFh	-	0FFFh	All	Immediately	Setup	635

◆ Pn530: Program Jogging-Related Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0005h	–	0000h	All	Immediately	Setup	344

Digit	Meaning
n.□□□X	Program Jogging Operation Pattern Speed Pos Trq
0 Default	(Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536
1	(Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536
2	(Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536 (Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536
3	(Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536 (Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536
4	(Waiting time in Pn535 → Forward by travel distance in Pn531 → Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536
5	(Waiting time in Pn535 → Reverse by travel distance in Pn531 → Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536
n.□□X□	Reserved (Do not change.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn531: Program Jogging Travel Distance

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
4	1 to 1073741824	1 reference unit	32768	All	Immediately	Setup	344

◆ Pn533: Program Jogging Movement Speed

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	1 to 10000	Rotary: 1 min^{-1} Direct Drive: 0.1 min^{-1}	500	Rotary	Immediately	Setup	344

◆ Pn534: Program Jogging Acceleration/Deceleration Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	2 to 10000	1 ms	100	All	Immediately	Setup	344

◆ Pn535: Program Jogging Waiting Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 ms	100	All	Immediately	Setup	344

◆ Pn536: Program Jogging Number of Movements

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 1000	1 time	1	All	Immediately	Setup	344

◆ Pn540: Maximum Search Gain

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 4000	0.1 Hz	3000	All	Immediately	Tuning	–

◆ Pn550: Analog Monitor 1 Offset Voltage

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	-10000 to 10000	0.1 V	0	All	Immediately	Setup	515

◆ Pn551: Analog Monitor 2 Offset Voltage

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	-10000 to 10000	0.1 V	0	All	Immediately	Setup	515

◆ Pn552: Analog Monitor 1 Magnification

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	-10000 to 10000	× 0.01	100	All	Immediately	Setup	515

◆ Pn553: Analog Monitor 2 Magnification

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	-10000 to 10000	× 0.01	100	All	Immediately	Setup	515

◆ Pn55A: Power Consumption Monitor Unit Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	1 to 1440	1 min	1	All	Immediately	Setup	–

◆ Pn560: Residual Vibration Detection Width

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	1 to 3000	0.1%	400	All	Immediately	Setup	438

◆ Pn561: Overshoot Detection Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 1000	1%	100	All	Immediately	Setup	402, 420

◆ Pn562: Setting Gain Ratio

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	10 to 100	1%	80	All	Immediately	Tuning	402, 420

◆ Pn580: Zero Clamping Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 mm/s	10	Linear	Immediately	Setup	240

◆ Pn581: Zero Speed Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	1 to 10000	1 mm/s	20	Linear	Immediately	Setup	227

◆ Pn582: Speed Coincidence Detection Signal Output Width

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 100	1 mm/s	10	Linear	Immediately	Setup	242

◆ Pn583: Brake Reference Output Speed Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 mm/s	10	Linear	Immediately	Setup	191

◆ Pn584: Speed Limit Level at Servo ON

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 10000	1 mm/s	10000	Linear	Immediately	Setup	366

◆ Pn585: Program Jogging Movement Speed

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	1 to 10000	1 mm/s	50	Linear	Immediately	Setup	344

◆ Pn586: Motor Running Cooling Ratio

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 100	1% / Maximum Motor Speed	0	Linear	Immediately	Setup	–

◆ Pn590: P-OT (Forward Drive Prohibit Input) Signal Allocation

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 3149h	–	1042h	All	After restart	Setup	187, 222

Digit	Meaning
n.□XXX	Allocated Pin Number **Speed** **Pos** **Trq**
040	Allocate the signal to CN1-40.
041	Allocate the signal to CN1-41.
042 Default	Allocate the signal to CN1-42.
043	Allocate the signal to CN1-43.
044	Allocate the signal to CN1-44.
045	Allocate the signal to CN1-45.
046	Allocate the signal to CN1-46.
100	Allocate the signal to SigmaLINK II Sequence Input 0.
101	Allocate the signal to SigmaLINK II Sequence Input 1.
102	Allocate the signal to SigmaLINK II Sequence Input 2.
103	Allocate the signal to SigmaLINK II Sequence Input 3.
104	Allocate the signal to SigmaLINK II Sequence Input 4.
105	Allocate the signal to SigmaLINK II Sequence Input 5.
106	Allocate the signal to SigmaLINK II Sequence Input 6.
107	Allocate the signal to SigmaLINK II Sequence Input 7.
Other values	The signal is always inactive.
n.X□□□	Polarity Selection **Speed** **Pos** **Trq**
0	Set the signal to always enable forward drive.
1 Default	Active when input signal is ON (closed).
2	Active when input signal is OFF (open).
3	Set the signal to always prohibit forward drive.

◆ Pn591: N-OT (Reverse Drive Prohibit Input) Signal Allocation

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 3149h	–	1043h	All	After restart	Setup	187, 222

Digit	Meaning
n.☐XXX	Allocated Pin Number Speed Pos Trq
040	Allocate the signal to CN1-40.
041	Allocate the signal to CN1-41.
042	Allocate the signal to CN1-42.
043 Default	Allocate the signal to CN1-43.
044	Allocate the signal to CN1-44.
045	Allocate the signal to CN1-45.
046	Allocate the signal to CN1-46.
100	Allocate the signal to SigmaLINK II Sequence Input 0.
101	Allocate the signal to SigmaLINK II Sequence Input 1.
102	Allocate the signal to SigmaLINK II Sequence Input 2.
103	Allocate the signal to SigmaLINK II Sequence Input 3.
104	Allocate the signal to SigmaLINK II Sequence Input 4.
105	Allocate the signal to SigmaLINK II Sequence Input 5.
106	Allocate the signal to SigmaLINK II Sequence Input 6.
107	Allocate the signal to SigmaLINK II Sequence Input 7.
Other values	The signal is always inactive.
n.X☐☐☐	Polarity Selection Speed Pos Trq
0	Set the signal to always enable reverse drive.
1 Default	Active when input signal is ON (closed).
2	Active when input signal is OFF (open).
3	Set the signal to always prohibit reverse drive.

◆ Pn598: /P-CL (Forward External Torque Limit Input) Signal Allocation

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer- ence
2	0000h to 3149h	–	1045h	All	After restart	Setup	222, 282

Digit	Meaning
n.☐XXX	**Allocated Pin Number** Speed Pos Trq
040	Allocate the signal to CN1-40.
041	Allocate the signal to CN1-41.
042	Allocate the signal to CN1-42.
043	Allocate the signal to CN1-43.
044	Allocate the signal to CN1-44.
045 Default	Allocate the signal to CN1-45.
046	Allocate the signal to CN1-46.
100	Allocate the signal to SigmaLINK II Sequence Input 0.
101	Allocate the signal to SigmaLINK II Sequence Input 1.
102	Allocate the signal to SigmaLINK II Sequence Input 2.
103	Allocate the signal to SigmaLINK II Sequence Input 3.
104	Allocate the signal to SigmaLINK II Sequence Input 4.
105	Allocate the signal to SigmaLINK II Sequence Input 5.
106	Allocate the signal to SigmaLINK II Sequence Input 6.
107	Allocate the signal to SigmaLINK II Sequence Input 7.
Other values	The signal is always inactive.
n.X☐☐☐	**Polarity Selection** Speed Pos Trq
0	The signal is always inactive.
1 Default	Active when input signal is ON (closed).
2	Active when input signal is OFF (open).
3	The signal is always active.

◆ Pn599: /N-CL (Reverse External Torque Limit Input) Signal Allocation

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 3149h	–	1046h	All	After restart	Setup	222, 282

Digit	Meaning
n.□XXX	Allocated Pin Number Speed Pos Trq
040	Allocate the signal to CN1-40.
041	Allocate the signal to CN1-41.
042	Allocate the signal to CN1-42.
043	Allocate the signal to CN1-43.
044	Allocate the signal to CN1-44.
045	Allocate the signal to CN1-45.
046 Default	Allocate the signal to CN1-46.
100	Allocate the signal to SigmaLINK II Sequence Input 0.
101	Allocate the signal to SigmaLINK II Sequence Input 1.
102	Allocate the signal to SigmaLINK II Sequence Input 2.
103	Allocate the signal to SigmaLINK II Sequence Input 3.
104	Allocate the signal to SigmaLINK II Sequence Input 4.
105	Allocate the signal to SigmaLINK II Sequence Input 5.
106	Allocate the signal to SigmaLINK II Sequence Input 6.
107	Allocate the signal to SigmaLINK II Sequence Input 7.
Other values	The signal is always inactive.
n.X□□□	Polarity Selection Speed Pos Trq
0	The signal is always inactive.
1 Default	Active when input signal is ON (closed).
2	Active when input signal is OFF (open).
3	The signal is always active.

◆ Pn5C3: Error Detection Setting

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0011h	–	0000h	All	After restart	Setup	527

Digit	Meaning
n.□□□X	Error Detection Selections Speed Pos Trq
0 Default	Disable error detection.
1	Enable error detection.
n.□□X□	Execution Selection when Error Detection Warning Speed Pos Trq
0 Default	Stop error detection when A.905 (Error Detection Warning) occurs.
1	Do not stop error detection when A.905 (Error Detection Warning) occurs.
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn5C4: Error Detection Sample Data Set 1 Warning Level 1

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 10000	0.01%	2000	All	Immediately	Setup	527

◆ Pn5C5: Error Detection Sample Data Set 1 Judgment Level 1

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 10000	–	1520	All	Immediately	Setup	527

◆ Pn5C6: Error Detection Sample Data Set 1 Warning Level 2

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 10000	0.01%	2000	All	Immediately	Setup	527

◆ Pn5C7: Error Detection Sample Data Set 1 Judgment Level 2

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 10000	–	1520	All	Immediately	Setup	527

◆ Pn5C8: Error Detection Sample Data Set 2 Warning Level 1

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 10000	0.01%	2000	All	Immediately	Setup	527

◆ Pn5C9: Error Detection Sample Data Set 2 Judgment Level 1

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 10000	–	1520	All	Immediately	Setup	527

◆ Pn5CA: Error Detection Sample Data Set 2 Warning Level 2

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 10000	0.01%	2000	All	Immediately	Setup	527

◆ Pn5CB: Error Detection Sample Data Set 2 Judgment Level 2

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 10000	–	1520	All	Immediately	Setup	527

◆ Pn600: Regenerative Resistor Capacity

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to SERVOPACK's maximum applicable motor capacity	10 W	0	All	Immediately	Setup	212

◆ Pn601: Dynamic Brake Resistor Allowable Energy Consumption

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
2	0 to 65535	10 J	0	All	After restart	Setup	–

◆ Pn603: Regenerative Resistance

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 65535	10 mΩ	0	All	Immediately	Setup	212

◆ Pn604: Dynamic Brake Resistance

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 65535	10 mΩ	0	All	After restart	Setup	–

◆ Pn61A: Overheat Protection Selections

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0000h to 0003h	–	0000h	Linear	After restart	Setup	324

Digit	Meaning
n.□□□X	Overheat Protection Selections Speed Pos Trq
0 Default	Disable overheat protection.
1	Use overheat protection in the Yaskawa linear servomotor.
2	Monitor a negative voltage input from a sensor attached to the machine and use overheat protection.
3	Monitor a positive voltage input from a sensor attached to the machine and use overheat protection.
n.□□X□	Reserved (Do not change.)
n.□X□□	Reserved (Do not change.)
n.X□□□	Reserved (Do not change.)

◆ Pn61B: Overheat Alarm Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 500	0.01 V	250	All	Immediately	Setup	326

Note:

Valid only when Pn61A is set to n.□□□2 or n.□□□3 (enable overheat protection).

◆ Pn61C: Overheat Warning Level

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 100	1%	100	All	Immediately	Setup	326

Note:

Valid only when Pn61A is set to n.□□□2 or n.□□□3 (enable overheat protection).

◆ Pn61D: Overheat Alarm Filter Time

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
2	0 to 65535	1 s	0	All	Immediately	Setup	326

Note:

Valid only when Pn61A is set to n.□□□2 or n.□□□3 (enable overheat protection).

◆ Pn621: Reserved (Do not change.)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Reference
–	–	–	–	All	–	–	–

◆ Pn622: Reserved (Do not change.)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
–	–	–	–	All	–	–	–

◆ Pn623: Reserved (Do not change.)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
–	–	–	–	All	–	–	–

◆ Pn624: Reserved (Do not change.)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
–	–	–	–	All	–	–	–

◆ Pn625: Reserved (Do not change.)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
–	–	–	–	All	–	–	–

◆ Pn626: Reserved (Do not change.)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
–	–	–	–	All	–	–	–

◆ Pn627: Reserved (Do not change.)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
–	–	–	–	All	–	–	–

◆ Pn628: Reserved (Do not change.)

Speed Pos Trq

Size	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classification	Refer-ence
–	–	–	–	All	–	–	–

15.3 Parameter Recording Table

Use the following table to record the settings of the parameters.

Parameter No.	Default Setting						Name	When Enabled
Pn000	0000h						Basic Function Selections 0	After restart
Pn001	0000h						Application Function Selections 1	After restart
Pn002	0000h						Application Function Selections 2	After restart
Pn006	0002h						Application Function Selections 6	Immediately
Pn007	0000h						Application Function Selections 7	Immediately
Pn008	0000h						Application Function Selections 8	After restart
Pn009	0040h						Application Function Selections 9	After restart
Pn00A	0001h						Application Function Selections A	After restart
Pn00B	0000h						Application Function Selections B	After restart
Pn00C	0040h						Application Function Selections C	After restart
Pn00D	0000h						Application Function Selections D	After restart
Pn00F	0000h						Application Function Selections F	After restart
Pn021	0000h						Reserved (Do not change.)	–
Pn022	0000h						Application Function Selections 22	After restart
Pn02F	0000h						Application Function Selections 2F	After restart
Pn040	0000h						Reserved (Do not change.)	–
Pn050	00000000h						SigmaLINK II Response Data Selection 1	After restart
Pn052	00000000h						SigmaLINK II Response Data Selection 2	After restart
Pn054	00000000h						SigmaLINK II Response Data Selection 3	After restart
Pn056	00000000h						SigmaLINK II Response Data Selection 4	After restart
Pn058	00000000h						SigmaLINK II Response Data Selection 5	After restart
Pn05A	00000000h						SigmaLINK II Response Data Selection 6	After restart
Pn05C	00000000h						SigmaLINK II Response Data Selection 7	After restart
Pn05E	00000000h						SigmaLINK II Response Data Selection 8	After restart
Pn080	0000h						Application Function Selections 80	After restart
Pn081	0000h						Application Function Selections 81	After restart
Pn0B1	0000h						SigmaLINK II Sequence Input Allocation 1	After restart
Pn0B2	0000h						SigmaLINK II Sequence Input Allocation 2	After restart
Pn0B5	0000h						SigmaLINK II Sequence Output Allocation 1	After restart
Pn0D6	0000h						Reserved (Do not change.)	–
Pn0DA	0000h						SigmaLINK II Semi-closed Encoder Selection	After restart

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Parameter No.	Default Setting						Name	When Enabled
Pn0DB	0101h						SigmaLINK II Fully-closed Encoder Selection	After restart
Pn0DC	0000h						SigmaLINK II Node Change Detection Condition Selection	After restart
Pn0DD	0130h						SigmaLINK II I/O Device Error Detection Selection	After restart
Pn100	400						Speed Loop Gain	Immediately
Pn101	2000						Speed Loop Integral Time Constant	Immediately
Pn102	400						Position Loop Gain	Immediately
Pn103	100						Moment of Inertia Ratio	Immediately
Pn104	400						Second Speed Loop Gain	Immediately
Pn105	2000						Second Speed Loop Integral Time Constant	Immediately
Pn106	400						Second Position Loop Gain	Immediately
Pn109	0						Feedforward	Immediately
Pn10A	0						Feedforward Filter Time Constant	Immediately
Pn10B	0000h						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
Pn11F	0						Position Integral Time Constant	Immediately
Pn121	100						Friction Compensation Gain	Immediately
Pn122	100						Second Friction Compensation Gain	Immediately
Pn123	0						Friction Compensation Coefficient	Immediately
Pn124	0						Friction Compensation Frequency Correction	Immediately
Pn125	100						Friction Compensation Gain Correction	Immediately
Pn131	0						Gain Switching Time 1	Immediately
Pn132	0						Gain Switching Time 2	Immediately
Pn135	0						Gain Switching Waiting Time 1	Immediately
Pn136	0						Gain Switching Waiting Time 2	Immediately
Pn139	0000h						Automatic Gain Switching Selections 1	Immediately
Pn13D	2000						Current Gain Level	Immediately
Pn140	0100h						Model Following Control-Related Selections	Immediately
Pn141	500						Model Following Control Gain	Immediately
Pn142	1000						Model Following Control Gain Correction	Immediately

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Parameter No.	Default Setting						Name	When Enabled
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
Pn148	500						Second Model Following Control Gain	Immediately
Pn149	1000						Second Model Following Control Gain Correction	Immediately
Pn14A	800						Vibration Suppression 2 Frequency	Immediately
Pn14B	100						Vibration Suppression 2 Correction	Immediately
Pn14F	0030h						Control-Related Selections	After restart
Pn160	0010h						Anti-Resonance Control-Related Selections	Immediately
Pn161	1000						Anti-Resonance Frequency	Immediately
Pn162	100						Anti-Resonance Gain Correction	Immediately
Pn163	0						Anti-Resonance Damping Gain	Immediately
Pn164	0						Anti-Resonance Filter Time Constant 1 Correction	Immediately
Pn165	0						Anti-Resonance Filter Time Constant 2 Correction	Immediately
Pn166	0						Anti-Resonance Damping Gain 2	Immediately
Pn170	1401h						Tuning-less Function-Related Selections	–
Pn173	0000h						Load Fluctuation Compensation Control-Related Selections	Immediately
Pn174	400						Load Fluctuation Compensation Control Response Level	Immediately
Pn181	0						Mode Switching Level for Speed Reference	Immediately
Pn182	0						Mode Switching Level for Acceleration	Immediately
Pn200	0000h						Position Control Reference Form Selections	After restart
Pn205	65535						Multiturn Limit	After restart
Pn207	0000h						Position Control Function Selections	After restart
Pn20A	32768						Number of External Encoder Scale Pitches	After restart
Pn20E	256						Electronic Gear Ratio (Numerator)	After restart
Pn210	1						Electronic Gear Ratio (Denominator)	After restart
Pn212	2048						Number of Encoder Output Pulses	After restart
Pn216	0						Position Reference Acceleration/ Deceleration Time Constant	Immediately after the motor stops

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Parameter No.	Default Setting						Name	When Enabled
Pn217	0						Average Position Reference Movement Time	Immediately after the motor stops
Pn218	1						Reference Pulse Input Multiplier	Immediately
Pn21D	0080h						Encoder Resolution Setting	After restart
Pn22A	0000h						Fully-closed Control Selections	After restart
Pn281	20						Encoder Output Resolution	After restart
Pn282	0						Linear Encoder Scale Pitch	After restart
Pn300	600						Speed Reference Input Gain	Immediately
Pn301	100						Internal Set Speed 1	Immediately
Pn302	200						Internal Set Speed 2	Immediately
Pn303	300						Internal Set Speed 3	Immediately
Pn304	500						Jogging Speed	Immediately
Pn305	0						Soft Start Acceleration Time	Immediately
Pn306	0						Soft Start Deceleration Time	Immediately
Pn307	40						Speed Reference Filter Time Constant	Immediately
Pn308	0						Speed Feedback Filter Time Constant	Immediately
Pn30A	0						Deceleration Time for Servo OFF and Forced Stops	Immediately
Pn30C	0						Speed Feedforward Average Movement Time	Immediately
Pn310	0000h						Vibration Detection Selections	Immediately
Pn311	100						Vibration Detection Sensitivity	Immediately
Pn312	50						Vibration Detection Level	Immediately
Pn316	10000						Maximum Motor Speed	After restart
Pn324	300						Moment of Inertia Calculation Starting Level	Immediately
Pn380	10						Internal Set Speed 1	Immediately
Pn381	20						Internal Set Speed 2	Immediately
Pn382	30						Internal Set Speed 3	Immediately
Pn383	50						Jogging Speed	Immediately
Pn384	10						Vibration Detection Level	Immediately
Pn385	50						Maximum Motor Speed	After restart
Pn400	30						Torque Reference Input Gain	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
Pn407	10000						Speed Limit during Torque Control	Immediately

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Parameter No.	Default Setting						Name	When Enabled
Pn408	0000h						Torque-Related Function Selections	–
Pn409	5000						First Stage Notch Filter Frequency	Immediately
Pn40A	70						First Stage Notch Filter Q Value	Immediately
Pn40B	0						First Stage Notch Filter Depth	Immediately
Pn40C	5000						Second Stage Notch Filter Frequency	Immediately
Pn40D	70						Second Stage Notch Filter Q Value	Immediately
Pn40E	0						Second Stage Notch Filter Depth	Immediately
Pn40F	5000						Second Stage Second Torque Reference Filter Frequency	Immediately
Pn410	50						Second Stage Second Torque Reference Filter Q Value	Immediately
Pn412	100						First Stage Second Torque Reference Filter Time Constant	Immediately
Pn415	0						T-REF Filter Time Constant	Immediately
Pn416	0000h						Torque-Related Function Selections 2	Immediately
Pn417	5000						Third Stage Notch Filter Frequency	Immediately
Pn418	70						Third Stage Notch Filter Q Value	Immediately
Pn419	0						Third Stage Notch Filter Depth	Immediately
Pn41A	5000						Fourth Stage Notch Filter Frequency	Immediately
Pn41B	70						Fourth Stage Notch Filter Q Value	Immediately
Pn41C	0						Fourth Stage Notch Filter Depth	Immediately
Pn41D	5000						Fifth Stage Notch Filter Frequency	Immediately
Pn41E	70						Fifth Stage Notch Filter Q Value	Immediately
Pn41F	0						Fifth Stage Notch Filter Depth	Immediately
Pn423	0002h						Speed Ripple Compensation Selections	–
Pn424	50						Torque Limit at Main Circuit Voltage Drop	Immediately
Pn425	100						Release Time for Torque Limit at Main Circuit Voltage Drop	Immediately
Pn426	0						Torque Feedforward Average Movement Time	Immediately
Pn427	0						Speed Ripple Compensation Enable Speed	Immediately
Pn428	0001h						Output Torque Compensation Selections	After restart
Pn456	15						Sweep Torque Reference Amplitude	Immediately
Pn460	0101h						Notch Filter Adjustment Selections 1	Immediately
Pn475	0000h						Gravity Compensation-Related Selections	After restart
Pn476	0						Gravity Compensation Torque	Immediately
Pn480	10000						Speed Limit during Force Control	Immediately
Pn481	400						Polarity Detection Speed Loop Gain	Immediately
Pn482	3000						Polarity Detection Speed Loop Integral Time	Immediately

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Parameter No.	Default Setting						Name	When Enabled
Pn483	30						Forward Force Limit	Immediately
Pn484	30						Reverse Force Limit	Immediately
Pn485	20						Polarity Detection Reference Speed	Immediately
Pn486	25						Polarity Detection Reference Acceleration/Deceleration Time	Immediately
Pn487	0						Polarity Detection Constant Speed Time	Immediately
Pn488	100						Polarity Detection Reference Waiting Time	Immediately
Pn48E	10						Polarity Detection Range	Immediately
Pn490	100						Polarity Detection Load Level	Immediately
Pn495	100						Polarity Detection Confirmation Force Reference	Immediately
Pn498	10						Polarity Detection Allowable Error Range	Immediately
Pn49F	0						Speed Ripple Compensation Enable Speed (Linear)	Immediately
Pn501	10						Zero Clamping Level	Immediately
Pn502	20						Rotation Detection Level	Immediately
Pn503	10						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 Command Waiting Time	Immediately
Pn509	20						Momentary Power Interruption Hold Time	Immediately
Pn50A	2100h						Input Signal Selections 1	After restart
Pn50B	6543h						Input Signal Selections 2	After restart
Pn50C	8888h						Input Signal Selections 3	After restart
Pn50D	8888h						Input Signal Selections 4	After restart
Pn50E	3211h						Output Signal Selections 1	After restart
Pn50F	0000h						Output Signal Selections 2	After restart
Pn510	0000h						Output Signal Selections 3	After restart
Pn512	0000h						Output Signal Inverse Settings	After restart
Pn513	0000h						Output Signal Inverse Settings 2	After restart
Pn514	0000h						Output Signal Selections 4	After restart
Pn515	8888h						Input Signal Selections 6	After restart
Pn516	8888h						Input Signal Selections 7	After restart
Pn517	0654h						Output Signal Selections 5	After restart
Pn518	–						Reserved (Do not change.)	–
Pn51B	1000						Motor-Load Position Deviation Overflow Detection Level	Immediately

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Parameter No.	Default Setting						Name	When Enabled
Pn51E	100						Position Deviation Overflow Warning Level	Immediately
Pn520	6116694						Position Deviation Overflow Alarm Level	Immediately
Pn522	7						In-position Range	Immediately
Pn524	1073741824						Near Signal Width	Immediately
Pn526	6116694						Position Deviation Overflow Alarm Level at Servo ON	Immediately
Pn528	100						Position Deviation Overflow Warning Level at Servo ON	Immediately
Pn529	10000						Speed Limit Level at Servo ON	Immediately
Pn52A	20						Multiplier per Fully-closed Rotation	Immediately
Pn52B	20						Overload Warning Level	After restart
Pn52C	100						Base Current Derating at Motor Overload Detection	After restart
Pn52F	0FFFh						Monitor Display at Startup	Immediately
Pn530	0000h						Program Jogging-Related Selections	Immediately
Pn531	32768						Program Jogging Travel Distance	Immediately
Pn533	500						Program Jogging Movement Speed	Immediately
Pn534	100						Program Jogging Acceleration/Deceleration Time	Immediately
Pn535	100						Program Jogging Waiting Time	Immediately
Pn536	1						Program Jogging Number of Movements	Immediately
Pn540	3000						Maximum Search Gain	Immediately
Pn550	0						Analog Monitor 1 Offset Voltage	Immediately
Pn551	0						Analog Monitor 2 Offset Voltage	Immediately
Pn552	100						Analog Monitor 1 Magnification	Immediately
Pn553	100						Analog Monitor 2 Magnification	Immediately
Pn55A	1						Power Consumption Monitor Unit Time	Immediately
Pn560	400						Residual Vibration Detection Width	Immediately
Pn561	100						Overshoot Detection Level	Immediately
Pn562	80						Setting Gain Ratio	Immediately
Pn580	10						Zero Clamping Level	Immediately
Pn581	20						Zero Speed Level	Immediately
Pn582	10						Speed Coincidence Detection Signal Output Width	Immediately
Pn583	10						Brake Reference Output Speed Level	Immediately
Pn584	10000						Speed Limit Level at Servo ON	Immediately
Pn585	50						Program Jogging Movement Speed	Immediately
Pn586	0						Motor Running Cooling Ratio	Immediately
Pn590	1042h						P-OT (Forward Drive Prohibit Input) Signal Allocation	After restart

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Parameter No.	Default Setting						Name	When Enabled
Pn591	1043h						N-OT (Reverse Drive Prohibit Input) Signal Allocation	After restart
Pn598	1045h						/P-CL (Forward External Torque Limit Input) Signal Allocation	After restart
Pn599	1046h						/N-CL (Reverse External Torque Limit Input) Signal Allocation	After restart
Pn5C3	0000h						Error Detection Setting	After restart
Pn5C4	2000						Error Detection Sample Data Set 1 Warning Level 1	Immediately
Pn5C5	1520						Error Detection Sample Data Set 1 Judgment Level 1	Immediately
Pn5C6	2000						Error Detection Sample Data Set 1 Warning Level 2	Immediately
Pn5C7	1520						Error Detection Sample Data Set 1 Judgment Level 2	Immediately
Pn5C8	2000						Error Detection Sample Data Set 2 Warning Level 1	Immediately
Pn5C9	1520						Error Detection Sample Data Set 2 Judgment Level 1	Immediately
Pn5CA	2000						Error Detection Sample Data Set 2 Warning Level 2	Immediately
Pn5CB	1520						Error Detection Sample Data Set 2 Judgment Level 2	Immediately
Pn600	0						Regenerative Resistor Capacity	Immediately
Pn601	0						Dynamic Brake Resistor Allowable Energy Consumption	After restart
Pn603	0						Regenerative Resistance	Immediately
Pn604	0						Dynamic Brake Resistance	After restart
Pn61A	0000h						Overheat Protection Selections	After restart
Pn61B	250						Overheat Alarm Level	Immediately
Pn61C	100						Overheat Warning Level	Immediately
Pn61D	0						Overheat Alarm Filter Time	Immediately
Pn621	–						Reserved (Do not change.)	–
Pn622	–						Reserved (Do not change.)	–
Pn623	–						Reserved (Do not change.)	–
Pn624	–						Reserved (Do not change.)	–
Pn625	–						Reserved (Do not change.)	–
Pn626	–						Reserved (Do not change.)	–
Pn627	–						Reserved (Do not change.)	–
Pn628	–						Reserved (Do not change.)	–

16

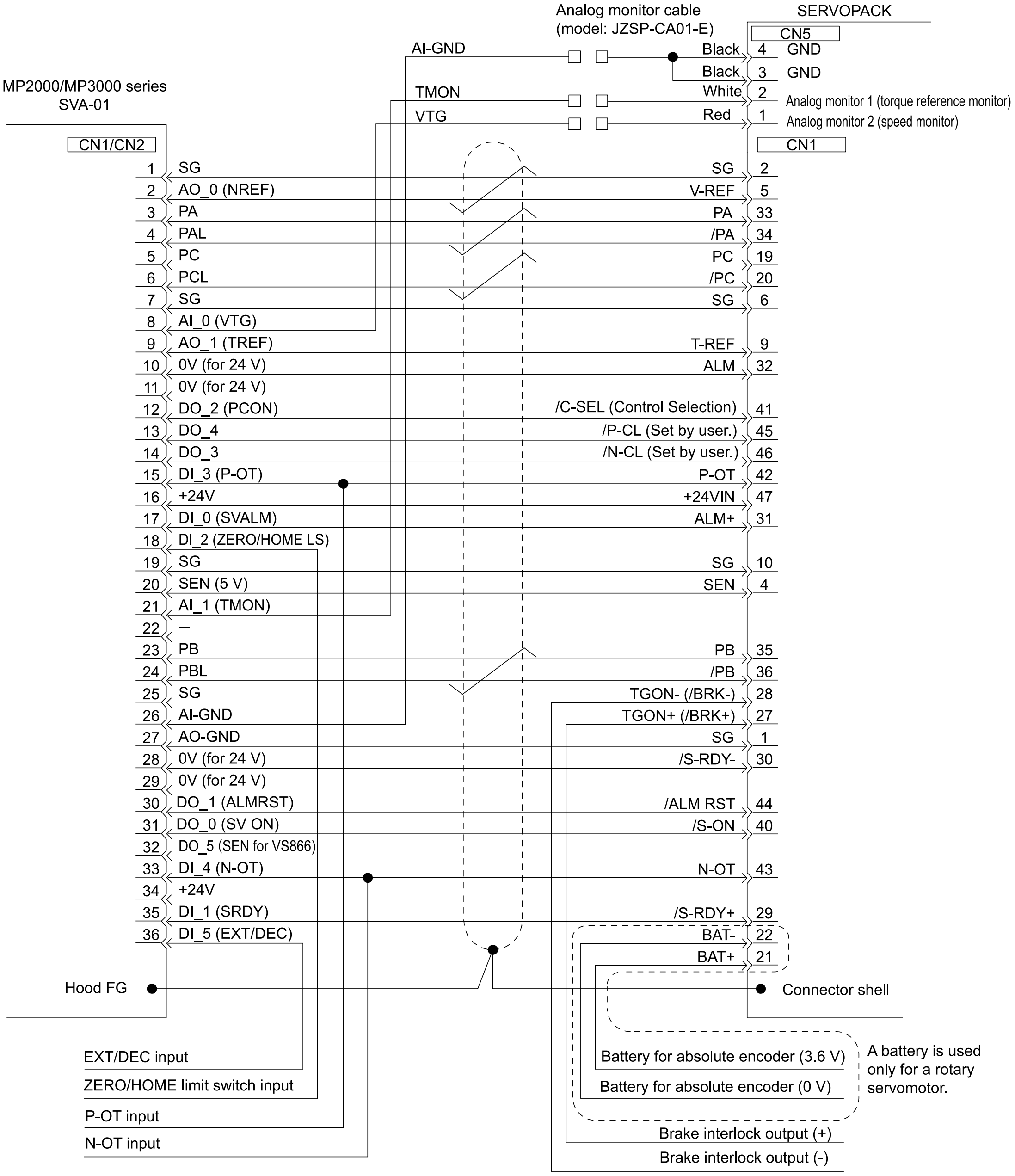
Appendices

Provides host controller connection examples and tables of corresponding SERVOPACK and SigmaWin+ function names.

16.1 Examples of Connections to Host Controllers

This section provides examples of connections to host controllers.

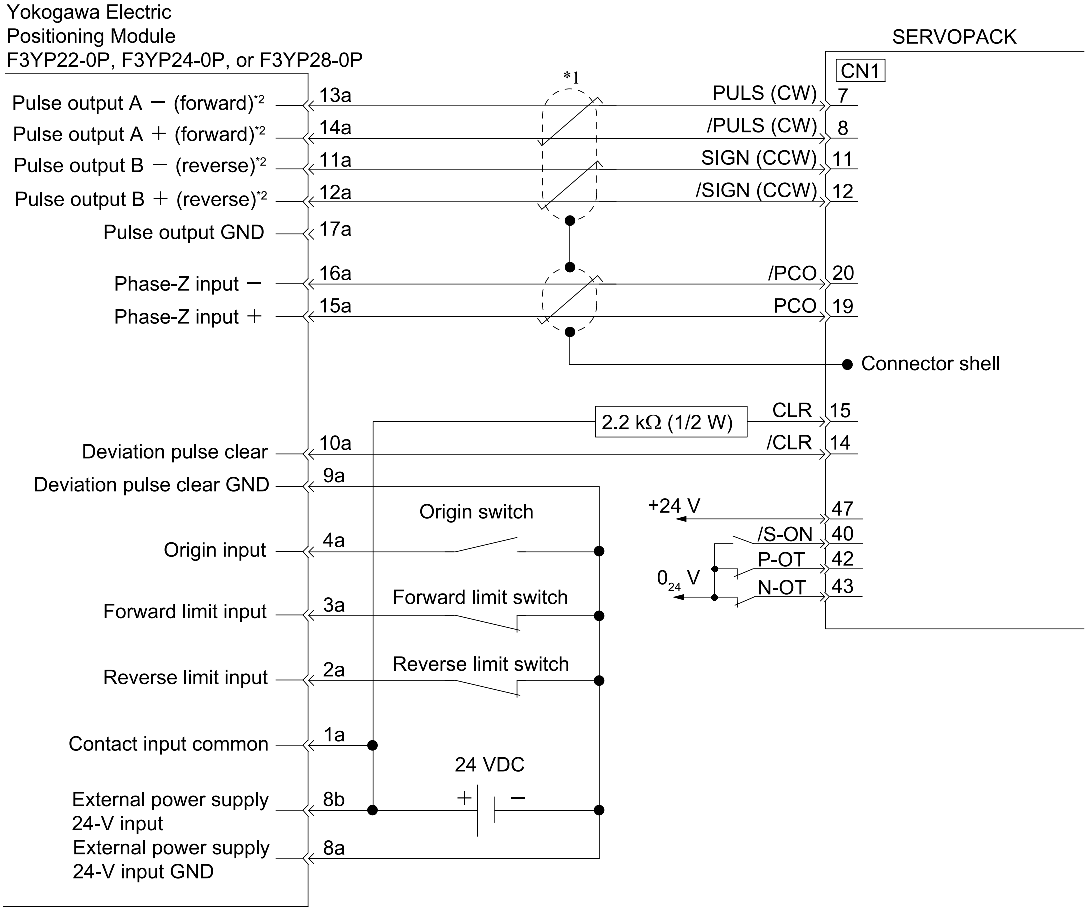
16.1.1 Example of Connections to MP2000/MP3000-Series SVA-01 Motion Module



Note:

1. Cables to connect the SERVOPACK to the MP2000/MP3000 are available from Yaskawa.
For details, refer to the manual for the machine controller.
2. Only signals that are applicable to the MP2000/MP3000-series SVA-01 motion module and the SERVOPACK are shown in the diagram.
3. The main circuit power supply for the SERVOPACK in this connection example is three-phase 200 VAC.
4. Incorrect wiring may damage the machine controller or SERVOPACK. Wire all connections carefully.
5. Do not wire any unused signal lines (i.e., leave them open).
6. The above wiring diagram shows the connections for only one axis. If you will use other axes, make connections to the SERVOPACK in the same way.
7. All normally closed input terminals that are not used at the machine controller's I/O connector section must be connected at the connector.
8. Set the parameters so that the servo can be turned ON and OFF with the /S-ON (Servo ON) signal.
9. The SERVOPACK provides safety functions to protect people from the hazardous operation of the moving parts of the machine. In order to use the safety functions, the required circuits must be configured for CN8. If the safety functions will not be used, leave the enclosed safety jumper connector connected to the SERVOPACK (CN8). Refer to the following chapter for details.
☞ *12 Safety Functions on page 563*

16.1.2 Example of Connections to Yokogawa Electric's F3YP2□-0P Positioning Module for Position Control

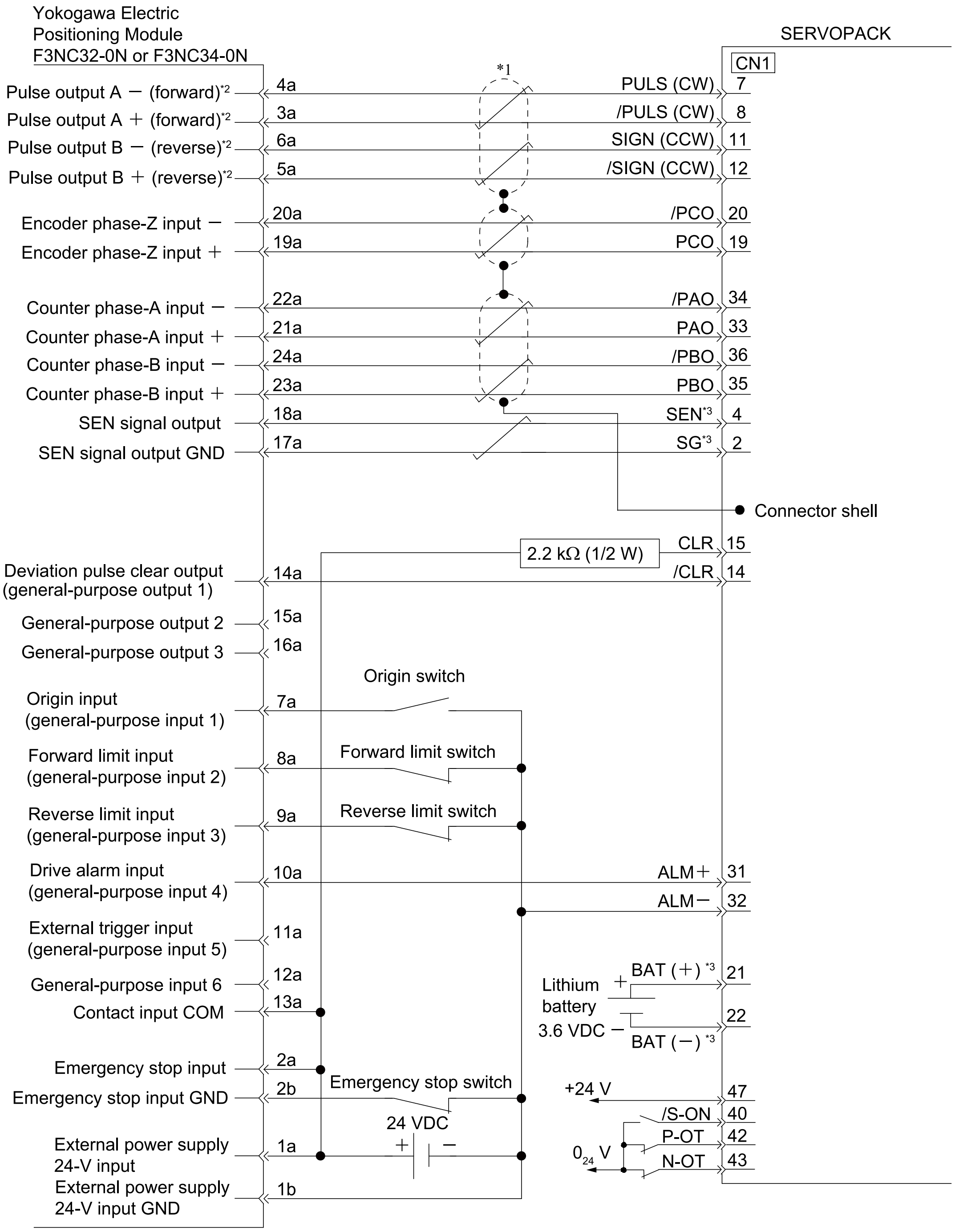


*1 Indicates shielded twisted-pair cable.
*2 The pulse output from Yokogawa Electric's F3YP2□-0P positioning module uses negative logic, so the positive and negative connections are reversed.

Note:

1. Only signals that are applicable to the SERVOPACK and Yokogawa Electric's F3YP2□-0P positioning module are shown in the diagram.
2. Incorrect wiring may damage the positioning module or SERVOPACK. Wire all connections carefully.
3. Do not wire any unused signal lines (i.e., leave them open).
4. The above wiring diagram shows the connections for only one axis. If you will use other axes, performing wiring to the SERVOPACK in the same way.

16.1.3 Example of Connections to Yokogawa Electric's F3NC3□-0N Positioning Module for Position Control



*1 Indicates shielded twisted-pair cable.

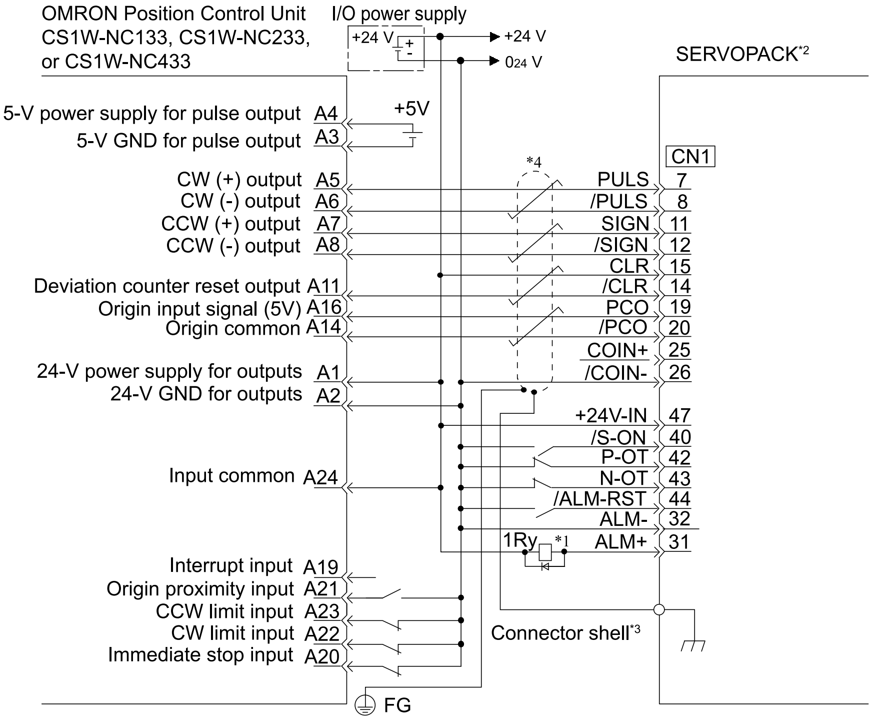
*2 The pulse output from Yokogawa Electric's F3NC3□-0N positioning module uses negative logic, so the positive and negative connections are reversed.

*3 Connect these when using an absolute encoder.

Note:

1. Only signals that are applicable to the SERVOPACK and Yokogawa Electric's F3NC3□-0N positioning module are shown in the diagram.
2. Incorrect wiring may damage the positioning module or SERVOPACK. Wire all connections carefully.
3. Do not wire any unused signal lines (i.e., leave them open).
4. The above wiring diagram shows the connections for only one axis. If you will use other axes, performing wiring to the SERVOPACK in the same way.

16.1.4 Example of Connections to an OMRON Position Control Unit



*1 The ALM (Servo Alarm) signal is output for up to 10 seconds when the power supply is turned ON. Take this into consideration when designing the power ON sequence. Also, use the ALM signal to actuate the alarm detection relay (1Ry) to stop the main circuit power supply to the SERVOPACK.

*2 Set Pn200 to n.□□□1 (CW and CCW pulse trains with positive logic).

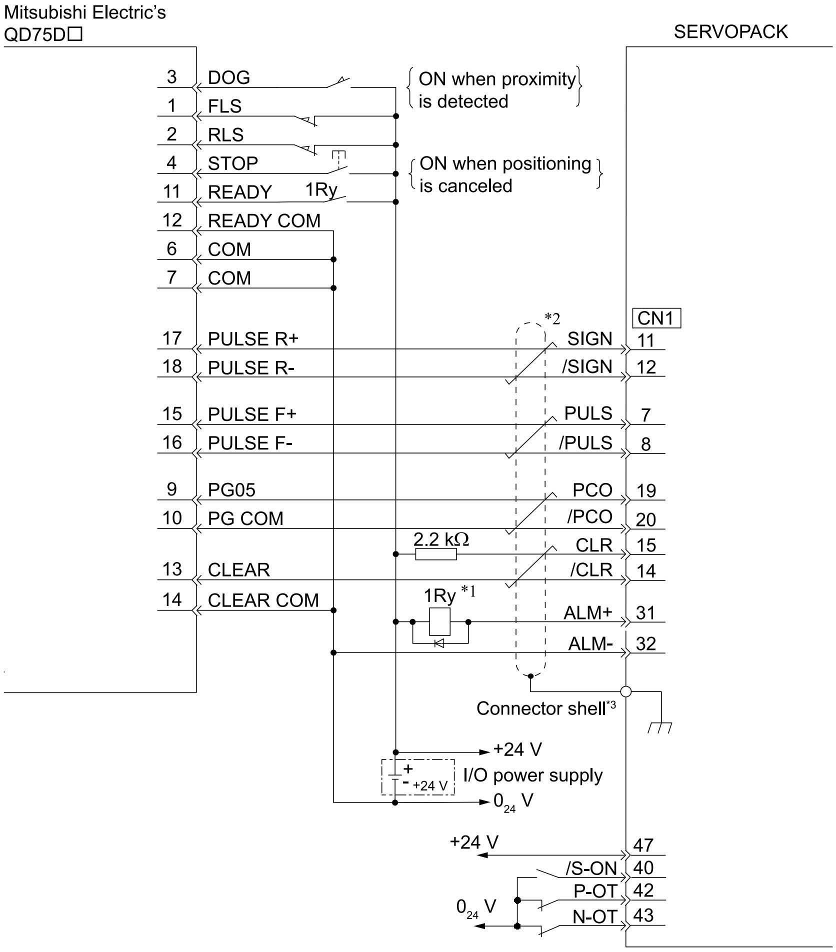
*3 Connect the shielded wire to the connector shell.

*4 ⌀ represents a shielded twisted-pair cable.

Note:

1. Only the signals that are applicable to the SERVOPACK and the OMRON position control unit are shown in the diagram.
2. The main circuit power supply for the SERVOPACK in this connection example is three-phase 200 VAC.
3. Incorrect wiring may damage the position control unit or SERVOPACK. Wire all connections carefully.
4. Do not wire any unused signal lines (i.e., leave them open).
5. The above wiring diagram shows the connections for only the X axis. If you will use other axes, make connections to the SERVOPACK in the same way.
6. All normally closed input terminals that are not used at the position control unit's I/O connector section must be connected at the connector.
7. Set the parameters so that the servo can be turned ON and OFF with the /S-ON (Servo ON Input) signal.
8. The SERVOPACK provides safety functions to protect people from the hazardous operation of the moving parts of the machine. In order to use the safety functions, the required circuits must be configured for CN8. If the safety functions will not be used, leave the enclosed safety jumper connector connected to the SERVOPACK (CN8). Refer to the following chapter for details.
   ☞ *12 Safety Functions on page 563*

16.1.5 Example of Connection to Mitsubishi's QD75D□ Positioning Module for Position Control



*1 The ALM (Servo Alarm) signal is output for up to 10 seconds when the power supply is turned ON. Take this into consideration when designing the power ON sequence. Also, use the ALM signal to actuate the alarm detection relay (1Ry) to stop the main circuit power supply to the SERVOPACK.

*2  represents a shielded twisted-pair cable.

*3 Connect the shielded wire to the connector shell.

Note:

1. Only the signals that are applicable to the SERVOPACK and Mitsubishi Electric's QD75D□ positioning module are shown in the diagram.
2. The main circuit power supply for the SERVOPACK in this connection example is three-phase 200 VAC.
3. Incorrect wiring may damage the positioning module or SERVOPACK. Wire all connections carefully.
4. Do not wire any unused signal lines (i.e., leave them open).
5. The above wiring diagram shows the connections for only one axis. If you will use other axes, make connections to the SERVOPACK in the same way.
6. All normally closed input terminals that are not used at the positioning module's I/O connector section must be connected at the connector.
7. Set the parameters so that the servo can be turned ON and OFF with the /S-ON (Servo ON Input) signal.
8. The SERVOPACK provides safety functions to protect people from the hazardous operation of the moving parts of the machine. In order to use the safety functions, the required circuits must be configured for CN8. If the safety functions will not be used, leave the enclosed safety jumper connector connected to the SERVOPACK (CN8). Refer to the following chapter for details.
☞ *12 Safety Functions on page 563*

16.2 Corresponding SERVOPACK and SigmaWin+ Function Names

This section gives the names and numbers of the utility functions and monitor display functions used by the SERVOPACKs and the names used by the SigmaWin+.

16.2.1 Corresponding SERVOPACK Utility Function Names

SigmaWin+		SERVOPACK	
Button in [Menu] Window	**Function Name**	**Fn No.**	**Function Name**
Basic Functions	Initialize	Fn005	Initialize Parameters
	Software Reset	Fn030	Software Reset
	Setup Wizard	–	–
	I/O Signal Allocation	–	–
	Product Information	Fn011	Display Servomotor Model
		Fn012	Display Software Version
		Fn01E	Display SERVOPACK and Servomotor IDs
		Fn01F	Display Servomotor ID from Feedback Option Module
Encoder Setting	Reset Absolute Encoder	Fn008	Reset Absolute Encoder
	Multi-turn Limit Setup	Fn013	Multiturn Limit Setting after A.CC0 (Multiturn Limit Disagreement) Alarm
	Search Origin	Fn003	Origin Search
	Zero Point Position Setting	Fn020	Set Absolute Linear Encoder Origin
	Polarity Detection	Fn080	Polarity Detection
Troubleshooting	Display Alarm	Fn000	Display Alarm History
		Fn006	Clear Alarm History
		Fn014	Reset Option Module Configuration Error
	Alarm Trace	–	–
	Reset Motor Type Alarm	Fn021	Reset Motor Type Alarm
Operation	Jog	Fn002	Jog
	Program JOG Operation	Fn004	Program JOG Operation
Monitor	Trace	–	–
	Real Time Trace	–	–
	Monitor	–	–
	Life Monitor	–	–

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SigmaWin+		SERVOPACK	
Button in [Menu] Window	**Function Name**	**Fn No.**	**Function Name**
Tuning	Tuning - Autotuning without Host Reference	Fn201	Advanced Autotuning without Reference
	Tuning - Autotuning with Host Reference	Fn202	Advanced Autotuning with Reference
	Tuning - Custom Tuning	Fn203	One-Parameter Tuning
	Tuning - Custom Tuning - Adjust Anti-resonance Control	Fn204	Adjust Anti-resonance Control
	Tuning - Custom Tuning - Vibration Suppression	Fn205	Vibration Suppression
	System Tuning	–	–
	Response Level Setting	Fn200	Tuning-less Level Setting
	Edit Online Parameters	–	–
Diagnostic	Mechanical Analysis	–	–
	Easy FFT	Fn206	Easy FFT
	Ripple Compensation	–	–
	Online Vibration Monitor	–	–
Others	Adjust the Speed and Torque Reference Offset	Fn009	Autotune Analog (Speed/ Torque) Reference Offset
		Fn00A	Manually Adjust Speed Reference Offset
		Fn00B	Manually Adjust Torque Reference Offset
	Adjust the Analog Monitor Output	Fn00C	Adjust Analog Monitor Output Offset
		Fn00D	Adjust Analog Monitor Output Gain
	Adjust the Motor Current Detection Signal Offsets	Fn00E	Autotune Motor Current Detection Signal Offset
		Fn00F	Manually Adjust Motor Current Detection Signal Offset
	Initialize Vibration Detection Level	Fn01B	Initialize Vibration Detection Level
	Parameter Converter	–	–
	SERVOPACK Axis Name Setting	–	–
	Write Prohibited Setting	Fn010	Write Prohibition Setting
	Motor Parameter SERVOPACK Write	–	–

16.2.2 Corresponding SERVOPACK Monitor Display Function Names

SigmaWin+ Button in [Menu] Window: [Monitor] - [Operation]	SERVOPACK	
Name [Unit]	**Un No.**	**Name [Unit]**
Motor Speed [min^{-1}]	Un000	Motor Speed [min^{-1}]
Speed Reference [min^{-1}]	Un001	Speed Reference [min^{-1}]
Torque Reference [%]	Un002	Torque Reference [%] (percentage of rated torque)

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SigmaWin+ Button in [Menu] Window: [Monitor] - [Operation]	**SERVOPACK**	
Name [Unit]	**Un No.**	**Name [Unit]**
• Rotary servomotors: Rotational Angle 1 [encoder pulses] (number of encoder pulses from origin within one encoder rotation) • Linear servomotors: Electrical Angle 1 [linear encoder pulses] (linear encoder pulses from the polarity origin)	Un003	• Rotary servomotors: Rotational Angle 1 [encoder pulses] (number of encoder pulses from origin within one encoder rotation displayed in decimal) • Linear servomotors: Electrical Angle 1 [linear encoder pulses] (linear encoder pulses from the polarity origin displayed in decimal)
• Rotary servomotors: Rotational Angle 2 [deg] (electrical angle from origin within one encoder rotation) • Linear servomotors: Electrical Angle 2 [deg] (electrical angle from polarity origin)	Un004	• Rotary servomotors: Rotational Angle 2 [deg] (electrical angle from polarity origin) • Linear servomotors: Electrical Angle 2 [deg] (electrical angle from polarity origin)
Input Reference Pulse Speed [min^{-1}]	Un007	Input Reference Pulse Speed [min^{-1}] (displayed only during position control)
Position Deviation [reference units]	Un008	Position Deviation [reference units] (displayed only during position control)
Accumulated Load Ratio [%]	Un009	Accumulated Load Ratio [%] (percentage of rated torque: effective torque in cycles of 10 seconds)
Regenerative Load Ratio [%]	Un00A	Regenerative Load Ratio [%] (percentage of processable regenerative power: regenerative power consumption in cycles of 10 seconds)
Dynamic Brake Resistor Power Consumption [%]	Un00B	Dynamic Brake Resistor Power Consumption [%] (percentage of processable power at DB activation: displayed in cycles of 10 seconds)
Input Reference Pulse Counter [reference units]	Un00C	Input Reference Pulse Counter [reference units]
Feedback Pulse Counter [encoder pulses]	Un00D	Feedback Pulse Counter [encoder pulses]
Fully-closed Loop Feedback Pulse Counter [external encoder resolution]	Un00E	Fully-closed Loop Feedback Pulse Counter [external encoder resolution]
Upper Limit Setting of Motor Maximum Speed/Upper Limit Setting of Encoder Output Resolution	Un010 *1	Upper Limit Setting of Motor Maximum Speed/Upper Limit Setting of Encoder Output Resolution
Total Operation Time [100 ms]	Un012	Total Operation Time [100 ms]
Feedback Pulse Counter [reference units]	Un013	Feedback Pulse Counter [reference units]
Overheat Protection Input [0.01 V]	Un02F	Overheat Protection Input [0.01 V]
Power Consumption [W]	Un032	Power Consumption [W]
Consumed Power [0.001 Wh]	Un033	Consumed Power [0.001 Wh]
Cumulative Power Consumption [Wh]	Un034	Cumulative Power Consumption [Wh]
Absolute Encoder Multiturn Data	Un040	Absolute Encoder Multiturn Data
Position within One Rotation of Absolute Encoder [encoder pulses]	Un041	Position within One Rotation of Absolute Encoder [encoder pulses]
Lower Bits of Absolute Encoder Position [encoder pulses]	Un042	Lower Bits of Absolute Encoder Position [encoder pulses]
Upper Bits of Absolute Encoder Position [encoder pulses]	Un043	Upper Bits of Absolute Encoder Position [encoder pulses]
Lower Bits of External Absolute Encoder Position [encoder pulses]	Un054	Lower Bits of External Absolute Encoder Position [encoder pulses]
Upper Bits of External Absolute Encoder Position [encoder pulses]	Un055	Upper Bits of External Absolute Encoder Position [encoder pulses]
Maximum Value of Amplitude of Estimated Vibration [min^{-1}]	Un078	Maximum Value of Amplitude of Estimated Vibration [min^{-1}]

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SigmaWin+ Button in [Menu] Window: [Monitor] - [Operation]	**SERVOPACK**	
Name [Unit]	**Un No.**	**Name [Unit]**
Estimated External Disturbance Torque [%]	Un079	Estimated External Disturbance Torque [%]
Maximum Value of Estimated External Disturbance Torque [%]	Un07A	Maximum Value of Estimated External Disturbance Torque [%]
Minimum Value of Estimated External Disturbance Torque [%]	Un07B	Minimum Value of Estimated External Disturbance Torque [%]
Identified Moment of Inertia Ratio [%]	Un07C	Identified Moment of Inertia Ratio [%]
Maximum Identified Moment of Inertia Ratio [%]	Un088	Maximum Identified Moment of Inertia Ratio [%]
Minimum Identified Moment of Inertia Ratio [%]	Un089	Minimum Identified Moment of Inertia Ratio [%]
Number of Serial Encoder Communications Errors [times]	Un104	Number of Serial Encoder Communications Errors [times]
Settling Time [0.1 ms]	Un105	Settling Time [0.1 ms]
Amount of Overshoot [reference units]	Un106	Amount of Overshoot [reference units]
Residual Vibration Frequency [0.1 Hz]	Un107	Residual Vibration Frequency [0.1 Hz]
Maximum Settling Time [0.1 ms]	Un108	Maximum Settling Time [0.1 ms]
Maximum Amount of Overshoot [reference units]	Un109	Maximum Amount of Overshoot [reference units]
Estimated Vibration [min^{-1}]	Un10C	Estimated Vibration [min^{-1}]
Margin until Regenerative Overload [0.01%]	Un13C	Margin until Regenerative Overload [0.01%]
Margin until Undervoltage [V]	Un13E	Margin until Undervoltage [V]
Margin until Overvoltage [V]	Un13F	Margin until Overvoltage [V]
Maximum Value of Accumulated Load Ratio [%]	Un145	Maximum Value of Accumulated Load Ratio [%]
Margin until Overload [0.01 %]	Un14E	Margin until Overload [0.01 %]
Temperature Margin until SERVOPACK Overheats [°C]	Un173	Temperature Margin until SERVOPACK Overheats [°C]
Temperature Margin until Servomotor Overheats [°C]	Un174	Temperature Margin until Servomotor Overheats [°C]
Encoder Power Supplied Time [100 ms]	Un177	Encoder Power Supplied Time [100 ms]
Encoder Power Supply Voltage [0.01 V]	Un17A	Encoder Power Supply Voltage [0.01 V]
Encoder Battery Voltage [0.1 V]	Un17B	Encoder Battery Voltage [0.1 V]
Motor Total Number of Rotations [100 rev]	Un181	Motor Total Number of Rotations [100 rev]
Maintenance Prediction Monitor - Bearings	Un183	Maintenance Prediction Monitor - Bearings
Maintenance Prediction Monitor - Oil Seal	Un184	Maintenance Prediction Monitor - Oil Seal
Motor Vibration in X-Axis Direction [0.0001 G]	Un190	Motor Vibration in X-Axis Direction [0.0001 G]
Motor Vibration in Y-Axis Direction [0.0001 G]	Un191	Motor Vibration in Y-Axis Direction [0.0001 G]
Motor Vibration in Z-Axis Direction [0.0001 G]	Un192	Motor Vibration in Z-Axis Direction [0.0001 G]
Motor Vibration XYZ Composite Value [0.0001 G]	Un193	Motor Vibration XYZ Composite Value [0.0001 G]
Maximum Motor Vibration [0.0001 G]	Un194	Maximum Motor Vibration [0.0001 G]
Σ-LINK II Response Data 1	Un1A0	Σ-LINK II Response Data 1
Σ-LINK II Response Data 2	Un1A1	Σ-LINK II Response Data 2
Σ-LINK II Response Data 3	Un1A2	Σ-LINK II Response Data 3
Σ-LINK II Response Data 4	Un1A3	Σ-LINK II Response Data 4
Σ-LINK II Response Data 5	Un1A4	Σ-LINK II Response Data 5
Σ-LINK II Response Data 6	Un1A5	Σ-LINK II Response Data 6

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SigmaWin+ Button in [Menu] Window: [Monitor] - [Operation]	SERVOPACK	
Name [Unit]	**Un No.**	**Name [Unit]**
Σ-LINK II Response Data 7	Un1A6	Σ-LINK II Response Data 7
Σ-LINK II Response Data 8	Un1A7	Σ-LINK II Response Data 8
Σ-LINK II Command Data 1	Un1C0	Σ-LINK II Command Data 1
Σ-LINK II Command Data 2	Un1C1	Σ-LINK II Command Data 2
Σ-LINK II Command Data 3	Un1C2	Σ-LINK II Command Data 3
Σ-LINK II Command Data 4	Un1C3	Σ-LINK II Command Data 4
Σ-LINK II Data Status	Un1CC	Σ-LINK II Data Status
Σ-LINK II Data Status	Un1CD	Σ-LINK II Data Status
Σ-LINK II Data Status	Un1CE	Σ-LINK II Data Status
Σ-LINK II Data Status	Un1CF	Σ-LINK II Data Status

*1 You can use Un010 to monitor the upper limit setting for the maximum motor speed or the upper limit setting for the encoder output resolution.
You can monitor the upper limit of Pn281 (Encoder Output Resolution) for the current Pn385 (Maximum Motor Speed), or you can monitor the upper limit of the maximum motor speed setting for the current encoder output resolution setting.
Select which signal to monitor with Pn080 = n.X□□□ (Calculation Method for Maximum Speed or Encoder Output Pulses).

- If Pn080 = n.0□□□, Pn281 (Encoder Output Resolution) that can be set is displayed.
- If Pn080 = n.1□□□, Pn385 (Maximum Motor Speed) that can be set is displayed in mm/s.

SigmaWin+ Button in [Menu] Window: [Monitor] - [Status]	SERVOPACK	
Name [Unit]	**Un No.**	**Name [Unit]**
Active Gain Monitor	Un014	Active Gain Monitor (gain settings 1 = 1, gain settings 2 = 2)
Safety I/O Signal Monitor	Un015	Safety I/O Signal Monitor

SigmaWin+ Button in [Menu] Window: [Monitor] - [I/O]	SERVOPACK	
Name [Unit]	**Un No.**	**Name [Unit]**
Input Signal Monitor	Un005	Input Signal Monitor
Output Signal Monitor	Un006	Output Signal Monitor
Σ-LINK II Sequence Input Signal Monitor	Un1C8	Σ-LINK II Sequence Input Signal Monitor
Σ-LINK II Sequence Output Signal Monitor	Un1CA	Σ-LINK II Sequence Output Signal Monitor

SigmaWin+ Button in [Menu] Window: [Service Life]	SERVOPACK	
Name [Unit]	**Un No.**	**Name [Unit]**
Installation Environment Monitor − SERVOPACK	Un025	SERVOPACK Installation Environment Monitor [%]
Installation Environment Monitor − Servomotor *1	Un026	Servomotor Installation Environment Monitor [%]
Service Life Prediction Monitor − Built-in Fan	Un027	Built-in Fan Remaining Life Ratio [%]
Service Life Prediction Monitor − Capacitor	Un028	Capacitor Remaining Life Ratio [%]
Service Life Prediction Monitor − Surge Prevention Circuit	Un029	Surge Prevention Circuit Remaining Life Ratio [%]
Service Life Prediction Monitor − Dynamic Brake Circuit	Un02A	Dynamic Brake Circuit Remaining Life Ratio [%]
Maintenance Prediction Monitor - Bearings	Un183	Maintenance Prediction Monitor - Bearings
Maintenance Prediction Monitor - Oil Seal	Un184	Maintenance Prediction Monitor - Oil Seal

*1 This applies to the following motors. The display will show 0 for all other models.

- SGMXJ, SGMXA, SGMXP, SGMXG, SGM7M, SGM7D, SGM7E, SGM7F

SigmaWin+ Button in [Menu] Window: [Product Information]	**SERVOPACK**	
Name [Unit]	**Un No.**	**Name [Unit]**
Motor − Resolution	Un084	Linear Encoder Pitch (Scale pitch = Un084 × 10^{Un085} [pm])
	Un085	Linear Encoder Pitch Exponent (Scale pitch = Un084 × 10^{Un085} [pm])

SigmaWin+ Button in [Menu] Window: [Trace]	**SERVOPACK**	
Name [Unit]	**Un No.**	**Name [Unit]**
Main Circuit DC Voltage	Un023	Main Circuit DC Voltage

The following Un numbers are not displayed as monitors in SigmaWin+.

SERVOPACK	
Un No.	**Name [Unit]**
Un011	Polarity Sensor Signal Monitor
Un020	Motor Rated Speed [min^{-1}]
Un021	Maximum Motor Speed [min^{-1}]

Index

Revision History

The date of publication, revision code, revision number, and web revision number are given at the bottom right of the back cover. Refer to the following example.

Revision number
Revision code
Web revision number
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Date of Publication	Rev. Code	Rev. No.	Web Rev. No.	Section	Revised Contents
October 2023	F	<5>	0	All chapters	Partly revised.
				Back cover	Revision: Address
February 2023	E	<4>	0	8.8.5	Deletion: Operating procedure for multi-axis simultaneous tuning
				All chapters	Partly revised.
				Back cover	Revision: Address
April 2022	D	<3>	0	All chapters	Addition: Information on SGDXS-590A, and -780A
					Addition: Information on SGMXA-15 to -70, SGMXP, SGMXG-03, -05, -1A, -1E, and SGM7M
					Partly revised.
December 2021	C	<2>	0	5.12.4	Addition: Overtravel alarms
				8.5.4	Addition: When the travel distance is less than 0.25 rotations (2.5 mm for a linear servomotor)
				8.8.5	Addition: Operating procedure for multi-axis simultaneous tuning
				8.12	Addition: Speed ripple compensation
				11.8	Addition: Changing detection conditions of alarms related to Σ-LINK II
				All chapters	Partly revised.
August 2021	B	<1>	0	All chapters	Addition: Information on SGDXS-330A, -470A, -550A
					Addition: Information on SGMXG-30A, -44A, -55A, -75A
					Partly revised.
April 2021	A	<0>	0	–	First edition

Σ-X-Series AC Servo Drive

Σ-XS SERVOPACK with Analog Voltage/Pulse Train References

Product Manual

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YASKAWA ELECTRIC CORPORATION

In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

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