YASKAWA

Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with Analog Voltage/Pulse Train References Product Manual

Model: SGD7S-UUUU00AUUUUUU



s Motors Wiring and Connecting SERVOPACKs

Basic Functions That Require Setting before Operation

Application Functions

Trial Operation and Actual Operation

Tuning

Monitoring

Fully-Closed Loop Control

Safety Functions

Maintenance

Panel Displays and Panel Operator Procedures

Parameter Lists

Appendices

MANUAL NO. SIEP S800001 26K

SERVOPACK Installation



Drives Motors Controls

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About this Manual

This manual provides information required to select Σ -7S SERVOPACKs with Analog Voltage/Pulse Train References for Σ -7-Series AC Servo Drives, and to design, perform trial operation of, tune, operate, and maintain the Servo Drives.

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

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

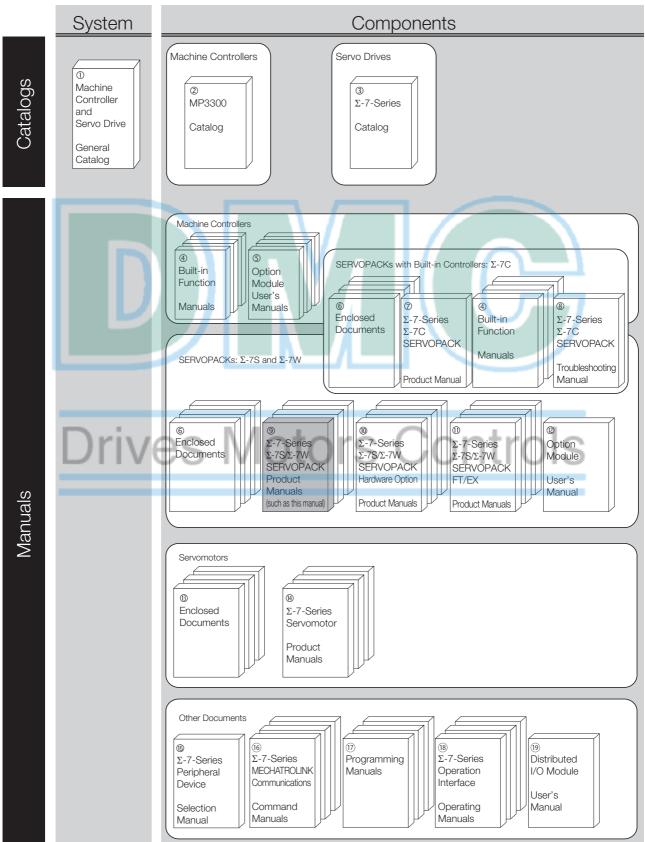
Outline of Manual

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

Chapter	Chapter Title	Contents
1	Basic Information on SERVOPACKs	Provides information required to select SERVOPACKs, such as 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	Safety Functions	Provides detailed information on the safety functions of the SERVO-PACK.
12	Maintenance	Provides information on the meaning of, causes of, and corrections for alarms and warnings.
13	Panel Displays and Panel Operator Procedures	Describes how to interpret panel displays and the operation of the Panel Operator.
14	Parameter Lists	Provides information on the parameters.
15	Appendices	Provides host controller connection examples and tables of corresponding SERVOPACK and SigmaWin+ function names.

Related Documents

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



Classification	Document Name	Document No.	Description
Machine Controller and Servo Drive General Catalog Machine Controller and AC Servo Drive Solutions Catalog		KAEP S800001 22	Describes the features and application examples for combinations of MP3000-Series Machine Controllers and Σ -7-Series AC Servo Drives.
② MP3300 Catalog	Machine Controller MP3300	KAEP C880725 03	Provides detailed information on MP3300 Machine Controllers, including features and specifications.
③ Σ-7-Series Catalog	AC Servo Drives Σ-7 Series	KAEP S800001 23	Provides detailed information on Σ -7-Series AC Servo Drives, including features and specifications.
	Σ-7-Series AC Servo Drive Σ-7C SERVOPACK Motion Control User's Manual	SIEP S800002 03	Provides detailed information on the specifications, system configuration, and application methods of the Motion Control Function Modules (SVD, SVC4, and SVR4) for Σ -7-Series Σ -7C SERVOPACKs.
Built-in Function Manuals	Machine Controller MP3000 Series Communications User's Manual	SIEP C880725 12	Provides detailed information on the specifications, system configuration, and communications connection methods for the Ethernet communications that are used with MP3000-Series Machine Controllers and Σ -7-Series Σ -7C SERVO-PACKs.
	Machine Controller MP2000 Series Communication Module User's Manual	SIEP C880700 04	
	Machine Controller MP2000 Series 262IF-01 FL-net Communication Module User's Manual	SIEP C880700 36	Provide detailed information on the specifications and communications methods for the Communications Modules that can be mounted to MP3000-Series Machine Controllers and Σ-7-Series Σ-7C
Drive	Machine Controller MP2000 Series 263IF-01 EtherNet/IP Communication Module User's Manual	SIEP C880700 39	SERVOPACKs.
Option Module User's Manuals	Machine Controller MP2000 Series I/O Module User's Manual	SIEP C880700 34	
	Machine Controller MP2000 Series Analog Input/Analog Output Module Al-01/AO-01 User's Manual	SIEP C880700 26	Provide detailed information on the specifications and communications methods for the I/O Modules that can be mounted to MP3000-Series Machine Controllers and Σ -7-Series Σ -7C SERVOPACKs.
	Machine Controller MP2000 Series Counter Module CNTR-01 User's Manual	SIEP C880700 27	Continued on payt page

Salety Frequitions Option Module	Clossification	Decument Name	Dogument Na	Continued from previous page.
Substitutions Substitutions	Classification		Document No.	· · · · · · · · · · · · · · · · · · ·
ToBP C720829 00 Provides detailed information for the safe usage of Option Modules		Σ -7S and Σ -7W SERVOPACK	TOMP C710828 00	the safe usage of Σ-7-Series
Tobs		for Large-Capacity Models/ Σ-7-Series Safety Precautions	TOBP C720829 00	Provides detailed information for the safe usage of Option Modules.
For Large-Capacity Models/ Σ-7-Series TOBP C720829 03 Installation Guide Fully-closed Module Enclosed Documents		for Large-Capacity Models/ Σ-7-Series Installation Guide	TOBP C720829 01	installing the Command Option
for Large-Capacity Models/ Σ-7-Series Installation Guide Safety Module Σ-V-Series/Σ-V-Series for Large-Capacity Models/ Σ-7-Series Installation Guide ServOPACK. TOBP C720829 02 Provides detailed procedures for installing the INDEXER Module in SERVOPACK. TOBP C720829 02 Provides detailed procedures for installing the INDEXER Module in SERVOPACK. TOBP C720829 02 Provides detailed procedures for installing the INDEXER Module in SERVOPACK. TOBP C720829 07 Provides detailed procedures for installing the DeviceNet Module in SERVOPACK. Provides detailed procedures for installing the DeviceNet Module in SERVOPACK. Provides detailed procedures for installing the DeviceNet Module in SERVOPACK. Provides detailed information on selecting Σ-7-Series Σ-7C SERVOPACK. PACKs; installing, connecting, set ting, testing in trial operation, and tuning Servo Drives; writing, monitoring, and maintaining programs; and other information. ServoPacks Σ-7-Series Σ-7-Series Σ-7-Series Δ-Servo Drive Σ-7-Series Σ-7-Series Δ-Servo Drive Σ-7-Serie	_	for Large-Capacity Models/ Σ-7-Series Installation Guide	TOBP C720829 03	installing the Fully-closed Module in
for Large-Capacity Models/ Σ-7-Series Installation Guide INDEXER Module Σ-V-Series/Σ-V-Series for Large-Capacity Models/ Σ-7-Series for Large-Capacity Models/ Σ-7-Series for Large-Capacity Models/ Σ-7-Series Installation Guide DeviceNet Module Σ-7-Series Σ-7-Series Σ-7-Series ΔC Servo Drive Σ-7C SERVOPACK Product Manual Σ-7-Series ΔC Servo Drive Σ-7-Series		for Large-Capacity Models/ Σ-7-Series Installation Guide	TOBP C720829 06	installing the Safety Module in a
for Large-Capacity Models/ Σ-7-Series Installation Guide DeviceNet Module Provides detailed procedures for installing the DeviceNet Module in SERVOPACK. Provides detailed information on selecting Σ-7-Series Σ-7C SERVOPACK PACKs; installing, connecting, set ting, testing in trial operation, and tuning Servo Drives; writing, monitoring, and maintaining programs; and other information. S-7-Series Σ-7-Series Σ-7-Series ΔC Servo Drive Σ-7-Series Σ-7-Series Σ-7-Series ΔC Servo Drive Σ-7-Series Σ-7-Series ΔC Servo Drive		for Large-Capacity Models/ Σ-7-Series Installation Guide	TOBP C720829 02	installing the INDEXER Module in a
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$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	Σ -7-Series Σ -7C SERVOPACK	Σ-7C SERVOPACK	SIEP S800002 04	selecting Σ-7-Series Σ-7C SERVO-PACKs; installing, connecting, setting, testing in trial operation, and tuning Servo Drives; writing, monitoring, and maintaining programs;
	Σ -7-Series Σ -7C SERVOPACK	Σ-7C SERVOPACK	SIEP S800002 07	information for Σ -7-Series Σ -7C

Classification	Document Name	Document No.	Continued from previous page. Description
Ciassilloation	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with MECHATROLINK-III Communications References Product Manual	SIEP \$800001 28	Безаприон
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with MECHATROLINK-II Communications References Product Manual	SIEP S800001 27	
⑨Σ-7-SeriesΣ-7S/Σ-7W	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with Analog Voltage/Pulse Train References Product Manual	This manual (SIEP S800001 26)	Provide detailed information on selecting Σ-7-Series SERVO-PACKs and information on installing, connecting, setting, performing
SERVOPACK Product Manuals	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK Command Option Attachable Type with INDEXER Module Product Manual	SIEP S800001 64	trial operation for, tuning, monitoring, and maintaining the Servo Drives.
	Σ-7-Series AC Servo Drive Σ-7S SERVOPACK Command Option Attachable Type with DeviceNet Module Product Manual		
	Σ-7-Series AC Servo Drive Σ-7W SERVOPACK with MECHATROLINK-III Communications References Product Manual	SIEP S800001 29	
© Σ-7-Series	Σ-7-Series AC Servo Drive Σ-7S/Σ-7W SERVOPACK with Hardware Option Specifica- tions Dynamic Brake	SIEP S800001 73	ntrols
Σ -7-3eries Σ -7S/ Σ -7W	Product Manual		Provide detailed information on
SERVOPACK with Hardware Option Specifications Product Manuals	Σ-7-Series AC Servo Drive Σ-7W/Σ-7C SERVOPACK with Hardware Option Specifica- tions HWBB Function Product Manual	SIEP S800001 72	Hardware Options for Σ -7-Series SERVOPACKs.

Classification Document Name Document No. Description Σ-7-Series AC Servo Drive Σ-7s SERVOPACK with FT/EX Specification for Indexing Application Product Manual SIEP S800001 84 Σ-7-Series AC Servo Drive Σ-7s SERVOPACK with FT/EX Specification for Tracking Application Product Manual SIEP S800001 89 Σ-7-Series AC Servo Drive Σ-7s Series AC Servo Drive Σ-7s Series AC Servo Drive Σ-7s Series AC Servo Drive Σ-7s SERVOPACK with FT/EX Specification for Product Manual SIEP S800001 91 Φ-T-Series AC Servo Drive Σ-7s SERVOPACK with FT/EX Specification for Product Manual SIEP S800001 94 Σ-7-Series AC Servo Drive Σ-7s SERVOPACK with FT/EX Specification for Transfer and Alignment Application Product Manual SIEP S800001 95 SIEP S800001 95 SIEP S800001 95	
Σ-7S SERVOPACK with FT/EX Specification for Indexing Application Product Manual Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification Product Manual Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification Product Manual Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Application with Special Motor, SGM7D Motor Product Manual Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Press and Injection Molding Application FT/EX Option for Σ-7-Series SERVOPACK with FT/EX Specification for Press and Injection Molding Application Product Manual Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Press and Injection Molding Application Product Manual Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Transfer and Alignment Application Product Manual	
Σ-7S SERVOPACK with FT/EX Specification for Tracking Application Product Manual Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Application with Special Motor, SGM7D Motor Product Manual Σ-7-Series AC Servo Drive Σ-7-Series AC Servo Drive Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Product Manual Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Press and Injection Molding Application Product Manual Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification Product Manual Servo Drive SIEP S800001 95 SIE	
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Σ-7S SERVOPACK with FT/EX Specification for Transfer and Alignment Application Product Manual	
Σ-7-Series AC Servo Drive	
Σ-7S SERVOPACK with FT/EX Specification for Torque/Force Assistance for Conveyance Application Product Manual	
Σ-7-Series AC Servo Drive Σ-7S SERVOPACK with FT/EX Specification for Cutting Application Feed Shaft Motor Product Manual	
	d mainte-
AC Servo Drive Rotary Servomotor Safety Precautions TOBP C230260 00 Provides detailed informati the safe usage of Rotary S tors and Direct Drive Servo	Servomo-
Enclosed Documents AC Servomotor Linear Σ Series Safety Precautions TOBP C230800 00 Provides detailed informati the safe usage of Linear Settors. Continued on the safe usage of Linear Settors.	

Classification	Document Name	Document No.	Description
	Σ-7-Series AC Servo Drive Rotary Servomotor Product Manual	SIEP S800001 36	·
® Σ-7-Series Servomotor Product Manuals	Σ-7-Series AC Servo Drive Linear Servomotor Product Manual	SIEP S800001 37	Provide detailed information on selecting, installing, and connecting the Σ -7-Series Servomotors.
	Σ-7-Series AC Servo Drive Direct Drive Servomotor Product Manual	SIEP S800001 38	
© Σ-7-Series Peripheral Device Selection Manual	Σ-7-Series AC Servo Drive Peripheral Device Selection Manual	SIEP S800001 32	 Provides the following information in detail for Σ-7-Series Servo Systems. Cables: Models, dimensions, wiring materials, connector models, and connection specifications Peripheral devices: Models, specifications, diagrams, and selection (calculation) methods
© Σ-7-Series	Σ-7-Series AC Servo Drive MECHATROLINK-II Communications Command Manual	SIEP S800001 30	Provides detailed information on the MECHATROLINK-II communications commands that are used for a Σ -7-Series Servo System.
MECHATROLINK Communications Command Manuals	Σ-7-Series AC Servo Drive MECHATROLINK-III Communications Standard Servo Profile Command Manual	SIEP S800001 31	Provides detailed information on the MECHATROLINK-III communications standard servo profile commands that are used for a Σ -7-Series Servo System.
0	Machine Controller MP3000 Series Ladder Programming Manual	SIEP C880725 13	Provides detailed information on the ladder programming specifications and instructions for MP3000-Series Machine Controllers and Σ -7-Series Σ -7C SERVOPACKs.
Programming Manuals	Machine Controller MP3000 Series Motion Programming Manual	SIEP C880725 14	Provides detailed information on the motion programming and sequence programming specifications and instructions for MP3000-Series Machine Controllers and Σ -7-Series Σ -7C SERVOPACKs.

Classification	Classification Document Name		Description
	Machine Controller MP2000/MP3000 Series Engineering Tool MPE720 Version 7 User's Manual	SIEP C880761 03	Describes in detail how to operate MPE720 version 7.
[®] Σ-7-Series Operation Interface Operating Manuals	Σ-7-Series AC Servo Drive Digital Operator Operating Manual	SIEP S800001 33	Describes the operating procedures for a Digital Operator for a Σ-7-Series Servo System.
	AC Servo Drive Engineering Tool SigmaWin+ Operation Manual	SIET S800001 34	Provides detailed operating procedures for the SigmaWin+ Engineering Tool for a Σ -7-Series Servo System.
® Distributed I/O Module User's Manual	MECHATROLINK-III Compatible I/O Module User's Manual	SIEP C880781 04	Describes the functions, specifications, operating methods, and MECHATROLINK-III communications for the Remote I/O Modules for MP2000/MP3000-Series Machine Controllers.

Using This Manual

◆ Technical Terms Used in This Manual

The following terms are used in this manual.

Term	Meaning			
Servomotor	A Σ-7-Series Rotary Servomotor, Direct Drive Servomotor, or Linear Servomotor.			
Rotary Servomotor	A generic term used for a Σ-7-Series Rotary Servomotor (SGMMV, SGM7J, SGM7A, SGM7P, or SGM7G) or a Direct Drive Servomotor (SGM7E, SGM7F, SGMCV, or SGMCS). 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, or SGLT).			
SERVOPACK	A Σ -7-Series Σ -7S 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.			

◆ Differences in Terms for Rotary Servomotors and Linear Servomotors

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

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

Notation Used in this Manual

■ Notation for Reverse Signals

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

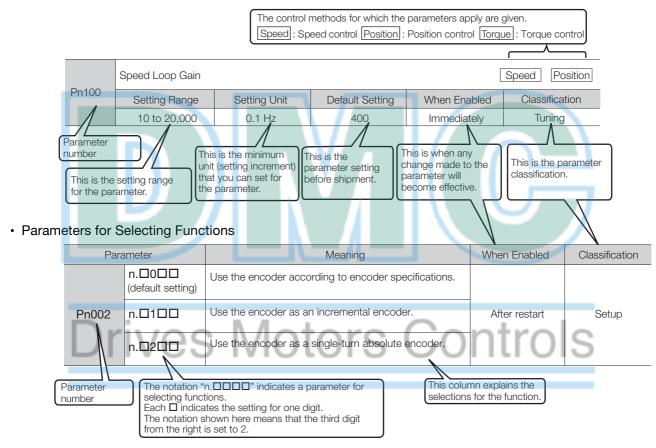
Notation Example

BK is written as /BK.

■ Notation for Parameters

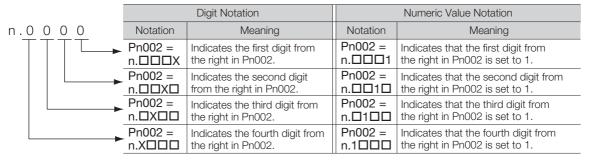
The notation depends on whether the parameter requires a numeric setting (parameter for numeric setting) or requires the selection of a function (parameter for selecting functions).

· Parameters for Numeric Settings



Notation Example

Notation Examples for Pn002



◆ Engineering Tools Used in This Manual

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

♦ Trademarks

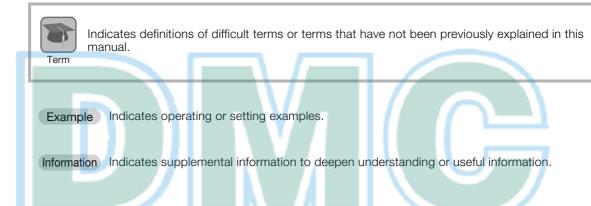
- QR code is a trademark of Denso Wave Inc.
- Other product names and company names are the trademarks or registered trademarks of the respective company. "TM" and the ® mark do not appear with product or company names in this manual.

Visual Aids

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



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



Safety Precautions

Safety Information

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

DANGER

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

WARNING

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

CAUTION

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

NOTICE

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

- Safety Precautions That Must Always Be Observed
- General Precautions

DANGER

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

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

MARNING

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

CAUTION

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

There is a risk of electric shock.

- Do not damage, pull on, apply excessive force to, place heavy objects on, or pinch cables. There is a risk of failure, damage, or electric shock.
- The person who designs the system that uses the hard wire base block safety function must have a complete knowledge of the related safety standards and a complete understanding of the instructions in this document.

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

 Do not use the product in an environment that is subject to water, corrosive gases, or flammable gases, or near flammable materials.

There is a risk of electric shock or fire.

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

 Electronic devices used near the SERVOPACK may be affected by electromagnetic interference.
- Always use a Servomotor and SERVOPACK in one of the specified combinations.
- Do not touch a SERVOPACK or Servomotor with wet hands.
 There is a risk of product failure.

■ Storage Precautions

M CAUTION

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

There is a risk of injury or damage.

NOTICE

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

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

■ Transportation Precautions

CAUTION

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

There is a risk of injury or damage.

- Do not hold onto the front cover or connectors when you move a SERVOPACK.
 There is a risk of the SERVOPACK falling.
- A SERVOPACK or Servomotor is a precision device. Do not drop it or subject it to strong shock. There is a risk of failure or damage.
- Do not subject connectors to shock.

 There is a risk of faulty connections or damage.
- If disinfectants or insecticides must be used to treat packing materials such as wooden frames, plywood, or pallets, the packing materials must be treated before the product is packaged, and methods other than fumigation must be used.

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

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

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

Installation Precautions

CAUTION

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

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

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

- Use the product in an environment that is appropriate for the product specifications. If you use the product in an environment that exceeds product specifications, the product may fail or be damaged.
- A SERVOPACK or Servomotor is a precision device. Do not drop it or subject it to strong shock. There is a risk of failure or damage.
- Always install a SERVOPACK in a control panel.
- Do not allow any foreign matter to enter a SERVOPACK or a Servomotor with a Cooling Fan and do not cover the outlet from the Servomotor's cooling fan.
 There is a risk of failure.

■ Wiring Precautions

A DANGER

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

MARNING

- Wiring and inspections must be performed only by qualified engineers.
 There is a risk of electric shock or product failure.
- Check all wiring and power supplies carefully.
 Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures. If a short-circuit failure occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident that may result in death or injury.
- Connect the AC and DC power supplies to the specified SERVOPACK terminals.
 - Connect an AC power supply to the L1, L2, and L3 terminals and the L1C and L2C terminals on the SERVOPACK.
 - Connect a DC power supply to the B1/⊕ 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 six minutes after turning OFF the power supply (with a SERVOPACK for a 100-VAC power supply input, wait for at least nine minutes) and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the power supply terminals while the CHARGE lamp is lit because high voltage may still remain in the SERVOPACK even after turning OFF the power supply.

There is a risk of electric shock.

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

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

- Check the wiring to be sure it has been performed correctly.
 Connectors and pin layouts are sometimes different for different models. Always confirm the pin layouts in technical documents for your model before operation.
 There is a risk of failure or malfunction.
- Connect wires to power supply terminals and motor connection terminals securely with the specified methods and tightening torque.
 Insufficient tightening may cause wires and terminal blocks to generate heat due to faulty contact, possibly resulting in fire.
- Use shielded twisted-pair cables or screened unshielded multi-twisted-pair cables for I/O Signal Cables and Encoder Cables.
- Observe the following precautions when wiring the SERVOPACK's main circuit terminals.
 - Turn ON the power supply to the SERVOPACK only after all wiring, including the main circuit terminals, has been completed.
 - If a connector is used for the main circuit terminals, remove the main circuit connector from the SERVOPACK before you wire it.
 - · Insert only one wire per insertion hole in the main circuit terminals.
 - When you insert a wire, make sure that the conductor wire (e.g., whiskers) does not come into contact with adjacent wires 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 cable connector screws and lock mechanisms.
 Insufficient tightening may result in cable connectors falling off during operation.
- Do not bundle power lines (e.g., the Main Circuit Cable) and low-current lines (e.g., the I/O Signal Cables or Encoder Cables) together or run them through the same duct. If you do not place power lines and low-current lines in separate ducts, separate them by at least 30 cm. If the cables are too close to each other, malfunctions may occur due to noise affecting the low-current lines.
- Install a battery at either the host controller or on the Encoder Cable.
 If you install batteries both at the host controller and on the Encoder Cable at the same time, you will create a loop circuit between the batteries, resulting in a risk of damage or burning.
- When connecting a battery, connect the polarity correctly. There is a risk of battery rupture or encoder failure.

Operation Precautions

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 (Fn002), Origin Search (Fn003), or Easy FFT (Fn206) utility function is executed. Take necessary precautions. There is a risk of machine damage or injury.
- When an alarm occurs, the Servomotor will coast to a stop or stop with the dynamic brake
 according to the SERVOPACK Option and settings. The coasting distance will change with the
 moment of inertia of the load and the resistance of the External Dynamic Brake Resistor. Check
 the coasting distance during trial operation and implement suitable safety measures on the
 machine.
- Do not enter the machine's range of motion during operation.
 There is a risk of injury.
- Do not touch the moving parts of the Servomotor or machine during operation.
 There is a risk of injury.

CAUTION

- Design the system to ensure safety even when problems, such as broken signal lines, occur. For example, the P-OT and N-OT signals are set in the default settings to operate on the safe side if a signal line breaks. Do not change the polarity of this type of signal.
- When overtravel occurs, the power supply to the motor is turned OFF and the brake is released.
 If you use the Servomotor to drive a vertical load, set the Servomotor to enter a zero-clamped state after the Servomotor stops. Also, install safety devices (such as an external brake or counterweight) to prevent the moving parts of the machine from falling.
- Always turn OFF the servo before you turn OFF the power supply. If you turn OFF the main circuit power supply or control power supply during operation before you turn OFF the servo, the Servomotor will stop as follows:
 - If you turn OFF the main circuit power supply during operation without turning OFF the servo, the Servomotor will stop abruptly with the dynamic brake.
 - If you turn OFF the control power supply without turning OFF the servo, the stopping method that is used by the Servomotor depends on the model of the SERVOPACK. For details, refer to the manual for the SERVOPACK.
 - If you use a SERVOPACK with the Dynamic Brake Hardware Option, the Servomotor stopping methods will be different from the stopping methods used without the Option or with other Hardware Options. For details, refer to the following manual.
 - Σ -7-Series Σ -7S/ Σ -7W SERVOPACK with Dynamic Brake Hardware Option Specifications Product Manual (Manual No.: SIEP S800001 73)
- Do not use the dynamic brake for any application other than an emergency stop.

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

- When you adjust the gain during system commissioning, use a measuring instrument to monitor the torque waveform and speed waveform and confirm that there is no vibration.
 If a high gain causes vibration, the Servomotor will be damaged quickly.
- Do not frequently turn the power supply ON and OFF. After you have started actual operation, allow at least one hour between turning the power supply ON and OFF (as a guideline).
 Do not use the product in applications that require the power supply to be turned ON and OFF frequently.

The elements in the SERVOPACK will deteriorate quickly.

- An alarm or warning may occur if communications are performed with the host controller while the SigmaWin+ or Digital Operator is operating.
 - If an alarm or warning occurs, it may interrupt the current process and stop the system.
- After you complete trial operation of the machine and facilities, use the SigmaWin+ to back up
 the settings of the SERVOPACK parameters. You can use them to reset the parameters after
 SERVOPACK replacement.

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

■ Maintenance and Inspection Precautions

A 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.

Drive CAUTION And

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

■ Troubleshooting Precautions

DANGER

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

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

WARNING

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

CAUTION

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

There is a risk of injury or machine damage.

- Always insert a magnetic contactor in the line between the main circuit power supply and the
 main circuit power supply terminals on the SERVOPACK so that the power supply can be shut
 OFF at the main circuit power supply.
 If a magnetic contactor is not connected when the SERVOPACK fails, a large current may flow con-
- tinuously, possibly resulting in fire.

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

■ Disposal Precautions

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

■ General Precautions

- Figures provided in this 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.



Warranty

Details of Warranty

■ Warranty Period

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

■ Warranty Scope

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

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

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

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

Limitations of Liability

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

Suitability for Use

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

◆ Specifications Change

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

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

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

North American Safety Standards (UL)





Product	Model	North American Safety Standards (UL File No.)
SERVOPACKs	SGD7S	UL 61800-5-1 (E147823) CSA C22.2 No.274
Rotary Servomotors - SGMMV - SGM7A - SGM7J - SGM7P - SGM7G		UL 1004-1 UL 1004-6 (E165827)
Direct Drive Servomotors	• SGM7E*1 • SGM7F*2 • SGMCV	UL 1004-1 UL 1004-6 (E165827)
Linear Servomotors	• SGLGW • SGLFW • SGLFW2*1 • SGLTW	UL 1004 (E165827)

^{*1.} Certification is pending.

^{*2.} SGM7F-DDB, -DDC, and -DDD: Certified; SGM7F-DDA: Certification is pending.

◆ European Directives







Product	Model	EU Directive	Harmonized Standards
		Machinery Directive 2006/42/EC	EN ISO13849-1: 2015
SERVOPACKs	SGD7S	EMC Directive 2014/30/EU	EN 55011 group 1, class A EN 61000-6-2 EN 61000-6-4 EN 61800-3(Category C2, Second environment)
		Low Voltage Directive 2014/35/EU	EN 50178 EN 61800-5-1
	SGMMV	EMC Directive 2004/104/EC	EN 55011 group 1, class A EN 61000-6-2 EN 61800-3
		Low Voltage Directive 2006/95/EC	EN 60034-1 EN 60034-5
Rotary Servomotors	• SGM7J • SGM7A • SGM7P	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 envi- ronment)
	• SGM7G	Low Voltage Directive 2014/35/EU	EN 60034-1 EN 60034-5
Direct Drive	• SGM7E*1 • SGM7F • SGMCV • SGMCS-	EMC Directive 2004/108/EC	EN 55011 group 1, class A EN 61000-6-2 EN 61000-6-4*2 EN 61800-3*2
Servomotors	□□B, □□C, □□D, □□E (Small-Capacity, Coreless Servomotors)	Low Voltage Directive 2006/95/EC	EN 60034-1 EN 60034-5
Linear Servomotors	• SGLG • SGLF • SGLFW2	EMC Directive 2004/108/EC	EN 55011 group 1, class A EN 61000-6-2 EN 61000-6-4
23.7011101010	• SGLT	Low Voltage Directive 2006/95/EC	EN 60034-1

^{*1.} Certification is pending.

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

Safety Standards



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

st2. SGM7E: Certification is pending, SGMCS: No application has been made for certification.

^{2.} These products are for industrial use. In home environments, these products may cause electromagnetic interference and additional noise reduction measures may be necessary.

◆ Safety Parameters

Item	Standards	Performance Level
Safety Integrity Level	IEC 61508	SIL3
Safety integrity Level	IEC 62061	SILCL3
Probability of Dangerous Failure per Hour	IEC 61508 IEC 62061	PFH = 4.04×10 ⁻⁹ [1/h] (4.04% of SIL3)
Performance Level	EN ISO 13849-1	PLe (Category 3)
Mean Time to Dangerous Failure of Each Channel	EN ISO 13849-1	MTTFd: High
Average Diagnostic Coverage	EN ISO 13849-1	DCavg: Medium
Stop Category	IEC 60204-1	Stop category 0
Safety Function	IEC 61800-5-2	STO
Mission Time	IEC 61508	10 years
Hardware Fault Tolerance	IEC 61508	HFT = 1
Subsystem	IEC 61508	В



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Basic Information on SERVOPACKs

1

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

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1.2	Interpreting the Nameplate
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	1.5.1 Combinations of Rotary Servomotors and SERVOPACKs
	and SERVOPACKs
1.6	Functions

1.1

The Σ -7 Series

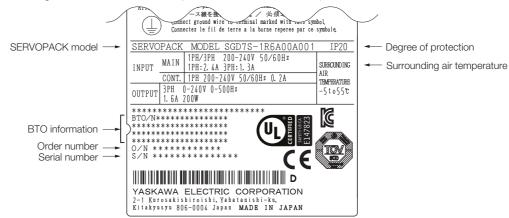
The Σ -7-series SERVOPACKs are designed for applications that require frequent high-speed and high-precision positioning. The SERVOPACK will make the most of machine performance in the shortest time possible, thus contributing to improving productivity.

The Σ -7-series SERVOPACKs include Σ -7S SERVOPACKs for single-axis control and Σ -7W SERVOPACKs for two-axis control.



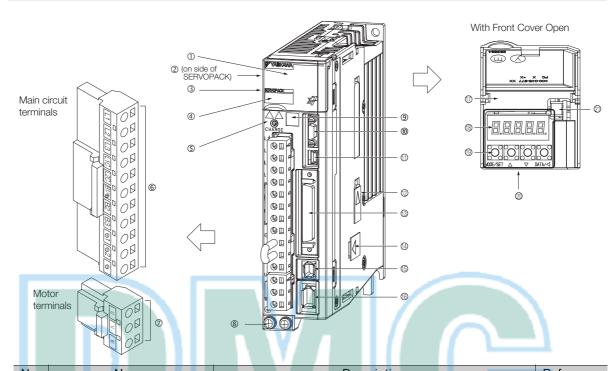
1.2 Interpreting the Nameplate

The following basic information is provided on the nameplate.





1.3 Part Names



No.	Name	Description	Reference
1	Front Cover] -
2	Nameplate	Indicates the SERVOPACK model and ratings.	page 1-3
3	Input Voltage		-
4	Model	The model of the SERVOPACK.	page 1-6
(5)	CHARGE	Lit while the main circuit power is being supplied. Note: Even if you turn OFF the main circuit power supply, this indicator will be lit as long as the internal capacitor remains charged. Do not touch the main circuit or motor terminals while this indicator is lit. Doing so may result in electric shock.	-
6	Main Circuit Terminals	The terminals depend on the main circuit power supply input specifications of the SERVOPACK.	page 4-11
7	Servomotor Terminals (U, V, and W)	The connection terminals for the Servomotor Main Circuit Cable (power line).	page 4-25
8	Ground Terminal (((=))	The ground terminals to prevent electric shock. Always connect this terminal.	_
9	QR Code	The QR code that is used by the MechatroCloud service.	_
(1)	Serial Communications Connector (CN3)	Connects to the Digital Operator (a peripheral device) or a computer (RS-422).	page 4-51
11)	Computer Connector (CN7)	A USB connector to connect a computer.	page 4-51
12	Safety Option Module Connector	Connects to a Safety Option Module.	_
13	I/O Signal Connector (CN1)	Connects to reference input signals and sequence I/O signals.	page 4-34
14)	Feedback Option Module Connector	Connects to a Feedback Option Module.	_
15	Safety Connector (CN8)	Connects to a safety function device.	page 4-49
16	Encoder Connector (CN2)	 Rotary Servomotor: Connects to the encoder in the Servomotor. Linear Servomotor: Connects to a Serial Converter Unit or linear encoder. 	page 4-25
17	Serial Number	-	_

Continued from previous page.

No.	Name	Description	Reference
18	Panel Display	Used to display SERVOPACK status, alarm numbers, and parameters.	
19	Panel Operator Keys	Used to set parameters.	page 13-3
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.	page 4-51



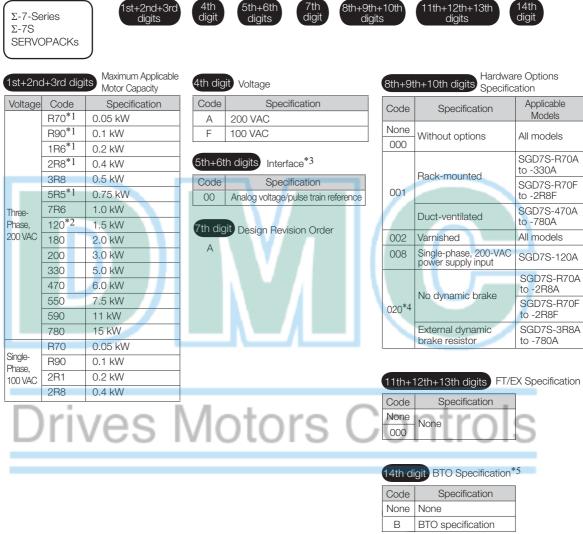
1.4.1 Interpreting SERVOPACK Model Numbers

SGD7S

1.4 Model Designations

1.4.1 Interpreting SERVOPACK Model Numbers

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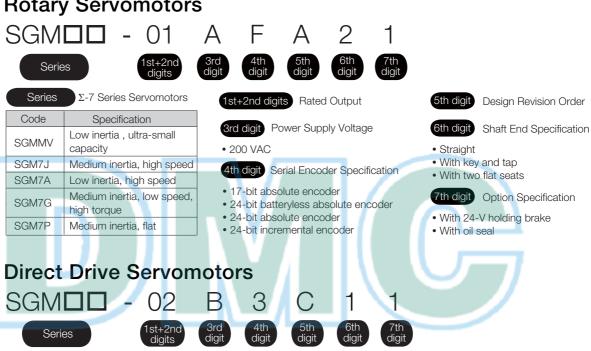
- *1. You can use these models with either a single-phase or three-phase input.
- *2. A model with a single-phase, 200-VAC power supply input is available as a hardware option (model: SGD7S-120A00A008).
- *3. The same SERVOPACKs are used for both Rotary Servomotors and Linear Servomotors.
- *4. Refer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

Interpreting Servomotor Model Numbers 1.4.2

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

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

Rotary Servomotors



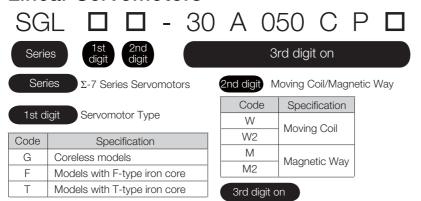
	Series	Σ-7 Series Servomotors		
_	Code	Specification		
L	SGM7E	Small capacity, coreless inner rotor		
	SGM7F	Small capacity, with core inner rotor		
	3GIVI7F	Medium capacity, with core inner rotor		
	SGMCV	Small capacity, with core inner rotor		
	SGMCS	Small capacity, coreless inner rotor		
	SOIVIOS	Medium capacity, with core inner rotor		

1st+2nd digits Rated Torque Servomotor Outer Diameter 4th digit Serial Encoder Specification Design Revision Order

- Flange Specification Cable drawn to load side
- · Cable drawn to non-load side
- 7th digit Option Specification
- High mechanical precision

1.4.2 Interpreting Servomotor Model Numbers

Linear Servomotors



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



1.5.1 Combinations of Rotary Servomotors and SERVOPACKs

1.5 Combinations of SERVOPACKs and Servomotors

1.5.1 Combinations of Rotary Servomotors and SERVOPACKs

Determi Comicon	atau Madal	Canacity	SERVOPACK Model
Rotary Servomotor Model		Capacity	SGD7S-
SGMMV	SGMMV-A1A	10 W	R90A or R90F
(Low Inertia, Ultrasmall Capacity),	SGMMV-A2A	20 W	1100/10111001
3,000 min ⁻¹	SGMMV-A3A	30 W	1R6A or 2R1F
	SGM7J-A5A	50 W	R70A or R70F
	SGM7J-01A	100 W	R90A or R90F
SGM7J	SGM7J-C2A	150 W	1D6A or 2D1E
(Medium Inertia, Small Capacity),	SGM7J-02A	200 W	1R6A or 2R1F
3,000 min ⁻¹	SGM7J-04A	400 W	2R8A or 2R8F
.,	SGM7J-06A	600 W	EDE A
	SGM7J-08A	750 W	5R5A
	SGM7A-A5A	50 W	R70A or R70F
	SGM7A-01A	100 W	R90A or R90F
	SGM7A-C2A	150 W	4D04 - 0D45
	SGM7A-02A	200 W	1R6A or 2R1F
	SGM7A-04A	400 W	2R8A or 2R8F
	SGM7A-06A	600 W	
SGM7A	SGM7A-08A	750 W	5R5A
Low Inertia, Small Capacity),	SGM7A-10A	1.0 kW	
3,000 min ⁻¹	SGM7A-15A	1.5 kW	120A
0,000	SGM7A-20A	2.0 kW	180A
	SGM7A-25A	2.5 kW	0004
	SGM7A-30A	_ 3.0 kW	200A
)rive	SGM7A-40A	4.0 kW	330A
	SGM7A-50A	5.0 kW	330A
	SGM7A-70A	7.0 kW	550A
	SGM7P-01A	100 W	R90A or R90F
SGM7P	SGM7P-02A	200 W	2R8A or 2R1F
(Medium Inertia, Flat),	SGM7P-04A	400 W	2R8A or 2R8F
3,000 min ⁻¹	SGM7P-08A	750 W	5R5A
.,	SGM7P-15A	1.5 kW	120A
	SGM7G-03A	300 W	0004
	SGM7G-05A	450 W	3R8A
	SGM7G-09A	850 W	7R6A
	SGM7G-13A	1.3 kW	120A
SGM7G	SGM7G-20A	1.8 kW	180A
(Medium Inertia,	COM7C 004*	2.4 kW	200A
Medium Capacity),	SGM7G-30A*	2.9 kW	0004
1,500 min ⁻¹	SGM7G-44A	4.4 kW	330A
	SGM7G-55A	5.5 kW	470A
	SGM7G-75A	7.5 kW	550A
	SGM7G-1AA	11 kW	590A
	SGM7G-1EA	15 kW	780A

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

1.5.2 Combinations of Direct Drive Servomotors and SERVOPACKs

		Rated Torque	Instantaneous	SERVOPACK Model
Direct Drive S	Direct Drive Servomotor Model		Maximum Torque [N·m]	SGD7S-
	SGM7E-02B	2	6	
	SGM7E-05B	5	15	2R8A or 2R1F
	SGM7E-07B	7	21	
	SGM7E-04C	4	12	
SGM7E	SGM7E-10C	10	30	
(Small Capacity, Coreless,	SGM7E-14C	14	42	0004 64 0005
Inner Rotor)	SGM7E-08D	8	24	- 2R8A or 2R8F
,	SGM7E-17D	17	51	
	SGM7E-25D	25	75	
	SGM7E-16E	16	48	EDE A
	SGM7E-35E	35	105	5R5A
	SGM7F-02A	2	6	0004 0045
	SGM7F-05A	5	15	2R8A or 2R1F
	SGM7F-07A	7	21	
	SGM7F-04B	4	12	2R8A or 2R8F
SGM7F	SGM7F-10B	10	30	
(Small Capacity, With Core,	SGM7F-14B	14	42	5R5A
Inner Rotor)	SGM7F-08C	8	24	2R8A or 2R8F
,	SGM7F-17C	17	51	5R5A
	SGM7F-25C	25	75	7R6A
	SGM7F-16D	16	48	5R5A
	SGM7F-35D	35	105	7R6A* or 120A
	SGM7F-45M	45	135	7R6A
SGM7F	SGM7F-80M	80	240	1004
(Medium Capacity,	SGM7F-80N	80	240	120A
With Core,	SGM7F-1AM	110	330	180A
Inner Rotor)	SGM7F-1EN	150	450	0004
	SGM7F-2ZN	200	600	- 200A
	SGMCV-04B	4	12	0004 as 0000
	SGMCV-10B	10	30	- 2R8A or 2R8F
SGMCV	SGMCV-14B	14	42	5R5A
(Small Capacity,	SGMCV-08C	8	24	2R8A or 2R8F
With Core,	SGMCV-17C	17	51	5R5A
Inner Rotor)	SGMCV-25C	25	75	7R6A
	SGMCV-16D	16	48	5R5A
	SGMCV-35D	35	105	7R6A* or 120A

1.5.3 Combinations of Linear Servomotors and SERVOPACKs

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Continued	1110111	previous	page

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

1.5.3 Combinations of Linear Servomotors and SERVOPACKs

Linear Servomotor Model		Rated Force [N]	Instantaneous Maximum Force [N]	SERVOPACK Model SGD7S-
DITVE	SGLGW-30A050C	12.5	40	R70A or R70F
	SGLGW-30A080C	25	80	R90A or R90F
	SGLGW-40A140C	47	140	N90A OF N90F
201.0	SGLGW-40A253C	93	280	1R6A or 2R1F
SGLG (Coreless), Used	SGLGW-40A365C	140	420	2R8A or 2R8F
with Standard-	SGLGW-60A140C	70	220	1R6A or 2R1F
Force Magnetic	SGLGW-60A253C	140	440	2R8A or 2R8F
Way	SGLGW-60A365C	210	660	5R5A
	SGLGW-90A200C	325	1300	120A
	SGLGW-90A370C	550	2200	180A
	SGLGW-90A535C	750	3000	200A
	SGLGW-40A140C	57	230	1R6A or 2R1F
SGI G	SGLGW-40A253C	114	460	2R8A or 2R8F
(Coreless), Used	SGLGW-40A365C	171	690	3R8A
with High-Force Magnetic Way	SGLGW-60A140C	85	360	1R6A or 2R1F
	SGLGW-60A253C	170	720	3R8A
	SGLGW-60A365C	255	1080	7R6A

1.5.3 Combinations of Linear Servomotors and SERVOPACKs

Continued from previous page.

		Rated Force	Instantaneous	SERVOPACK Model
Linear Serv	omotor Model	[N]	Maximum Force [N]	SGD7S-
	SGLFW-20A090A	25	86	
	SGLFW-20A120A	40	125	1R6A or 2R1F
	SGLFW-35A120A	80	220	
	SGLFW-35A230A	160	440	3R8A
	SGLFW-50A200B	280	600	5R5A
	SGLFW-50A380B	560	1200	120A
	SGLFW-1ZA200B	300	1200	120A
	SGLFW-1ZA380B	1120	2400	200A
SGLF (With F-type Iron	SGLFW2-30A070A	45	135	- 1R6A or 2R1F
Cores)	SGLFW2-30A120A	90	270	INUA UI ZN IF
,	SGLFW2-30A230A*	180	540	3R8A
	SGLFWZ-SUAZSUA	170	500	2R8A or 2R8F
	SGLFW2-45A200A	280	840	5R5A
	SGLFW2-45A380A*	560	1680	180A
	3GLI WZ-43A380A	300	1500	120A
	SGLFW2-90A200A	560	1680	120A
	SGLFW2-90A380A	1120	3360	200A
	SGLFW2-1DA380A	1680	5040	200A
	SGLTW-20A170A	130	380	3R8A
	SGLTW-20A320A	250	760	7R6A
	SGLTW-20A460A	380	1140	120A
	SGLTW-35A170A	220	660	- 5R5A
	SGLTW-35A170H	300	600	JIIJA
	SGLTW-35A320A	440	1320	- 120A
SGLT (With T-type Iron	SGLTW-35A320H	600	1200	120A
Cores)	SGLTW-35A460A	670	2000	- 180A
Drive	SGLTW-40A400B	670	2600	TOUA
	SGLTW-40A600B	1000	4000	330A
	SGLTW-50A170H	450	900	5R5A
	SGLTW-50A320H	900	1800	120A
	SGLTW-80A400B	1300	5000	330A
	SGLTW-80A600B	2000	7500	550A

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

1.6 Functions

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

· Functions Related to the Machine

Power Supply Type Settings for the Main Circuit and Control Circuit Automatic Detection of Connected Motor Motor Direction Setting Linear Encoder Pitch Setting Writing Linear Servomotor Parameters Selecting the Phase Sequence for a Linear Servomotor Polarity Sensor Setting Polarity Detection Polarity Detection Povertravel Function and Settings Motor Stopping Methods for Servo OFF and Alarms Resetting the Absolute Encoder Setting the Origin of the Absolute Encoder Setting the Regenerative Resistor Capacity Operation for Momentary Power Interruptions Setting the Motor Maximum Speed Multiturn Limit Setting Adjustment of Motor Current Detection Signal Offset Current Control Mode Selection Speed Page 8-73 Speed Detection Method Selection Page 8-74 Fully-Closed Loop Control Safety Functions Page 11-1	Function	Reference
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/COIN (Positioning Completion) Signal	page 6-37
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Selecting a SERVOPACK

2

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

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2.1.1 Ratings

2.1 Ratings and Specifications

This section gives the ratings and specifications of SERVOPACKs.

2.1.1 Ratings

Three-Phase, 200 VAC

	Model SGD7S-		R70A	R90A	1R6A	2R8A	3R8A	5R5A	7R6A	120A	180A	200A	330A
Maximui ity [kW]	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
Continuo	ous Output Cu	irrent [Arms]	0.66	0.91	1.6	2.8	3.8	5.5	7.6	11.6	18.5	19.6	32.9
Instanta Current	neous Maxim [Arms]	num Output	2.1	3.2	5.9	9.3	11	16.9	17	28	42	56	84
Main	Power Supp	oly			200 VA	C to 24	0 VAC,	-15% t	o +10%	5, 50 H	z/60 Hz		•
Circuit	Input Curre	nt [Arms]*	0.4	0.8	1.3	2.5	3.0	4.1	5.7	7.3	10	15	25
Con-	Power Su	apply			200 VA	C to 24	0 VAC,	-15% t	0 +10%	5, 50 Hz	z/60 Hz		
trol	Input Curre	nt [Arms]*	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.25	0.25	0.3
Power S	Supply Capac	ity [kVA]*	0.2	0.3	0.5	1.0	1.3	1.6	2.3	3.2	4.0	5.9	7.5
	Main Circuit Power Loss [W]		5.0	7.0	11.9	22.5	28.5	38.9	49.2	72.6	104.2	114.2	226.6
Power Loss*	Control Circuit Power Loss [W]		12	12	12	12	14	14	14	15	16	16	19
LUSS	Built-in Regenerative Resistor Power Loss [W]		-	-	-		8	8	8	10	16	16	36
	Total Power	Loss [W]	17.0	19.0	23.9	34.5	50.5	60.9	71.2	97.6	136.2	146.2	281.6
Dogon	Built-In Regener-	Resistance $[\Omega]$	_	_	_	_	40	40	40	20	12	12	8
Regen- erative Resis-	ative Resistor	Capacity [W]	-	_	_	-	40	40	40	60	60	60	180
tor	Minimum A nal Resistar	llowable Externce $[\Omega]$	40	40	40	40	40	40	40	20	12	12	8
Overvolt	tage Categor	У						III					

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

	Model SGD7S-		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 Maxir	num Output Current [A	arms]	110	130	140	170
Main Circuit	Power Supply		200 VAC to	240 VAC, -15	% to +10%, 5	0 Hz/60 Hz
Main Circuit	Input Current [Arms]	*1	6.0 7.5 11 15 46.9 54.7 58.6 78.6 110 130 140 170 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 29 37 54 73 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 0.3 0.3 0.4 0.4 10.7 14.6 21.7 29.6 271.7 326.9 365.3 501. 21 21 28 28 180*2 350*3 350*3 350*3 350* 292.7 347.9 393.3 529. 6.25*2 3.13*3 3.13*3 3.13 880*2 1760*3 1760*3 1760*	73		
Cantual	Power Supply		200 VAC to	240 VAC, -15	% to +10%, 5	0 Hz/60 Hz
Control	Input Current [Arms]	*1	6.0 7.5 11 15 46.9 54.7 58.6 78.0 110 130 140 170 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz 29 37 54 73 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz 0.3 0.3 0.4 0.4 10.7 14.6 21.7 29.6 271.7 326.9 365.3 501.4 21 21 28 28 180*2 350*3 350*3 350*3 350*3 292.7 347.9 393.3 529.4 6.25*2 3.13*3 3.13*3 3.13*3 880*2 1760*3 1760*3 1760*3 [Ω] 5.8 2.9 2.9 2.9	0.4		
Power Supply Capac	city [kVA]*1		10.7 14.6 21.7 29.			29.6
	Main Circuit Power L	oss [W]	271.7	326.9	365.3	501.4
Main Circuit Control Power Supply Capa Power Loss*1	Control Circuit Powe	r Loss [W]	21	21	28	28
Power Loss*1	External Regenerative Resistor Unit Power Loss [W]		180*2	350*³	350*³	350*3
	Total Power Loss [W]	292.7	347.9	393.3	529.4
	External Regenera-	Resistance $[\Omega]$	6.25*2	3.13*3	3.13* ³	3.13*3
External Regenerative Resistor Unit	tive Resistor Unit	Capacity [W]	880*2	1760 ^{*3}	1760 ^{*3}	1760*3
	Minimum Allowable External Resistance $[\Omega]$		5.8	2.9	2.9	2.9
Overvoltage Categor	ry				I	

- *1. This is the net value at the rated load.
- *2. This value is for the optional JUSP-RA04-E Regenerative Resistor Unit.
 *3. This value is for the optional JUSP-RA05-E Regenerative Resistor Unit.

Single-Phase, 200 VAC

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

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

2.1.1 Ratings

270 VDC

Model	SGD7S-	- 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					1.0	1.5				
Continuous Output Current	[Arms]	0.66	0.91	1.6	2.8	3.8	5.5	7.6	11.6	
Instantaneous Maximum Ou	itput 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, -15					DC, -15	% to +1	0%		
Main Circuit	Input Current [Arms]*1	0.66 0.91 1.6 2.8 3.8 5.5 7.6 Current [Arms] 2.1 3.2 5.9 9.3 11.0 16.9 17.0 Ver Supply 270 VDC to 324 VDC, -15% to +10% Ver Supply 270 VDC to 324 VDC, -	11							
Control	Power Supply	270 VDC to 324 VDC, -15% to +10%								
Control	Input Current [Arms]*1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2*2	
Power Supply Capacity [kVA	4]*1	0.2	0.3	0.6	1 1.4 1.6 2.3 3.2			3.2		
	Main Circuit Power Loss [W]	4.4	5.9	9.8	17.5	23.0	30.7	38.7	55.8	
Power Loss*1	Control Circuit Power Loss [W]	12	12	12	12	14	14	14	15	
	Total Power Loss [W]	16.4	17.9	21.8	29.5	37.0	44.7	52.7	70.8	
Overvoltage Category					I	II				

^{*1.} This is the net value at the rated load.
*2. The value is 0.25 Arms for the SGD7S-120A00A008.

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

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

Single-Phase, 100 VAC

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

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

2.1.2 SERVOPACK Overload Protection Characteristics

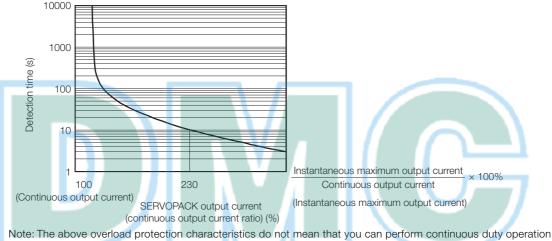
The overload detection level is set for hot start conditions with a SERVOPACK surrounding air temperature of 55°C.

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

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

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

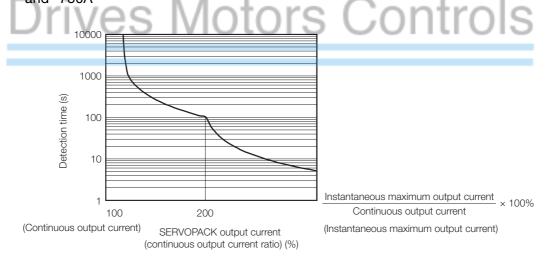
• SGD7S-R70A, -R90A, -1R6A, -2R8A, -R70F, -R90F, -2R1F, and -2R8F



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

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

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



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

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

	Item	Specification			
Control Meth	hod	IGBT-based PWM control, sine wave current drive			
Feedback	With Rotary Servomotor	Serial encoder: 17 bits (absolute encoder) 20 bits or 24 bits (incremental encoder/absolute encoder) 22 bits (absolute encoder)			
	With Linear Servomotor	 Absolute linear encoder (The signal resolution depends on the absolute linear encoder.) Incremental linear encoder (The signal resolution depends on the incremental linear encoder or Serial Converter Unit.) 			
	Surrounding Air Temperature*1	-5°C to 55°C (With derating, usage is possible between 55°C and 60°C.) Refer to the following section for derating specifications. 3.6 Derating Specifications on page 3-8			
	Storage Temperature	-20°C to 85°C			
	Surrounding Air Humidity	95% relative humidity max	(with no freezing or condensation)		
	Storage Humidity	95% relative humidity max. (with no freezing or condensation)			
	Vibration Resistance	4.9 m/s ²			
	Shock Resistance	19.6 m/s ²			
Environ- mental Conditions	Degree of Protection	IP20 R70A, R90A, 1 R70F, R90F, 2F	SERVOPACK Model: SGD7S- R6A, 2R8A, 3R8A, 5R5A, 7R6A, 120A, 11F, 2R8F 80A, 200A, 330A, 470A, 550A, 590A, 780A		
	Pollution Degree	 Must be no corrosive or flammable gases. Must be no exposure to water, oil, or chemicals. Must be no dust, salts, or iron dust. 			
Dr	Altitude*1	1,000 m max. (With derating, usage is possible between 1,000 m and 2,000 m.) Refer to the following section for derating specifications. 3.6 Derating Specifications on page 3-8			
		Do not use the SERVOPACK in the following locations: Locations sub-			
	Others	ject to static electricity noise, strong electromagnetic/magnetic fields, or radioactivity			
Applicable Standards		Refer to the following section for details. Compliance with UL Standards, EU Directives, and Other Safety Standards on page xxvi			
		Mounting	SERVOPACK Model: SGD7S-		
		Base-mounted	All Models		
Mounting		Rack-mounted	R70A, R90A, 1R6A, 2R8A, 3R8A, 5R5A, 7R6A, 120A, 180A, 200A, 330A, R70F, R90F, 2R1F, 2R8F		
		Duct-ventilated	470A, 550A, 590A, 780A		

			Continued from previous page.		
Item			Specification		
	Speed Control Range		1:5000 (At the rated torque, the lower limit of the speed control range must not cause the Servomotor to stop.)		
			±0.01% of rated speed max. (for a load fluctuation of 0% to 100%)		
	Coefficient of Speed Fluctuation*2 Torque Control Precision (Repeatability)		0% of rated speed max. (for a voltage fluctuation of ±10%)		
Perfor- mance			±0.1% of rated speed max. (for a temperature fluctuation of 25°C ±25°C)		
			±1%		
	Soft Start Time Set- ting		0 s to 10 s (Can be set separately for acceleration and deceleration.)		
	Encoder Divided Pulse Output Overheat Protection Input		Phase A, phase B, phase C: Line-driver output Number of divided output pulses: Any setting is allowed.		
			Number of input points: 1 Input voltage range: 0 V to +5 V		
		Fixed Input	Allowable voltage range: 5 VDC ±5% Number of input points: 1 SEN (Absolute Data Request) signal		
I/O Signals			Allowable voltage range: 24 VDC ±20% Number of input points: 7 Input method: Sink inputs or source inputs Input Signals • /S-ON (Servo ON) signal • /P-CON (Proportional Control) signal • P-OT (Forward Drive Prohibit) and N-OT (Reverse Drive Prohibit) signals • /ALM-RST (Alarm Reset) signal • /P-CL (Forward External Torque Limit) and /N-CL (Reverse External Torque Limit) signals • /SPD-D (Motor Direction) signal • /SPD-A and /SPD-B (Internal Set Speed Selection) signals • /C-SEL (Control Selection) signal • /ZCLAMP (Zero Clamping) signal • /INHIBIT (Reference Pulse Inhibit) signal • /G-SEL (Gain Selection) signal • /P-DET (Polarity Detection) signal • SEN (Absolute Data Request) signal • /PSEL (Reference Pulse Input Multiplication Switch) signal • FSTP (Forced Stop Input) signal A signal can be allocated and the positive and negative logic can be changed.		

Continued from previous page.

			Continued from previous page.		
Item			Specification		
		Fixed	Allowable voltage range: 5 VDC to 30 VDC		
		Output	Number of output points: 1		
			Output signal: ALM (Servo Alarm) signal		
			Allowable voltage range: 5 VDC to 30 VDC		
			Number of output points: 6 (A photocoupler output (isolated) is used for three of the outputs.)		
			(An open-collector output (non-isolated) is used for the other three out-		
			puts.)		
			Output Signals		
			/COIN (Positioning Completion) signal		
	Sequence	Outrout	· /V-CMP (Speed Coincidence Detection) signal		
I/O Signals	Output	Output Signals	/TGON (Rotation Detection) signal		
	Signals	That Can	• /S-RDY (Servo Ready) signal		
		Ве			
		Allocated	/VET (Speed Limit Detection) signal /BK (Brake) signal		
			/WARN (Warning) signal		
			/NEAR (Near) signal		
			/PSELA (Reference Pulse Input Multiplication Switching Output) sig-		
			nal		
			ALO1, ALO2, and ALO3 (Alarm Code) signals A signal can be allocated and the positive and pagetive legic can be		
			A signal can be allocated and the positive and negative logic can be changed.		
_		Inter-	Digital Operator (JUSP-OP05A-1-E) and personal computer (with Sig-		
		faces	maWin+)		
	RS-422A Communi- cations	1:N			
		Commu- nications	Up to N = 15 stations possible for RS-422A port		
Communi-	(CN3)	Axis			
cations		Address Setting	Set with parameters.		
		Interface	Personal computer (with SigmaWin+)		
	USB		reisonal computer (with signaviin+)		
Dr	Communi-	Commu- nica-	latara Cumptrolo		
	cations (CN7)	tions	Conforms to USB2.0 standard (12 Mbps).		
	(0117)	Standard			
Displays/Ind	icators		CHARGE indicator and five-digit seven-segment display		
Panel Opera	itor		Four push switches		
			Number of points: 2		
			Output voltage range: ±10 VDC (effective linearity range: ±8 V)		
Analog Moni	itor (CN5)		Resolution: 16 bits		
			Accuracy: ±20 mV (Typ) Maximum output current: ±10 mA		
			Settling time (±1%): 1.2 ms (Typ)		
Dynamic Brake (DB)			Activated when a servo alarm or overtravel (OT) occurs, or when the		
			power supply to the main circuit or servo is OFF.		
			Built-in (An external resistor must be connected to the SGD7S-470A to		
Regenerative Processing			-780A.)		
			Refer to the following catalog for details.		
			AC Servo Drives Σ-7 Series (Catalog No.: KAEP S800001 23)		
Overtravel (OT) Prevention			Stopping with dynamic brake, deceleration to a stop, or coasting to a		
Overtravel (C) i) Preventio	П	stop for the P-OT (Forward Drive Prohibit) or N-OT (Reverse Drive Prohibit) signal		
Protective Functions			Overcurrent, overvoltage, low voltage, overload, regeneration error, etc.		
Utility Functions			Gain adjustment, alarm history, jogging, origin search, etc.		

Continued from previous page.

	lt	em		Specification
Inputs			/HWBB1 and /HWBB2: Base block signals for Power Modules	
Safety	Ou	Output		EDM1: Monitors the status of built-in safety circuit (fixed output).
Functions Applicable Standards*3		Stan-	ISO13849-1 PLe (Category 3) and IEC61508 SIL3	
Applicable Option Modules		es	Fully-closed Modules and Safety Modules Note: You cannot use a Fully-closed Module and a Safety Module together.	
		Soft Start Time Set- ting		0 s to 10 s (Can be set separately for acceleration and deceleration.)
			Refer- ence Voltage	 Maximum input voltage: ±12 V (forward motor rotation for positive re erence). 6 VDC at rated speed (default setting). Input gain setting can be changed.
		Input Signal	Input Imped- ance	Approx. 14 kΩ
Spee	Speed		Circuit Time Con-	30 μs
trol			stant	
	Se	ernal : Speed ntrol	Rota- tion Direc- tion Selec- tion	With Proportional Control signal
Controls		ittioi	Speed Selec- tion	With Forward/Reverse External Torque Limit signals (speed 1 to 3 selection). Servomotor stops or another control method is used when both signal are OFF.
Con		dforwar		0% to 100%
Ori	tior	Output Signal Positioning Completed Width Setting Refer-		0 to 1,073,741,824 reference units
			ence Pulse	One of the following is selected: Sign + pulse train, CW + CCW pulse trains, and two-phase pulse train with 90° phase differential
Posi			Form Input Form	Line driver or open collector
tion Con trol		- Ses	Maxi- mum Input Fre- quency	 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 Multiplica- tion Switching	1 to 100 times
		Clear Signal		Position deviation clear Line driver or open collector

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Continued from pre						
	Item			Specification		
Controls	Torque Con- trol	orque Control Input Signal Input Imped ance Circui Time	Refer- ence 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. 		
			Imped-	Approx. 14 k Ω		
			Circuit Time Constant	16 μs		

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

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

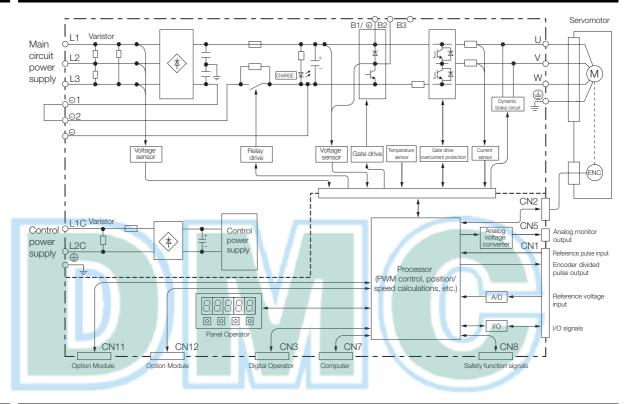
*3. Always perform risk assessment for the system and confirm that the safety requirements are met.



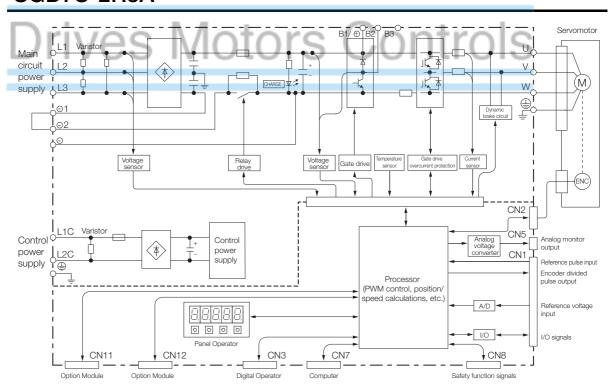
^{*2.} The coefficient of speed fluctuation for load fluctuation is defined as follows:

2.2 Block Diagrams

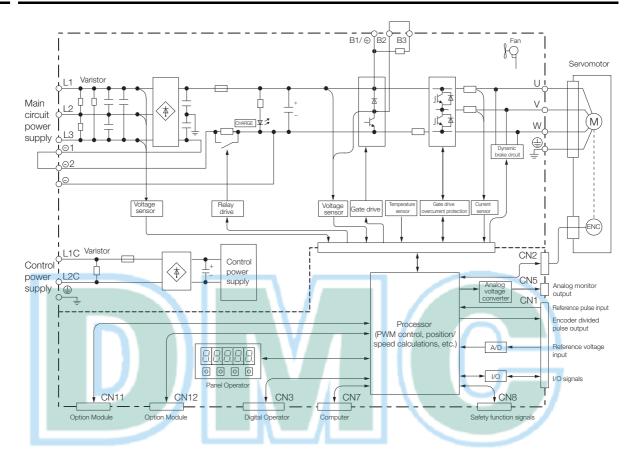
2.2.1 SGD7S-R70A, -R90A, and -1R6A



2.2.2 SGD7S-2R8A

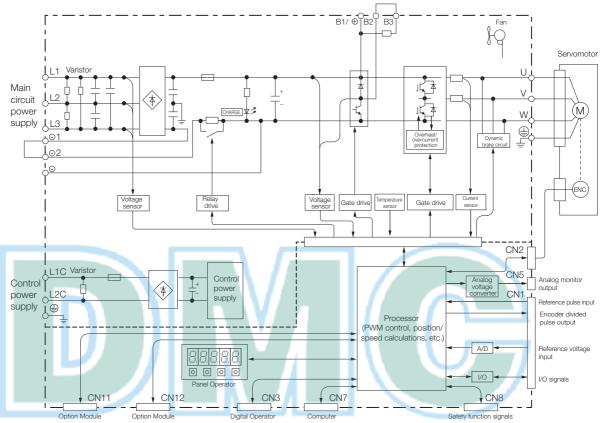


2.2.3 SGD7S-3R8A, -5R5A, and -7R6A

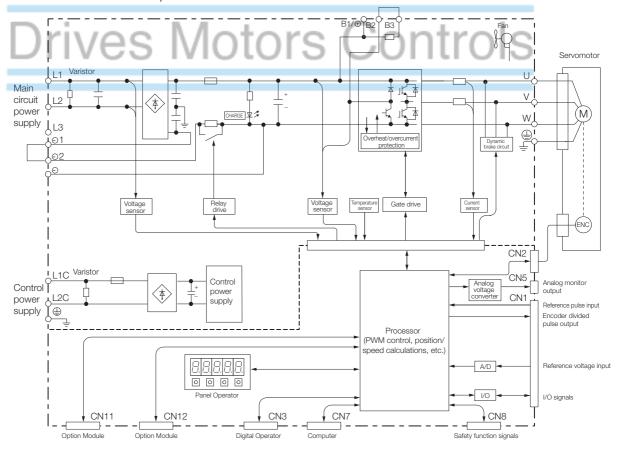


2.2.4 SGD7S-120A

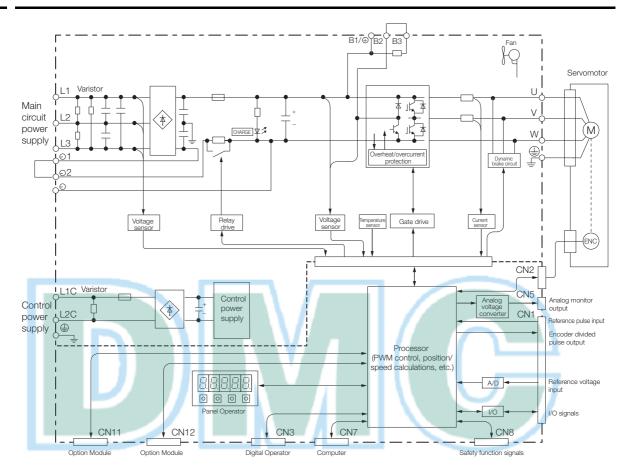
• Standard Specifications: Three-Phase, 200-VAC Power Supply Input



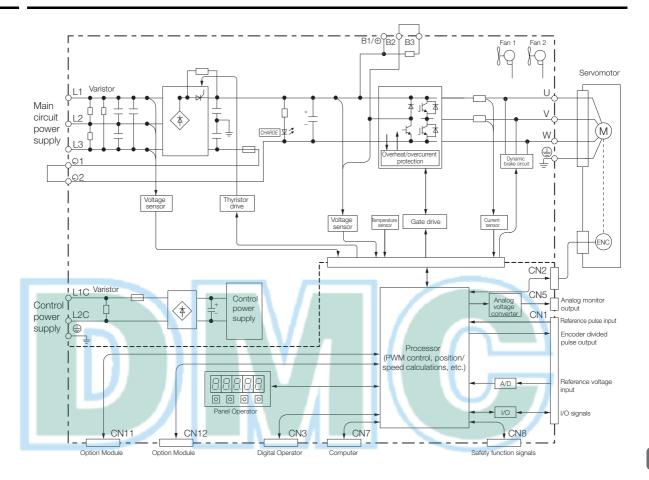
 Optional Specifications: Single-Phase, 200-VAC Power Supply Input (SERVOPACK Model: SGD7S-120A00A008)



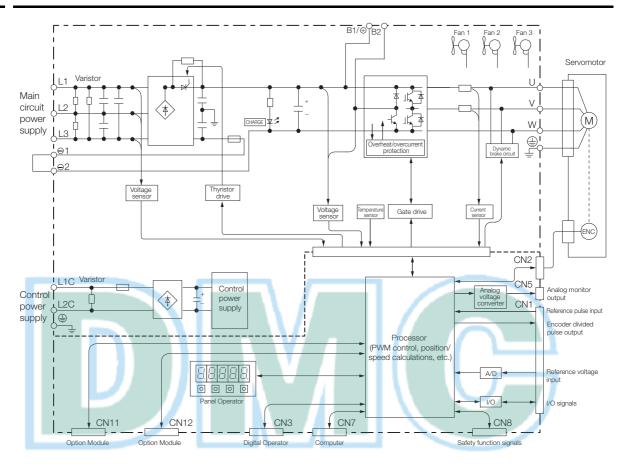
2.2.5 SGD7S-180A and -200A



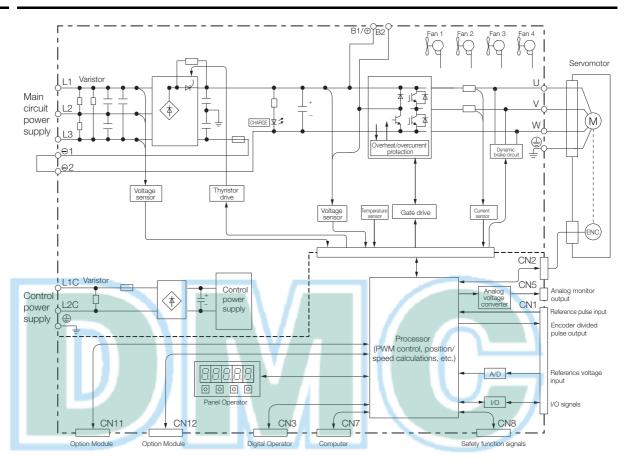
2.2.6 SGD7S-330A



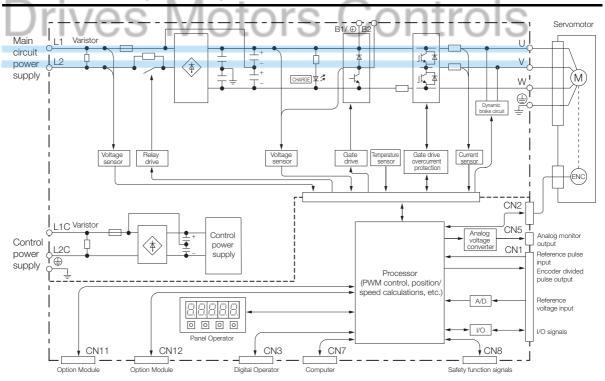
2.2.7 SGD7S-470A and -550A



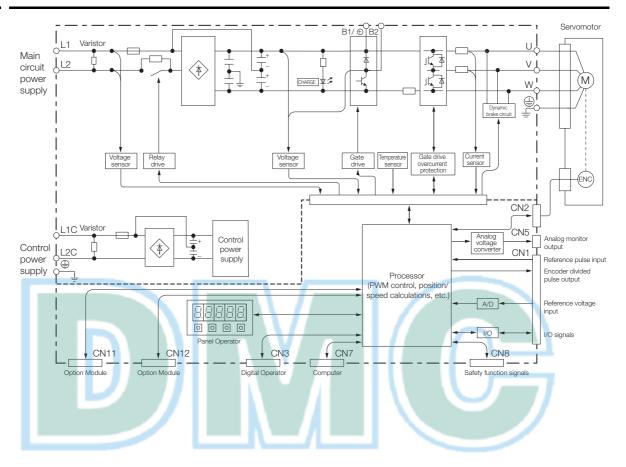
2.2.8 SGD7S-590A and -780A



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



2.2.10 SGD7S-2R8F

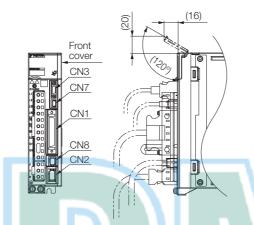


2.3 External Dimensions

2.3.1 Front Cover Dimensions and Connector Specifications

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

· Front Cover Dimensions



Connector Specifications

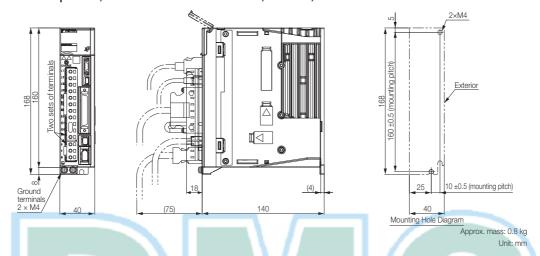
Connector No.	Model	Number of Pins	Manufacturer
CN1	10250-59A3MB	50	3M Japan Limited
CN2	3E106-0220KV	6	3M Japan Limited
CN3	HDR-EC14LFDTN- SLD-PLUS	14	Honda Tsushin Kogyo Co., Ltd.
CN7	2172034-1	5	Tyco Electronics Japan G.K.
CN8	1981080-1	8	Tyco Electronics Japan G.K.

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

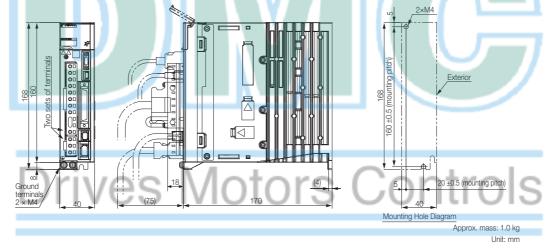
2.3.2 SERVOPACK External Dimensions

Base-mounted SERVOPACKs

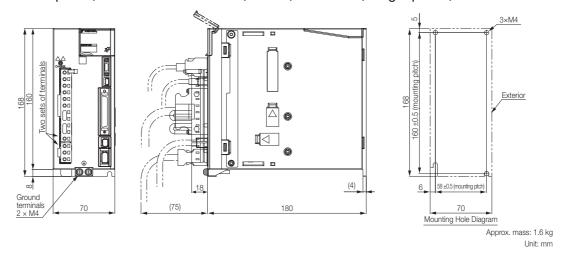
• Three-phase, 200 VAC: SGD7S-R70A, -R90A, and -1R6A



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

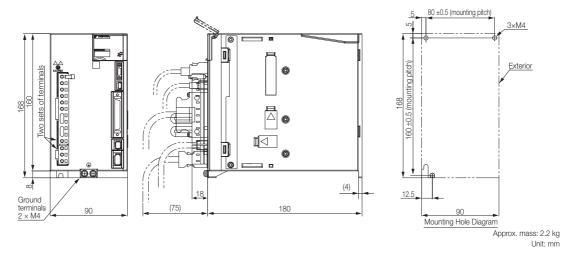


• Three-phase, 200 VAC: SGD7S-3R8A, -5R5A, and -7R6A; Single-phase, 100 VAC: SGD7S-2R8F

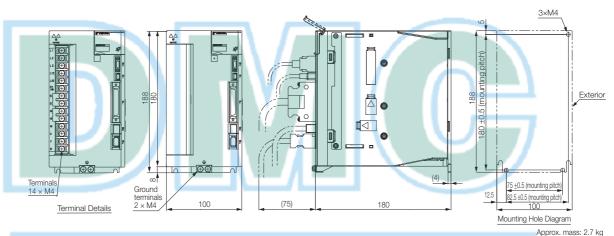


Unit: mm

• Three-phase, 200 VAC: SGD7S-120A



• Three-phase, 200 VAC: SGD7S-180A and -200A; Single-phase, 200 VAC: SGD7S-120A00A008



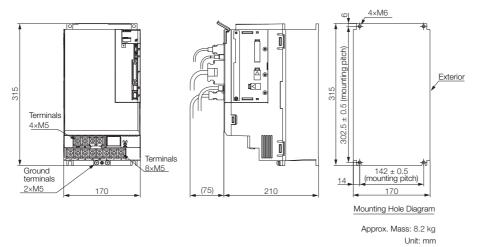
• Three-phase, 200 VAC: SGD7S-330A

**M5

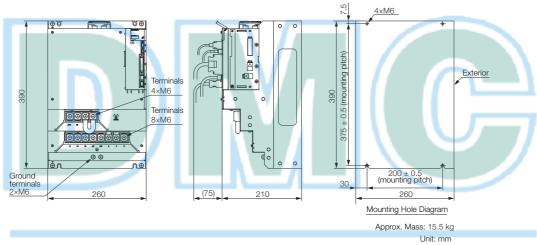
| Exterior |

2.3.2 SERVOPACK External Dimensions

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



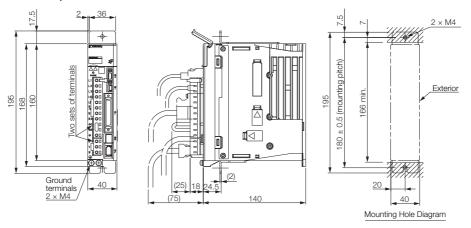
• Three-phase, 200 VAC: SGD7S-590A and -780A



Rack-mounted SERVOPACKs

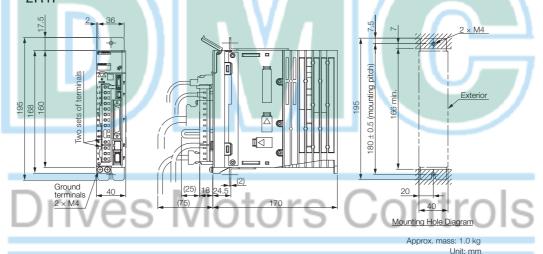
Hardware Option Code: 001

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

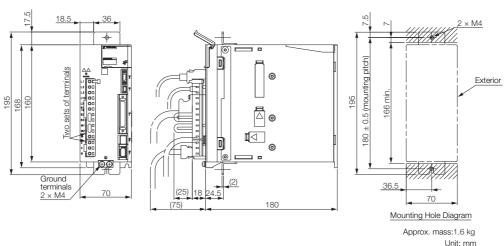


Approx. mass: 0.8 kg

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

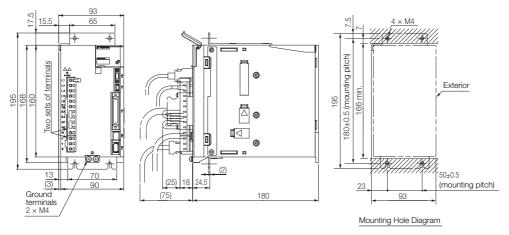


 Three-phase, 200 VAC: SGD7S-3R8A, -5R5A, and -7R6A; Single-phase, 100 VAC: SGD7S-2R8F



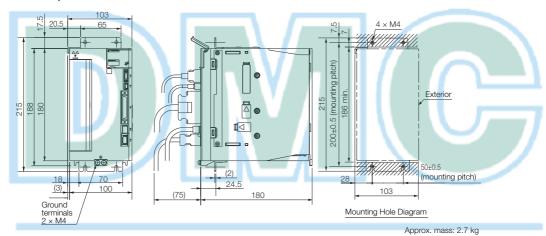
2.3.2 SERVOPACK External Dimensions

• Three-phase, 200 VAC: SGD7S-120A

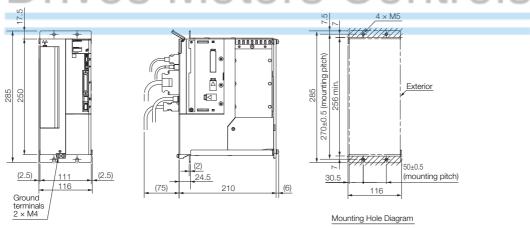


Approx. mass: 2.2 kg Unit: mm

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



• Three-phase, 200 VAC: SGD7S-330A

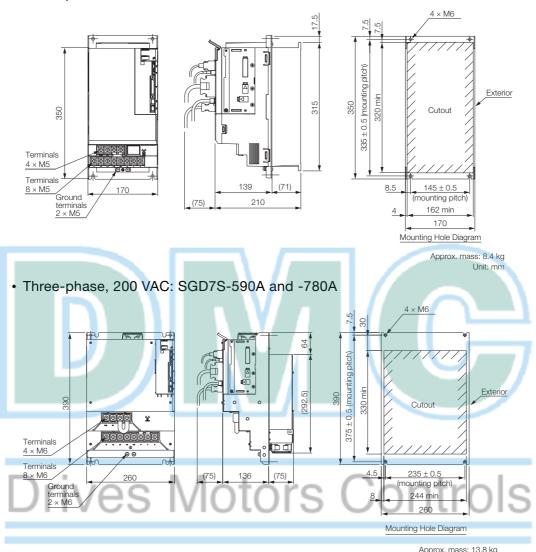


Approx. mass: 4.9 kg Unit: mm

Duct-ventilated SERVOPACKs

Hardware Option Code: 001

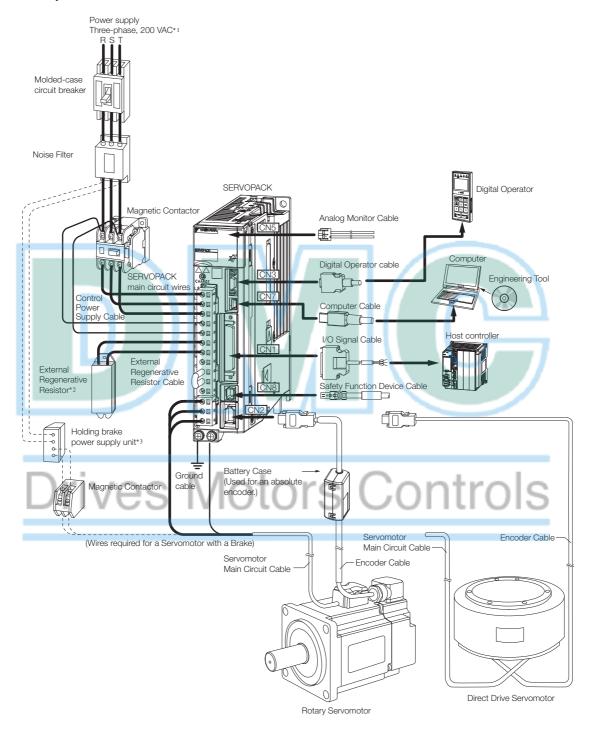
• Three-phase, 200 VAC: SGD7S-470A and -550A



Approx. mass: 13.8 kg Unit: mm

Examples of Standard Connections between SERVOPACKs and Peripheral Devices

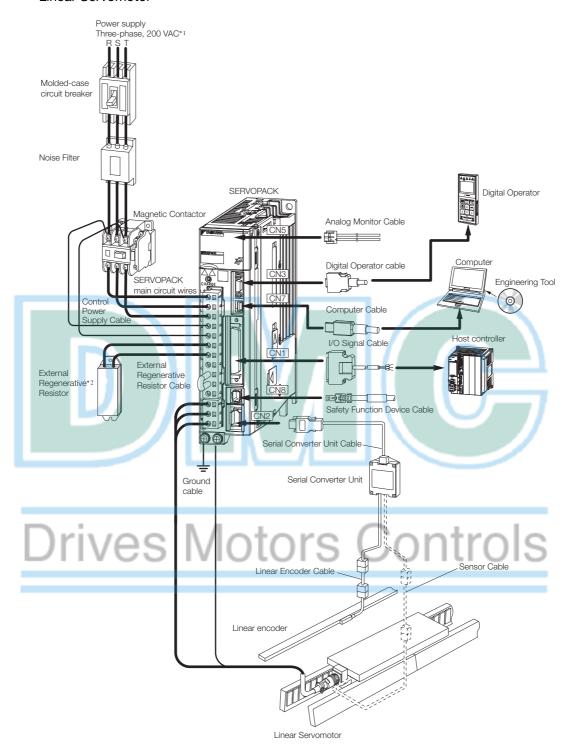
Rotary Servomotors



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

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

· Linear 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.

SERVOPACK Installation

3

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

3.1	Installation Precautions
3.2	Mounting Types and Orientation 3-3
3.3	Mounting Hole Dimensions
3.4	Mounting Interval3-6
	3.4.1 Installing One SERVOPACK in a Control Panel 3-6 3.4.2 Installing More Than One SERVOPACK in a Control Panel
3.5	Monitoring the Installation Environment 3-7
3.6	Derating Specifications
3.7	EMC Installation Conditions3-9

3.1

Installation Precautions

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

■ Installation Near Sources of Heat

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

■ Installation Near Sources of Vibration

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

■ Other Precautions

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



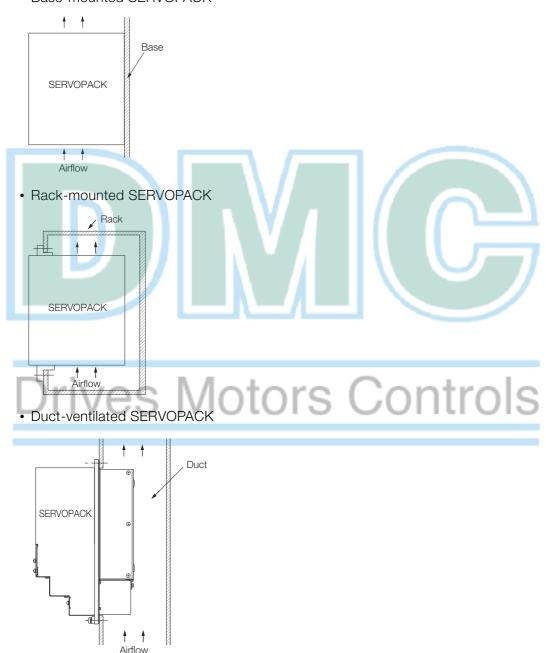
3.2 Mounting Types and Orientation

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

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

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

Base-mounted SERVOPACK

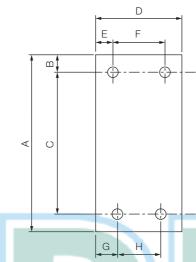


3.3

Mounting Hole Dimensions

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

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



♦ Σ-7-series Mounting Hole Dimensions

SERVOPACK Model			Dimensions (mm)							Screw	Number
		А	В	С	D	Е	F	G	Н	Size	of Screws
	R70A, R90A, 1R6A	168	5	160±0.5	40	35] - `	25	_	M4	2
	2R8A, R70F, R90F, 2R1F	168	5	160±0.5	40	5	-	25	-	M4	2
	3R8A, 5R5A, 7R6A, 2R8F	168	5	160±0.5	70	6	58±0.5	64		M4	3
SGD7S-	120A	168	5	160±0.5	90	5	80±0.5	12.5	Trc	M4	3
	180A, 200A, 120A□□□008	188	5	180±0.5	100	95	<u> </u>	12.5	75±0.5	M4	3
	330A	258	6	250±0.5	110	5	100±0.5	13	84±0.5	M5	4
	470A, 550A	315	6	302.5±0.5	170	14	142±0.5	14	142±0.5	M6	4
	590A, 780A	390	7.5	375±0.5	260	30	200±0.5	30	200±0.5	M6	4

♦ Σ-V-series-Compatible Mounting Hole Dimensions

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

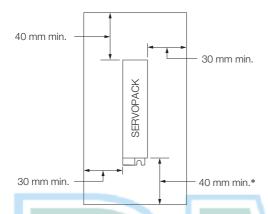
			Dimensions (mm)							Screw	Number
SERVO	SERVOPACK Model		В	С	D	Е	F	G	Н	Size	of Screws
	R70A, R90A, 1R6A	168	5	150±0.5	40	35	_	35	-	M4	2
	2R8A, R70F, R90F, 2R1F	168	5	150±0.5	40	5	_	35	_	M4	2
00070	3R8A, 5R5A, 7R6A, 2R8F	168	5	150±0.5	70	6	58±0.5	6	_	M4	3
SGD7S-	120A	168	5	150±0.5	90	5	80±0.5	5	_	M4	3
	180A, 200A, 120A□□□008	188	5	170±0.5	100	95	_	5	90±0.5	M4	3
	330A	250	6	238.5±0.5	110	5	100±0.5	5	100±0.5	M5	4
	470A, 550A, 590A, 780A		A special attachment is required. Contact your Yaskawa representative for details.								



3.4 Mounting Interval

3.4.1 Installing One SERVOPACK in a Control Panel

Provide the following spaces around the SERVOPACK.



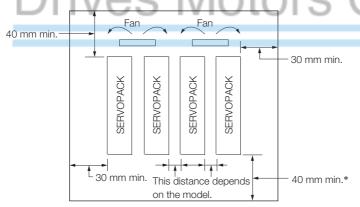
* For this dimension, ignore items protruding from the main body of the SERVOPACK.

3.4.2 Installing More Than One SERVOPACK in a Control Panel

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



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



^{*} 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
R70A, R90A, 1R6A, 2R8A, 3R8A, 5R5A, 7R6A, R70F, SGD7S- R90F, 2R1F, 2R8F		1 mm min.	Air speed: 0.5 m/s min.
	120A, 180A, 200A, 330A, 470A, 550A, 590A, 780A	10 mm min.	Air speed: 0.5 m/s min.

3.5 Monitoring the Installation Environment

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

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

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

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

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



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



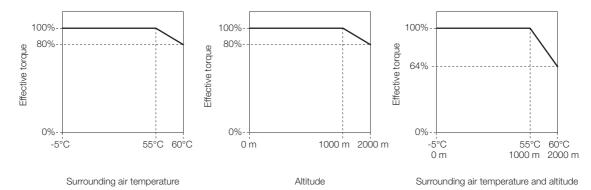
Always observe the surrounding air temperature given in the SERVOPACK environment conditions. Even if the monitor value is 100% or lower, you cannot use a SERVOPACK in a location that exceeds the specified surrounding air temperature.

3.6

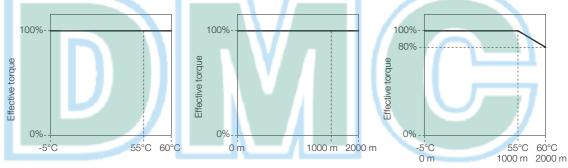
Derating Specifications

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

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



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



Surrounding air temperature

Altitude

Surrounding air temperature and altitude

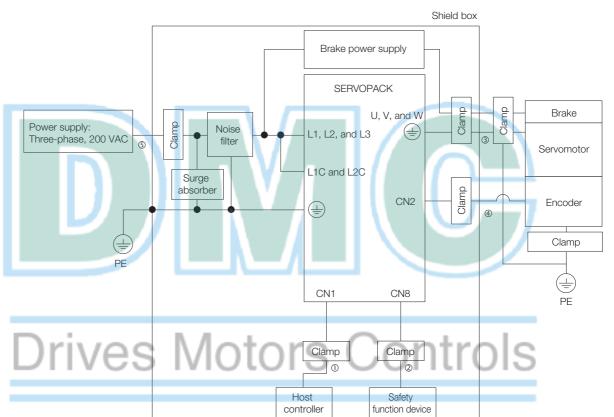
3.7 EMC Installation Conditions

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

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

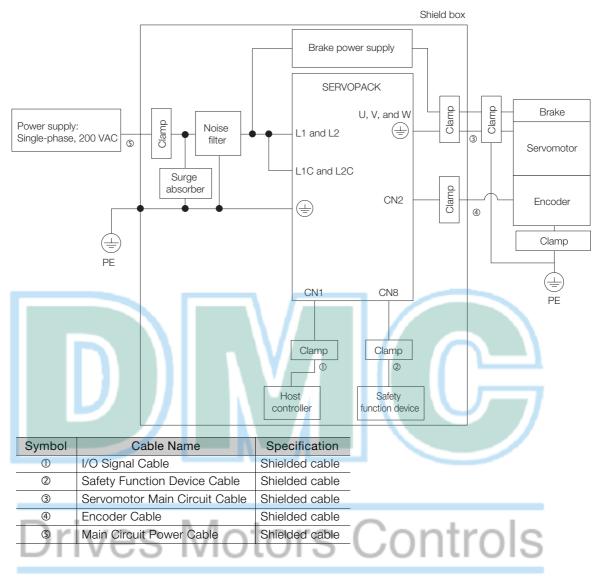
The applicable standards are EN 55011 group 1 class A, EN 61000-6-2, EN 61000-6-4, and EN 61800-3 (category C2, second environment).

• Three-Phase, 200 VAC

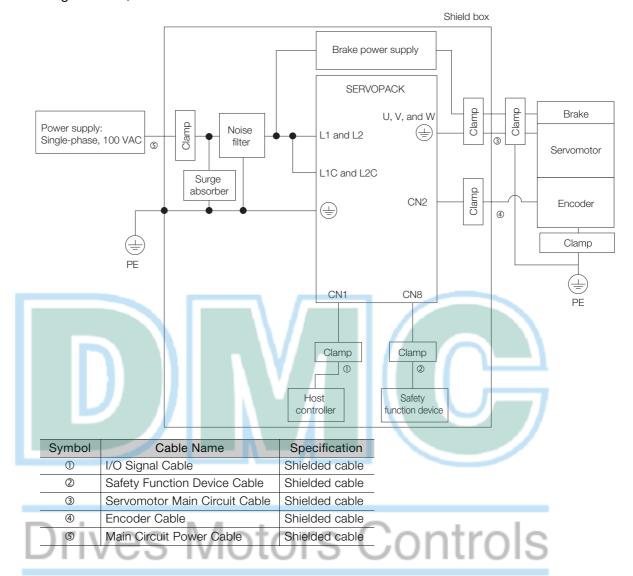


Symbol	Cable Name	Specification
1	I/O Signal Cable	Shielded cable
2	Safety Function Device Cable	Shielded cable
3	Servomotor Main Circuit Cable	Shielded cable
4	Encoder Cable	Shielded cable
(5)	Main Circuit Power Cable	Shielded cable

• Single-Phase, 200 VAC



• Single-Phase, 100 VAC



Wiring and Connecting SERVOPACKs

4

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

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4.7							



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

There is a risk of failure or fire.

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

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

4.1.1 General Precautions

CAUTION

- Wait for at least six minutes after turning OFF the power supply (with a SERVOPACK for a 100-VAC power supply input, wait for at least nine minutes) and then make sure that the CHARGE indicator is not lit before starting wiring or inspection work. Do not touch the power supply terminals while the CHARGE lamp is lit because high voltage may still remain in the SERVOPACK even after turning OFF the power supply.
 There is a risk of electric shock.
- Observe the precautions and instructions for wiring and trial operation precisely as described in this document.

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

- Check the wiring to be sure it has been performed correctly.
 Connectors and pin layouts are sometimes different for different models. Always confirm the pin layouts in technical documents for your model before operation.
 There is a risk of failure or malfunction.
- Connect wires to power supply terminals and motor connection terminals securely with the specified methods and tightening torque.
 Insufficient tightening may cause wires and terminal blocks to generate heat due to faulty contact, possibly resulting in fire.
- Use shielded twisted-pair cables or screened unshielded multi-twisted-pair cables for I/O Signal Cables and Encoder Cables.
- Observe the following precautions when wiring the SERVOPACK's main circuit terminals.
 - Turn ON the power supply to the SERVOPACK only after all wiring, including the main circuit terminals, has been completed.
 - If a connector is used for the main circuit terminals, remove the main circuit connector from the SERVOPACK before you wire it.
 - Insert only one wire per insertion hole in the main circuit terminals.
 - When you insert a wire, make sure that the conductor wire (e.g., whiskers) does not come into contact with adjacent wires.
- Install molded-case circuit breakers and other safety measures to provide protection against short circuits in external wiring.
 There is a risk of fire or failure.

NOTICE

- Whenever possible, use the Cables specified by Yaskawa.
 If you use any other cables, confirm the rated current and application environment of your model and use the wiring materials specified by Yaskawa or equivalent materials.
- Securely tighten cable connector screws and lock mechanisms.
 Insufficient tightening may result in cable connectors falling off during operation.
- Do not bundle power lines (e.g., the Main Circuit Cable) and low-current lines (e.g., the I/O Signal Cables or Encoder Cables) together or run them through the same duct. If you do not place power lines and low-current lines in separate ducts, separate them by at least 30 cm. If the cables are too close to each other, malfunctions may occur due to noise affecting the lowcurrent lines.
- Install a battery at either the host controller or on the Encoder Cable.

 If you install batteries both at the host controller and on the Encoder Cable at the same time, you will create a loop circuit between the batteries, resulting in a risk of damage or burning.
- When connecting a battery, connect the polarity correctly.
 There is a risk of battery rupture or encoder failure.



- Use a molded-case circuit breaker (1QF) 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 (1QF) or fuse to protect the servo system from accidents involving different power system voltages or other accidents.
- Install an earth leakage breaker. The SERVOPACK does not have a built-in ground fault protective circuit. To configure a safer system, install a ground fault detector against overloads and short-circuiting, or install a ground fault detector combined with a molded-case circuit breaker.
- Do not turn the power supply ON and OFF more than necessary.
 - Do not use the SERVOPACK for applications that require the power supply to turn ON and OFF frequently. Such applications will cause elements in the SERVOPACK to deteriorate.
 - After you have started actual operation, allow at least one hour between turning the power supply ON and OFF (as a guideline).

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

- Use the cables specified by Yaskawa. Design and arrange the system so that each cable is as short as possible.
 - Refer to the following manual or catalog for information on the specified cables.
 - \square AC Servo Drives Σ-7 Series (Catalog No.: KAEP S800001 23)
 - Σ-7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)
- The signal cable conductors are as thin as 0.2 mm² or 0.3 mm². Do not subject them to excessive bending stress or tension.

4.1.2 Countermeasures against Noise



The SERVOPACK is designed as an industrial device. It therefore provides no measures to prevent radio interference. The SERVOPACK uses high-speed switching elements in the main circuit. Therefore peripheral devices may be affected by switching noise.

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

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

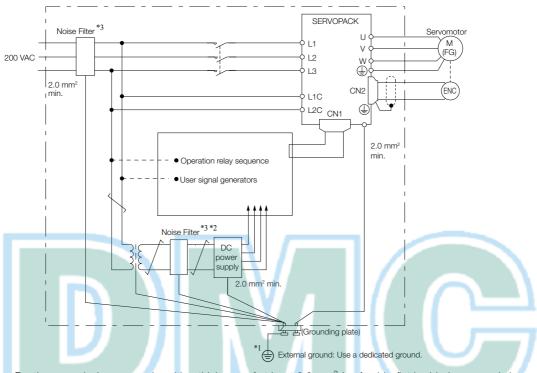
To prevent the noise from the SERVOPACK or the peripheral devices from causing malfunctions of any devices, take the following countermeasures against noise as required.

- Install the input reference device and Noise Filter as close to the SERVOPACK as possible.
- Always install a Surge Absorber for relays, solenoids, and Magnetic Contactor coils.
- Do not place the following cables in the same duct or bundle them together. Also, separate the cables from each other by at least 30 cm.
 - •Main Circuit Cables and I/O Signal Cables
 - •Main Circuit Cables and Encoder Cables
- Do not share the power supply with an electric welder or electrical discharge machine. If the SERVOPACK is placed near a high-frequency generator, install Noise Filters on the input side on the Main Circuit Power Supply Cable and Control Power Supply Cable even if the same power supply is not shared with the high-frequency generator. Refer to the following section for information on connecting Noise Filters.
 - Noise Filters on page 4-6
- Implement suitable grounding measures. Refer to the following section for information on grounding measures.
 - (3 4.1.3 Grounding on page 4-8

4.1.2 Countermeasures against Noise

Noise Filters

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

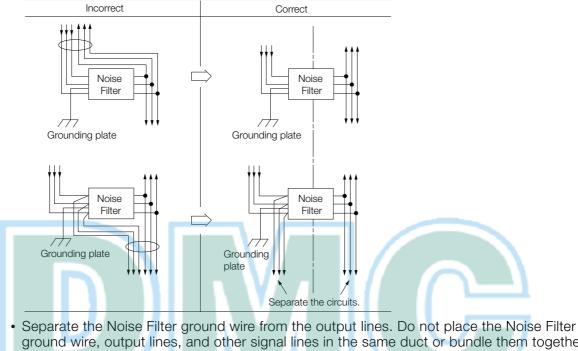


- *1. For the ground wire, use a wire with a thickness of at least 2.0 mm² (preferably, flat braided copper wire).
- *2. Whenever possible, use twisted-pair wires to wire all connections marked with
- *3. Refer to the following section for precautions when using Noise Filters.
 - Noise Filter Wiring and Connection Precautions on page 4-7

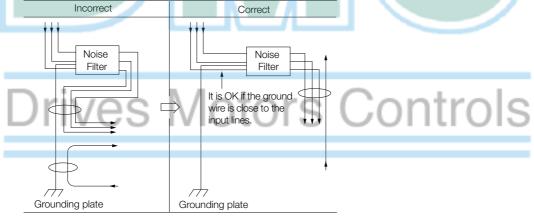
Noise Filter Wiring and Connection Precautions

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

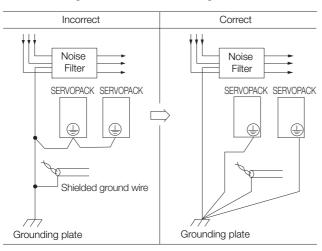
• Separate input lines from output lines. Do not place input lines and output lines in the same duct or bundle them together.



ground wire, output lines, and other signal lines in the same duct or bundle them together.

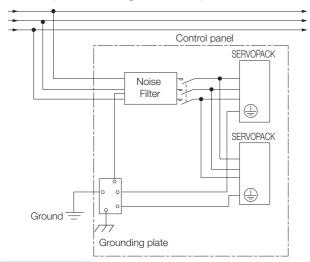


Connect the Noise Filter ground wire directly to the grounding plate. Do not connect the Noise Filter ground wire to other ground wires.



4.1.3 Grounding

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



4.1.3 Grounding

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

Observe the following precautions when wiring the ground cable.

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

Motor Frame Ground or Motor Ground

If you ground the Servomotor through the machine, 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 motor frame terminal (FG) or ground terminal (FG) of the Servomotor to the ground terminal \oplus on the SERVOPACK. Also be sure to ground the ground terminal \oplus .

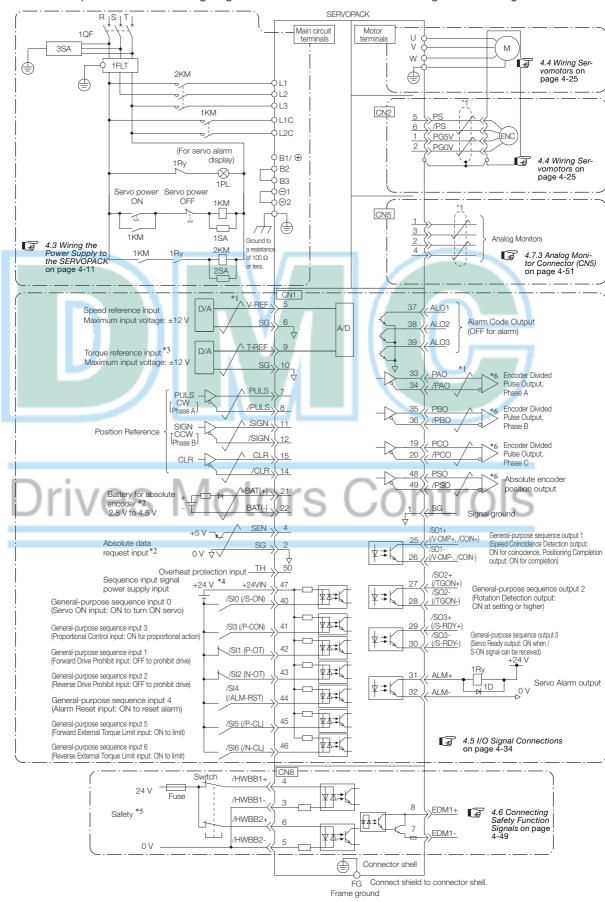
Ground both the Moving Coil and Magnetic Way of a Linear Servomotor.

Noise on I/O Signal Cables

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

4.2 Basic Wiring Diagrams

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



- *1. represents twisted-pair wires.
 *2. Connect these when using an absolute encoder. If the Encoder Cable with a Battery Case is connected, do not connect a backup battery.
- *3. 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.

Chapter 11 Safety Functions

If you do not use the safety function, insert the Safety Jumper Connector (provided as an accessory) into CN8 when you use the SERVOPACK.

- *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.



4.3 Wiring the Power Supply to the SERVOPACK

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

- AC Servo Drives Σ-7 Series (Catalog No.: KAEP S800001 23)
- Σ-7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)

4.3.1 Terminal Symbols and Terminal Names

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

⚠ CAUTION

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

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

Three-Phase, 200-VAC Power Supply Input

Terminal

Symbols	Terminal Name	Specifications and Reference
L1, L2, L3	Main circuit power supply input terminals for AC power supply input	Three-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz
L1C, L2C	Control power supply terminals	Single-phase, 200 VAC to 240 VAC, -15% to +10%, 50 Hz/60 Hz
		4.3.5 Wiring Regenerative Resistors on page 4-22
Driv	es Mot	■ For SGD7S-R70A, -R90A, -1R6A, and -2R8A If the regenerative capacity is insufficient, connect an External Regenerative Resistor between B1/⊕ and B2. The External Regenerative Resistor is not included. Obtain it separately.
		■ For SGD7S-3R8A,- 5R5A, -7R6A, -120A, -180A, -200A,
B1/⊕, B2, B3	Regenerative Resistor terminals	and -330A If the internal regenerative resistor is insufficient, remove the lead or short bar between B2 and B3 and connect an External Regenerative Resistor between B1/⊕ and B2. The External Regenerative Resistor is not included. Obtain it separately.
		■ For SGD7S-470A, -550A, -590A, and -780A
		Connect a Regenerative Resistor Unit between B1/⊕ and B2. Obtain a Regenerative Resistor Unit separately. These models do not have a B3 terminal.
01.00	DC Reactor terminals for	4.3.6 Wiring Reactors for Harmonic Suppression on page 4-24
⊖1, ⊖2	power supply harmonic suppression	These terminals are used to connect a DC Reactor for power supply harmonic suppression or power factor improvement.
Θ	_	None. (Do not connect anything to this terminal.)

4.3.1 Terminal Symbols and Terminal Names

• Single-Phase, 200-VAC Power Supply Input

Terminal Symbols	Terminal Name	Specifications and Reference
L1, L2	Main circuit power supply input terminals for AC power supply input	Single-phase, 200 VDC to 240 VDC, -15% to +10%, 50 Hz/ 60 Hz
L1C, L2C	Control power supply terminals	Single-phase, 200 VDC to 240 VDC, -15% to +10%, 50 Hz/ 60 Hz
		3.3.5 Wiring Regenerative Resistors on page 4-22
B1/⊕, B2, B3	Regenerative Resistor termi-	■ For SGD7S-R70A, -R90A, -1R6A, and -2R8A If the regenerative capacity is insufficient, connect an External Regenerative Resistor between B1/⊕ and B2. The External Regenerative Resistor is not included. Obtain it separately.
B1/⊕, B2, B0	nals	■ For SGD7S-5R5A and 120A□0A008 If the internal regenerative resistor is insufficient, remove the lead or short bar between B2 and B3 and connect an External Regenerative Resistor between B1/⊕ and B2.
		The External Regenerative Resistor is not included. Obtain it separately.
	DC Reactor terminals for	4.3.6 Wiring Reactors for Harmonic Suppression on page 4- 24
⊖1, ⊖2	power supply harmonic suppression	These terminals are used to connect a DC Reactor for power supply harmonic suppression or power factor improvement.
L3, ⊖	-	None. (Do not connect anything to these terminals.)

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

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

If you use a single-phase, 200-VAC power supply input for the SERVOPACK's main circuit power supply, set parameter Pn00B to n. \$\sim\$1\$ (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 5-15

Information

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

DC Power Supply Input

Terminal Symbols	Terminal Name	Specifications and Reference
L1C, L2C	Control power supply terminals	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	270 VDC to 324 VDC, -15% to +10%
⊝2	input terminals for DC power supply input	0 VDC
L1, L2, L3, B2, B3, ⊖1, ⊖	_	None. (Do not connect anything to these terminals.)

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

5.3.1 AC Power Supply Input/DC Power Supply Input Setting on page 5-14

• Single-Phase, 100-VAC Power Supply Input

Terminal Symbols	Terminal Name	Specifications and Reference
L1, L2	Main circuit power supply input terminals for AC power supply input	Single-phase, 100 VAC to 120 VAC, -15% to +10%, 50 Hz/60 Hz
L1C, L2C	Control power supply terminals	Single-phase, 100 VAC to 120 VAC, -15% to +10%, 50 Hz/60 Hz
		4.3.5 Wiring Regenerative Resistors on page 4-22
B1, B2	Regenerative Resistor terminals	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.

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

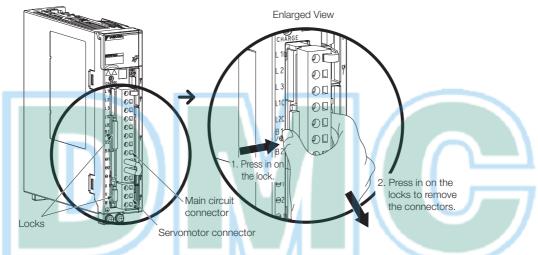


4.3.2 Wiring Procedure for Main Circuit Connector

· Required Items

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

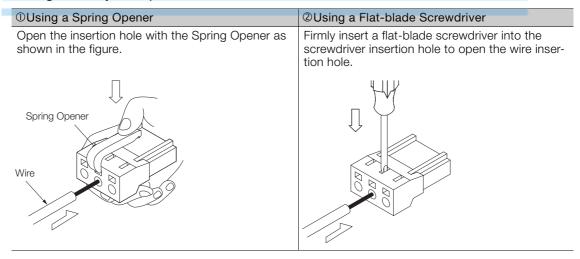
1. Remove the main circuit connector and motor connector from the SERVOPACK.



2. Remove the sheath from the wire to connect.



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

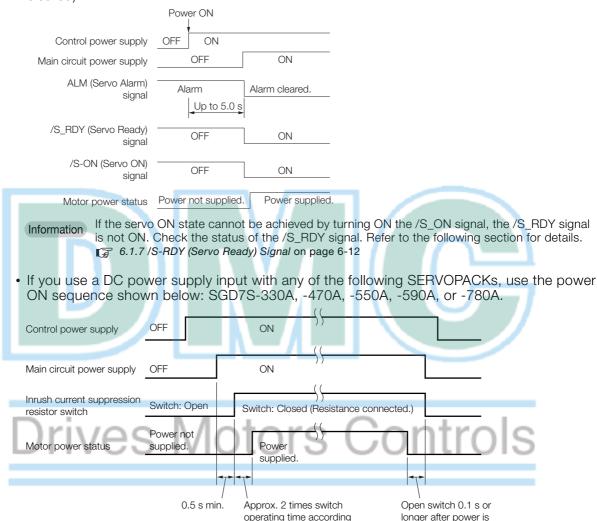


- **4.** Insert the conductor into the wire insertion hole. Then, remove the Spring Opener or flat-blade screwdriver.
- 5. Make all other connections in the same way.
- 6. When you have completed wiring, attach the connectors to the SERVOPACK.

4.3.3 Power ON Sequence

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

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



• Design the power ON sequence so that main circuit power supply is turned OFF when an ALM (Servo Alarm) signal is output.

to switch specifications

- Make sure that the power supply specifications of all parts are suitable for the input power supply.
- Allow at least 1 s after the power supply is turned OFF before you turn it ON again.



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

not supplied to motor.

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

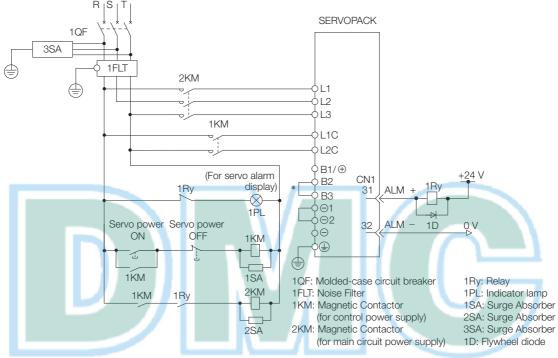
MARNING

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

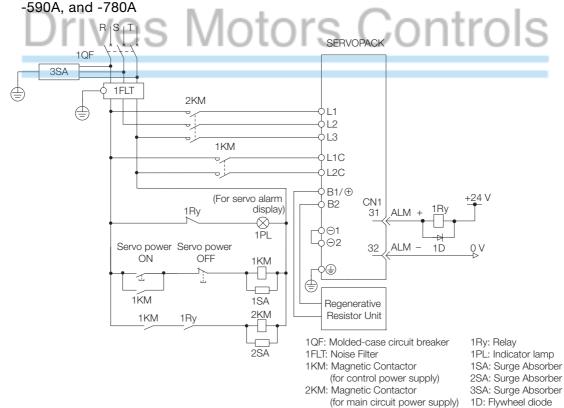
4.3.4 Power Supply Wiring Diagrams

Using Only One SERVOPACK

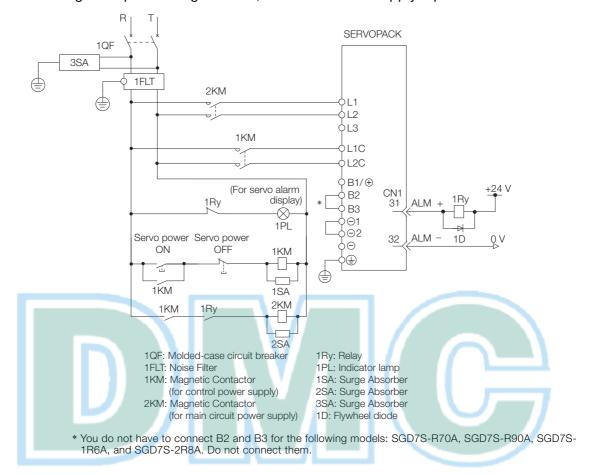
Wiring Example for Three-Phase, 200-VAC Power Supply Input: SGD7S-R70A, -R90A, -1R6A, -2R8A, -3R8A, -5R5A, -7R6A, -120A, -180A, -200A, and -330A



- * You do not have to connect B2 and B3 for the following models: SGD7S-R70A, SGD7S-R90A, SGD7S-1R6A, and SGD7S-2R8A. Do not connect them.
- Wiring Example for Three-Phase, 200-VAC Power Supply Input: SGD7S-470A, -550A,

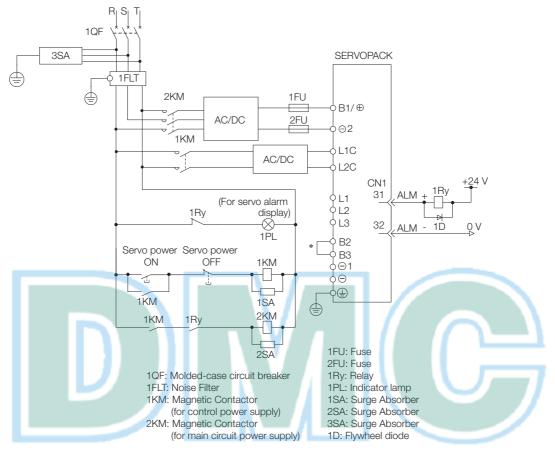


• Wiring Example for Single-Phase, 200-VAC Power Supply Input



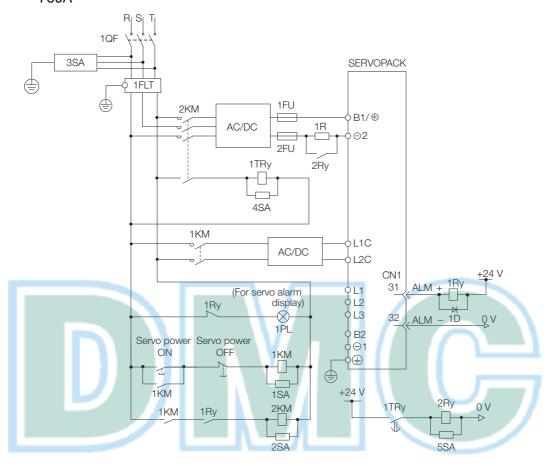
4.3.4 Power Supply Wiring Diagrams

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



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

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



1QF: Molded-case circuit breaker

1FLT: Noise Filter

1KM: Magnetic Contactor

(for control power supply) 2KM: Magnetic Contactor

(for main circuit power supply, auxiliary contact)

1FU: Fuse, positive side

2FU: Fuse, negative side 1Ry: Relay

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

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

2SA: Surge Absorber 3SA: Surge Absorber

4SA: Surge Absorber

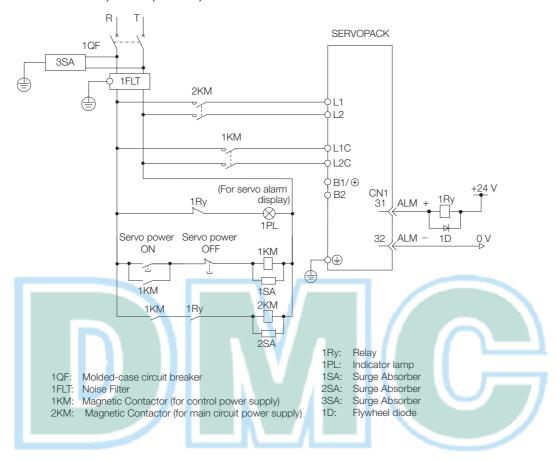
5SA: Surge Absorber

1D: Flywheel diode

1R: External inrush current suppression resistor

4.3.4 Power Supply Wiring Diagrams

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



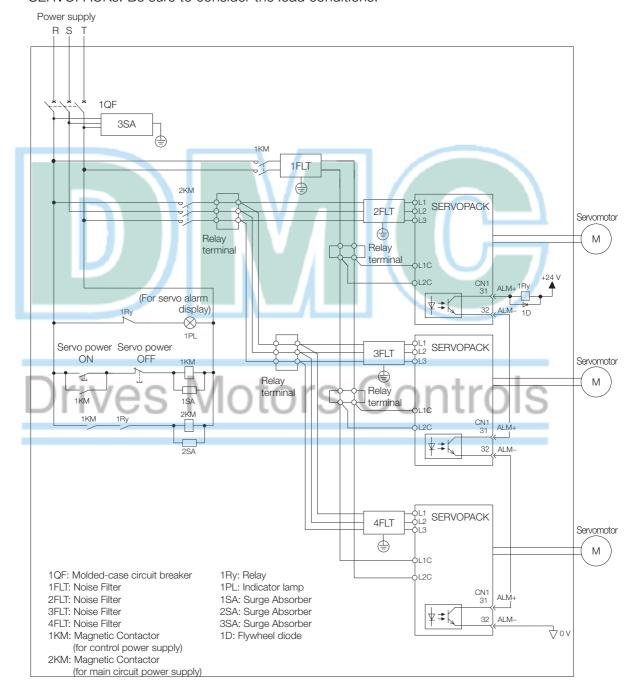
Using More Than One SERVOPACK

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

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

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

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



4.3.5 Wiring Regenerative Resistors

This section describes how to connect External Regenerative Resistors.

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

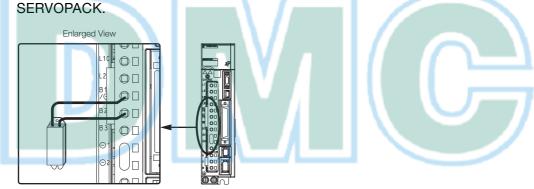
Ω Σ-7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)

MARNING

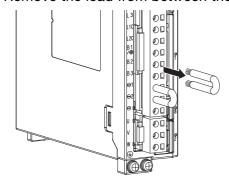
Be sure to wire Regenerative Resistors correctly. Do not connect B1/⊕ and B2.
 Doing so may result in fire or damage to the Regenerative Resistor or SERVOPACK.

Connecting Regenerative Resistors

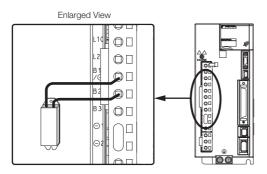
- ◆ SERVOPACK Models SGD7S-R70A, -R90A, -1R6A, -2R8A, -R70F, -R90F, -2R1F, and -2R8F
- 1. Connect the External Regenerative Resistor between the B1/⊕ and B2 terminals on the



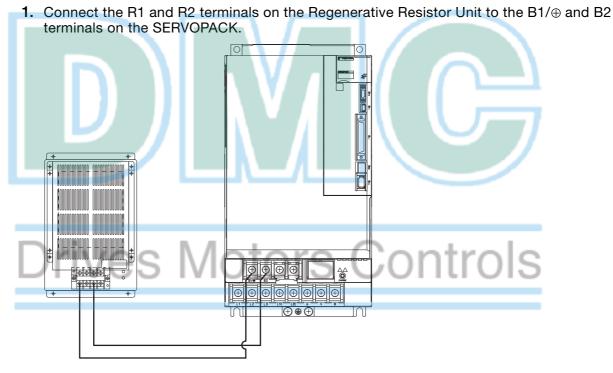
- 2. Set Pn600 (Regenerative Resistor Capacity) and Pn603 (Regenerative Resistance). Refer to the following section for details on the settings.
 5.19 Setting the Regenerative Resistor Capacity on page 5-57
- SERVOPACK Models SGD7S-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, and -330A
- 1. Remove the lead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







- 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 5-57
- ◆ SERVOPACK Models SGD7S-470A, -550A, -590A, and -780A



- 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.

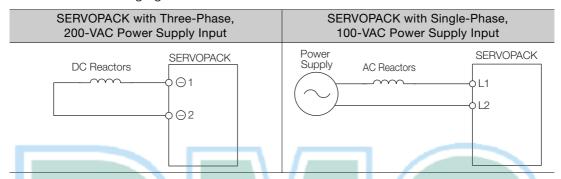
5.19 Setting the Regenerative Resistor Capacity on page 5-57

4.3.6 Wiring Reactors for Harmonic Suppression

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

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

Refer to the following figures to connect reactors.



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

4.4 Wiring Servomotors

4.4.1 Terminal Symbols and Terminal Names

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

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

4.4.2 Pin Arrangement of Encoder Connector (CN2)

When Using a Rotary Servomotor

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



· When Using a Direct Drive Servomotor

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

When Using a Linear Servomotor

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

4.4.3 Wiring the SERVOPACK to the Encoder

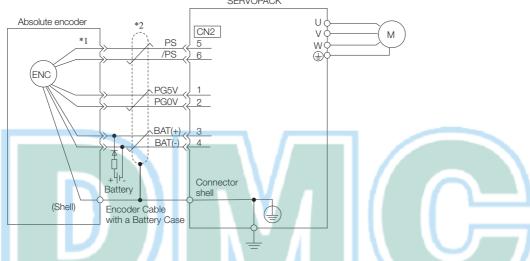
When Using an Absolute Encoder

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

Refer to the following section for the battery replacement procedure.

12.1.3 Replacing the Battery on page 12-3

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



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

• Wiring Example When Installing a Battery on the Host Controller

SERVOPACK

Absolute encoder

*1

PS
5

W

PG5V
1

PG5V
1

PG0V
2

CN1

BAT(+)
3

BAT(+)
3

BAT(+)
4

22

BAT (-)

Connector shell

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

*2. represents a shielded twisted-pair cable.



When Installing a Battery on the Encoder Cable
 Use the Encoder Cable with a Battery Case that is specified by Yaskawa.
 Refer to the following manual for details.

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

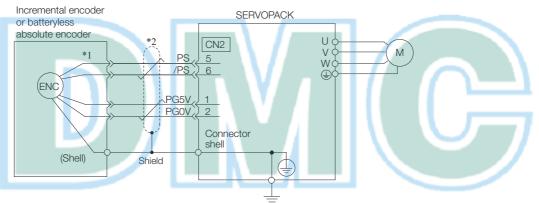
 When Installing a Battery on the Host Controller Insert a diode near the battery to prevent reverse current flow.

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: $\pm 5\%$ max. Rated power: 0.25 W min.

When Using an Incremental Encoder or Batteryless Absolute Encoder



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

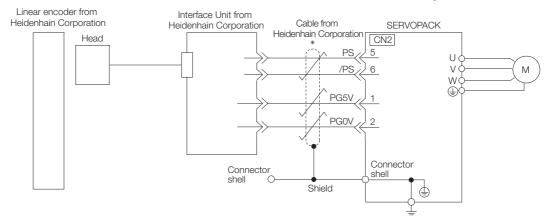


4.4.3 Wiring the SERVOPACK to the Encoder

When Using an Absolute Linear Encoder

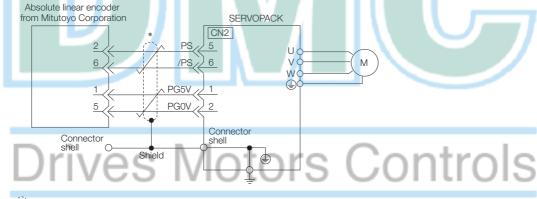
The wiring depends on the manufacturer of the linear encoder.

◆ Connections to Linear Encoder from Heidenhain Corporation



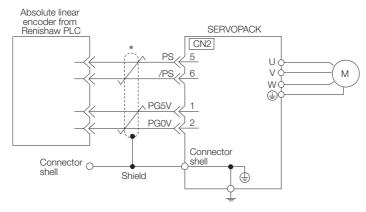


◆ Connections to Linear Encoder from Mitutoyo Corporation



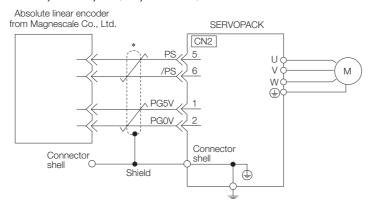
* represents a shielded twisted-pair cable.

◆ Connections to Absolute Linear Encoder from Renishaw PLC



* represents a shielded twisted-pair cable.

- ◆ Connections to Absolute Linear Encoder from Magnescale Co., Ltd.
- SR77, SR87, SQ47, and SQ57



* represents a shielded twisted-pair cable.

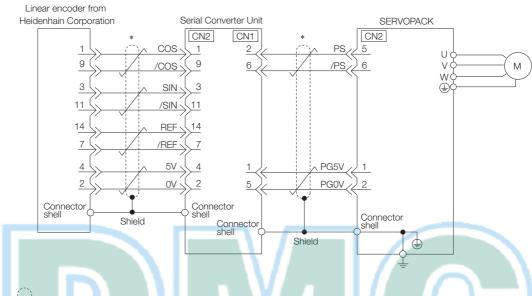


4.4.3 Wiring the SERVOPACK to the Encoder

When Using an Incremental Linear Encoder

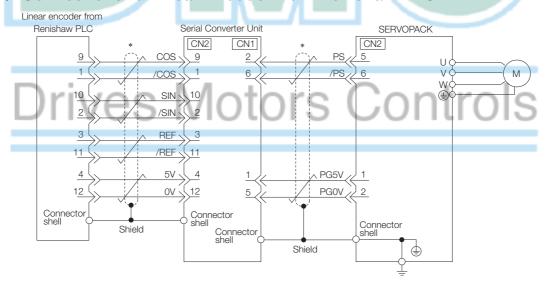
The wiring depends on the manufacturer of the linear encoder.

◆ Connections to Linear Encoder from Heidenhain Corporation



* represents a shielded twisted-pair cable.

◆ Connections to Linear Encoder from Renishaw PLC

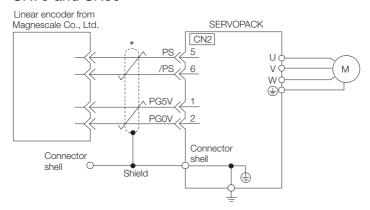


* represents a shielded twisted-pair cable.

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

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

■ SR75 and SR85



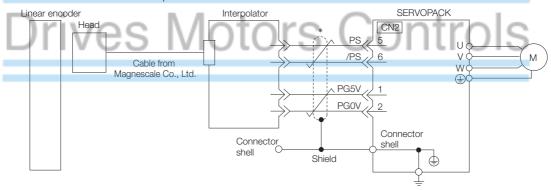


■ SL700, SL710, SL720, SL730, and SQ10

PL101-RY, MQ10-FLA, or MQ10-GLA Interpolator
 The following table gives the Linear Encoder and Interpolator combinations.

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

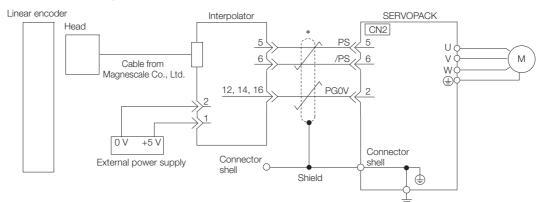
- *1. This is the model of the Head with Interpolator.
- *2. This is the model of the Interpolator.



* represents a shielded twisted-pair cable.

4.4.3 Wiring the SERVOPACK to the Encoder

- SL700, SL710, SL720, and SL730
- MJ620-T13 Interpolator



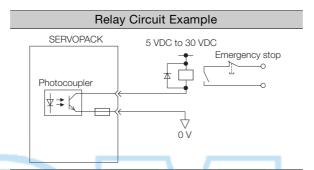
* represents a shielded twisted-pair cable.



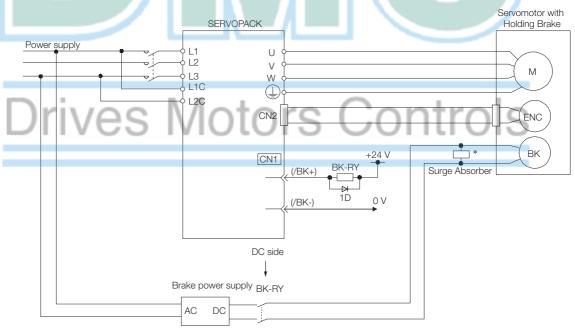
4.4.4 Wiring the SERVOPACK to the Holding Brake



- If you use a Rotary Servomotor, select a Surge Absorber according to the brake current and brake power supply. Refer to the following manual for details.
 - Σ-7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)
- After the Surge Absorber is connected, check the brake operation delay time in your application. The Surge Absorber may affect the brake operation delay time.
 Configure the relay circuit to activate the holding brake for an emergency stop.



- The /BK (Brake) signal cannot be used with the default settings. You must allocate the output signal. Refer to the following section for details.
 - Allocating the /BK (Brake) Signal on page 5-38
- If you use a 24-V brake, install a separate power supply for the 24-VDC power supply from other power supplies, such as the one for the I/O signals of the CN1 connector. If the power supply is shared, the I/O signals may malfunction.



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

^{*} Install the surge absorber near the brake terminals on the Servomotor.

4.5

I/O Signal Connections

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

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

Input Signals

Default settings are given in parentheses.

Control Method	Signal	Pin No.	Name	Function	Reference Page
	/SI0* (/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).)	page 5-17
	/SI3* (/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.)	page 8-75
	/SI1* (P-OT)	42	General-purpose Sequence Input 1 (Forward Drive Prohibit Input)	You can allocate the input signals to use with parameters. (Stops Servomotor drive (to prevent over-	page 5-31
	/SI2* (N-OT)	43	General-purpose Sequence Input 2 (Reverse Drive Prohibit Input)	travel) when the moving part of the machine exceeds the range of movement.)	page 3-31
Any Control Method	/SI5* (/P-CL)	45	General-purpose Sequence Input 5 (Forward Exter- nal Torque Limit Input) General-purpose Sequence Input 6	You can allocate the input signals to use with parameters. (Activates/deactivates external torque limiting.)	page 6-64
Wethod	(/N-CL)	46	(Reverse Exter- nal Torque Limit Input)		
	/SI4* (/ALM- RST)	44	General-purpose Sequence Input 4 (Alarm Reset Input)	You can allocate the input signal to use with a parameter. (Clears alarms.)	page 12-42
	+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.	_
	SEN	4 (2)	Absolute Data Request Input (SEN)	Inputs the position data request signal for an absolute encoder.	page 6-73 page 6-87
	BAT+	21	Battery for absolute encoder (+)	These are the pins to connect the absolute encoder backup battery.	
	BAT-	22	Battery for absolute encoder (-)	Do not connect these pins if you use the Encoder Cable with a Battery Case.	_
	ТН	50	Overheat Protection Input	Inputs the overheat protection signal from a Linear Servomotor or from a sensor attached to the machine.	page 6-109
Speed Control	V-REF	5 (6)	Speed Reference	Inputs the speed reference. Maximum input voltage: ±12 V	page 6-13

Continued on next page.

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

Continued from previous page.

Control Method	Signal	Pin No.	Name	Function	Reference Page
	PULS /PULS	7 8	Pulse Reference Input	One of the following input pulse forms is set. • Sign + pulse train	page 6-31
Position Control	SIGN /SIGN	11 12	Sign of Reference Input	CW + CCW pulse trains 90° phase-differential pulses	page 0-31
	CLR /CLR	15 14	Position Deviation Clear Input	Clears the position deviation during position control.	page 6-33
Torque Control	T-REF	9 (10)	Torque Refer- ence Input	Inputs the torque reference. Maximum input voltage: ±12 V	page 6-40

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

6.1.1 Input Signal Allocations on page 6-5

- 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.



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

Output Signals

Default settings are given in parentheses.

Control Method	Signal	Pin No.	Name	Function	Reference Page
	ALM+	31 32	Servo Alarm Output	Turns OFF (opens) when an error is detected.	page 6-10
	/SO2+* (/TGON+)	27	General-pur- pose Sequence	You can allocate the output signal to use with a parameter.	0.44
	/SO2-* (/TGON-)	28	Output 2 (Rota- tion Detection Output)	(Turns ON (closes) when the Servomotor speed exceeds a set value.)	page 6-11
	/SO3+* (/S-RDY+)	29	General-pur- pose Sequence	You can allocate the output signal to use with a parameter.	0 10
	/SO3-* (/S-RDY-)	30	Output 3 (Servo Ready Output)	(Turns ON (closes) when the SERVO-PACK is ready to acknowledge the /S-ON (Servo ON) signal.)	page 6-12
	PAO	33	Encoder Divided		
Any	/PAO	34	Pulse Output, Phase A	Output the encoder divided pulse output	
Control	PBO	35	Encoder Divided	signals with a 90° phase differential.	
Method	/PBO	36	Pulse Output, Phase B		page 6-73
	PCO	19	Encoder Divided	Outputs the origin signal once every	page 6-87
	/PCO	20	Pulse Output, Phase C	encoder rotation.	7
	PSO	48	Absolute	Outputs the position data of the absolute	
	/PSO	49	Encoder Position Output	Outputs the position data of the absolute encoder.	J
	ALO1*	37 (1)	Alarm Code Out-		
	ALO2*	38 (1)	put	Output a 3-bit alarm code.	page 6-10
	ALO3*	39 (1)		Connected to the frame ground if the	
	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	/SO1+* (/V-CMP+)	25	General-pur- pose Sequence Output 1 (Speed	You can allocate the output signal to use with a parameter. (Turns ON (closes) if the motor speed is	page 6-27
Control	/SO1-*	26	Coincidence Detection Out-	within the set range and matches the ref- erence speed value when speed control	page 6-21
	(/V-CMP-)		put)	is selected.)	
	/SO1+* (/COIN+)	25	General-pur- pose Sequence	You can allocate the output signals to use with parameters.	
Position	/SO1-* (/COIN-)	26	Output 1 (Positioning Completion Output)	(Turns ON (closes) if the position deviation reaches the set value when position control is selected.)	page 6-37
Control	PL1	3	Open-Collector Power Supply Output for Refer- for reference pulses.		
	PL2	13			_
	PL3	18	ence Pulses	Tot toterence pulses.	
-	_	16 17 23 24	_	Do not use these terminals.	_

 $[\]ensuremath{^{*}}$ You can change the allocations. Refer to the following section for details.

Note: Pin numbers in parentheses () indicate signal grounds.

^{6.1.2} Output Signal Allocations on page 6-8

4.5.2 I/O Signal Connector (CN1) Pin Arrangement

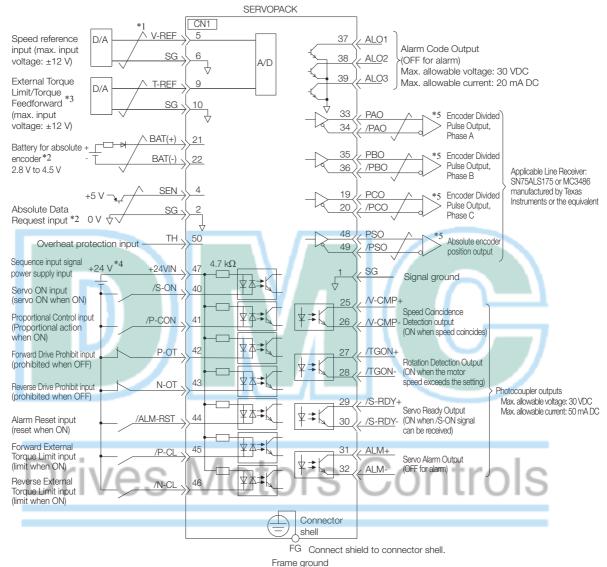
The following figure gives the pin arrangement of the of the I/O signal connector (CN1) for the default settings.

aciaali settirigs.							1				Ī	I .
	2	SG	Signal Ground	1	SG	Signal Ground	27	/SO2+ (TGON+)	General- purpose Sequence	26	/SO1- (V-CMP-)	General- purpose Sequence Output 1
	4	SEN	Absolute Data Request Input	3	PL1	Open-Collector Power Supply Output for Reference Pulses	29	/SO3+ (/S-RDY+)	General- purpose Sequence	28	/SO2- (TGON-)	General- purpose Sequence Output 2
	6	SG	(SEN) Signal Ground	5	V-REF	Speed Reference Input	31	ALM+	Output 3 Servo Alarm Output	30	/SO3- (/S-RDY-)	General- purpose Sequence Output 3
	8	/PULS	Pulse Reference	7	PULS	Pulse Reference Input	33	PAO	Encoder Divided Pulse	32	ALM-	Servo Alarm Output
Pin 1	10	SG	Input Signal	9	T-REF	Torque Reference Input	35	PBO	Output, Phase A Encoder Divided Pulse	34	/PAO	Encoder Divided Pulse Output, Phase A
Pin 2 Pin 26	12	/SIGN	Ground Sign of Refer-	11	SIGN	Sign of Reference Input	37	ALO1	Output, Phase B	36	/PBO	Encoder Divided Pulse Output,
Pin 24 Pin 49	12	/SIGIN	ence Input Position	13	PL2	Open-Collector Power Supply Out-	31	ALUT	Output	38	ALO2	Phase B Alarm Code
The above view is from the direc-	14	/CLR	Deviation Clear Input	10	1 62	put for Reference Pulses	39	ALO3	Code Output	30	ALOZ	Output General-
tion of the follow- ing arrow without the connector shell attached.	16	S I	Vlc	15	CLR	Position Devi- ation Clear Input	41	/SI3 (P-CON)	General- purpose Sequence Input 3	40	/SI0 (/S-ON)	purpose Sequence Input 0
	18	PL3	Open- Collector Power Supply	17	-	-	43	/SI2	General- purpose	42	/SI1 (P-OT)	General- purpose Sequence Input 1
	10	T LO	Output for Refer- ence Pulses	19	PCO	Encoder Divided Pulse Output, Phase C	40	(N-OT)	Sequence Input 2	44	/SI4 (/ALM- RST)	General- purpose Sequence Input 4
	20	/PCO	Encoder Divided Pulse Output, Phase C	21	BAT+	Battery for Absolute Encoder (+)	45	/SI5 (/P-CL)	General- purpose Sequence Input 5	46	/SI6 (/N-CL)	General- purpose Sequence Input 6
	22	BAT-	Battery for Abso- lute Encoder (-)	23	-	-	47	+24VIN	Sequence Input Sig- nal Power Supply Input	48	PSO	Absolute Encoder Position Output
	24	-	-	25	/SO1+ (V-CMP+)	General-pur- pose Sequence Output 1	49	/PSO	Absolute Encoder Position Output	50	TH	Overheat Protec- tion Input

4.5.3

I/O Signal Wiring Examples

Speed Control with a Rotary Servomotor



^{*1.} represents twisted-pair wires.

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.

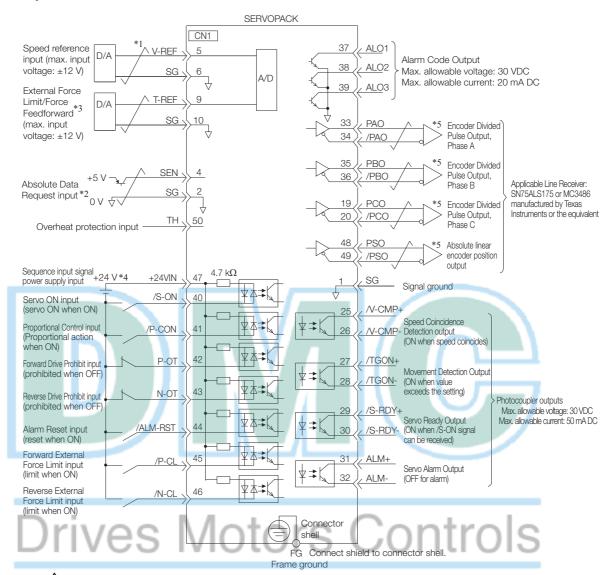
^{*2.} Connect these when using an absolute encoder. If the Encoder Cable with a Battery Case is connected, do not connect a backup battery.

^{*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.

Speed Control with a Linear Servomotor

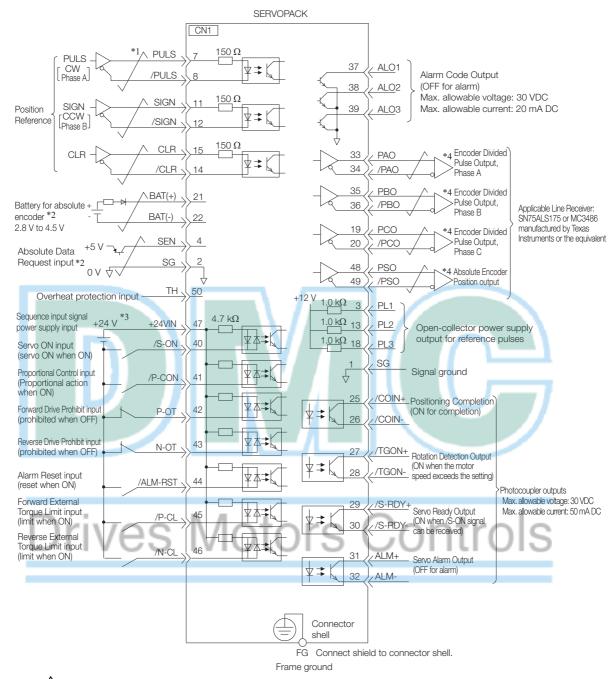


- *1. Trepresents twisted-pair wires.
- *2. Connect these when using an absolute linear encoder.
- *3. You can enable this function with a parameter setting.
- *4. The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.
- *5. Always 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 supply fies, 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.

Position Control with a Rotary Servomotor

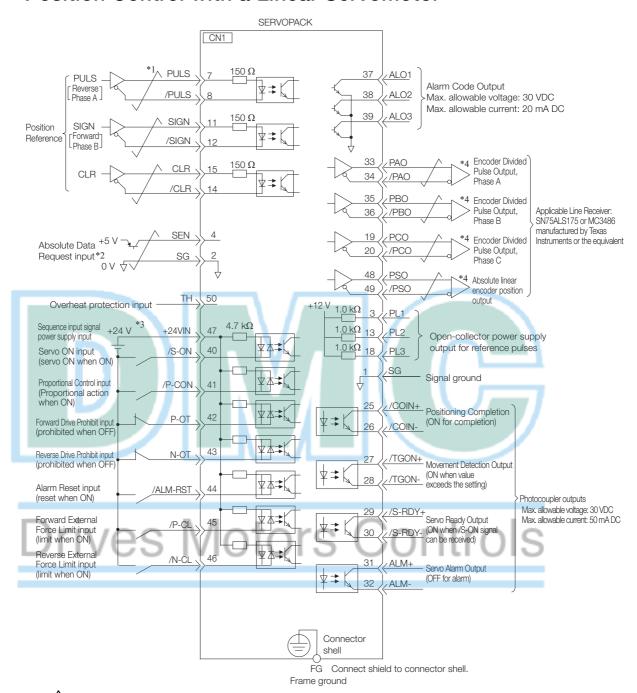


- *1. represents twisted-pair wires.
- *2. Connect these when using an absolute encoder. If the Encoder Cable with a Battery Case is connected, do not connect a backup battery.
- *3. The 24-VDC power supply is not provided by Yaskawa. Use a 24-VDC power supply with double insulation or reinforced insulation.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

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

If the power supply is shared, the I/O signals may malfunction.

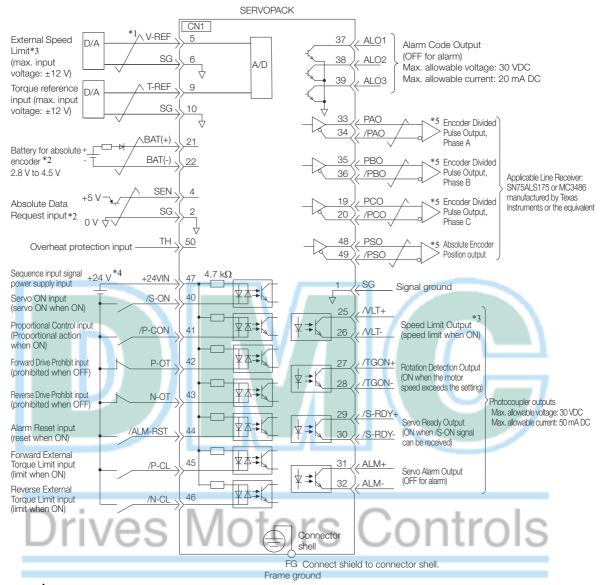
Position Control with a Linear Servomotor



- *1. Trepresents twisted-pair wires.
- *2. Connect 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.

Torque Control with a Rotary Servomotor



^{*1.} represents twisted-pair wires.

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.

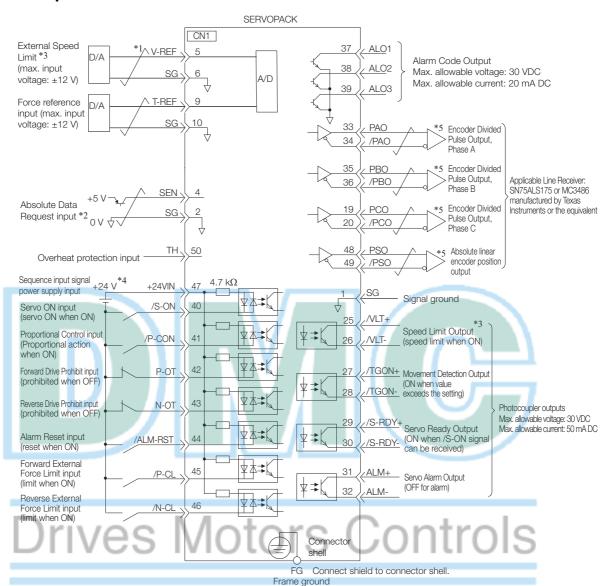
^{*2.} Connect these when using an absolute encoder. If the Encoder Cable with a Battery Case is connected, do not connect a backup battery.

^{*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.

Torque Control with a Linear Servomotor



- 1. Trepresents twisted-pair wires.
- *2. Connect 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

Reference Input Circuits

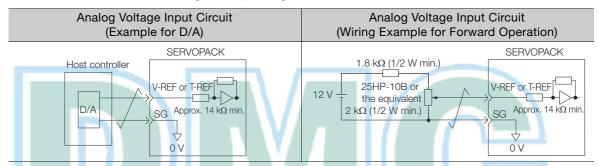
Analog Input Circuits

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: Approx. 14 k Ω
- Torque Reference Input: Approx. 14 $\mbox{k}\Omega$

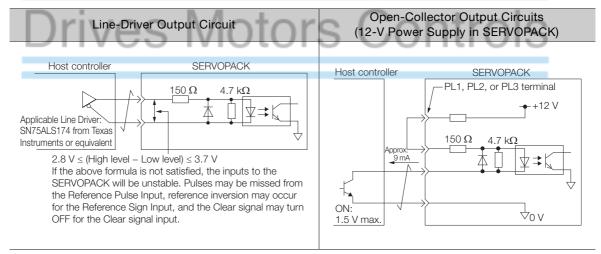
The maximum allowable voltage for input signals is ± 12 V.



◆ 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.



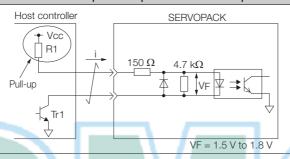


Precaution When Host Controller Uses Open-Collector Output with User-Supplied Power Supply

The SERVOPACK may fail depending on the relationship between the pull-up voltage (Vcc) and the pull-up resistance (R1). Before you wire the circuits, confirm that the specifications of the host controller satisfy the values shown in the following table.

Pull-Up Voltage (Vcc)	Pull-Up Resistance (R1)	Output Current (i)
24 V	1.8 k Ω to 2.7 k Ω	
12 V max.	820 Ω to 1.5 kΩ	20 mA max.
5 V max.	180 Ω to 470 Ω	

Circuit Example for Open-Collector Outputs

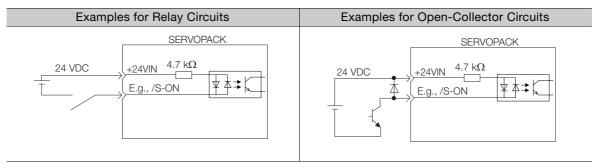




Sequence Input Circuits

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 low-current relay. If you do not use a low-current relay, a faulty contact may result.



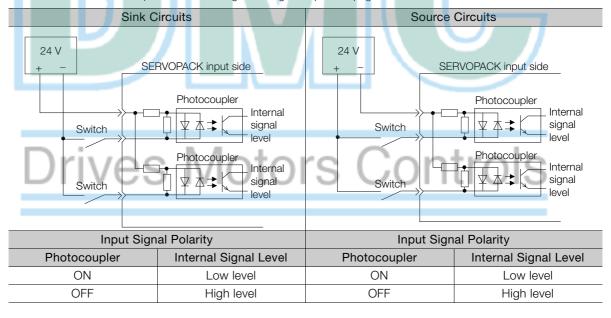
Note: The 24-VDC external power supply capacity must be 50 mA minimum.

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

6.12.2 Structure of the Position Data of the Absolute Encoder on page 6-74

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

Note: The connection examples in 4.5.3 I/O Signal Wiring Examples on page 4-38 are for sink circuit connections.



Sequence Output Circuits



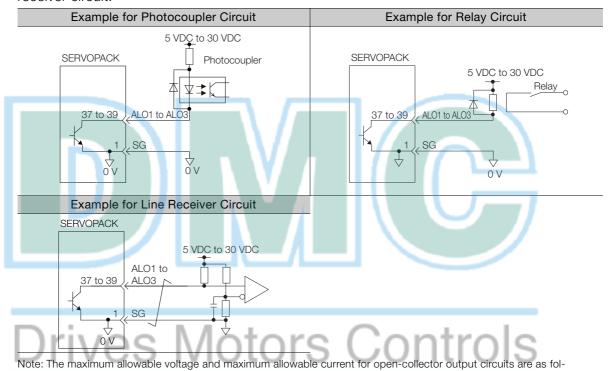
Incorrect wiring or incorrect voltage application to the output circuits may cause short-circuit failures.

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

◆ Open-Collector Output Circuits

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

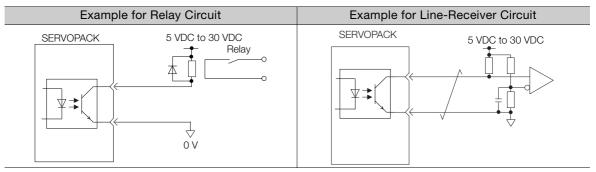
The Alarm Code (ALO1, ALO2, and ALO3) signals are output from open-collector transistor output circuits. Connect an open-collector output circuit to a photocoupler, relay, or line-receiver circuit.



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

◆ Photocoupler Output Circuits

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



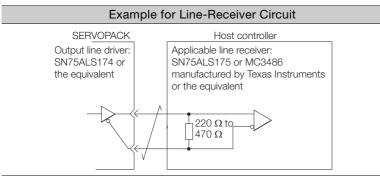
Note: The maximum allowable voltage and current range for photocoupler output circuits are as follows:

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

◆ Line-Driver Output Circuits

This section describes CN1 connector 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 and PBO, /PBO), origin pulse signal (PCO and /PCO), and the absolute encoder position output signals (PSO and /PSO) are output with line-driver output circuits. Connect the line-driver output circuits to line-receiver circuits at the host controller.





4.6 Connecting Safety Function Signals

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

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

Chapter 11 Safety Functions

4.6.1 Pin Arrangement of Safety Function Signals (CN8)

Pin No.	Signal	Name	Function		
1	_	- (Do not use these pins because they	are connected to internal circuits)		
2	_	- (Do not use these pins because they	are connected to internal circuits.)		
3	/HWBB1-	Hard Wire Base Block Input 1			
4	/HWBB1+	Tiald Wife 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.		
5	/HWBB2-	Hard Wire Base Block Input 2			
6	/HWBB2+	Tiald Wife base block input 2			
7	EDM1-		Turns ON when the /HWBB1 and the /		
8	EDM1+	External Device Monitor Output	HWBB2 signals are input and the SERVOPACK enters a base block state.		

4.6.2 I/O Circuits



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

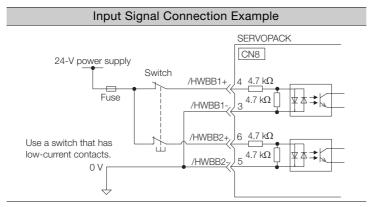
To avoid confusion, the ON and OFF status of signals for the safety function are defined as follows:

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

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

Safety Input Circuits

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



4.6.2 I/O Circuits

◆ Input (HWBB) Signal Specifications

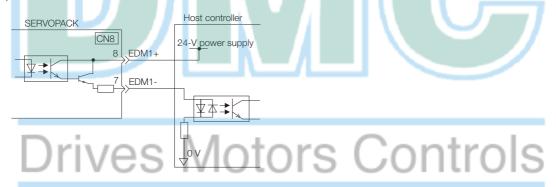
Туре	Signal	Connector Pin No.	Status	Meaning
		CN8-4		Does not activate the HWBB (normal operation).
Inputs	Inputs /HWBB1	CN8-3	OFF (open)	Activates the HWBB (motor current shut-OFF request).
inputs		CN8-6	ON (closed)	Does not activate the HWBB (normal operation).
	/HWBB2	HWBB2 CN8-5 OF		Activates the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

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

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

Diagnostic Output Circuits

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



◆ EDM1 Output Signal Specifications

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

The electrical characteristics of the EDM1 signal are as follows:

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

4.7 Connecting the Other Connectors

4.7.1 Serial Communications Connector (CN3)

To use a Digital Operator or to connect a computer with an RS-422 cable, connect CN3 on the SERVOPACK.

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

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

4.7.2 Computer Connector (CN7)

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

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

AC Servo Drive Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)

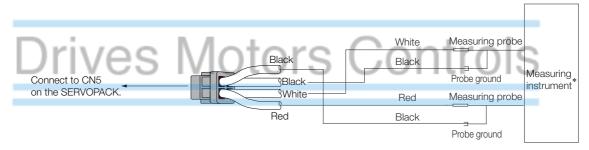


Use the Yaskawa-specified cables. Operation will not be dependable due to low noise resistance with any other cable.

4.7.3 Analog Monitor Connector (CN5)

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

Wiring Example



^{*} The measuring instrument is not provided by Yaskawa.

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

3.3 Monitoring Machine Operation Status and Signal Waveforms on page 9-8

Basic Functions That Require Setting before Operation

5

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

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Drives Motors Controls

5.1.1 Parameter Classification

5.1

Manipulating Parameters (Pn□□□)

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

5.1.1 Parameter Classification

There are the following two types of SERVOPACK parameters.

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



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. \$\square\$ (Display all parameters).

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

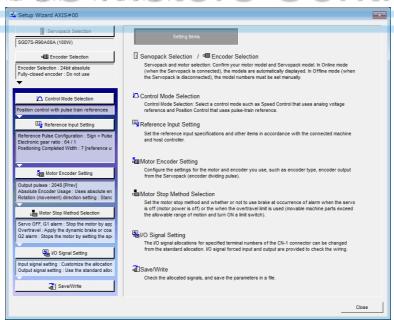
The setting method for each type of parameter is described below.

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.



Tuning Parameters

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

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

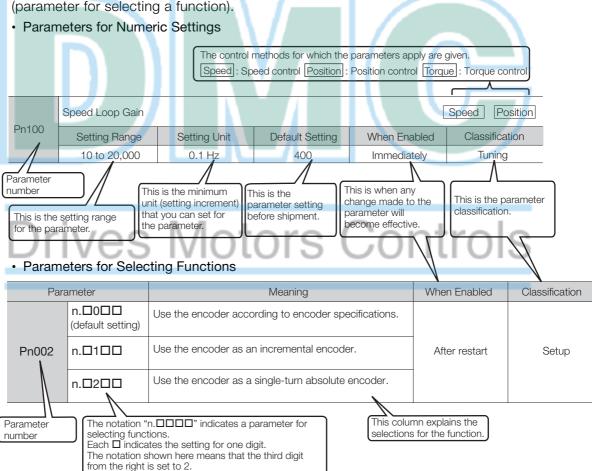
- 8.6 Autotuning without Host Reference on page 8-24
- 8.7 Autotuning with a Host Reference on page 8-35
- 8.8 Custom Tuning on page 8-42

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

8.13 Manual Tuning on page 8-76

5.1.2 Notation for Parameters

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



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.

Setting Parameters with the SigmaWin+

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

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



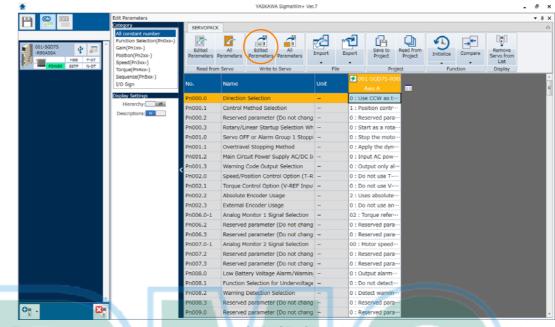
4. Change the setting of the parameter.



- 1. For a parameter for a numeric setting, input the numeric setting.
- 2. If the parameter requires selection of a function, select the function from the list of selections.
- **5.** Press the **Enter** Key.

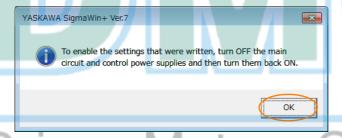
The background of the edited parameter cell will change to green.





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

7. Click the OK Button.



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

This concludes the procedure to set the parameters.

Setting Parameters with a Digital Operator

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

Setting Parameters with the Panel Operator

Refer to the following section for information on setting the parameters with the Panel Operator.

13.2 Parameter (Pn \(\Pi \) \(\Display \) Operations on the Panel Operator on page 13-6

5.1.4 Write Prohibition Setting for Parameters

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+.

Preparations

No preparations are required.

Applicable Tools

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

Tool	Function	Reference
Panel Operator	Fn010	13.4.15 Write Prohibition Setting (Fn010) on page 13-23
Digital Operator	Fn010	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Write Prohibited Setting	© Operating Procedure on page 5-8

Operating Procedure

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

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

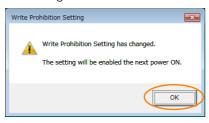


4. Click the **Setting** Button.



5. Click the OK Button.

The setting will be written to the SERVOPACK.



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

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

Restrictions

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

	SigmaWin+	Panel Operator or Digital Operator		When Writ-	
Button in Menu Dialog Box	SigmaWin+ Function Name	Fn No.	Utility Function Name	ing Is Pro- hibited	Reference
	Origin Search	Fn003	Origin Search	Cannot be executed.	page 7-25
	Absolute Encoder Reset	Fn008	Reset Absolute Encoder	Cannot be executed.	page 5-52
		Fn009	Autotune Analog (Speed/ Torque) Reference Offset	Cannot be executed.	page 6-24, page 6-41
	Speed/Torque Reference Offset Adjustment	Fn00A	Manually Adjust Speed Reference Offset	Cannot be executed.	page 6-24
Duin		Fn00B	Manually Adjust Torque Reference Offset	Cannot be executed.	page 6-41
	Analog Monitor Output	Fn00C	Adjust Analog Monitor Output Offset	Cannot be executed.	page 9-10
	Adjustment	Fn00D	Adjust Analog Monitor Output Gain	Cannot be executed.	page 9-10
	Motor Current Detection	Fn00E	Autotune Motor Current Detection Signal Offset	Cannot be executed.	7070 G 100
Setup	Offset Adjustment	Fn00F	Manually Adjust Motor Current Detection Signal Offset	Cannot be executed.	page 6-102
	Multiturn Limit Setting	Fn013	Multiturn Limit Setting after Multiturn Limit Disagreement Alarm	Cannot be executed.	page 6-84
	Reset Configuration Error of Option Module	Fn014	Reset Option Module Configuration Error	Cannot be executed.	page 12-45
	Initialize Vibration Detection Level	Fn01B	Initialize Vibration Detection Level	Cannot be executed.	page 6-98
	Set Origin	Fn020	Set Absolute Linear Encoder Origin	Cannot be executed.	page 5-54
	Software Reset	Fn030	Software Reset	Can be executed.	page 6-96
	Polarity Detection	Fn080	Polarity Detection	Cannot be executed.	page 5-30
	Tuning-less Level Setting	Fn200	Tuning-less Level Setting	Cannot be executed.	page 8-16
	EasyFFT	Fn206	Easy FFT	Cannot be executed.	page 8-94

Continued on next page.

5.1.4 Write Prohibition Setting for Parameters

Continued from previous page.

	SigmaWin+	Panel	Operator or Digital Operator	When Writ-	
Button in Menu Dialog Box	SigmaWin+ Function Name	Fn No.	Utility Function Name	ing Is Pro- hibited	Reference
Parameters	Initialize*	Fn005	Initialize Parameters	Cannot be executed.	page 5-11
	Autotuning without Reference Input	Fn201	Advanced Autotuning with- out Reference	Cannot be executed.	page 8-24
	Autotuning with Reference Input	Fn202	Advanced Autotuning with Reference	Cannot be executed.	page 8-35
Tuning	Custom Tuning	Fn203	One-Parameter Tuning	Cannot be executed.	page 8-42
	Anti-Resonance Control Adjustment	Fn204	Adjust Anti-resonance Control	Cannot be executed.	page 8-51
	Vibration Suppression	Fn205	Vibration Suppression	Cannot be executed.	page 8-56
		Fn011	Display Servomotor Model	Can be executed.	page 9-2
Monitor	Product Information	Fn012	Display Software Version	Can be executed.	page 9-2
Worlitor		Fn01E	Display SERVOPACK and Servomotor IDs	Can be executed.	page 0. 2
		Fn01F	Display Servomotor ID from Feedback Option Module	Can be executed.	page 9-2
Test Opera-	Jogging	Fn002	Jog	Cannot be executed.	page 7-7
tion	Program Jogging	Fn004	Jog Program	Cannot be executed.	page 7-20
	Display Alarm	Fn000	Display Alarm History	Can be executed.	page 12-43
Alarm	Display Alalili	Fn006	Clear Alarm History	Cannot be executed.	page 12-44
Dri	Reset Motor Type Alarm	Fn021	Reset Motor Type Alarm	Cannot be executed.	page 5-16

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

5.1.5 Initializing Parameter Settings

You can return the parameters to their default settings.

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



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

Preparations

Always check the following before you initialize the parameter settings.

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

Applicable Tools

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

Tool	Function	Reference
Panel Operator	Fn005	13.4.5 Initialize Parameters (Fn005) on page 13-16
Digital Operator	Fn005	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Parameters - Edit Parameters	© Operating Procedure on page 5-11

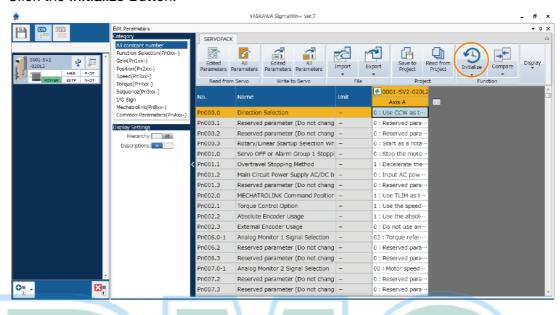
Operating Procedure

Use the following procedure to initialize the parameter settings.

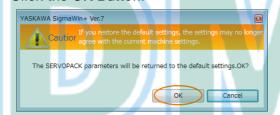
- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Edit Parameters in the Menu Dialog Box. The Parameter Editing Dialog Box will be displayed.
- 3. Select any parameter of the axis to initialize.

5.1.5 Initializing Parameter Settings

4. Click the Initialize Button.



5. Click the OK Button.



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

6. Click the OK Button.



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

This concludes the procedure to initialize the parameter settings.

5.2 Control Method Selection

You can use the SERVOPACK for speed control, position control, or torque control. You set the control method in $Pn000 = n.\square\square X\square$ (Control Method Selection).

Control Method Selection				
Pn000 = n.□□X□	Control Method	Outline	Reference	
n.□□0□ (default set- ting)	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	page 6-17	
n.0010	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.	page 6-30	
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.	page 6-40	
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.	page 6-54	
n.□□4□	Switching between internal set speed control and speed control with analog references			
n.□□5□ n.□□6□	Switching between internal set speed control and position control Switching between internal set speed control and torque 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.	page 6-58	
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 with analog references and speed control with zero clamping	You can use zero clamping for speed control.	page 6-25	
n.□□B□	Switching between normal position con- trol and position con- trol with reference pulse inhibition	You can use reference pulse inhibition for position control.	page 6-40	

5.3.1 AC Power Supply Input/DC Power Supply Input Setting

5.3

Power Supply Type Settings for the Main Circuit and Control Circuit

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



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

5.3.1 AC Power Supply Input/DC Power Supply Input Setting

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

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

Example

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

- A DC power supply is connected between the B1/⊕ and ⊝2 terminals, but an AC power supply input is specified (Pn001 = n.□0□□).
- An AC power supply is input to the L1, L2, and L3 terminals, but a DC power supply is specified (Pn001 = n.□1□□).

Parameter		Meaning	When Enabled	Classification
Pn001	n.□0□□ (default setting)	Use an AC power supply input.	After restart	Setup
	n.□1□□	Use a DC power supply input.		

WARNING

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

There is a risk of failure or fire.

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

There is a risk of equipment damage.

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

4.3.3 Power ON Sequence on page 4-15

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

4.3.4 Power Supply Wiring Diagrams on page 4-16

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

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.

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

If you use a single-phase, 200-VAC power supply input for the SERVOPACK's main circuit power supply, set parameter Pn00B to n. \$\sim\$1 \$\sim\$ (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: SGD7S-120A□□□008) or for a SERVOPACK with a single-phase 100-VAC power supply input.

Parameter		Meaning	When Enabled	Classification
Pn00B	n.□0□□ (default setting)	Use a three-phase power supply input.	After restart	Setup
ПООВ	n.□1□□	Use a three-phase power supply input as a single-phase power supply input.	After restart	Setup



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

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

• Wiring Example for Single-Phase, 200-VAC Power Supply Input on page 4-17

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.

Parameter		Meaning	When Enabled	Classification
Pn000	n.0□□□ (default setting)	When an encoder is not connected, start as SERVOPACK for Rotary Servomotor.	After restart	Setup
111000	n.1□□□	When an encoder is not connected, start as SERVOPACK for Linear Servomotor.	Alter restart	Setup



Drives Motors Controls

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

The /S-ON (Servo ON) 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) Signal

Type	Signal	Connector Pin No.	Signal Status	Function
Input	/C ON	CN1-40	ON (closed)	Power is supplied to the Servomotor to enable operation.
прис	/S-ON (default setting)	OFF (open)	Power supply to the Servomotor is stopped and operation is disabled.	

You can use $Pn50A = n.\square\square X\square$ (/S-ON (Servo ON) 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.

6.1.1 Input Signal Allocations on page 6-5



- 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 supply to start the Servomotor. Doing so will degrade internal elements and may
 cause an accident.
- 2. 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 $Pn50A = n.\square\square X\square$ (/S-ON (Servo ON) Signal Allocation) to 7 (The signal is always active) to keep the servo ON and supply power to the motor continuously.

Parameter		Meaning	When Enabled	Classification
Pn50A	n.□□0□ (default setting)	The S-ON signal is active when CN1-40 input signal is ON (closed).	After restart	Setup
Pn50A	n.□□7□	The signal is always active. (The /S-ON signal is always active.)	Arter restart	Getup



- 1. If you set this parameter to keep the servo ON continuously, power will be supplied to the motor as soon the main circuit power supply 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.
- 2. 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 reverse the direction of Servomotor rotation by changing the setting of $Pn000 = n.\Box\Box\BoxX$ (Direction Selection) without changing the polarity of the speed or position reference.

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

Refer to the following section for details on the encoder divided pulse output. 6.8 Encoder Divided Pulse Output on page 6-47

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 End	coder Divided Pulse Outputs	Applicable Overtravel Signal (OT)
Pn000	n.□□□0 Use CCW as	Forward reference	Torque reference Time Motor speed	PBO Phase-B lead	P-OT (For- ward Drive Prohibit) signal
	the forward direction. (default setting)	Reverse reference	Torque reference Time Motor speed	Encoder Divided Pulse Outputs PAO Phase-A lead PBO PBO	N-OT (Reverse Drive Prohibit) signal
	n.□□□1 Use CW as the forward direc-	Forward reference	Time Motor speed	PAO Phase-B lead	P-OT (Forward Drive Prohibit) signal
	tion. (Reverse Rota- tion Mode)		Torque reference Time Motor speed	Encoder Divided Pulse Outputs PAO Phase-A lead PBO PBO	N-OT (Reverse Drive Prohibit) signal

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

Linear Servomotors

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

Parameter Forward/Rever			_	nd Encoder Divided Pulse puts	Applicable Overtravel Signal (OT)
Pn000	n.□□□0 Use the direction in which the linear	Forward reference	Moves in the count-up direction.	Encoder Divided Pulse Outputs PAO TT Phase-B lead	P-OT (For- ward Drive Prohibit) signal
	encoder counts up as the for- ward direction. (default setting)	Reverse reference	Moves in the count-down direction. Force reference Time Motor speed	Encoder Divided Pulse Outputs PAO Phase-A lead PBO PBO	N-OT (Reverse Drive Prohibit) signal
	n. □□□1 Use the direction in which the linear encoder counts down as the forward direction.	Forward reference	Moves in the count-down direction. Force reference Time Motor speed	Encoder Divided Pulse Outputs PAO PBO Phase-B lead	P-OT (For- ward Drive Prohibit) signal
		Reverse reference	Moves in the count-up direction.	Encoder Divided Pulse Outputs PAO Phase-A lead PBO PBO	N-OT (Reverse Drive Prohibit) signal

Note: The trace waveforms of the SigmaWin+ are shown in the above table for the 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, you do not need to set Pn282.



Serial Converter Unit

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

Term

Scale Pitch

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

	Linear Encoder Sc	ale Pitch	h Speed Position Force			
Pn282	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 6,553,600	0.01 μm	0	After restart	Setup	

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

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

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

Information

Linear Encoder Pitch

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

9.1 Monitoring Product Information on page 9-2

5.8

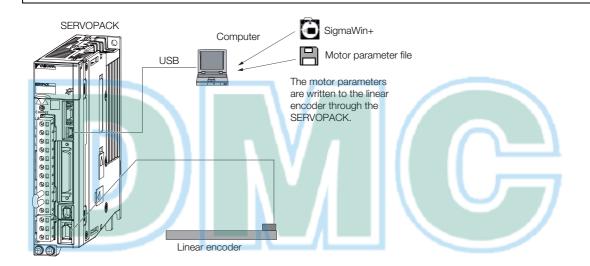
Writing Linear Servomotor Parameters

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 parameters to the linear encoder. The motor parameters contain the information that is required by the SERVOPACK to operate the Linear Servomotor.

MARNING

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

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





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

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

Precautions

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

Applicable Tools

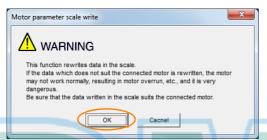
The following table lists the tools that you can use to write the parameters to the Linear Servomotor and the applicable tool functions.

Tool	Function	Reference	
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+ Setup - Motor Parameter Scale Write		© Operating Procedure on page 5-21	

Operating Procedure

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

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



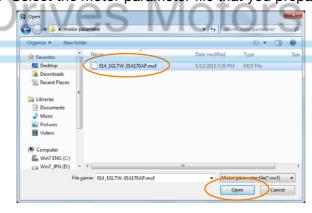
Click the Cancel Button to cancel writing the motor parameters to the linear encoder. The Main Window will return.

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

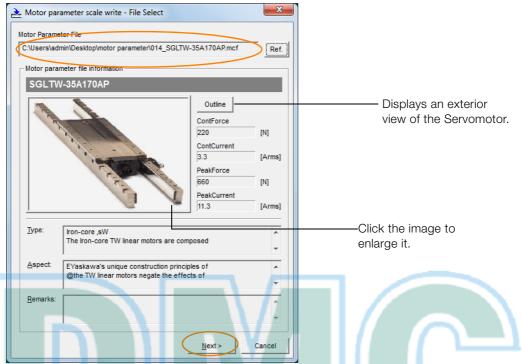
5. Click the Ref. Button.



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

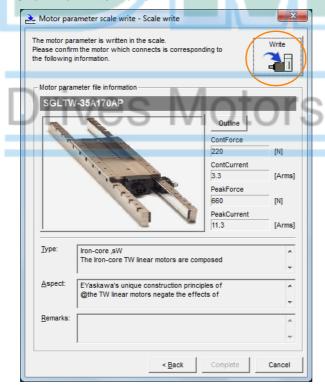


7. Confirm that the motor parameter file information that is displayed is suitable for your Servomotor, and then click the **Next** Button.



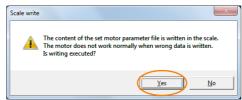
Click the **Cancel** Button to cancel writing the motor parameters to the linear encoder. The Main Window will return.

8. Click the Write Button.



Controls

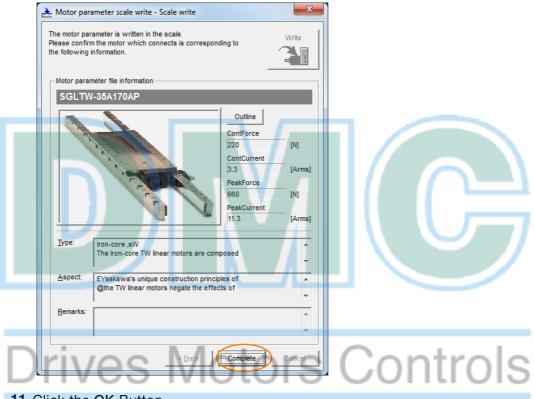
9. Click the Yes Button.



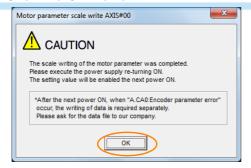
Click the **No** Button to cancel writing the motor parameters to the linear encoder.

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

10. Click the Complete Button.



11. Click the OK Button.



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

This concludes the procedure to write the motor parameters.

Confirming If the Motor Parameters Have Been Written

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

If the motor parameters have not been written, no information on the Servomotor will be dis-

9.1 Monitoring Product Information on page 9-2

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.

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

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



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

Related Parameters

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

Operating Procedure

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

- 1. Set Pn000 to n.□□□0 (Set a phase-A lead as a phase sequence of U, V, and W). This setting is to make following confirmation work easier to understand.
- 2. Select Monitor in the Menu Dialog Box.

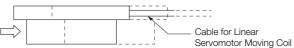
The Operation Pane will be displayed so that you can check the feedback pulse counter. To check the feedback pulse counter with the Panel Operator or Digital Operator, use Un00D (Feedback Pulse Counter).

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.

Example

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



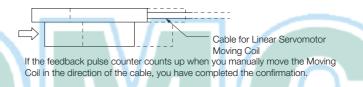
If there are 128,000 pulses on the feedback pulse counter after you manually move the Moving Coil in the direction of the cable, you have completed the confirmation.

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

Information

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

- The linear encoder pitch is not correct.
 If the scale pitch that is set in Pn282 does not agree with the actual scale pitch, the expected number of feedback pulses will not be returned. Check the specifications of the linear encoder.
- The linear encoder is not adjusted properly.
 If the linear encoder is not adjusted properly, the output signal level from the linear encoder will drop and the correct number of pulses will not be counted. Check the adjustment of the linear encoder. Contact the manufacturer of the linear encoder for details.
- There is a mistake in the wiring between the linear encoder and the Serial Converter Unit.
 - If the wiring is not correct, the correct number of pulses will not be counted. Correct the wiring.
- 4. Manually move the Moving Coil in the direction of the cable and check the value of the feedback pulse counter in the Operation Pane to confirm that it is counting up. If the pulses are counted up, the forward direction of the Linear Servomotor is the same as the countup direction of the linear encoder.



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

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

Drives Motors Controls

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 $Pn080 = n.\square\square\square\square X$ (Polarity Sensor Selection).

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

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

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

Information

If you set Pn080 to n. \$\square\$ 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 supply OFF and ON again.



Drives Motors Controls

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 supply 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 supply to the SERVOPACK is turned OFF.)	 Use the /S-ON (Servo ON) signal. Use the /P-DET (Polarity Detection) 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 supply 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.	
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

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.)

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

Preparations

Always check the following before you execute polarity detection.

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



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

Important

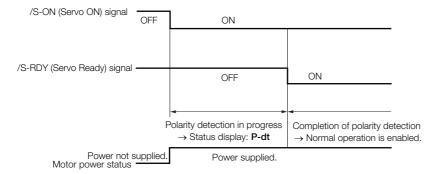
Polarity detection is affected by many factors.For example, polarity detection may fail if the mass ratio or friction is too large or the cable tension is too strong.

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

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

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

Туре	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) Signal to Perform Polarity Detection

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

You can allocate the /P-DET (Polarity Detection) signal if you want to create a sequence on the host computer to monitor the /S-RDY (Servo Ready) signal and output the /S-ON (Servo ON) 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 ON and the /S-RDY (Servo Ready) 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.

Туре	Signal	Connector Pin No.	Signal Status	Meaning	
	/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.	
Input			ON	Executes polarity detection, but only on the first falling	
	/P-DET M	Must be allocated.	(closed)	edge of the signal after the power supply is turned ON.	
			OFF (open)		

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

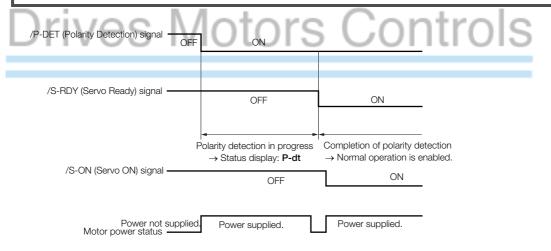
- Pn50A = n.□□□1 (Change the sequence input signal allocations.)
 Pn50D = n.X□□□ (/P-DET (Polarity Detection Input) Signal Allocation)

Refer to the following section for details.

6.1.1 Input Signal Allocations on page 6-5



When the /P-DET (Polarity Detection) signal is set to be always active, polarity detection will automatically start when the main circuit power supply is turned ON. This can result in unexpected operation of the Servomotor. Always implement safety measures when you preform polarity detection.



5.11.4 Using a Tool Function to Perform Polarity Detection

Applicable Tools

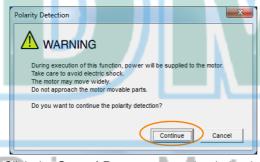
The following table lists the tools that you can use to perform polarity detection and the applicable tool functions.

Tool	Function	Reference
Panel Operator	Fn080	13.4.26 Polarity Detection (Fn080) on page 13-29
Digital Operator	Fn080	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Polarity Detection	Operating Procedure on page 5-30

Operating Procedure

Use the following procedure to perform polarity detection.

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



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

4. Click the Start Button.

Polarity detection will be executed.



This concludes the polarity detection procedure.

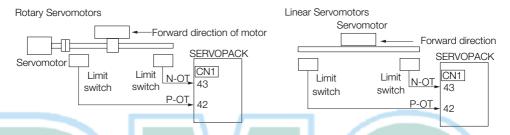
5.12 Overtravel and Related Settings

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

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

You use the P-OT and N-OT signals to stop the machine by installing limit switches at the positions where you want to stop the machine that is operated by the Servomotor.

A SERVOPACK wiring example is provided below.



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

This section describes the parameters settings related to overtravel.

CAUTION

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

5.12.1 Overtravel Signals

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

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input -	P-OT	CN1-42	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.



When the Servomotor stops due to overtravel during position control, the position deviation is held.

You must input the CLR (Clear) signal to clear the position deviation.

Refer to the following section for information on the CLR signal.

6.6.2 CLR (Position Deviation Clear) Signal Function and Settings on page 6-33

5.12.2 Setting to Enable/Disable Overtravel

You can use $Pn50A = n.X \square \square \square$ (P-OT (Forward Drive Prohibit) Signal Allocation) and $Pn50B = n.\square \square \square \square X$ (N-OT (Reverse Drive Prohibit) Signal Allocation) to enable and disable the overtravel function.

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

Parameter		Meaning	When Enabled	Classification
Pn50A	n.2□□□ The forward overtravel function is ena and the P-OT (Forward Drive Prohibit) is input from CN1-42.		ritro	15
	n.8□□□	The forward overtravel function is disabled. Forward drive is always enabled.	After restart	Setup
Pn50B	n.□□□3 (default setting)	The reverse overtravel function is enabled and the N-OT (Reverse Drive Prohibit) signal is input from CN1-43.	Alter restart	Seruh
	n.□□□8	The reverse overtravel function is disabled. Reverse drive is always enabled.		

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

6.1.1 Input Signal Allocations on page 6-5

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

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

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

5.14.1 Stopping Method for Servo OFF on page 5-42

Stopping the Servomotor by Setting Emergency Stop Torque

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

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

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

	Emergency Stop To	rque	Speed Position		
Pn406	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	800	Immediately	Setup

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

Stopping the Servomotor by Setting the Deceleration Time

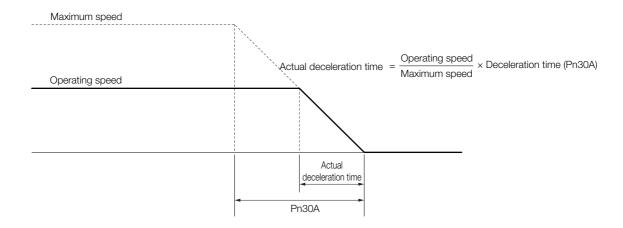
To specify the Servomotor deceleration time and use it to stop the Servomotor, set Pn30A (Deceleration Time for Servo OFF and Forced Stops).

	Deceleration Time f	or Servo OFF and Fo	Speed Position	า	
Pn30A	Setting Range Setting Unit Default Setting			When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup

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

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

5.12.4 Overtravel Warnings



5.12.4 Overtravel Warnings

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

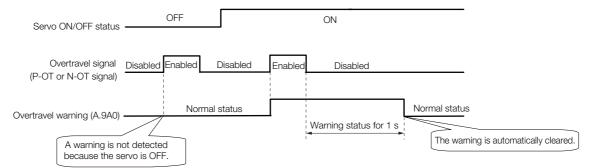


- 1. The occurrence of an A.9A0 warning will not stop the motor or have any affect on host controller motion operations. The next step (e.g., the next motion or command) can be executed even if an overtravel warning exists.
 - However, depending on the processing specifications and programming for warnings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

The following parameter is set for this function.

Parameter		Meaning	When Enabled	Classification
Pn00D	n.0□□□ (default setting)	Do not detect overtravel warnings.	Immediately	Setup
	n.1□□□	Detect overtravel warnings.		

A timing chart for warning detection is provided below.



Information

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



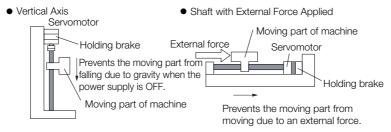
Drives Motors Controls

5.13.1 Brake Operating Sequence

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.





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.

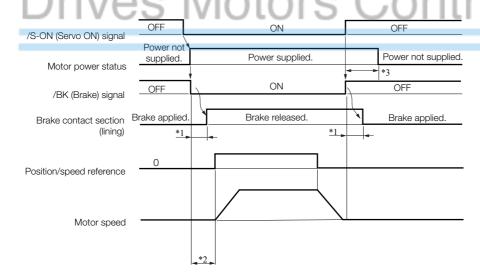
S

Brake Release Delay Time

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

Brake Operation Delay Time

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



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

Model	Voltage	Brake Release Delay Time [ms]	Brake Operation Delay Time [ms]
SGM7J-A5 to -04		60	
SGM7J-06 and -08		80	100
SGM7A-A5 to -04		60	100
SGM7A-06 to -10		80	
SGM7A-15 to -25		170	80
SGM7A-30 to -50		100	60
SGM7P-01	24 VDC	20	
SGM7P-02 and -04		40	100
SGM7P-08 and -15		20	
SGM7G-03 to -20		100	80
SGM7G-30 to -44		170	100
SGM7G-55 to -1A		170	80
SGM7G-1E		250	00

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)
 - 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)

Connection Examples

Refer to the following section for information on brake wiring.

4.4.4 Wiring the SERVOPACK to the Holding Brake on page 4-33

5.13.2 /BK (Brake) Signal

The following settings are for the output signal that controls the brake. The /BK (Brake) signal is not allocated by default. To use the brake, change the setting of Pn50F = $n.\Box X\Box\Box$ (/BK (Brake Output) Signal Allocation).

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

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output /BK	Must be allocated	ON (closed)	Releases the brake.	
	/BK Must be allocated.	OFF (open)	Activates the brake.	

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

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

Allocating the /BK (Brake) Signal

To use the brake, you must allocate an output signal for the /BK signal. Set the allocation for the /BK signal in Pn50F = $n.\Box X\Box\Box$ (/BK (Brake Output) Signal Allocation).

Parameter		Connector Pin No.		Meaning	When	Classification
		+ Pin	- Pin	ivieariiig	Enabled	Classification
	n.□0□□ (default setting)	_	-	The /BK signal is not used.		
Pn50F	n.□1□□	CN1-25	CN1-26	The /BK signal is output from CN1-25 and CN1-26.	After restart	Setup
	n.□2□□	CN1-27	CN1-28	The /BK signal is output from CN1-27 and CN1-28.	Aiter restart	
	n.□3□□	CN1-29	CN1-30	The /BK signal is output from CN1-29 and CN1-30.		



 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) signal is allocated to CN1-25 and the /V-CMP (Speed Coincidence Detection) 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.

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

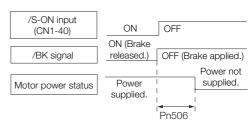
For example, never allocate the /TGON (Rotation Detection) signal and /BK signal to the same output connector pin. If you did so, the /TGON signal would be turned ON by the falling speed on a vertical axis, and the brake would not operate.

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

When the Servomotor is stopped, the /BK signal turns OFF at the same time as the /S-ON signal turns OFF. Use the servo OFF delay time (Pn506) to change the timing to turn OFF power supply to the motor after the /S-ON signal turns OFF.

	Brake Reference-Se	Speed Position Torque			
Pn506	Setting Range	Setting Unit Default Setting Wh		When Enabled	Classification
	0 to 50	10 ms	0	Immediately	Setup

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





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

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

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

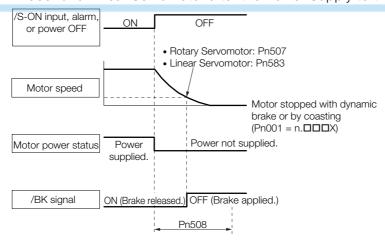
Note: If zero-speed stopping is set as the stopping method for alarms, the setting of Pn506 (Brake Reference-Servo OFF Delay Time) is used after the motor stops.

· Rotary Servomotors

	Brake Reference O	utput Speed Level	Speed Positi	on Torque		
Pn507	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	1 min ⁻¹	100	Immediately	Setup	
	Servo OFF-Brake C	ommand Waiting Ti	me	Speed Positi	on Torque	
Pn508	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	10 to 100	10 ms	50	Immediately	Setup	
• Linear S	Linear Servomotors					
	Brake Reference O	utput Speed Level		Speed Positi	on Force	
Pn583	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	1 mm/s	10	Immediately	Setup	
	Servo OFF-Brake Command Waiting Time			Speed Positi	on Force	
Pn508	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	10 to 100	10 ms	50	Immediately	Setup	

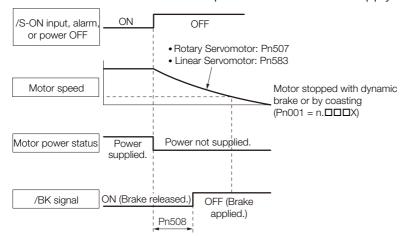
The brake operates when either of the following conditions is satisfied:

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



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

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





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

Drives Motors Controls

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 Clamping	The speed reference is set to 0 to stop the Servomotor quickly.
Decelerating to a Stop	Emergency stop torque is used to decelerate the motor to a stop.

There are the following three conditions after stopping.

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



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

		Servomotor Stopping Method				
ri۱	Condition	SGD7S-R70A, -1R6A, -2R8A, -3R8A, -5R5A, -7R6A, -120A, -180A, -200A, -R70F, -R90F, -2R1F, or -2R8F	SGD7S-330A, -470A, -550A, -590A, or -780A			
	Main circuit power supply turned OFF before turning OFF the servo	Stopping with	dynamic brake			
	Control power supply turned OFF before turning OFF the servo	Stopping with dynamic brake	Coasting to a stop			

- If the Servomotor must be stopped by coasting rather than with the dynamic brake when the main circuit power supply or the control power supply 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 = $n.\Box\Box\Box$ X (Motor Stopping Method for Servo OFF and Group 1 Alarms).

Parameter		Servomotor Stop- ping Method	Status after Servo- motor Stops	When Enabled	Classifi- cation
D=001	n.□□□0 (default setting)	Dynamic brake	Dynamic brake	A ft au va at aut	Setup
Pn001	n.□□□1		Coasting	After restart	
	n.□□□2	Coasting	Coasting		

Note: If Pn001 is set to n. \(\sim \subseteq \subseteq 0\) (Stop the motor by applying the dynamic brake) and the Servomotor is stopped or operates at a low speed, braking force may not be generated, just like it is not generated for coasting to a stop.

5.14.2 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.

12.2.1 List of Alarms on page 12-5

Motor Stopping Method for Group 1 Alarms

When a group 1 alarm occurs, the Servomotor will stop according to the setting of $Pn001 = n.\Box\Box\Box X$. 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 5-42

Motor Stopping Method for Group 2 Alarms

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

- Pn001 = n.□□□X (Motor Stopping Method for Servo OFF and Group 1 Alarms)
- Pn00A = n.□□□X (Motor Stopping Method for Group 2 Alarms)
- Pn00B = n.□□X□ (Motor Stopping Method for Group 2 Alarms)

However, during torque control, the group 1 stopping method is always used. If you set Pn00B to n. \$\square\$ (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.

	Paramete	er	Servomotor	Status after	When	
Pn00B	Pn00A	Pn001	Stopping Method	Servomotor Stops	Enabled	Classification
n.□□0□ (default		n.□□□0 (default setting)	Zero-speed stop-	Dynamic brake		
setting)	_	n.□□□1 n.□□□2	ping	Coasting		
		n.□□□0 (default setting)	Dynamic brake	Dynamic brake		
n.□□1□	_	n.□□□1 n.□□□2	Coasting	Coasting		
	n.□□□0	n.□□□0 (default setting)	Dynamic brake	Dynamic brake		
		n.□□□1 n.□□□2	Coasting	Coasting		
	n.□□□1	n.□□□0 (default setting)		Dynamic brake		
	(default setting) n.□□□1 n.□□□2	Motor is decelerated using the	Coasting	After restart	Setup	
n.□□2□	n.□□□2	n.□□□0 (default setting) n.□□□1 n.□□□2	torque set in Pn406 as the maximum torque.	Coasting		7
	n.□□□3	n.□□□0 (default setting) n.□□□1 n.□□□2	Motor is deceler-	Dynamic brake Coasting		
	n.□□□4	n.□□□0 (default setting) n.□□□1 n.□□□2	ated according to setting of Pn30A.	Coasting		

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

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

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

Stopping the Servomotor by Setting Emergency Stop Torque on page 5-33

^{4.} Refer to the following section for details on Pn30A (Deceleration Time for Servo OFF and Forced Stops).

Stopping the Servomotor by Setting the Deceleration Time on page 5-33

5.15.1 Detection Timing for Overload Warnings (A.910)

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.

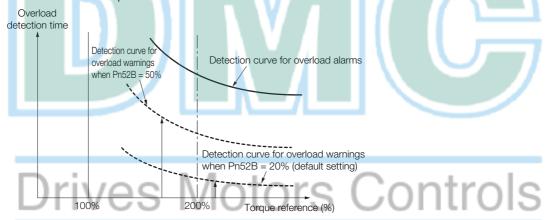
It is designed to prevent Servomotor overheating.

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 the overload warning level (Pn52B). You can increase safety by using overload warning detection as an overload protection function matched to the system.

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



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

5.15.2 Detection Timing for Overload Alarms (A.720)

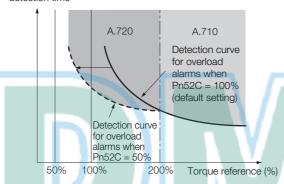
If Servomotor heat dissipation is insufficient (e.g., if the heat sink is too small), you can lower the overload alarm detection level to help prevent overheating.

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

	Base Current Derati	ng at Motor Overloa	Speed Position	Torque	
Pn52C	Setting Range	Range Setting Unit Default Setting When Er			Classification
	10 to 100	1%	100	After restart	Setup

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

Overload detection time



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

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

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

5.16 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.

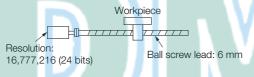
Note: 1. If you set an electronic gear in the host controller, normally set the electronic gear ratio in the SERVOPACK to 1:1.

2. 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:

①Calculate the number of revolutions.
The Servomotor will move 6 mm for each revolution, so 10/6 revolutions are required to move 10 mm.

②Calculate the required number of reference pulses.

One revolution is 16,777,216 pulses, therefore 10/6 × 16,777,216 = 27,962,026.66 pulses. ③Input 27,962,027 pulses as the reference.

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

When the Electronic Gear Is Used

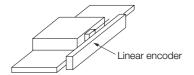
If you use reference units to move the workpiece when one reference unit is set to 1 μm , the travel distance is 1 μm per pulse.

To move the workpiece 10 mm (10,000 μ m), 10,000 ÷ 1 = 10,000 pulses, so 10,000 pulses would be input.

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

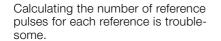
Linear Servomotors

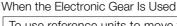
In this example, the following machine configuration is used to move the load 10 mm. We'll assume that the resolution of the Serial Converter Unit is 256 and that the linear encoder pitch is $20~\mu m$.

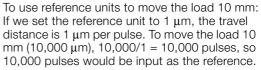


When the Electronic Gear Is Not Used

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







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

5.16.1 Electronic Gear Ratio Settings

Set the electronic gear ratio using Pn20E and Pn210.



The setting range of the electronic gear depends on the setting of $Pn040 = n.\square\square X\square$ (Encoder Resolution Compatibility Selection).

Pn040 = n.□□0□ (Use the encoder resolution of the Servomotor.)
 Set the electronic gear ratio within the following range.
 0.001 ≤ Electronic gear ratio (B/A) ≤ 64,000

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

Pn040 = n.□□1□ (Use a resolution of 20 bits when connected to an SGM7J, SGM7A, SGM7P, SGM7G, SGM7E, or SGM7F Servomotor.)

Set the electronic gear ratio within the following range. $0.001 \le \text{Electronic gear ratio (B/A)} \le 4,000$

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

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

5.16.1 Electronic Gear Ratio Settings

Calculating the Settings for the Electronic Gear Ratio

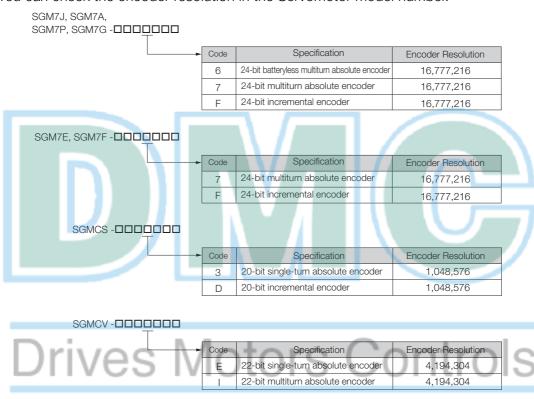
◆ Rotary Servomotors

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

$$\label{eq:electronic gear ratio} \begin{array}{l} \frac{B}{A} = \frac{Pn20E}{Pn210} = \frac{Encoder\ resolution}{Travel\ distance\ per\ load\ shaft\ revolution\ (reference\ units)} \times \frac{m}{n} \end{array}$$

■ Encoder Resolution

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



Linear Servomotors

You can calculate the settings for the electronic gear ratio with the following equation:

When Not Using a Serial Converter Unit

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

Electronic gear ratio
$$\frac{B}{A} = \frac{Pn20E}{Pn210} = \frac{Travel distance per reference unit (reference units) \times Linear encoder resolution}{Linear encoder pitch (the value from the following table)}$$

When Using a Serial Converter Unit

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

■ Feedback Resolution of Linear Encoder

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

Type of Linear Encoder	Manufac- turer	Linear Encoder Model	Linear Encoder Pitch [µm]*1		Model of Serial Con- erter Unit or Model of Interpolator	Resolution	Resolution
		LIDA48□		JZDP-H003-□□□-E*2		256	0.078 μm
	Heidenhain		20	J	ZDP-J003-□□□-E*2	4,096	0.0049 μm
	Corporation	LIF48□	4	J	ZDP-H003-□□□-E*2	256	0.016 μm
		LIF40LI	4	J	ZDP-J003-□□□-E*2	4,096	0.00098 μm
	Renishaw	DOLLOOD	00	J	ZDP-H005- □□□ -E*2	256	0.078 μm
	PLC	RGH22B	20	J	ZDP-J005-□□□-E*2	4,096	0.0049 μm
Incre-		SR75-0000LF*5	80		-	8,192	0.0098 μm
mental		SR75-0000MF	80		_	1,024	0.078 μm
		SR85-0000LF*5	80		_	8,192	0.0098 μm
	Magnes-	SR85-000MF	80		1 -	1,024	0.078 μm
	cale Co., Ltd.	SL700*5, SL710*5,	000		PL101-RY*3	0.400	0.0077
	Ltd.	SL720*5, SL730*5	800		MJ620-T13*4	8,192	0.0977 μm
		TI TO V			MQ10-FLA*4		
		SQ10	400		MQ10-GLA*4	8,192	0.0488 μm
		LIC4100 Series	20.48		EIB3391Y*4	4,096	0.005 μm
		ZIOTTOO GONGO	204.8		EIB3391Y*4	4096	0.05 μm
	Heidenhain	LIC2100 Series	409.6		EIB3391Y*4	4096	0.00 μm
	Corporation	LC115	40.96		EIB3381Y*4	4,096	0.01 μm
		LC415	40.96		EIB3391Y*4	4096	0.01 μm
		ST781A/ST781AL	256			512	0.5 μm
		ST782A/ST782AL	256		-	512	0.5 μm
Ori	VAC	ST783/ST783AL	51.2	1	Contr	512	0.1 μm
\cup 11	Mitutoyo	ST784/ST784AL	51.2			512	0.1 μm
	Corporation	ST788A/ST788AL	51.2		_	512	0.1 μm
		ST789A/ST789AL	25.6		_	512	0.05 μm
		ST1381	5.12		_	512	0.01 μm
		ST1382	0.512		-	512	0.001 μm
Absolute		EL36Y-0050F000	12.8		_	256	0.05 μm
710001010	Renishaw	EL36Y-00100F000	25.6		_	256	0.1 μm
	PLC	EL36Y-00500F000	128			256	0.5 μm
		RL36Y-00500000	12.8		_	256	0.05 μm
		RL36Y-0001000	0.256		_	256	0.001 μm
		SR77-00000LF*5	80		_	8,192	0.0098 μm
		SR77-0000MF	80		_	1,024	0.078 μm
		SR87-0000LF*5	80		_	8,192	0.0098 μm
	Magnes- cale Co., Ltd.	SR87-0000MF SQ47/SQ57- 000S0F000 SQ47/SQ57- 0000T0F000	20.48		-	1,024	0.078 μm 0.005 μm
		SQ47/SQ57- □□□□A□F□□□ SQ47/SQ57- □□□□F□F□□□	40.96		-	4096	0.01 μm

5.16.2 Electronic Gear Ratio Setting Examples

- *1. These are reference values for setting SERVOPACK parameters. Contact the manufacturer for actual linear encoder scale pitches.
- *2. This is the model of the Serial Converter Unit.
- *3. This is the model of the Head with Interpolator.
- *4. This is the model of the Interpolator.
- *5. If you use an encoder pulse output with this linear encoder, the setting range of the encoder output resolution (Pn281) is restricted. Refer to the following section for details on the encoder output resolution (Pn281).

6.8.2 Setting for the Encoder Divided Pulse Output on page 6-52

Information

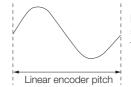
Resolution

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

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

Resolution of Serial Converter Unit or linear encoder

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



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

5.16.2 Electronic Gear Ratio Setting Examples

Setting examples are provided in this section.

Rotary Servomotors

		Machine Configuration						
		Ball Screw	Rotary Table	Belt and Pulley				
Step	Description	Reference unit: 0.001 mm Load shaft Encoder: Ball screw lead: 24 bits 6 mm	Reference unit: 0.01° Gear ratio: 1/100 Load shaft Encoder: 24 bits	Reference unit: 0.005 mm Load shaft Gear ratio: Pulley dia.: 100 mm 1/50 Encoder: 24 bits				
1	Machine Specifications	Ball screw lead: 6 mm Gear ratio: 1/1	Rotational angle per revolution: 360° Gear ratio: 1/100	Pulley dia.: 100 mm (Pulley circumference: 314 mm)Gear ratio: 1/50				
2	Encoder Resolution	16,777,216 (24 bits)	16,777,216 (24 bits)	16,777,216 (24 bits)				
3	Reference Unit	0.001 mm (1 μm)	0.01°	0.005 mm (5 μm)				
4	Travel Distance per Load Shaft Revolution (Reference Units)	6 mm/0.001 mm = 6,000	360°/0.01° = 36,000	314 mm/0.005 mm = 62,800				
5	Electronic Gear Ratio	$\frac{B}{A} = \frac{16,777,216}{6,000} \times \frac{1}{1}$	$\frac{B}{A} = \frac{16,777,216}{36,000} \times \frac{100}{1}$	$\frac{B}{A} = \frac{16,777,216}{62,800} \times \frac{50}{1}$				
6	Parameters	Pn20E: 16,777,216 Pn210: 6,000	Pn20E: 167,772,160 Pn210: 3,600	Pn20E: 838,860,800				
		F11210. 0,000	F11210. 3,000	Pn210: 62,800				

Linear Servomotors

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

		Machine Configuration		
Step	Description	Reference unit: 0.02 mm (20 µm) Forward direction		
1	Linear encoder pitch	0.02 mm (20 μm)		
2	Reference Unit	0.001 mm (1 μm)		
3	Electronic Gear Ratio	$\frac{B}{A} = \frac{1 (\mu m)}{20 (\mu m)} \times 256$		
4	Setting Parameters	Pn20E: 256		
	221	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 alarm related to the absolute encoder (A.810 or A.820) will occur when the absolute encoder must be reset, such as when the power supply is turned ON.

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

Reset the absolute encoder in the following cases.

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

M CAUTION

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

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

Information

- The multiturn data will always be zero in the following cases. It is never necessary to reset the absolute encoder in these cases. An alarm related to the absolute encoder (A.810 or A.820) will not occur.
 - When you use a single-turn absolute encoder
 - When the encoder is set to be used as a single-turn absolute encoder (Pn002 = n.□2□□)
- 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.

Drives Motors Controls

5.17.1 Precautions on Resetting

- You cannot use the /ALM-RST (Alarm Reset) 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 supply 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 and the applicable tool functions.

Tool	Function	Reference
Panel Operator	Fn008	13.4.7 Reset Absolute Encoder (Fn008) on page 13-17
Digital Operator	Fn008	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup – Absolute Encoder Reset	5.17.4 Operating Procedure on page 5-52

5.17.4 Operating Procedure

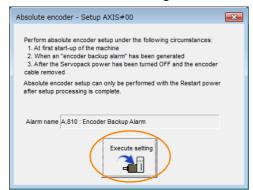
Use the following procedure to reset the absolute encoder.

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



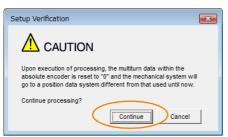
Click the Cancel Button to cancel resetting the absolute encoder. The Main Window will return.

5. Click the Execute setting Button.



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

6. Click the Continue Button.



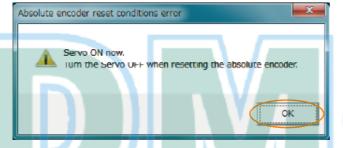
Click the Cancel Button to cancel resetting the absolute encoder. The previous dialog box will return.

7. Click the OK Button.

The absolute encoder will be reset.

When Resetting Fails

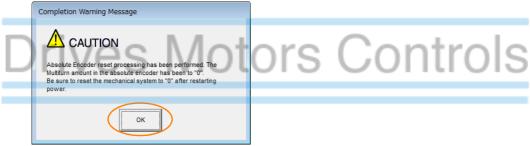
If you attempted to reset the absolute encoder when the servo was ON in the SERVOPACK, the following dialog box will be displayed and processing will be canceled.



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

When Resetting Is Successful

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



The Main Window will return.

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

This concludes the procedure to reset the absolute encoder.

5.18

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.

Mitutoyo Corporation

ABS ST780A Series or ST1300 Series Models: ABS ST780A/ST780AL/ST1300

 Renishaw PLC EVOLUTE Series

Models: EL36Y-

 Renishaw PLC RESOLUTE Series

Models: RL36Y-DDDDDDDDD



 After you set the origin, the /S-RDY (Servo Ready) signal will become inactive because the system position data was changed. Always turn the SERVOPACK power supply OFF and ON again.

Important

2. After you set the origin, the Servomotor phase data in the SERVOPACK will be discarded. If you are using a Linear Servomotor without a Polarity Sensor, execute polarity detection again to save the Servomotor phase data in the SERVOPACK.

Preparations

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

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

Applicable Tools

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

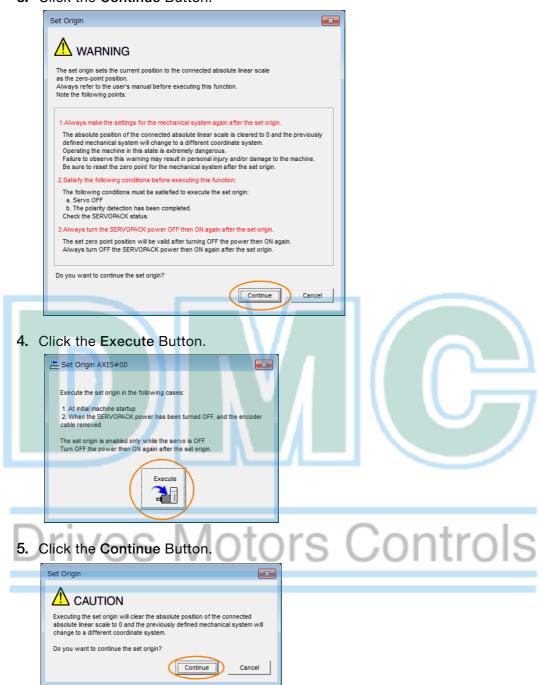
Tool	Function	Reference
Panel Operator	Fn020	13.4.23 Set Absolute Linear Encoder Origin (Fn020) on page 13-28
Digital Operator	Fn020	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Set Origin	Operating Procedure on page 5-54

Operating Procedure

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

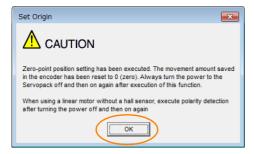
- 1. Click the P Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Set Origin in the Menu Dialog Box. The Set Origin Dialog Box will be displayed.





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

6. Click the OK Button.



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

5.18.1 Setting the Origin of the Absolute Linear Encoder

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 5-27

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

MARNING

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

There is a risk of personal injury or fire.

_	Regenerative Resiste	or Capacity		Speed Pos	sition Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
Pn600	0 to SERVOPACK's maximum applicable motor capacity	10 W	0	Immediately	Setup
	Regenerative Resista	ance		Speed Pos	Torque
Pn603	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	10 mΩ	0	Immediately	Setup

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

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

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

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

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



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

Application Functions

6

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

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6.1 I/O Signal Allocations

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

This section describes the I/O signal allocations.

6.1.1 Input Signal Allocations

Although you can use the input signals with the default settings, you can also allocate the desired input signals to pins 40 to 46 on the I/O signal connector (CN1).

Specify the allocation method to use in Pn50A = n. \(\sigma\) \(\text{Input Signal Allocation Mode}\).

Parameter		Description	When Enabled	Classification
Pn50A	n.□□□0 (default set- ting)	Use the sequence input signal terminals with the default allocations.	After restart	Setup
	n.□□□1	Change the individual sequence input signal allocations.		

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 $Pn000 = n.\square\square X\square$, the signals will be allocated as required for the specified control method, as given in the following table.

If the control method is set to internal set speed control with contact commands ($Pn000 = \square \square 3 \square$), 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.

(OTT 40) do tho 701 b 7 dighai, and tho 714 of old dighai.								
Pn000 =	Control Method Selection	CN1 Pin No.						
n.□□X□	Control Method Selection		41	42	43	44	45	46
0	Speed control)	0		5	400	2	
	Position control	()	/P-CON)ر		HT (/P-CL	/N-CL
2	Torque control)				91		
3	Internal set speed control							
4	Switching between internal set speed control and speed control with analog references							
5	Switching between internal set speed control and position control		/SPD-D	D OT	N OT	/ALM-	/SPD-A	/SPD-B
6	Switching between internal set speed control and torque control	/S-						
7	Switching between position control and speed control	ON		P-OT	N-OT	RST		
8	Switching between position control and torque control		/C-SEL					/N-CL
9	Switching between torque control and speed control							
А	Switching between speed control with analog references and speed control with zero clamping		/ZCLAMP				/P-CL	
В	Switching between normal position control and position control with reference pulse inhibition		/INHIBIT					

6.1.1 Input Signal Allocations

Changing Input Signal Allocations



- If you change the default polarity settings for the /S-ON (Servo ON), P-OT (Forward Drive Prohibit), or N-OT (Reverse Drive Prohibit) signal, the main circuit power supply 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.

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

Input Signal	Input Signal Name	Parameter
/S-ON	Servo ON	Pn50A = n.□□X□
/P-CON	Proportional Control	Pn50A = n.□X□□
P-OT	Forward Drive Prohibit	Pn50A = n.X□□□
N-OT	Reverse Drive Prohibit	Pn50B = n.□□□X
/ARM-RST	Alarm Reset	Pn50B = n.□□X□
/P-CL	Forward External Torque Limit	Pn50B = n.□X□□
/N-CL	Reverse External Torque Limit	Pn50B = n.XDDD
/SPD-D	Motor Direction	Pn50C = n.□□□X
/SPD-A	Internal Set Speed Selection	Pn50C = n.□□X□
/SPD-B	Internal Set Speed Selection	Pn50C = n.□X□□
/C-SEL	Control Selection	Pn50C = n.X□□□
/ZCLAMP	Zero Camping	Pn50D = n.□□□X
/INHIBIT	Reference Pulse Inhibit	Pn50D = n.□□X□
/G-SEL	Gain Selection	Pn50D = n.□X□□
/P-DET	Polarity Detection	Pn50D = n.X□□□
SEN	Absolute Data Request	Pn515 = n.□□□X
/PSEL	Reference Pulse Input Multiplication Switch	Pn515 = n.□□X□
FSTP	Forced Stop	Pn516 = n.□□□X

Relationship between Parameter Settings, Allocated Pins, and Polarities

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

Parameter Setting	Pin No.	Description
0	40	
1	41	+24 V
2	42	
3	43	A reverse signal (a signal with "/" before the signal abbreviation, such as the /
4	44	S-ON signal) is active when the contacts are ON (closed).
5	45	A signal that does not have "/" before the signal abbreviation (such as the P-OT signal) is active when the contacts are OFF (open).
6	46	(eper)
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	40	
Α	41	+24 V
В	42	
С	43	A reverse signal (a signal with "/" before the signal abbreviation, such as the /
D	44	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-
Е	45	OT signal) is active when the contacts are ON (closed).
F	46	

Note: Refer to the following section for details on input signal parameter settings.

14.1 List of Parameters on page 14-2

Example of Changing Input Signal Allocations

The following example shows reversing the P-OT (Forward Drive Prohibit) signal allocated to CN1-42 and the /P-CL (External Torque Limit) signal allocated to CN1-45.



 $Pn50A = n.5 \square \square 1$ $Pn50B = n.\square 2 \square \square$ After change

Refer to the following section for the parameter setting procedure.

5.1.3 Parameter Setting Methods on page 5-6

Confirming Input Signals

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

9.2.3 I/O Signal Monitor on page 9-7

6.1.2 Output Signal Allocations

You can allocate the desired output signals to pins 25 to 30 and 37 to 39 on the I/O signal connector (CN1). You set the allocations in the following parameters: Pn50E, Pn50F, Pn510, Pn512, Pn513, Pn514, and Pn517.

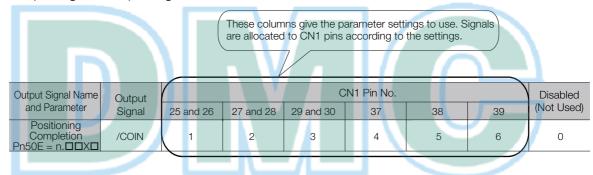


- The signals that are not detected are considered to be OFF. For example, the /COIN (Positioning Completion) signal is considered to be OFF during speed control.
- Reversing the polarity of the /BK (Brake) signal, i.e., changing it to positive logic, will prevent the holding brake from operating if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

Output signals are allocated as shown in the following table.

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

Interpreting the Output Signal Allocation Tables



Drives Motors Controls

Outrat Circul Name	Output			CN1 F	Pin No.			Disabled
Output Signal Name and Parameter	Signal	25 and 26	27 and 28	29 and 30	37	38	39	Disabled (Not Used)
Positioning Completion Pn50E = n.□□□X	/COIN	1 (default setting)	2	3	4	5	6	0
Speed Coincidence Detection Pn50E = n.□□X□	/V-CMP	1 (default setting)	2	3	4	5	6	0
Rotation Detection Pn50E = n.□X□□	/TGON	1	2 (default setting)	3	4	5	6	0
Servo Ready Pn50E = n.X□□□	/S-RDY	1	2	3 (default setting)	4	5	6	0
Torque Limit Detection Pn50F = n.□□□X	/CLT	1	2	3	4	5	6	0 (default setting)
Speed Limit Detection Pn50F = n.□□X□	/VLT	1	2	3	4	5	6	0 (default setting)
Brake $Pn50F = n.\Box X\Box\Box$	/BK	1	2	3	4	5	6	0 (default setting)
Warning Pn50F = n.X□□□	/WARN	1	2	3	4	5	6	0 (default setting)
Near Pn510 = n.□□□X	NEAR	1	2	3	4	5	6	0 (default setting)
Reference Pulse Input Multiplication Switch- ing Output Pn510 = n.□□X□	/PSELA	1	2	3	4	5	6	0 (default setting)
Preventative Mainte- nance Pn514 = n.□X□□	/PM	1	2	3	4	5	6	0 (default setting)
Alarm Code Pn517 = n.□□□X	ALO1	1	2	3	4 (default setting)	5	6	0
Alarm Code Pn517 = n.□□X□	ALO2	1	2	3	4	5 (default setting)	6	0
Alarm Code Pn517 = n.□X□□	ALO3	ot	2	5 3(4	5 T	6 (default setting)	0
Pn512 = n.□□□1	Reverse pola CN1-25 and							
Pn512 = n.□□1□	Reverse polarity for CN1-27 and CN1-28							
Pn512 = n.□1□□	Reverse polarity for CN1-29 and CN1-30				0 (default setting) The polarity			
Pn512 = n.1□□□	Reverse polarity for CN1-37					is not reversed in the default settings.		
Pn513 = n.□□□1		Revers	se polarity	for CN1-3	8			
Pn513 = n.□□1□		R	leverse po	larity for C	N1-39			

Example of Changing Output Signal Allocations

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

Pn50E = n. \square \square \square Pn50F = n. \square \square Before change $\downarrow \qquad \qquad \downarrow$ Pn50E = n. \square \square Pn50F = n. \square \square After change

Refer to the following section for the parameter setting procedure.

5.1.3 Parameter Setting Methods on page 5-6

6.1.3 ALM (Servo Alarm) Signal

Checking Output Signal Status

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

9.2.3 I/O Signal Monitor on page 9-7

6.1.3 ALM (Servo Alarm) Signal

This signal is output when the SERVOPACK detects an error.



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

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	ALM CN1-31 and	ON (closed)	Normal SERVOPACK status	
Output	ALIVI	CN1-32	OFF (open)	SERVOPACK alarm

Alarm Reset Methods

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

Balance of the following section for information on the alarm reset methods.

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6.1.4 ALO1 to ALO3 (Alarm Code) Signals

The ALO1 to ALO3 (Alarm Code) signals report alarms and warnings that occur in the SERVO-PACK. 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.

12.2.1 List of Alarms on page 12-5

12.3.1 List of Warnings on page 12-48

ALO1 to ALO3 (Alarm Code) Signals

The ALO1 to ALO3 signals are allocated to the following output signal terminals (CN1) by default.

Type	Signal	Name	Pin No.
	ALO1		CN1-37
Output	ALO2	Alarm Code Output	CN1-38
Output	ALO3		CN1-39
	SG	Signal ground for alarm code output	CN1-1

You can allocate the ALO1 to ALO3 signals to connector pins other than those given above. Refer to the following section for details.

6.1.2 Output Signal Allocations on page 6-8

6.1.5 /WARN (Warning) Signal

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

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

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	Dutnut /MARN Must be allocated	M. set les elle este el	ON (closed)	Warning
Output		OFF (open)	Normal status	

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

6.1.2 Output Signal Allocations on page 6-8

Setting the Warning Code Output

You can use the ALO1 to ALO3 (Alarm Code Output) signals to output warning codes. Use $Pn001 = n.X \square \square \square$ (Warning Code Output Selection) to set the output.

Refer to the following sections for details on the warnings.

3 12.3.1 List of Warnings on page 12-48

Р	arameter	Description	When Enabled	Classification
	n.0□□□ (default setting)	Output only alarm codes on the ALO1 to ALO3 terminals.		4
Pn001	n.1000	Output both warning codes and alarm codes on the ALO1 to ALO3 terminals. If there is an alarm, the alarm code is output.	After restart	Setup

6.1.6 /TGON (Rotation Detection) Signal

The /TGON signal indicates that the Servomotor is operating.

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

The /TGON signal is allocated to CN1-27 and CN1-28 by default.

Туре	Signal	Connector Pin No.	Signal Status	Servomotor	Meaning
Output /TGON		CN1-27 and CN1- 28 (default setting)	ON (aloned)	Rotary Servomotors	The Servomotor is operating at the setting of Pn502 or faster.
			ON (closed)	Linear Servomotors	The Servomotor is operating at the setting of Pn581 or faster.
	/TGON		OFF (speed)	Rotary Servomotors	The Servomotor operating at a speed that is slower than the setting of Pn502.
			OFF (open)	Linear Servomotors	The Servomotor is operating at a speed that is slower than the setting of Pn581.

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

6.1.2 Output Signal Allocations on page 6-8

6.1.7 /S-RDY (Servo Ready) Signal

Setting the Rotation Detection Level

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

Rotary Servomotors

	Rotation Detection	Speed Position Torque			
Pn502	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 10,000	1 min ⁻¹	20	Immediately	Setup

• Linear Servomotors

	Zero Speed Level			Speed Position	Force
Pn581	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 10,000	1 mm/s	20	Immediately	Setup

6.1.7 /S-RDY (Servo Ready) Signal

The /S-RDY (Servo Ready) 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 supply is ON.
- There is no hard wire base block state.
- There are no alarms.
- If an absolute encoder is used, the SEN (Absolute Data Request) signal is ON (high level).
- If a Servomotor without a polarity sensor is used, polarity detection has been completed. *
- If an absolute encoder is used, the SERVOPACK must be ready to accept the /S-ON (Servo ON) 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.
- * Do not include this condition if the /S-ON (Servo ON) signal is input for the first time after the control power supply 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.

Туре	Signal	Connector Pin No.	Signal Status	Meaning
		CN1-29 and CN1-	ON (closed)	Ready to receive the /S-ON (Servo ON) signal.
Output	/S-RDY		OFF (open)	Not ready to receive the /S-ON (Servo ON) signal.

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

^{6.1.2} Output Signal Allocations on page 6-8

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

^{11.2.7 /}S-RDY (Servo Ready Output) Signal on page 11-6

6.2

Operation for Momentary Power Interruptions

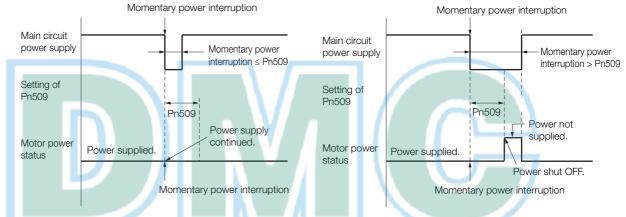
Even if the main power supply to the SERVOPACK is interrupted momentarily, power supply to the motor (servo ON status) will be maintained for the time set in Pn509 (Momentary Power Interruption Hold Time).

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

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

Setting of Pn509 ≥ Momentary power interruption time

Setting of Pn509 < Momentary power interruption time



Information

- 1. If the momentary power interruption time exceeds the setting of Pn509, the /S-RDY (Servo Ready) signal will turn OFF.
- 2. If uninterruptible power supplies are used for the control power supply and main circuit power supply, the SERVOPACK can withstand a power interruption that lasts longer than 50,000 ms.



. The holding time of the SERVOPACK control power supply is approximately 100 ms. If control operations become impossible during a momentary power interruption of the control power supply, the setting of Pn509 will be ignored and the same operation will be performed as for when the power supply is turned OFF normally.



The holding time of the main circuit power supply depends on the output from the SERVOPACK. If the load on the Servomotor is large and an A.410 alarm (Undervoltage) occurs, the setting of Pn509 will be ignored.

6.3

SEMI F47 Function

The SEMI F47 function detects an A.971 warning (Undervoltage) and limits the output current if the DC main circuit power supply voltage to the SERVOPACK drops to a specified value or lower because the power was momentarily interrupted or the main circuit power supply voltage was temporarily reduced.

This function complies with the SEMI F47 standards for semiconductor manufacturing equipment.

You can combine this function with the momentary power interruption hold time (Pn509) to allow the Servomotor to continue operating without stopping for an alarm or without recovery work even if the power supply voltage drops.

Execution Sequence

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

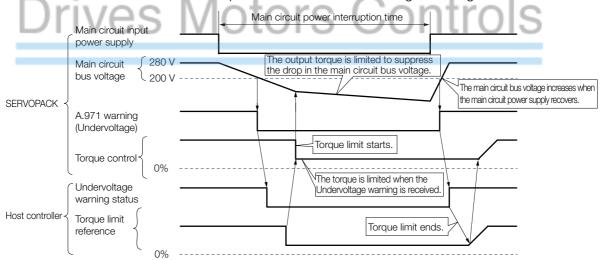
The default setting (Pn008 = $n.\square\square0\square$) disables detection of an A.971 warning (Undervoltage).

Parameter		Description	When Enabled	Classification
Pn008	n.□□0□ (default set- ting)	Do not detect undervoltage.		Setup
	n.0010	Detect undervoltage warning and limit torque at host controller.	After restart	
	n.□□2□	Detect undervoltage warning and limit torque with Pn424 and Pn425 (i.e., only in SERVO-PACK).		

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

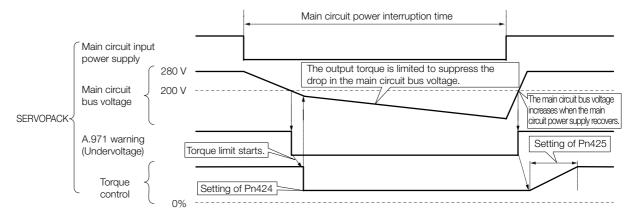
The host controller limits the torque in response to an A.971 warning (Undervoltage).

The host controller removes the torque limit after the Undervoltage warning is cleared.



◆ Execution with the SERVOPACK (Pn008 = n.□□2□)

The torque is limited in the SERVOPACK in response to an Undervoltage warning. The SERVOPACK controls the torque limit for the set time after the Undervoltage warning is cleared.



Related Parameters

The following parameters are related to the SEMI F47 function.

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

* Set a percentage of the motor rated torque.

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



- This function handles momentary power interruptions for the voltage and time ranges stipulated in SEMI F47. An uninterruptible power supply (UPS) is required as a backup for momentary power interruptions that exceed these voltage and time ranges.
- Set the host controller or SERVOPACK torque limit so that a torque reference that exceeds the specified acceleration torque will not be output when the power supply for the main circuit is restored.
- For a vertical axis, do not limit the torque to a value that is lower than the holding torque.
- This function limits torque within the range of the SERVOPACK's capability for power interruptions. It is not intended for use under all load and operating conditions. Set the parameters while monitoring operation on the actual machine.
- You can set the momentary power interruption hold time to increase the amount of time from when the power supply is turned OFF until power supply to the motor is stopped. To stop the power supply to the motor immediately, use the /S-ON (Servo ON) signal.

6.4

Setting the Motor Maximum Speed

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

Rotary Servomotors

	Maximum Motor Speed			Speed Positi	Torque
Pn316	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	1 min ⁻¹	10,000	After restart	Setup

Linear Servomotors

	Maximum Motor Speed			Speed Positi	on Force
Pn385	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 100	100 mm/s	50	After restart	Setup

You can achieve the following by lowering the maximum speed of the Servomotor.

- If the Servomotor speed exceeds the setting, an A.510 alarm (Overspeed) will occur.
- With a Linear Servomotor, you can increase the upper limit for the setting of Pn281 (Encoder Output Resolution). Refer to the following section for details.

6.8 Encoder Divided Pulse Output on page 6-47

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 not driven beyond the allowable moment of inertia Refer to relevant manual from the following list for the relationship between the speed and the allowable moment of inertia.
 - Σ-7-Series Rotary Servomotor Product Manual (Manual No.: SIEP S800001 36)
 - 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)

Drives Motors Controls

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 6-54

- 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 set the control method in $Pn000 = n.\square\square X\square$ (Control Method Selection).

Set Pn000 to n. □□0□ to set the control method to speed control.

Р	arameter	Meaning	When Enabled	Classification
Pnnnn	n.□□0□ (default setting)	Speed control with analog references	After restart	Setup

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.

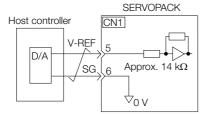
V-REF (Speed Reference Input) Signal

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
Input	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.

/SPD-D (Motor Direction Input) Signal

You can turn the /SPD-D signal ON and OFF to change the direction of the Servomotor.

Classification	Signal	Connector Pin No.	Description
Input	/SPD-D	Must be allocated.	Changes the Servomotor direction.

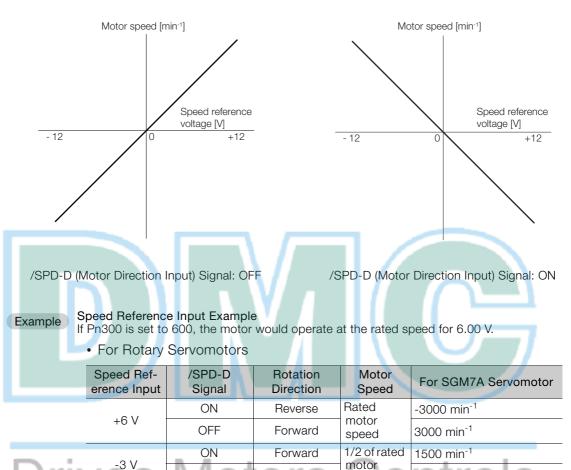
Note: You must allocate the /SPD-D signal to use it. Use Pn50C = n.□□□X (/SPD-D (Motor Direction) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

(a) 6.1.1 Input Signal Allocations on page 6-5

6.5.1 Basic Settings for Speed Control

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.



Reverse

Reverse

Forward

speed 1/6 of rated

motor

speed

-1500 min

-500 min⁻¹

500 min⁻¹

• Linear Servomotors

OFF

ON

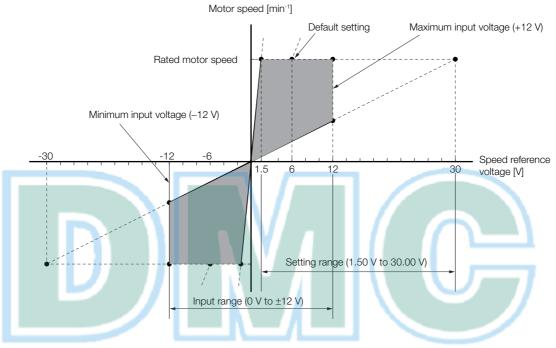
OFF

Speed Reference Input	/SPD-D Signal	Rotation Direction	Movement Speed	For SGLGW-30A Linear Servomotor
	ON	Reverse	Rated	-1500 mm/s
+6 V	OFF	Forward	motor speed	1500 mm/s
	ON	Forward	1/2 of rated	750 mm/s
-3 V	OFF	Reverse	motor speed	-750 mm/s
	ON	Reverse	1/6 of rated	-250 mm/s
+1 V	OFF	Forward	motor speed	250 mm/s

Setting the Speed Reference Input Gain (Pn300)

The reference voltage for the rated motor speed is set for the speed reference input gain (Pn300) to define the relationship between the position reference voltage and the motor speed.

	Speed Reference Input Gain			Speed Position	Torque
Pn300	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
111000	150 to 3,000	0.01 V	600 (rated speed for 6.00 V)	Immediately	Setup

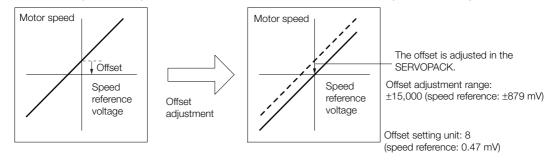


Adjusting the Speed Reference Offset

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.



6.5.1 Basic Settings for Speed Control

◆ Automatically Adjusting the Speed Reference Offset

To automatically adjust the speed reference offset, the amount of 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

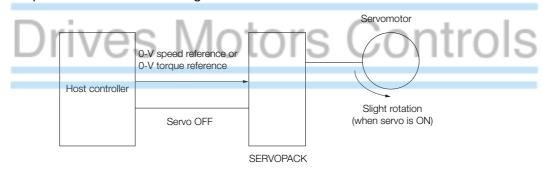
The following table lists the tools that you can use to automatically adjust the speed reference offset and the applicable tool functions.

Tool	Function	Operating Procedure Reference
Panel Operator	Fn009	13.4.8 Autotune Analog (Speed/Torque) Reference Offset (Fn009) on page 13-18
Digital Operator	Fn013	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup – Speed/Torque Reference Offset Adjustment	■ Operating Procedure on page 6-20

Operating Procedure

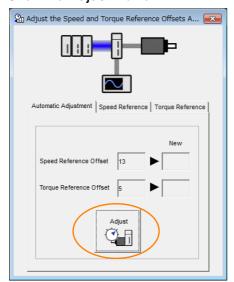
Use the following procedure to automatically adjust the speed reference offset.

- 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.

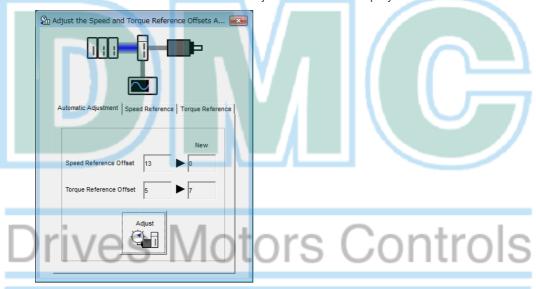


- 3. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **4.** Select Adjust the Speed and Torque Reference Offset in the Menu Dialog Box. The Adjust the Speed and Torque Reference Offset Dialog Box will be displayed.
- 5. Click the Automatic Adjustment Tab.

6. Click the Adjust Button.



The value that results from automatic adjustment will be displayed in the New Box.



This concludes the procedure to automatically adjust the speed reference offset.

6.5.1 Basic Settings for Speed Control

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.
- The servo must be in ready status.

■ Applicable Tools

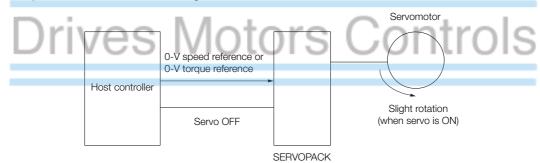
The following table lists the tools that you can use to manually adjust the speed reference offset and the applicable tool functions.

Tool	Function	Operating Procedure Reference
Panel Operator	Fn00A	13.4.9 Manually Adjust Speed Reference Offset (Fn00A) on page 13-18
Digital Operator	Fn00A	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup – Speed/Torque Reference Offset Adjustment	■ Operating Procedure on page 6-22

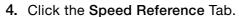
Operating Procedure

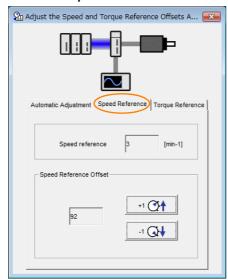
Use the following procedure to manually adjust the speed reference offset.

1. Input a 0-V reference voltage from the host controller or an external circuit.

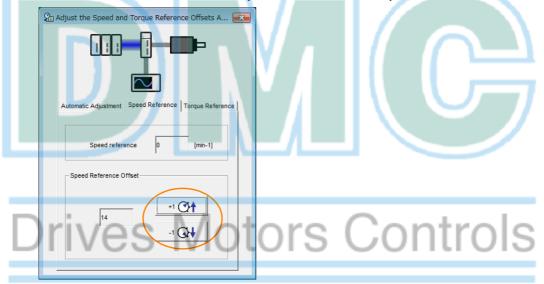


- 2. Click the 🎵 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 3. Select Adjust the Speed and Torque Reference Offset in the Menu Dialog Box. The Adjust the Speed and Torque Reference Offset Dialog Box will be displayed.





5. Use the +1 and -1 Buttons to adjust the value in the Speed Reference Box to 0.

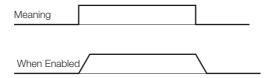


This concludes the procedure to manually adjust the speed reference offset.

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).

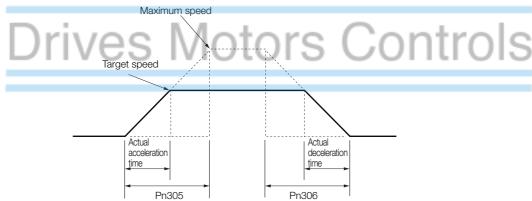
	Soft Start Acceleration Time			Speed	
Pn305	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup
	Soft Start Decelerat	ion Time	Speed		
Pn306	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup

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.





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.

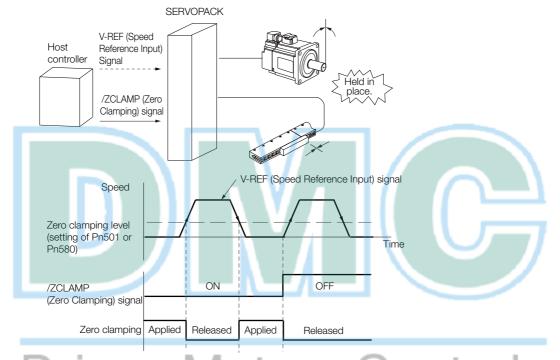
	Speed Reference Filter Time Constant			Speed Position	Torque
Pn307	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	40	Immediately	Setup

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 the zero clamping level (Pn501 or Pn580) while the /ZCLAMP (Zero Clamping) 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).

/ZCLAMP (Zero Clamping) Signal

Use the /ZCLAMP signal to enable zero clamping.

◆ When Using the Default Input Signal Allocations (Pn50A = n.□□□0)

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 the zero clamping level (Pn501 or Pn580).
			OFF (open)	Zero clamping is disabled.

6.5.4 Zero Clamping

◆ When Changing Input Signal Allocations (Pn50A = n.□□□1)

You must allocate the /ZCLAMP signal. Allocate the signal with Pn50D = $n.\Box\Box\Box$ X (/ZCLAMP (Zero Clamping Input) Signal Allocation).

Refer to the following section for details.

6.1.1 Input Signal Allocations on page 6-5

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 the zero clamping level (Pn501 or Pn580).
			OFF (open)	Zero clamping is disabled.

Enabling Zero Clamping

To enable using zero clamping, set the control method ($Pn000 = n.\Box\Box X\Box$) to 0, 3, 4, 5, 6, 7, 9 or A. You can use zero clamping only for operation with speed control.

If $Pn000 = n.\square\square X\square$ 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.

nformatior

If you set the parameter to keep the /ZCLAMP always active (Pn50D = $n.\Box\Box\Box$ 7) 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.

	Para	ameter	Control Method	Used Input Signals	When Enabled	Classification
		n.□□0□	Speed control	/ZCLAMP		
		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		Setup
ī		n.□□5□	Switching between internal set speed control and position control	/ZCLAMP, SPD-A, SPD-B, SPD-D, C-SEL	trol	
PnC	000	n.□□6□	Switching between internal set speed control and torque control	/ZCLAMP, SPD-A, SPD-B, SPD-D, C-SEL	After restart	
		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		

Related Parameters

You set the speed at which to apply zero clamping as the zero clamping level (Pn501 or Pn580). 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

	Zero Clamping Leve		Speed		
Pn501	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 min ⁻¹	10	Immediately	Setup

Linear Servomotors

	Zero Clamping Leve	I	Speed		
Pn580	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 mm/s	10	Immediately	Setup

6.5.5 /V-CMP (Speed Coincidence Detection) Signal

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

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

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output /V-CMP	A/ CMP	CN1-25 and CN1-26	ON (closed)	The speed coincides.
	(default setting)	OFF (open)	The speed does not coincide.	

Note: You can use Pn50E = n. \$\pi\text{NOTE}\$ (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 on allocations.

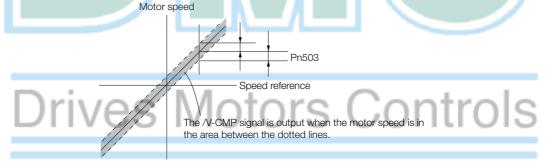
6.1.2 Output Signal Allocations on page 6-8

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

	Speed Coincidence	Detection Signal Ou	tout Width	Speed			
Pn503	Setting Range	Setting Unit	Default Setting	When Enabled	Classification		
	0 to 100	1 min ⁻¹	10	Immediately	Setup		
The signal is output when the difference between the reference speed and motor speed is equal or less than the setting.							
	If Pn503 is set to	100 and the speed r	eference is 2 000 min	n ⁻¹ the signal would b	ne output		

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

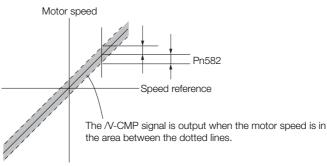


Linear Servomotors

	Speed Coincidence	Detection Signal Ou	Speed		
Pn582	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	1 mm/s	10	Immediately	Setup

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

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

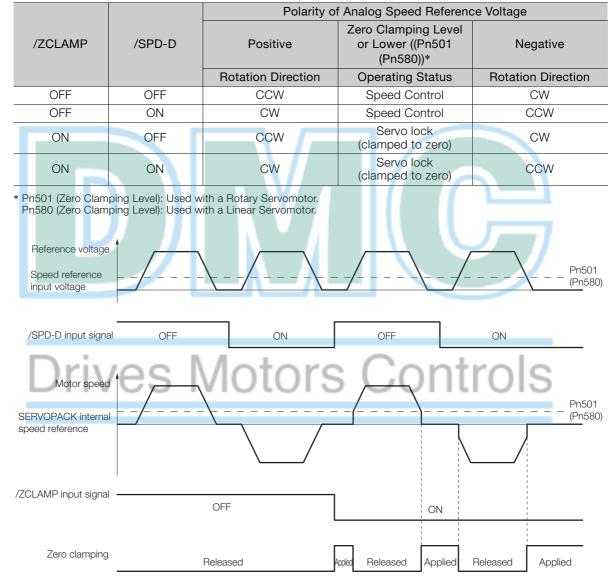


6.5.6 Operation Examples for Changing the Motor Direction

This section describes examples of using the /SPD-D (Motor Direction Input) signal in combination with zero clamping and internal set speed control.

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.



Note: The soft start function is used for the acceleration/deceleration time of the speed reference.

Operation Example for Changing the Motor Direction and Internal Set Speed Control

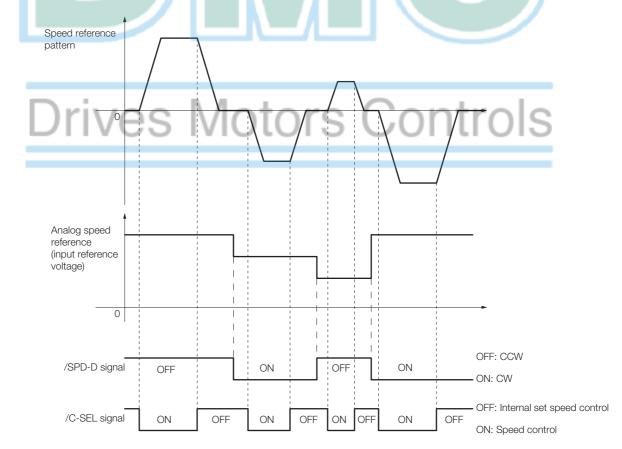
Even with a speed reference with the same polarity, you can change the Servomotor direction and stop the Servomotor by changing the control mode to internal set speed control and combining the /SPD-D (Motor Direction Input) signal and /C-SEL (Control Selection Input) signal.

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.

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.□□□X (Input Signal Allocation Mode) to 1 (Change the sequence input signal allocations).
- Set Pn50C = n. \(\sigma\) \(\sigma\) (/SPD-D (Motor Direction) 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 Selection Input) Signal Allocation) to 8 (the signal is always inactive).
- Set Pn50C = n.□X□□ (/SPD-B (Internal Set Speed Selection 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

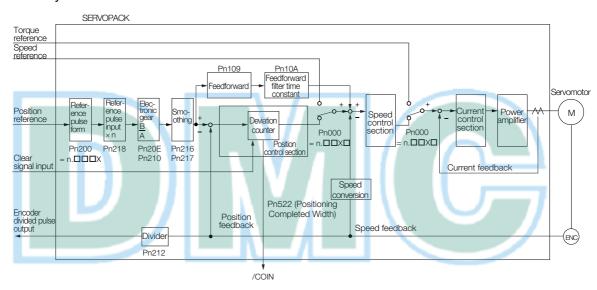
Position control is used to input a pulse train reference from the host controller to the SERVO-PACK to move to a target position. The position is controlled with the number of input pulses, and the speed is controlled with the input pulse frequency. Use position control when positioning is required.

You set the control method to position control in $Pn000 = n . \square \square X \square$ (Control Method Selection).

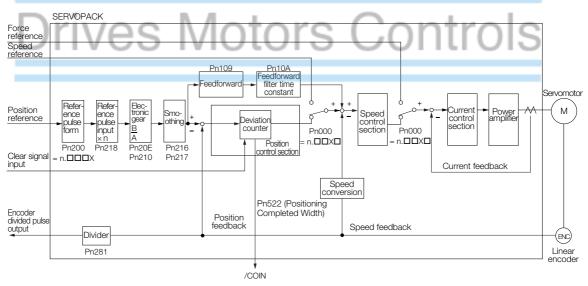
Parameter Meaning		When Enabled	Classification	
Pn000	n.□□1□	Position Control	After restart	Setup

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.

Reference Pulse Forms

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).

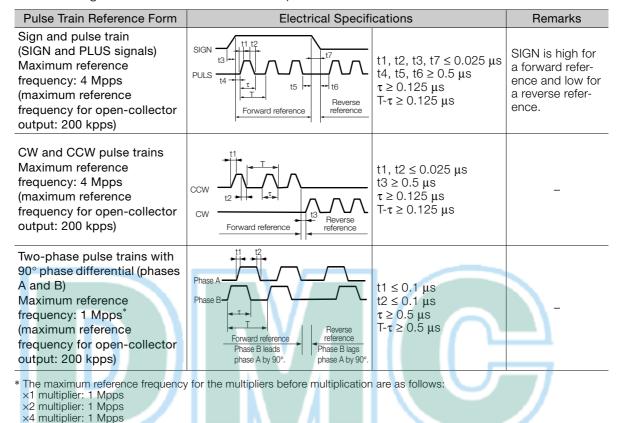
F	arameter	Reference Pulse Form	Input Pulse Multiplier	Forward Reference	Reverse Reference
	n.□□□0 (default setting)	Sign and pulse train, positive logic.	-	PULS (CN1-7) High level	PULS (CN1-7)
	n.□□□1	CW and CCW pulse trains, positive logic	-	CW (CN1-7) Low level CCW (CN1-11)	CW (CN1-7)
	n.□□□2	000 1 111	×1	→ - 90°	Phase A
Pn200	n.□□□3	90° phase-differen- tial pulses	×2	Phase A — L	(CN1-7)
	n.□□□4		×4	Phase B	Phase B (CN1-11)
	n.□□□5	Sign and pulse train, negative logic.	_	PULS (CN1-7) SIGN Low level (CN1-11)	PULS (CN1-7) SIGN (CN1-11) High level
	n.□□□6	CW and CCW pulse trains, negative logic	/ -	CW (CN1-7) High level CCW (CN1-11)	CW (CN1-7) High level

Selecting an Input Filter

Parameter		Meaning	When Enabled	Classification
Dri	n.0□□□ (default setting)	Use the reference input filter 1 for a line- driver signal. (1 Mpps max.)	ntrol	S
Pn200	n.1000	Use the reference input filter for an open-collector signal. (200 kpps max.)	After restart	Setup
	n.2□□□	Use reference input filter 2 for a line-driver signal. (1 to 4 Mpps)		

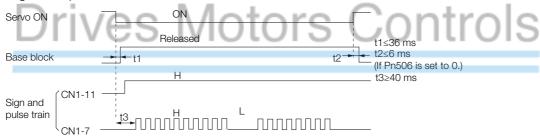
Electrical Specifications for Pulse Train Reference

The following table describes the forms for pulse train references.



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 SERVO-PACK.

6.6.2 CLR (Position Deviation Clear) Signal Function and Settings

The CLR (Position Deviation Clear) signal is used to clear the deviation counter in the SERVO-PACK

As long as the CLR signal is ON, the deviation counter will be 0, so a position loop will not be formed.



Deviation counter

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

CLR (Position Deviation Clear) Signal

Type	Signal	Connector Pin No.	Name
Input	CLR	CN1-15	Position doviation clear input
Input	/CLR	CN1-14	Position deviation clear input

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

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

Parameter		Reference Form	Clear Timing	When Enabled	Classification
	n.□□0□ (default setting)	Clear position deviation when the signal is at high level.	CLR ON Cleared.		
Pn200	n.0010	Clear position deviation on the rising edge of the signal.	CLR ON (CN1-15) Cleared here just once.	- After restart	Catura
	n.□□2□	Clear position deviation when the signal is at low level.	CLR OFF (CN1-15) Cleared.		Setup
	n.□□3□	Clear position deviation on the falling edge of the signal.	CLR OFF (CN1-15) Cleared here just once.		

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.

Setting the Clear Operation (Pn200 = $n.\Box X\Box\Box$)

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

Parameter		Meaning	When Enabled	Classification	
Pn200	n.□0□□ (default setting)	Clear position deviation at a base block (at servo OFF or when alarm occurs).			
	n.0100	Do not clear position deviation. The position deviation is cleared only with CLR (Clear Position Deviation) signal.		Setup	
	n.□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) signal. The number of reference pulses input to the SERVO-PACK 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 Switch) signal, the reference pulse input multiplier, and restrictions.

/PSEL (Reference Pulse Input Multiplication Switch) 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
			ON (closed)	Enables the reference pulse input multiplier.
Input	Input /PSEL	Must be allocated.	OFF (open)	Disables the reference pulse input multiplier. The multiplier will be 1.

Note: You must allocate the /PSEL signal to use it. You can use the following parameters to allocate the signal to a terminal.

• Pn50A = n.□□□1 (Change the sequence input signal allocations.)

• Pn515 = n. \$\square\$ \text{!/PSEL} (Reference Pulse Input Multiplication Switching Input) Signal Allocation) Refer to the following section for details.

6.1.1 Input Signal Allocations on page 6-5

/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		ON (closed)	The reference pulse input multiplier was enabled.	
	/PSELA	Must be allocated.	OFF (open)	The reference pulse input multiplier was disabled.

Note: You must allocate the /PSELA signal to use it. You can use Pn510 = n. \(\Delta\)\(\Delta\)\(\text{D}\)\(\Delta\)\(\text{D}\)\(\text{ELA}\) (Reference Pulse Input Multiplication Switching Output) Signal Allocation) to allocate the signal to a terminal. Refer to the following section for details.

6.1.2 Output Signal Allocations on page 6-8

CAUTION

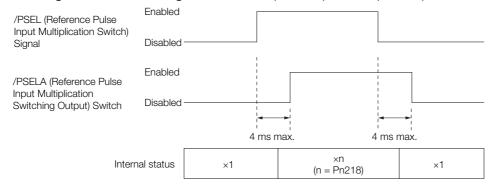
 Always use the /PSELA signal to confirm that the reference pulse input multiplier has been switched and make sure that there are no position reference pulses before you input a position reference.

Unexpected operation may occur if position reference pulses are input before the reference pulse input multiplier changes.

Setting the Reference Pulse Input Multiplier (Pn218)

	Reference Pulse Inp	out Multiplier	Position		
Pn218	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 100	×1	1	Immediately	Setup

A timing chart for switching the reference pulse input multiplier is provided below.



CAUTION

If you change the reference pulse input multiplier (Pn218), perform trial operation of the Servomotor without the machine coupled to the Servomotor shaft to confirm that no problems will occur in operation before you couple the Servomotor to the machine.

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 reference input

Drives Motors Controls

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.

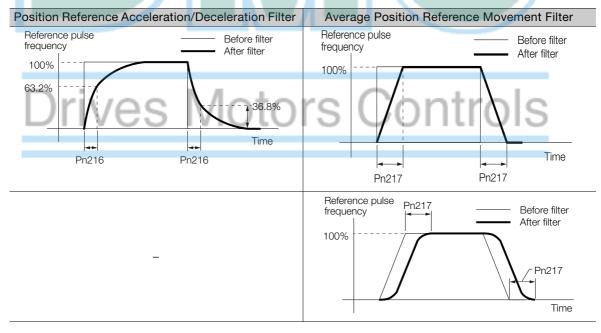
Pn216	Position Reference	Acceleration/Deceler	Position		
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.1 ms	0*	Immediately after the motor stops	Setup
	Average Position Re	eference Movement	Position		
Pn217	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	0.1 ms	0*	Immediately after the motor stops	Setup

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

Information

Changes to the settings in Pn216 or Pn217 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 position reference acceleration/deceleration time constant (Pn216) and the average position reference movement time (Pn217) is shown below.



6.6.5 /COIN (Positioning Completion) Signal

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

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

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

Type	Signal	Connector Pin No.	Signal Status	Meaning
Output	/(.() \()	CN1-25 and CN1-26 (default setting)	ON (closed)	Positioning has been completed.
			OFF (open)	Positioning has not been completed.

Note: Use Pn50E = n. \(\sigma\) \(\sigma\) (/COIN (Positioning Completion Output) Signal Allocation) to allocate the /COIN signal to other connector pins. Refer to the following section for details.

6.1.2 Output Signal Allocations on page 6-8

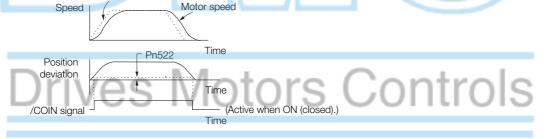
Reference

Setting the Positioning Completed Width

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

Positioning Completed Width				Position		
Pn522	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 1,073,741,824	1 reference unit	7	Immediately	Setup	

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



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

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

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

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

6.6.6 /NEAR (Near) Signal

Parameter		Description	When Enabled	Classification
Pn207	n.0□□□ (default setting)	Output the /COIN signal when the absolute value of the position deviation is the same or less than the setting of Pn522 (Positioning Completed Width).		
	n. 1000	Output the /COIN signal when the absolute value of		Setup
	n. 2000	Output the /COIN signal when the absolute value of the position deviation is the same or less than the setting of Pn522 (Positioning Completed Width) and the reference input is 0.		

6.6.6 /NEAR (Near) Signal

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

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

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

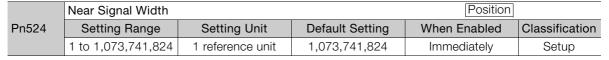
Type	Signal	Connector Pin No.	Signal Status	Meaning
Output /NE	/NEAD	Must be allocated.	ON (closed)	The Servomotor has reached a point near to positioning completion.
	/NEAR		OFF (open)	The Servomotor has not reached a point near to positioning completion.

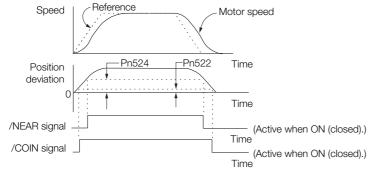
Note: You must allocate the /NEAR signal to use it. Use Pn510 = n. \(\sigma \sqrt{\text{I}}\) \(\text{NEAR (Near) Signal Allocation)}\) to allocate the signal to a connector pin. Refer to the following section for details.

6.1.2 Output Signal Allocations on page 6-8

/NEAR (Near) Signal Setting

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





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.

/INHIBIT (Reference Pulse Inhibit) Signal

If you set the control method to switch between normal position control and position control with reference pulse inhibition ($Pn000 = n.\square\square\square\square\square$), the /INHIBIT signal is used as the Reference Pulse Inhibit signal (default setting).

◆ When Using the Default Input Signal Allocations (Pn50A = n.□□□0)

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/INHIBIT	NHIBIT I XXXX III V	ON (closed)	Counting the reference pulses is stopped.
			OFF (open)	The reference pulses are counted.

◆ When Changing Input Signal Allocations (Pn50A = n.□□□1)

If you set $Pn000 = n.\square\square X\square$ (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.			
	/IINΠIDIT	iviusi be allocated.	OFF (open)	The reference pulses are counted.		

Note: You must allocate the /INHIBIT signal to use it. Use Pn50D = n. \$\square\$ (/INHIBIT (Reference Pulse Inhibit Input) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details. \$\iii \text{6.1.2 Output Signal Allocations}\$ on page 6-8

◆ Reference Pulse Inhibition Settings

To use reference pulse inhibition, set $Pn000 = n.\square\square X\square$ (Control Method Selection) to 1, 5, 7, 8, or B.

Parameter		Control Method	Used Input Sig- nals	When Enabled	Classifica-
\cup	n.0010	Position control	/INHIBIT	1013	
	n.0050	Switching between internal set speed control and position control	/INHIBIT /SPD-A /SPD-B /SPD-D /C-SEL		
Pn000	n.□□7□	Switching between position control and speed control	/INHIBIT /C-SEL	After restart	Setup
	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.

6.7.1 Basic Settings for Torque 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.

Torque control is set by setting $Pn000 = n.\square\square X\square$ (Control Method Selection) to 2 (Torque control).

Parameter		Meaning	When Enabled	Classification
Pn000	n.□□2□	Torque control	After restart	Setup

6.7.1 Basic Settings for Torque Control

This section describes the torque reference input signal and torque reference input gain.

T-REF (Torque Reference Input) Signal

The T-REF signal is described in the following table.

Туре	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

Example

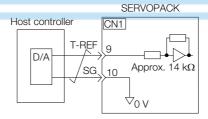
Input Circuit Example

Pn400 (Torque Reference Input Gain) is set to 3 (setting unit: V) 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		

Dr

If you will use a host controller, such as a programmable controller, for torque control, connect the above output pins to the analog reference output terminals on the host controller. Always use twisted-pair cables to control noise.

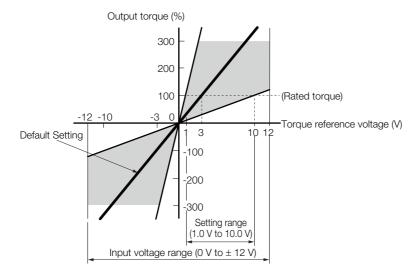


Setting the Torque Reference Input Gain (Pn400)

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 Position	n Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 100	0.1 V	30 (rated torque at 3.0 V)	Immediately	Setup



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.

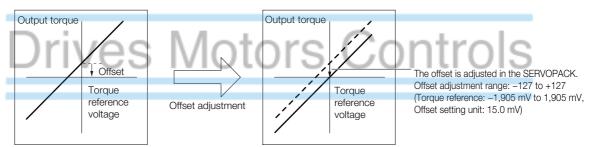
12.2.2 Troubleshooting Alarms on page 12-12

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.



Automatically Adjusting the Torque Reference Offset

To automatically adjust the torque reference offset, the amount of 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.

◆ 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.

6.7.2 Adjusting the Torque Reference Offset

◆ Applicable Tools

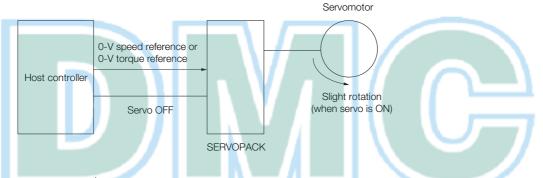
The following table lists the tools that you can use to automatically adjust the torque reference offset and the applicable tool functions.

Tool	Function	Operating Procedure Reference
Panel Operator	Fn009	13.4.8 Autotune Analog (Speed/Torque) Reference Off- set (Fn009) on page 13-18
Digital Operator	Fn009	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup – Speed/Torque Reference Offset Adjustment	

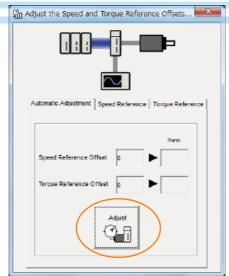
Operating Procedure

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.

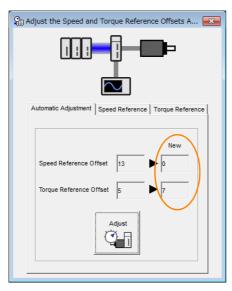


- 3. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **4.** Select Adjust the Speed and Torque Reference Offset in the Menu Dialog Box. The Adjust the Speed and Torque Reference Offset Dialog Box will be displayed.
- 5. Click the Automatic Adjustment Tab.
- 6. Click the Adjust Button.



6.7.2 Adjusting the Torque Reference Offset

The value that results from automatic adjustment will be displayed in the **New** Box.



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.

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

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

Preparations

The following conditions must be met to manually adjust the reference offse

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

Applicable Tools

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

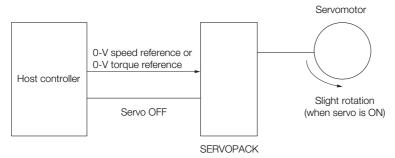
Tool	Function	Operating Procedure Reference
Panel Operator	Fn009	13.4.10 Manually Adjust Torque Reference Offset (Fn00B) on page 13-19
Digital Operator	Fn009	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup – Speed/Torque Reference Offset Adjust- ment	

6.7.2 Adjusting the Torque Reference Offset

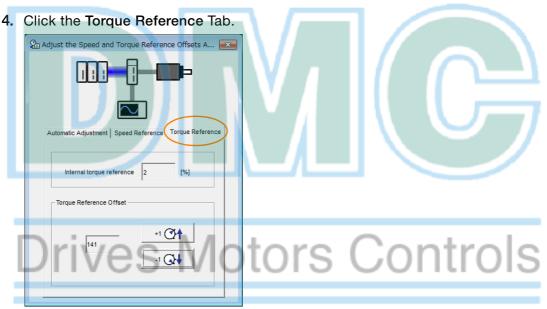
Operating Procedure

Use the following procedure to manually adjust the torque reference offset.

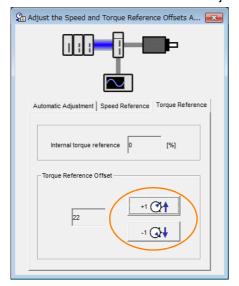
1. Input a 0-V reference voltage from the host controller or an external circuit.



- 2. Click the P Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **3.** Select Adjust the Speed and Torque Reference Offset in the Menu Dialog Box. The Adjust the Speed and Torque Reference Offset Dialog Box will be displayed.



5. Use the +1 and -1 Buttons to adjust the value in the Torque Reference Box to 0.



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.

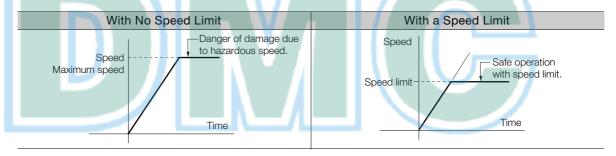
	T-REF Filter Time Co	onstant	Speed Position	Torque	
Pn415	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	0	Immediately	Setup

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.



/VLT (Speed Limit Detection) Signal

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

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

Note: You must allocate the /VLT signal to use it. Use Pn50F = n.□□X□ (/VLT (Speed Limit Detection) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

6.1.2 Output Signal Allocations on page 6-8

Selecting the Speed Limit

You set the speed limit to use in Pn002 = $n.\Box\Box X\Box$ (Torque Control Option). If you set Pn.002 to $n.\Box\Box 1\Box$ (Use V-REF as an external speed limit input), the smaller of the external speed limit and the internal speed limit will be used.

Parameter		Meaning	When Enabled	Classification
	n.□□0□ (default setting)	Use Pn407 or Pn480 as the speed limit. (Use internal speed limiting.)		
Pn002	n.□□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.)	After restart	Setup

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

6.7.4 Speed Limit during Torque Control

◆ Internal Speed Limiting

If you select internal speed limiting for the torque control option ($Pn002 = n.\square\square0\square$), set the speed limit for the motor in Pn407 (Speed Limit during Torque Control) or Pn480 (Speed Limit during Force Control).

Also set $Pn408 = n.\square\squareX\square$ (Speed Limit Selection) to specify using the maximum motor speed or the overspeed alarm detection speed as the speed limit. Select the overspeed alarm detection speed to limit the speed to the equivalent of the maximum motor speed.

Parameter		Meaning	When Enabled	Classification
n.□□0□ (default setting)		Use the smaller of the maximum motor speed and the setting of Pn407 or Pn480 as the speed limit.	After restart	Setup
P114U6	n.0010	Use the smaller of the overspeed alarm detection speed and the setting of Pn407 or Pn480 as the speed limit.	Allei Testart	Setup

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

Rotary Servomotors

	Speed Limit during	Torque			
Pn407	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 min ⁻¹	10000	Immediately	Setup
1 :	Camaaaataaa				

Linear Servomotors

	Speed Limit during F	Force Control			Force
Pn480	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 mm/s	10000	Immediately	Setup

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

External Speed Limiting

If you select external speed limiting for the torque control option ($Pn002 = n.\Box\Box1\Box$), set the V-REF (Speed Reference Input) signal and the speed reference input gain (Pn300).

	Туре	Signal	Connector Pin No.	Name
lor	put	V-REF	CN1-5	External speed limit input
ш		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

- 1. 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.
- 2. The setting of Pn300 determines the voltage level to be input as the speed limit. The polarity has no effect.
- 3. 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.

	Speed Reference In	put Gain	Speed Position Torque		
Pn300	Setting Range	Setting Unit	Default Setting	When Enabled	Classifica- tion
	150 to 3,000	0.01 V	600	Immediately	Setup

6.8 Encoder Divided Pulse Output

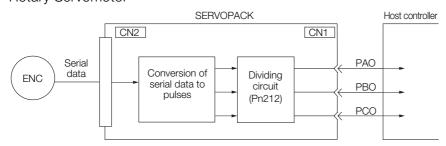
The encoder divided pulse output is a signal that is output from the encoder and processed inside the SERVOPACK. It is then output externally in the form of two phase pulse signals (phases A and B) with a 90° phase differential. At the host controller, it is used as the position feedback.

The following table describes the signals and output phase forms.

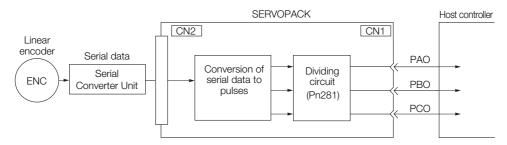
6.8.1 Encoder Divided Pulse Output Signals

Type	Signal	Connector Pin No.	Name	Remarks	
	PAO	CN1-33	Encoder Divided Pulse Output,	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	Phase A		
	РВО	CN1-35			
Output	/PBO	CN1-36	Encoder Divided Pulse Output, Phase B		
	PCO	CN1-19	Encoder Divided Pulse Output,	These pins output one pulse	
	/PCO	CN1-20	Phase C*	every Servomotor rotation.	

- $\boldsymbol{\ast}$ Refer to the following section for information on the origin within one encoder rotation.
- Prelation 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 6-48
- Rotary Servomotor

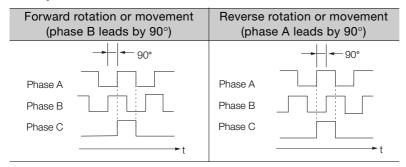


· Linear Servomotors



6.8.1 Encoder Divided Pulse Output Signals

Output Phase Forms



Note: The pulse width of the origin within one encoder rotation depends on the setting of number of encoder output pulses (Pn212) or the encoder output resolution (Pn281). It is the same as the width of phase A. Even for reverse operation (Pn000 = n.□□□1), the output phase form is the same as shown above.



If you use the SERVOPACK's phase-C pulse output for an origin return, rotate the Servomotor two or more rotations before you start an origin return. If the Servomotor cannot be rotated two or more times, perform an origin return operation at a motor speed of 600 min⁻¹ or lower. If the motor speed is higher than 600 min⁻¹, the phase-C pulse may not be output correctly.

Linear Encoder Application Precautions

The following precautions apply to the encoder output pulses when an external linear encoder is used.

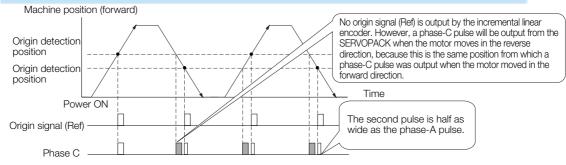
 Relation between Renishaw PLC Incremental Linear Encoders and Encoder Output Pulse Signal from the SERVOPACK When Using a RGS20 Scale and RGH22B Sensor Head

The output position of the origin signal (Ref) will depend on the direction of movement for some models of incremental linear encoders from Renishaw PLC.

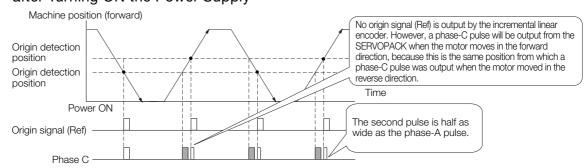
In that case, the phase-C pulse of the SERVOPACK is output at two positions.

For detailed specifications on the origin signal, refer to the manual for the Renishaw PLC incremental linear encoder.

When Passing the First Origin Signal (Ref) in the Forward Direction and Returning after Turning ON the Power Supply



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

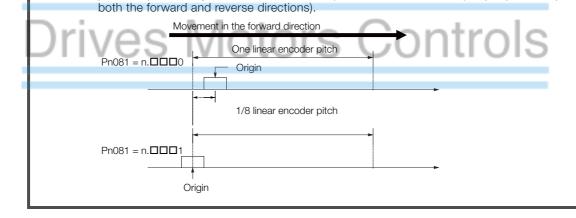


- Precautions When Using a Linear Incremental Encoder from Magnescale Co., Ltd.
- Encoder Divided Phase-C Pulse Output Selection

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

Parameter		Meaning	When Enabled	Classification	
Pn081	n.□□□0 (default setting)	Output phase-C pulses only in the forward direction.	After restart Setup		
1 11001	n.□□□1	Output phase-C pulses in both the forward and reverse directions.	7 titol rootait	Joseph	
Precautions on Setting the Phase-C Pulse Output Selection (Pn081 = n.□□□X) • 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



6.8.1 Encoder Divided Pulse Output Signals

Observe the following precaution if you set Pn081 to n. \$\square\$ (Output phase-C pulses only in the forward direction).

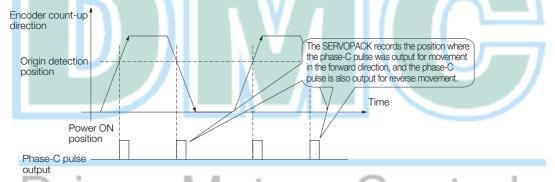
When a linear incremental encoder from Magnescale Co., Ltd. is used, the count direction of the encoder determines how the phase-C pulse (CN1-19 and CN1-20) is output.

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 the movement direction (Pn000 = n.□□□1).

Encoder Model	Interpolator	Linear Encoder Pitch [μm]	
SL710	DI 404 DV	800	
SL720	PL101-RY MJ620-T13	800	
SL730	1410020 110	800	
	SR75	80	
	SR85	80	
SQ10	MQ10-FLA	400	
3010	MQ10-GLA	400	

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

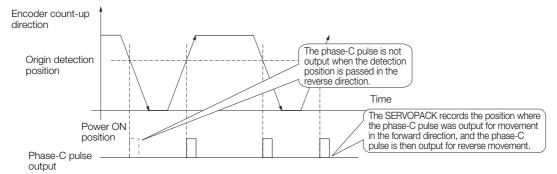
The encoder's phase-C pulse (CN1-19 and CN1-20) is output when the origin detection position is passed for the first time in the forward direction after the power supply is turned ON. After that, the phase-C pulse is output whenever the origin detection position is passed in the forward or reverse direction.



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

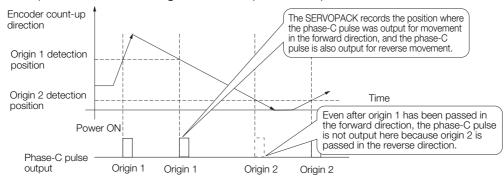
The encoder's phase-C pulse (CN1-19 and CN1-20) is not output when the origin detection position is passed for the first time in the reverse direction after the power supply is turned ON.

However, after the origin detection position is passed in the forward direction and the encoder's phase-C pulse is output, it will then also be output when the origin detection point is passed in the reverse direction.



■ When Using a Linear Encoder with Multiple Origins and First Passing the Origin Position in the Forward Direction and Returning after Turning ON the Power Supply

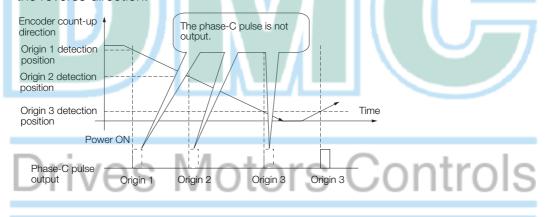
The encoder's phase-C pulse is output when the origin detection position is passed for the first time in the forward direction after the power supply is turned ON. After that, the phase-C pulse is output whenever the origin detection position is passed in the forward or reverse direction.



When Using a Linear Encoder with Multiple Origins and First Passing the Origin Position in the Reverse Direction after Turning ON the Power Supply

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

However, after the origin detection position is passed in the forward direction and the encoder's phase-C pulse it output, it will then also be output when the origin detection point is passed in the reverse direction.



6.8.2 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.

Encoder Divided Pulse Output When Using a Rotary Servomotor

If you will use a Rotary Servomotor, set the number of encoder output pulses (Pn212).

Ì		Number of Encoder C	output Pulses	Speed Position	on Torque	
	Pn212	Setting Range	Setting Range Setting Unit Default Setti		When Enabled	Classification
		16 to 1,073,741,824	1 P/Rev	2,048	After restart	Setup

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

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

The setting of the number of encoder output pulses is limited by the resolution of the encoder.

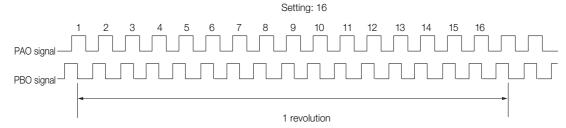
Setting of the Number		En	coder Res <mark>oluti</mark>	Upper Limit of Servo-	
of Encoder Output Pulses [P/Rev]	Setting Increment	20 bits (1,048,576 pulses)	22 bits (4,194,304 pulses)	24 bits (16,777,216 pulses)	motor Speed for Set Number of Encoder Output Pulses [min ⁻¹]
16 to 16,384	1	0	0	0	6,000
16,386 to 32,768	2	0	0	0	3,000
32,772 to 65,536	4	0	0	0	1,500
65,544 to 131,072	8	0	0	0	750
131,088 to 262,144	16	0	0	0	375
262,176 to 524,288	32	_	0	0	187
524,352 to 1,048,576	64	_	0	0	93
1,048,704 to 2,097,152	128	0+0	ro- (00+	46
2,097,408 to 4,194,304	256	OfO	12-	0	23

Note: 1. The setting range of the number of encoder output pulses (Pn212) depends on the resolution of the Servomotor encoder. An A.041 alarm (Encoder Output Pulse Setting Error) will occur if the above setting conditions are not met.

Correct setting example: Pn212 can be set to 25,000 [P/Rev]. Incorrect setting example: Pn212 cannot be set to 25,001 (P/Rev) because the setting increment in the above table is not used.

2. The upper limit of the pulse frequency is approximately 1.6 Mpps. The Servomotor speed will be limited if the setting of the number of encoder output pulses is too high.
An A.511 alarm (Encoder Output Pulse Overspeed) will occur if the upper limit of the motor speed is exceeded.

Output example: An output example is given below for the PAO (Encoder Pulse Output Phase A) signal and the PBO (Encoder Pulse Output Phase B) signal when Pn212 is set to 16 (16 pulses output per revolution).



Encoder Divided Pulse Output When Using a Linear Servomotor

If you will use a Linear Servomotor, set the encoder output resolution (Pn281).

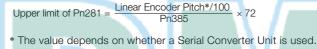
	Encoder Output Re	solution	Speed Posit	ion Force	
Pn281	Setting Range Setting Unit		Default Setting	When Enabled	Classification
	1 to 4,096	1 edge/pitch	20	After restart	Setup

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

Set the encoder output resolution for the encoder pulse output signals (PAO, /PAO, PBO, and /PBO) from the SERVOPACK to the host controller.

The number of feedback pulses per linear encoder pitch is divided by the setting of Pn281 (after multiplication by 4) inside the SERVOPACK and then the resulting number of pulses is output. Set the parameter according to the system specifications of the machine or host controller.

The setting range depends on the Servomotor's maximum speed (Pn385) and the Linear Encoder Scale Pitch (Pn282).* You can calculate the upper limit of the setting of Pn281 with the following formula.



Using a Serial Converter Unit Setting of Pn282

Not Using a Serial Converter Unit (when the linear encoder and SERVOPACK are connected directly or when a linear encoder that does not require a Serial Converter Unit is used)

The linear encoder pitch is automatically detected by the SERVO-PACK, so the setting of Pn282 is ignored. You can use the monitor functions of the SigmaWin+ to check the linear encoder pitch that was automatically detected.

Information

When the linear encoder pitch is 4 μ m, the maximum motor speed is limited to 1 mm/s because of the maximum response frequency of the Serial Converter Unit. If the setting is out of range or does not satisfy the setting conditions, an A.041 alarm

(Encoder Output Pulse Setting Error) will be output. If the motor speed exceeds the upper limit for the set encoder output resolution, an A.511 alarm (Encoder Output Pulse Overspeed) will be output.

The upper limit of the encoder output resolution is restricted by the dividing specifications of the Serial Converter Unit.

Example

Setting Example

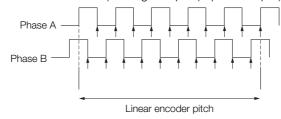
Correct setting for a linear encoder pitch of 20 µm and a maximum motor speed of 5 m/s (Pn385 = 50): Pn281 = 28 (edges/pitch)

Incorrect setting: Pn281 = 29 (edges/pitch) (An A.041 alarm would be output.)

Example

Pulse Output Example

When Pn281 = 20 (20-edge output (5-pulse output) per linear encoder pitch)



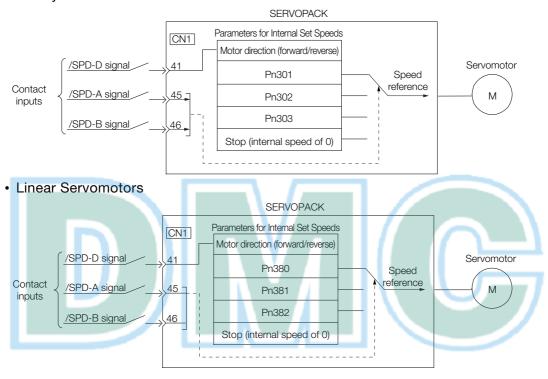
6.9.1 Input Signals for Internal Set Speed Control

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



6.9.1 Input Signals for Internal Set Speed Control

The following input signals are used to change the speed.

When Using the Default Input Signal Allocations (Pn50A = $n.\Box\Box\Box$ 0)

Type	Signal	Connector Pin No.	Meaning	
	/SPD-D CN1-41		Changes the Servomotor direction.	
Input	/SPD-A CN1-45		Used to select the internal set speed.	
	/SPD-B CN1-46		Used to select the internal set speed.	

When Changing Input Signal Allocations (Pn50A = $n.\Box\Box\Box$ 1)

Type	Signal	Connector Pin No.	Meaning	
	/SPD-D		Changes the Servomotor direction.	
Input	/SPD-A	Must be allocated.	Used to select the internal set speed.	
	/SPD-B	Used to select the internal set speed.		

Note: You must allocate the /SPD-D, /SPD-A, and /SPD-B signals to use them. You can 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.

6.1.1 Input Signal Allocations on page 6-5

6.9.2 Setting the Control Method to Internal Set Speed Control

Set Pn000 to n.□□X□ (Control Method Selection) to 3 to specify internal set speed control.

Parameter		Meaning	When Enabled	Classification
Pn000	n.□□3□	Internal set speed control with contact commands	After restart	Setup

6.9.3 Settings for Internal Set Speed Control

The parameters that you set depend on the type of Servomotor.

· Rotary Servomotors

	Internal Set Speed 1		Speed	Speed		
Pn301	Setting Range Setting Unit*		Default Setting	When Enabled	Classification	
	0 to 10,000 1 min ⁻¹		100	Immediately	Setup	
	Internal Set Speed 2			Speed		
Pn302	Setting Range	Setting Unit*	Default Setting	When Enabled	Classification	
	0 to 10,000	1 min ⁻¹	200	Immediately	Setup	
	Internal Set Speed 3	3		Speed		
Pn303	Setting Range	Setting Unit*	Default Setting	When Enabled	Classification	
	0 to 10,000	1 min ⁻¹	300	Immediately	Setup	

^{*} When a Direct Drive Servomotor is connected, the setting unit will automatically be 0.1 min⁻¹.

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

	Internal Set Speed 1			Speed	
Pn380	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
Dri	0 to 10,000	1 mm/s	10	Immediately	Setup
	Internal Set Speed 2	Speed			
Pn381	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 mm/s	20	Immediately	Setup
	Internal Set Speed 3	3		Speed	
Pn382	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 mm/s	30	Immediately	Setup

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) signal and the /SPD-A and /SPD-B (Internal Set Speed Selection) signals.

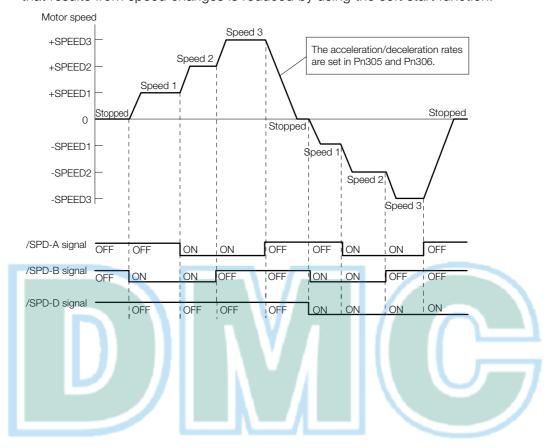
• Rotary Servomotors

	Input Signals		Motor	Motor Speed
/SPD-D	/SPD-A	/SPD-B	Direction	Motor Speed
	OFF	OFF		Stops the motor with an internal speed of 0.
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn301.
OFF	ON	ON	Forward	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.
	OFF	OFF		Stops the motor with an internal speed of 0.
	OFF	ON	Reverse	Operates the motor with internal set speed 1, which is set in Pn301.
ON	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	Motor Speed	
/SPD-D	/SPD-A	/SPD-B	Direction	Motor Speed	
	OFF	OFF		Stops the motor with an internal speed of 0.	
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn380.	
OFF	ON	ON	Forward	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.	
1)ri	OFF	OFF	γ t α r	Stops the motor with an internal speed of 0.	
	OFF	ON	Jioi	Operates the motor with internal set speed 1, which is set in Pn380.	
ON	ON	ON	Reverse	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.



Drives Motors Controls

6.10 Selecting Combined Control Methods

You can specify switching the SERVOPACK between two control methods. To combine control methods, set $Pn000 = n.\Box\Box X\Box$ (Control Method Selection) to between 4 and B. This section describes how to switch between the methods and the switching conditions.

Parameter		Combined	Cont	rol Methods	When Enabled	Classification
	n.□□4□	Internal set speed control	\Leftrightarrow	Speed control with external references		
	n.□□5□	Internal set speed control	\Leftrightarrow	Position control		
	n.□□6□	Internal set speed control	\Leftrightarrow	Torque control		Satura
Pn000	n.□□7□	Position control	\Leftrightarrow	Speed control with external references	After restart	
FIIOUU	n.□□8□	Position control	\Leftrightarrow	Torque control	Allel lestait	Setup
	n.□□9□	Torque control	\Leftrightarrow	Speed control with external references		
	n.□□A□	Speed control with external references	\Leftrightarrow	Speed control with zero clamping		
	n.□□B□	Normal position control	⇔	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.

When Using the Default Input Signal Allocations (Pn50A = $n.\Box\Box\Box$ 0)

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.

· Rotary Servomotors

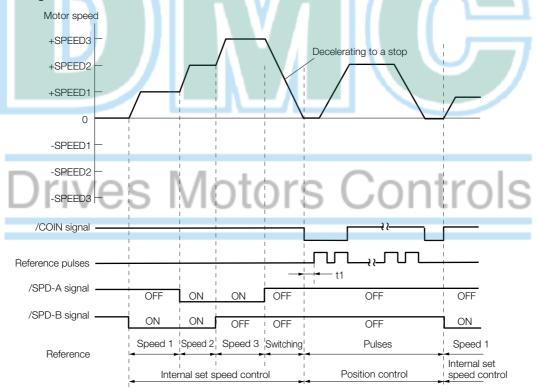
Input Pins		Motor	Operation for Setting of Pn000 = n.□□X□			
/SPD-D (CN1-41)	/SPD-A (CN1-45)	/SPD-B (CN1-46)	Direction	n.□□4□	n.□□5□	n.□□6□
	OFF	OFF		Speed control	Position control	Torque control
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn301.		
OFF	ON	ON	Forward	Operates the motor with internal set speed 2, which is set in Pn302.		
	ON	OFF		Operates the moto in Pn303.	r with internal set sp	eed 3, which is set
	OFF	OFF		Speed control	Position control	Torque control
	OFF	ON		Operates the moto in Pn301.	r with internal set sp	eed 1, which is set
ON	ON	ON	Reverse	Operates the moto in Pn302.	r with internal set sp	eed 2, which is set
	ON	OFF		Operates the moto in Pn303.	r with internal set sp	eed 3, which is set

6.10.1 Setting Pn000 = $n.\Box\Box X\Box$ (Control Method Selection) to 4, 5, or 6

Linear Servomotors

Input Pins		Motor	Operation for Setting of Pn000 = n.□□X□				
/SPD-D (CN1-41)	/SPD-A (CN1-45)	/SPD-B (CN1-46)	Direction	n.□□4□	n.□□5□	n.□□6□	
	OFF	OFF		Speed control	Position control	Force control	
	OFF	ON		Operates the moto in Pn380.	Operates the motor with internal set speed 1, which is set in Pn380.		
OFF	ON	ON	Forward	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.			
	OFF	OFF		Speed control	Position control	Force control	
	OFF	ON		Operates the moto in Pn380.	r with internal set sp	eed 1, which is set	
ON	ON	ON	Reverse	Operates the motor with internal set speed 2, which is set in Pn381.			
	ON	OFF		Operates the moto in Pn382.	r with internal set sp	eed 3, which is set	

An example of operation for $Pn000 = n. \square \square 5 \square$ (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: 1. 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.

- 2. A maximum delay of 2 ms occurs in reading the /SPD-A and /SPD-B signals.
- 3. 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) signal is output. Use the /COIN signal to confirm that the control method has changed.

6.10.1 Setting Pn000 = $n.\Box\Box X\Box$ (Control Method Selection) to 4, 5, or 6

When Changing Input Signal Allocations (Pn50A = $n.\Box\Box\Box$ 1)

The following four signals are assigned to CN1-40 to CN1-46 on the I/O signal connector: /C-SEL (Control Selection), /SPD-A and /SPD-B (Internal Set Speed Selection) signals, and /SPD-D (Motor Direction) 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□		
Type	Signal	Connector i ii ivo.	Setting	n.□□4□	n.□□5□	n.□□6□
Input	/C-SEL	C-SEL Must be allocated.	ON (closed)	Speed control	Position control	Torque control
iiiput	/U-3LL	iviusi de allocated.	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 DD (/C-SEL (Control Selection Input) Signal Allocation) to allocate the signal to a connector pin. Refer to the following section for details.

6.1.1 Input Signal Allocations on page 6-5

The operating method for internal set speed control (i.e., the /C-SEL signal is OFF) is given below.

Rotary Servomotors

Input Signals		Motor	Motor Speed	
/SPD-D	/SPD-A	/SPD-B	Direction	Motor Speed
	OFF	OFF	11/	Stops the motor with an internal speed of 0.
	OFF	ON	W	Operates the motor with internal set speed 1, which is set in Pn301.
OFF	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.
	OFF	OFF		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	ON	Reverse	Operates the motor with internal set speed 2, which is set in Pn302.
Dri	ON	OFF	tore	Operates the motor with internal set speed 3, which is set in Pn303.

Linear Servomotors

	Input Signals			Motor Spood
/SPD-D	/SPD-A	/SPD-B	Direction	Motor Speed
	OFF	OFF		Stops the motor with an internal speed of 0.
	OFF	ON		Operates the motor with internal set speed 1, which is set in Pn380.
OFF	ON	ON	Forward	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.
	OFF	OFF		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	ON	Reverse	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. You can 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.

6.1.1 Input Signal Allocations on page 6-5

6.10.2 Setting Pn000 = $n.\Box\Box X\Box$ (Control Method Selection) to 7, 8, or 9

You can set $Pn000 = n.\square\square X\square$ (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

When Using the Default Input Signal Allocations (Pn50A = $n.\Box\Box\Box$ 0)

Typo	Type Signal Connector Pin No.	Connector	Signal Status	Control Method for Setting of Pn000 = n.□□X□			
Type		Signal Status	n.□□7□	n.□□8□	n.□□9□		
Innut	In	CN11 41	ON (closed)	Speed control	Torque control	Speed control	
Input /C-SEL CN1-4	ON1-41	OFF (open)	Position control	Position control	Torque control		

When Changing Input Signal Allocations (Pn50A = n.□□□1)

Type Signal		Connector	Signal Status	Control Method for Setting of Pn000 = n.□□X□			
Type Signal Pin No.	Pin No.	Signal Status	n.0070	n.□□8□	n.□□9□		
Input		Must be allo-	ON (closed)	Speed control	Torque control	Speed control	
IIIput		cated.	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.

6.1.1 Input Signal Allocations on page 6-5

6.10.3 Setting Pn000 = n. DXD (Control Method Selection) to A or B

You can set $Pn000 = n.\square\square X\square$ (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

When Using the Default Input Signal Allocations (Pn50A = $n.\Box\Box\Box$ 0)

	-	_		0 1 114 11 11 0 11		
Type	Signal	Connector	Signal Status	Control Method for Setting of Pn000 = $n.\Box\Box X\Box$		
Турс	Pi		Olgital Otatas	n.□□A□	n.□□B□	
	/ZCLAMP	- CN1-41	ON (closed)	Speed control with zero clamping	_	
Input			OFF (open)	Speed control	_	
Input //INHIBIT	CN1-41	ON (closed)	_	Position control with reference pulse inhibition		
			OFF (open)	_	Position control	

6.10.3 Setting Pn000 = n.□□X□ (Control Method Selection) to A or B

When Changing Input Signal Allocations (Pn50A = n.□□□1)

Typo	Signal	Connector	Signal Status	Control Method for Setting of Pn000 = n.□□X□		
Type	Signai	Pin No.	Signal Status	n.□□A□	n.□□B□	
	/ZCLAMP	Must be allocated.	ON (closed)	Speed control with zero clamping	-	
Input			OFF (open)	Speed control	-	
прис	Input //NHIBIT		ON (closed)	-	Position control with reference pulse inhibition	
			OFF (open)	-	Position control	

Note: You must allocate the /ZCLAMP and /INHIBIT signals to use them. You can 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.

6.1.1 Input Signal Allocations on page 6-5



Drives Motors Controls

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	6.11.1
External Torque Limits	The torque is limited with an input signal from the host computer.		6.11.2
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 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

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

6.11.1 Internal Torque Limits

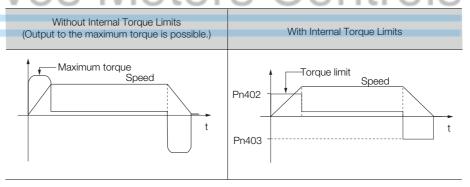
If you use internal torque limits, the maximum output torque will always be limited to the specified forward torque limit (Pn402) and reverse torque limit (Pn403).

Rotary Servomotors

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

* Set a percentage of the rated motor torque.

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



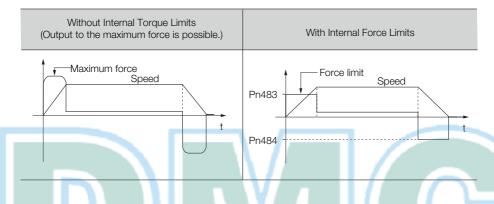
6.11.2 External Torque Limits

Linear Servomotors

	Forward Force Limit			Speed Position	n Force
Pn483	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	30	Immediately	Setup
	Reverse Force Limit			Speed Position	n Force
Pn484	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	30	Immediately	Setup

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

Note: If the setting of Pn483 or Pn484 is too low, the force may be insufficient for acceleration or deceleration of the Servomotor.



6.11.2 **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.

External Torque Limit Reference Signals

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

Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	/P-CL	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.
	(default set	(deradit setting)	OFF (open)	Cancels the forward external torque limit. The torque is limited to the setting of Pn402*1.
Input /N-CL	/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*2 and Pn405.
	(deradir setting)	OFF (open)	Cancels the reverse external torque limit. The torque is limited to the setting of Pn403*2.	

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

Note: You can use the following parameters to allocate the /P-CL and /N-CL signals to other terminals.

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

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

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

^{6.1.1} Input Signal Allocations on page 6-5

Setting the Torque Limits

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

Rotary Servomotors

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

	Forward Torque Lim	it	Speed Position	n Torque	
Pn402	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	800	Immediately	Setup
	Reverse Torque Lim	it		Speed Position	Torque
Pn403	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	800	Immediately	Setup
	Forward External To	rque Limit	Speed Position	Torque	
Pn404	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	100	Immediately	Setup
	Reverse External To		Speed Position	Torque	
Pn405	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	100	Immediately	Setup

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

Linear Servomotors

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

	Forward Force Limit			Speed Position	n Force	
Pn483	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 800	1%*	30	Immediately	Setup	
	Reverse Force Limit			Speed Position	n Force	
Pn484	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 800	1%*	30	Immediately	Setup	
)ri	Forward External Fo	orce Limit	0,0	Speed Position Force		
Pn404	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 800	1%*	100	Immediately	Setup	
	Reverse External Force Limit			Speed Position	Force	
Pn405	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 800	1%*	100	Immediately	Setup	

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

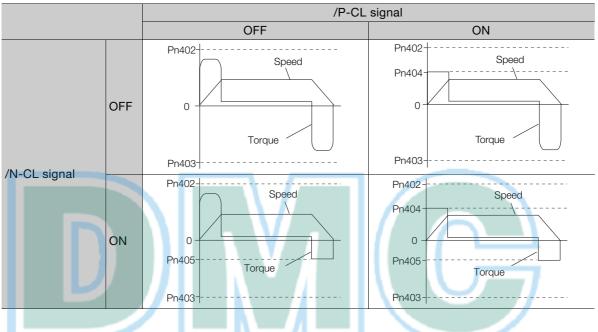
6.11.2 External Torque Limits

Changes in the Output Torque for External Torque Limits

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

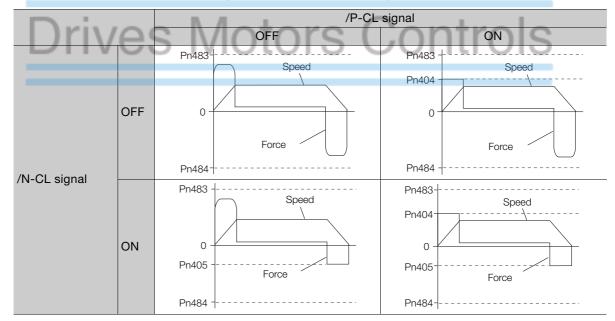
· Rotary Servomotors

In this example, the Servomotor direction is set to $Pn000 = n.\square\square\square\square0$ (Use CCW as the forward direction).



Linear Servomotors

In this example, the Servomotor direction is set to $Pn000 = n.\square\square\square\square0$ (Use the direction in which the linear encoder counts up as the forward direction).



6.11.3 Limiting Torque with an Analog Reference

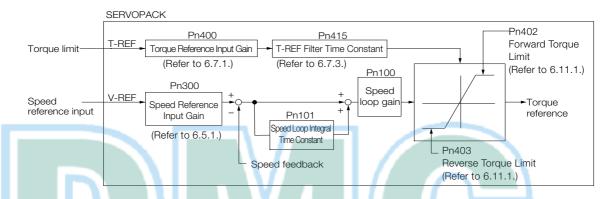
The analog voltage on the T-REF terminals (CN1-9 and CN1-10) is used to limit the torque with an analog reference.

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.

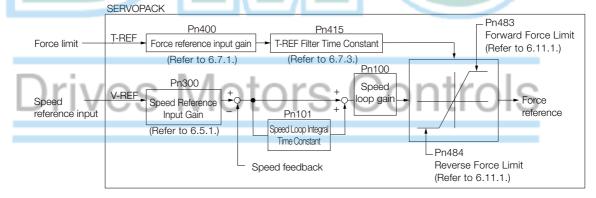
· Rotary Servomotors



Information

There is no polarity for the input voltage of the analog voltage reference for the torque limit. The absolute value of a positive or negative voltage is input, and a torque limit that corresponds to that absolute value is applied in the forward and reverse directions.

Linear Servomotors



Information

There is no polarity for the input voltage of the analog voltage reference for the force limit. The absolute value of a positive or negative 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.

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

6.11.3 Limiting Torque with an Analog Reference

Setting the External Torque Limit

You must set Pn002 to n. □□□1 (Use T-REF as an external torque limit input) to use T-REF (CN1-9 and CN1-10) as the torque limit input.

Parameter		Meaning	When Enabled	Classification
Pn002	n.001	Use T-REF as an external torque limit input.	After restart	Setup

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.

Rotary Servomotors

	Torque Reference I	nput Gain	Speed Positio	n Torque	
Pn400	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
111400	10 to 100	0.1 V	30 (rated torque at 3.0 V)	Immediately	Setup
	Forward Torque Lir	mit		Speed Position	n Torque
Pn402	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	800	Immediately	Setup
	Reverse Torque Lir	nit		Speed Position	n Torque
Pn403	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	800	Immediately	Setup
Pn415	T-REF Filter Time (Constant		Speed Position	n Torque
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	0	Immediately	Setup

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

· Linear Servomotors

	Force Reference In	put Gain	Speed Positio	n Force	
Pn400	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 100	0.1 V	30 (rated force at 3.0 V)	Immediately	Setup
	Forward Force Lim	it		Speed Positio	n Force
Pn483	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	30	Immediately	Setup
	Reverse Force Lim	it	Speed Positio	n Force	
Pn484	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	30	Immediately	Setup
	T-REF Filter Time Constant			Speed Positio	n Force
Pn415	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	0	Immediately	Setup

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

6.11.4 Limiting Torque with an External Torque Limit and an Analog Voltage Reference

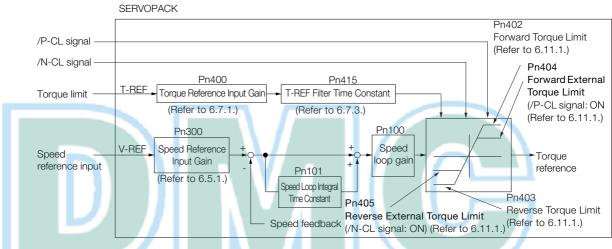
6.11.4 Limiting Torque with an External Torque Limit and an Analog Voltage Reference

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) or /N-CL (Reverse External Torque Limit) 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.

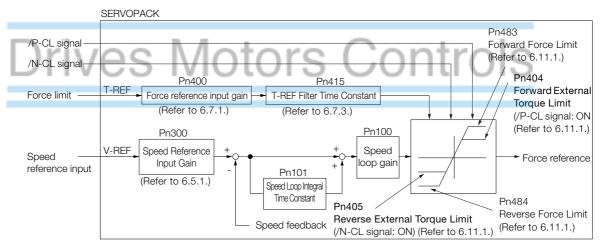
The following block diagram shows limiting the torque with an external torque limit and an analog voltage reference.

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.

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.

6.11.4 Limiting Torque with an External Torque Limit and an Analog Voltage Reference

/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.

◆ 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	

◆ /P-CL (Forward External Torque Limit) Signal and /N-CL (Reverse External Torque Limit) Signal

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.
		(derauit setting)	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.

/P-CL (Forward External Force Limit) Signal and /N-CL (Reverse External Force Limit) Signal

Туре	Signal	Connector Pin No.	Signal Status	Meaning
			ONI (-II)	Applies the forward external force limit.
Input	/P-CL	CN1-45 (default setting)	ON (closed)	The force is limited to the smallest of the analog reference or the setting of Pn483 or Pn404.
	ive		OFF (open)	Cancels the forward external force limit. The force is limited to the setting of Pn483.
				Applies the reverse external force limit.
			ON (closed)	The force is limited to the smallest of the analog
Input	/N-CL	CN1-46 (default setting)	(3 3 3 3 3)	reference or the setting of Pn484 or Pn405.
		(derauit setting)	OFF (open)	Cancels the reverse external force limit. The force is limited to the setting of Pn484.

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. \$\square\$D\$ (Use T-REF or /N_CL as the torque limit when /P_CL or /N_CL is active).

Parameter		Description	When Enabled	Classification
Pn002	n.□□□3	Use T-REF as the torque limit when /P_CL or /N_CL is active.	After restart	Setup

6.11.4 Limiting Torque with an External Torque Limit and an Analog Voltage Reference

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.

Rotary Servomotors

	Torque Reference I	nput Gain		Speed Positio	n Torque
Pn400	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
111100	10 to 100	0.1 V	30 (rated torque at 3.0 V)	Immediately	Setup
	Forward Torque Lir	nit		Speed Positio	n Torque
Pn402	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	800	Immediately	Setup
	Reverse Torque Limit			Speed Position	n Torque
Pn403	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	800	Immediately	Setup
	Forward External Torque Limit			Speed Position Torque	
Pn404	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	100	Immediately	Setup
	Reverse External Torque Limit			Speed Position	Torque
Pn405	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	100	Immediately	Setup
_	T-REF Filter Time (Constant		Speed Position	n Torque
Pn415	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	0	Immediately	Setup

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

• Linear Servomotors

	Force Reference In	put Gain		Speed Positio	n Force
Pn400	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
וויייי	10 to 100	0.1 V	30 (rated force at 3.0 V)	Immediately	Setup
	Forward Force Lim	it		Speed Positio	n Force
Pn483	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	30	Immediately	Setup
	Reverse Force Lim	it		Speed Positio	n Force
Pn484	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	30	Immediately	Setup
	Forward External Force Limit			Speed Positio	n Force
Pn404	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	100	Immediately	Setup
	Reverse External Force Limit			Speed Positio	n Force
Pn405	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%*	100	Immediately	Setup
Pn415	T-REF Filter Time (T-REF Filter Time Constant			n Force
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	0	Immediately	Setup

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

6.11.5 /CLT (Torque Limit Detection) Signal

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

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

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

6.1.2 Output Signal Allocations on page 6-8



Drives Motors Controls

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 supply to the system is turned ON.

There are four types of encoders for Rotary Servomotors. The usage of the encoder is specified in $Pn002 = n.\Box X \Box \Box$.

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

Refer to the following section for encoder models.

■ Encoder Resolution on page 5-48

· Parameter Settings When Using an Incremental Encoder

Parameter		Meaning	When Enabled	Classification
n.□0□□ (default setting)		Use the encoder as an incremental encoder. A battery is not required.		
Pn002	n.0100	Use the encoder as an incremental encoder. A battery is not required.	After restart	Setup
	n.□2□□	Use the encoder as a single-turn absolute encoder. A battery is not required.		

· Parameter Settings When Using a Single-Turn Absolute Encoder

Parameter		Meaning	When Enabled	Classification
n.□0□□ (default setting)		Use the encoder as a single-turn absolute encoder. A battery is not required.		
Pn002	n.0100	Use the encoder as an incremental encoder. A battery is not required.	After restart	Setup
	n.□2□□	Use the encoder as a single-turn absolute encoder. A battery is not required.		

· Parameter Settings When Using a Multiturn Absolute Encoder

	Parameter	Meaning	When Enabled	Classification
Dr	n.□0□□ (default setting)	Use the encoder as a multiturn absolute encoder. A battery is required.	trois	5
Pn002	n.□1□□	Use the encoder as an incremental encoder. A battery is not required.	After restart	Setup
	n.□2□□	Use the encoder as a single-turn absolute encoder. A battery is not required.		

• Parameter Settings When Using a Batteryless Multiturn Absolute Encoder

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

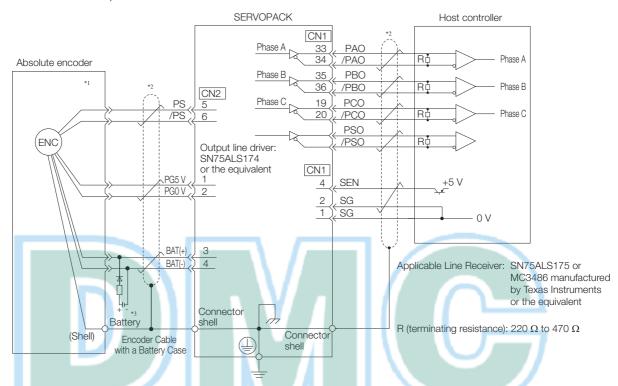
NOTICE

• Install a battery at either the host controller or on the Encoder Cable.

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

6.12.1 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. represents a shielded twisted-pair cable.
- *3. If you use an Encoder Cable with a Battery Case, 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 4-26

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.

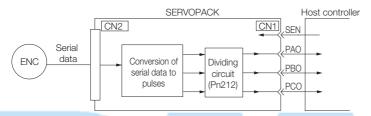
6.12.3 Output Ports for the Position Data from the Absolute Encoder

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.

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)
FBO	During normal operation	Incremental pulses
PCO	Always	Origin pulse

The PAO (Encoder Divided Pulse Output) signal outputs the position data from the absolute encoder after the control power supply is turned ON. There are two methods that you can use to output the position data from the absolute encoder: Using the SEN (Absolute Data Request) 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.

(a) 4.5.4 I/O Circuits on page 4-44

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) 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.

(a) 4.5.4 I/O Circuits on page 4-44

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) signal and not using the SEN signal.

Setting the Parameter to Specify Using or Not Using the SEN (Absolute Data Request) Signal

- Using the SEN Signal to Read the Position Data from the Absolute Encoder
- When Using the Default I/O Signals (Pn50A = n.□□□0)
 The setting of Pn515 = n.□□□X (SEN (Absolute Data Request Input) Signal Allocation) is ignored.
- Allocating the SEN Signal to CN1-40 to CN1-46 on the I/O Signal Connector (Pn50A = n.□□□1) Set Pn515 = n.□□□X (SEN (Absolute Data Request Input) Signal Allocation) to 0 to 6 or 9 to F.

Refer to the following section for the procedure to allocate input signals.

6.1.1 Input Signal Allocations on page 6-5

Information

To use the default allocation of the SEN signal and to change the default settings of other I/O signals (Pn50A = $n.\Box\Box\Box$ 1), set Pn515 to $n.\Box\Box\Box$ 8 (Active when 5 V is input to CN1-4).

 Reading the Position Data from the Absolute Encoder without Using the SEN Signal

Set Pn50A to n. DDD1 and set Pn515 to n. DDD7 (The signal is always active).

Refer to the following sections for details on the parameters.

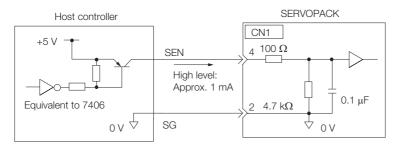
14.1 List of Parameters on page 14-2

Connecting the SEN (Absolute Data Request) Signal

◆ Allocating the SEN Signal to CN1-4

Type	Signal	Connector Pin No.	Signal Status	Meaning
				Does not request the position data from the absolute
Input	SEN	CN1-4	OFF (open)	encoder. (This is the status after the power supply is turned ON.)
			ON (closed)	Requests the position data from the absolute encoder.

Circuit Example When the SEN Signal Is Allocated to CN1-4



We recommend a PNP transistor.

◆ Allocating the SEN Signal to a General-Purpose Input

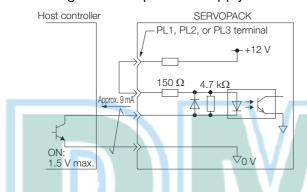
Type	Signal	Connector Pin No.	Signal Status	Meaning
Input	SEN	CN1-40 to CN1-46	OFF (open)	Does not request the position data from the absolute encoder. (This is the status after the power supply is turned ON.)
			ON (closed)	Requests the position data from the absolute encoder.

A circuit example for when the SEN signal is allocated to CN1-40 to CN1-46 on the I/O signal connector is provided below.

Refer to the following section for the procedure to allocate input signals.

6.1.1 Input Signal Allocations on page 6-5

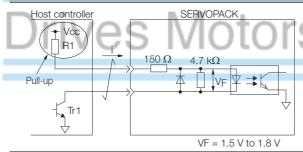
■ Using the Pull-Up Power Supply in the SERVOPACK



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





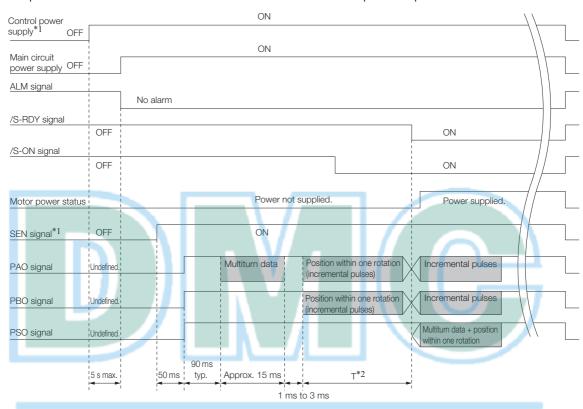
Controls

Sequence for Reading the Position Data from the Absolute Encoder Using the SEN (Absolute Data Request) Signal

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

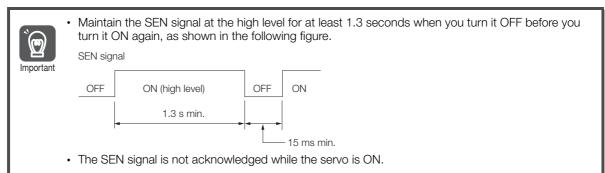
The multiturn data is sent according to the transmission specifications.

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



- *1. When you turn OFF the control power supply, 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 16,384	680 × Pn212/16,384 [kpps]	25 ms max.
16,386 to 32,768	680 × Pn212/32,768 [kpps]	50 ms max.
32,722 to 65,536	680 × Pn212/65,536 [kpps]	100 ms max.
65,544 to 131,072	680 × Pn212/131,072 [kpps]	200 ms max.
131,088 to 262,144	680 × Pn212/262,144 [kpps]	400 ms max.
262,176 to 524,288	680 × Pn212/524,288 [kpps]	800 ms max.
524,352 to 1,048,576	680 × Pn212/1,048,576 [kpps]	1,600 ms max.
1,048,704 to 2,097,152	680 × Pn212/2,097,152 [kpps]	3,200 ms max.
2,097,408 to 4,194,304	680 × Pn212/4,194,304 [kpps]	6,400 ms max.



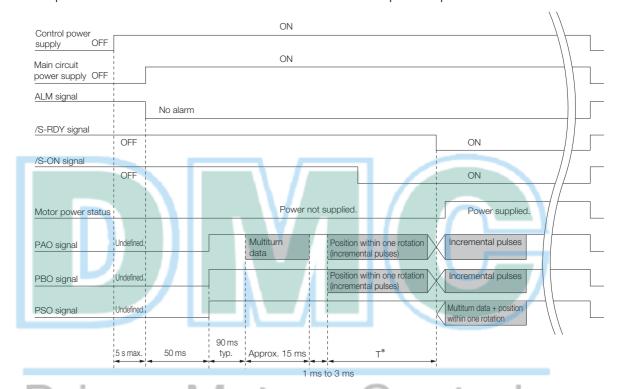
Sequence for Reading the Position Data from the Absolute Encoder without Using the SEN (Absolute Data Request) Signal

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 supply 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.



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

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

6.12.5 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.

Sequence for Reading the Position Data from the Absolute Encoder Using the SEN (Absolute Data Request) Signal on

Sequence for Reading the Position Data from the Absolute Encoder without Using the SEN (Absolute Data Request)

Item	PAO signal	PSO signal				
Synchronization Method Start-stop synchronization (ASYNC)						
Transmission Speed	9,600 bps	,600 bps				
Start Bits	1 bit	1 bit				
Stop Bits	1 bit	1 bit				
Parity	Even					
Character Code	ASCII, 7 bits					
Data Format	Refer to Data Format of PAO Signal.	Refer to Data Format of PSO Signal.				
Data Output Period	Using the SEN Signal Each time the SEN signal is input after the control power supply is turned ON Not Using the SEN Signal Only once after the control power supply is turned ON	40 ms				

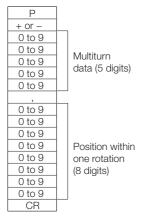
Data Format of PAO Signal

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).



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).



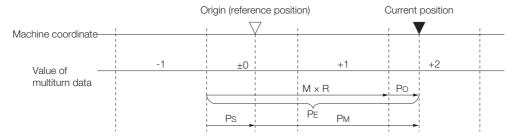
6.12.6 Calculating the Current Position in Machine Coordinates

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:

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

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

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

		Setting or Unit		
Symbol	Meaning	Encoder Divided Pulse Output (PAO and PBO) Signals	Absolute Encoder Position Output (PSO) Signal	
P _E	Position data for the current position of the absolute encoder	Encoder output pulses (encoder pulses x setting of Pn212)	Encoder pulses	
М	Current position of the multiturn data of the absolute encoder	-	-	
Po	Position of the current position within one rotation	Encoder output pulses	Encoder pulses	
P _S	Position data of the absolute encoder when absolute encoder was reset	(encoder pulses x setting of Pn212)		
M _S	Multiturn data of the absolute encoder when absolute encoder was reset	OUITH	013	
P _S '	Position of the absolute encoder within one rotation when absolute encoder was reset	Encoder output pulses (encoder pulses x setting	Encoder pulses	
P _M	Current position in machine coordinate system	of Pn212)		
R	Number of encoder pulses per revolution	Setting of Pn212	Encoder resolution	
Calculations	s for Reverse Rotation Mode (Pn000 = n.□□□1)	PM = PE - PS PE = -M × R + PO PS = MS × R + PS PM = PE - PS PE = -M × R - PC PS = MS × R - PS		

Information

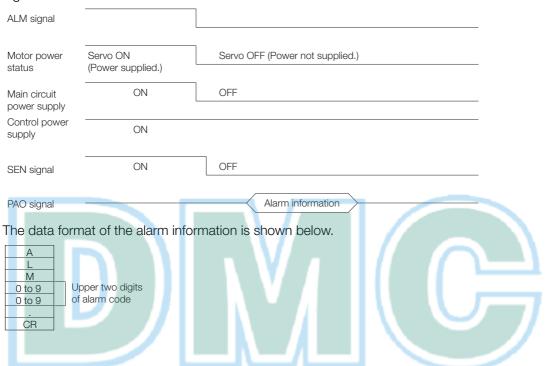
If you are using a Rotary Servomotor, you must reset the absolute encoder. Refer to the following section for information on resetting the absolute encoder.

5.17 Resetting the Absolute Encoder on page 5-51

6.12.7 Alarm Output from Output Ports for the Position Data from the Absolute Encoder

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) signal turns OFF.



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.

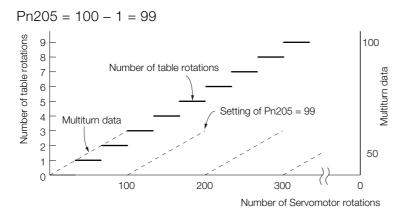
The multiturn limit is used in cases like this to prevent fractions from being produced by the integral ratio of the number of Servomotor rotations and the number of turntable rotations.

For a machine with a ratio of n:m between the number of Servomotor rotations and the number of turntable rotations, as shown above, the value of m minus 1 will be the setting for the multiturn limit setting (Pn205).

Multiturn limit (Pn205) = m - 1

If m = 100 and n = 3 (i.e., the turntable rotates three times for each 100 Servomotor rotations), the relationship between the number of Servomotor rotations and the number of turntable rotations would be as shown below.

Set Pn205 to 99.



	Multiturn Limit		Speed Position Torque		
Pn205	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	1 Rev	65,535	After restart	Setup

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

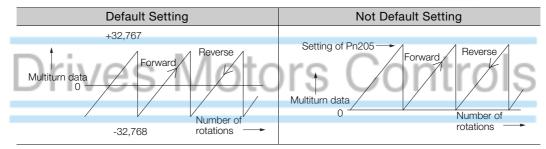
The data will change as shown below when this parameter is set to anything other than the default setting.

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

Set Pn205 to one less than the desired multiturn data.

If you change the multiturn limit in Pn205, an A.CCO alarm (Multiturn Limit Disagreement) will be displayed because the setting disagrees with the value in the encoder. Refer to the following section for the procedure to change the multiturn limit settings in the encoder.

6.12.9 Multiturn Limit Disagreement Alarm (A.CC0) on page 6-84



Information

The multiturn data will always be 0 in the following cases. It is not necessary to reset the absolute encoder in these cases.

- · When you use a single-turn absolute encoder
- When the encoder is set to be used as a single-turn absolute encoder (Pn002 = n.□2□□) Absolute encoder-related alarms (A.810 and A.820) will not occur.

6.12.9 Multiturn Limit Disagreement Alarm (A.CC0)

6.12.9 Multiturn Limit Disagreement Alarm (A.CC0)

If you change the multiturn limit in Pn205 (Multiturn Limit), an A.CCO alarm (Multiturn Limit Disagreement) will be displayed because the setting disagrees with the value in the encoder.

Display	Name	Alarm Code Output		tput	Meaning
A.CC0	Multiturn Limit Disagreement	ALO1	ALO2	ALO3	Different multiturn limits are set in the
		ON (low)	OFF (high)	ON (low)	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.

Applicable Tools

The following table lists the tools that you can use to set the multiturn limit and the applicable tool functions.

Tool	Function	Operating Procedure Reference		
Panel Operator Fn013		13.4.18 Multiturn Limit Setting after Multiturn Limit Disagreement Alarm (Fn013) on page 13-26		
Digital Operator	Fn013	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)		
SigmaWin+	Setup - Multiturn Limit Setting	© Operating Procedure on page 6-84		

Operating Procedure

Use the following procedure to adjust the multiturn limit setting.

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

ors Controls

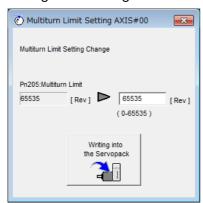
- **2.** Select Multiturn Limit Setting in the Menu Dialog Box. The Multiturn Limit Setting Dialog Box will be displayed.
- 3. Click the Continue Button.



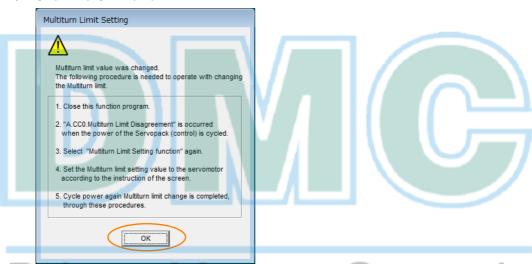
Click the Cancel Button to cancel setting the multiturn limit.

The Main Window will return.





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

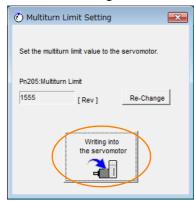


- 7. Turn the power supply to the SERVOPACK OFF and ON again.
 An A.CCO alarm (Multiturn Limit Disagreement) will occur because setting the multiturn limit in the Servomotor is not yet completed even though the setting has been changed in the SERVOPACK.
- 8. Display the Multiturn Limit Setting in the Menu Dialog Box.
- 9. Click the Continue Button.



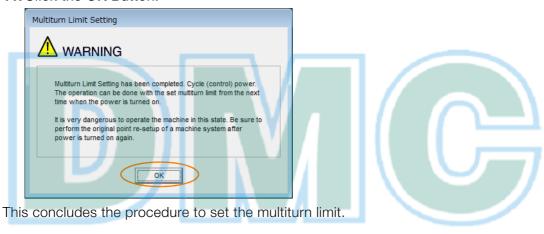
6.12.9 Multiturn Limit Disagreement Alarm (A.CC0)

10. Click the Writing into the servomotor Button.



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

11. Click the OK Button.



Drives Motors Controls

6.13 Absolute Linear Encoders

The absolute linear encoder records the current position of the stop position even when the power supply is OFF.

With a system that uses an absolute linear encoder, the host controller can monitor the current position. Therefore, it is not necessary to perform an origin return operation when the power supply to the system is turned ON.

There are three types of linear encoders for Linear Servomotors. The usage of the linear encoder is specified in $Pn002 = n.\Box X\Box\Box$.

Refer to the following section for linear encoder models.

Feedback Resolution of Linear Encoder on page 5-49

· Parameter Settings When Using an Incremental Linear Encoder

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

Parameter Settings When Using an Absolute Linear Encoder

Parameter		Meaning	When Enabled	Classification
Pn002	n.□0□□ (default setting)	Use the encoder as an absolute linear encoder.	After restart	Setup
	n.0100	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.

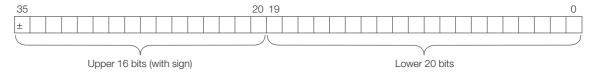
(3 4.4.3 Wiring the SERVOPACK to the Encoder on page 4-26

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

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

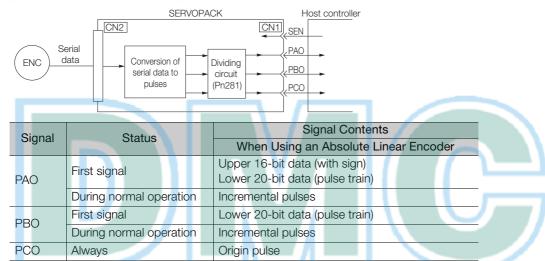
6.13.3 Output Ports for the Position Data from the Absolute Linear Encoder

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.

Encoder Divided Pulse Output (PAO, PBO, and PCO) 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.



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

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

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

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

(a) 4.5.4 I/O Circuits on page 4-44

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) 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 4-44

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) signal and not using the SEN signal.

Setting the Parameter to Specify Using or Not Using the SEN (Absolute Data Request) Signal

- Using the SEN Signal to Read the Position Data from the Absolute Linear Encoder
- When Using the Default I/O Signals (Pn50A = n.□□□0)
 Set Pn515 = n.□□□X (SEN (Absolute Data Request Input) Signal Allocation) to 0 to 6 or 9 to F.
- Allocating the SEN Signal to CN1-40 to CN1-46 on the I/O Signal Connector (Pn50A = n.□□□1) Set Pn515 = n.□□□X (SEN (Absolute Data Request Input) Signal Allocation) to 0 to 6 or 9 to F.

Refer to the following section for the procedure to allocate input signals.

6.1.1 Input Signal Allocations on page 6-5

Information

To use the default allocation of the SEN signal and to change the default settings of other I/O signals ($Pn50A = n.\Box\Box\Box1$), set Pn515 to $n.\Box\Box\Box8$ (Active when 5 V is input to CN1-4).

 Reading the Position Data from the Absolute Linear Encoder without Using the SEN Signal

Set Pn50A to n. DDD1 and set Pn515 to n. DDD7 (The signal is always active).

Refer to the following sections for details on the parameters.

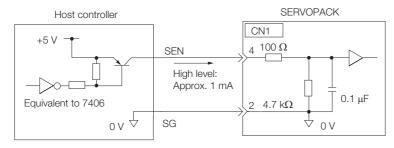
14.1 List of Parameters on page 14-2

Connecting the SEN (Absolute Data Request) Signal

◆ Allocating the SEN Signal to CN1-4

Type	Signal	Connector Pin No.	Signal Status	Meaning
			OFF (open)	Does not request the position data from the absolute linear encoder. (This is the status after the power sup-
Input	SEN	CN1-4	ON (closed)	ply is turned ON.) Requests the position data from the absolute linear encoder.

Circuit Example When the SEN Signal Is Allocated to CN1-4



We recommend a PNP transistor.

6.13.4 Reading the Position Data from the Absolute Linear Encoder

Allocating the SEN Signal to a General-Purpose Input

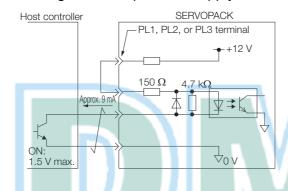
Type	Signal	Connector Pin No.	Signal Status	Meaning
Input SEN	SEN	CN1-40 to CN1-46	OFF (open)	Does not request the position data from the absolute linear encoder. (This is the status after the power supply is turned ON.)
			ON (closed)	Requests the position data from the absolute linear encoder.

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.

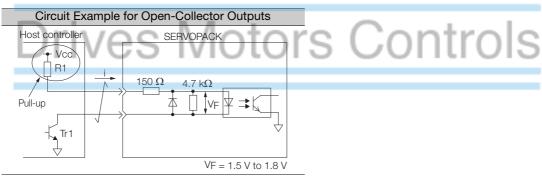
6.1.1 Input Signal Allocations on page 6-5

■ 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 k Ω to 2.7 k Ω	
12 V max.	820 Ω to 1.5 kΩ	
5 V max.	180 Ω to 470 Ω	



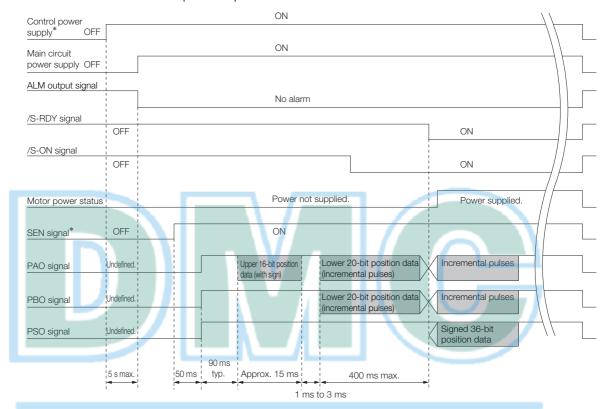


Sequence for Reading the Position Data from the Absolute Linear Encoder Using the SEN (Absolute Data Request) Signal

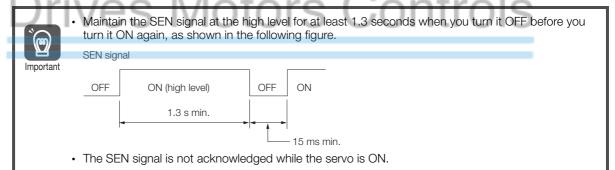
The sequence for using the SEN signal to read the position data from the absolute linear encoder of a Linear Servomotor is given below.

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.



* When you turn OFF the control power supply, turn OFF the SEN signal.



6.13.4 Reading the Position Data from the Absolute Linear Encoder

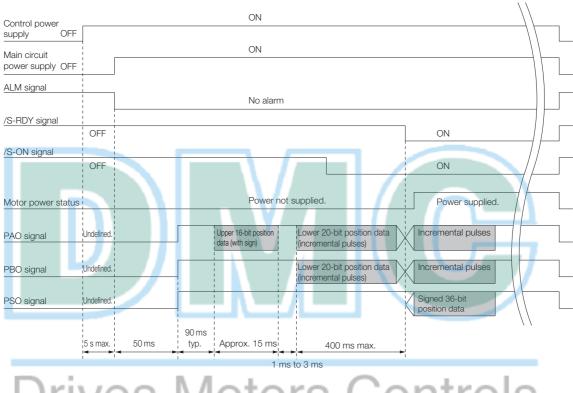
Sequence for Reading the Position Data from the Absolute Encoder without Using the SEN (Absolute Data Request) Signal

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 supply 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.



Drives Motors Controls

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.

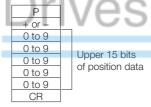
Refer to the following section for the timing of sending the position data from the absolute encoder.

- Sequence for Reading the Position Data from the Absolute Linear Encoder Using the SEN (Absolute Data Request) Signal on page 6-91
- Sequence for Reading the Position Data from the Absolute Encoder without Using the SEN (Absolute Data Request) Signal on page 6-92

Item	PAO signal	PSO signal	
Synchronization Method	Start-stop synchronization (ASYNC)		
Transmission Speed	9,600 bps		
Start Bits	1 bit		
Stop Bits	1 bit		
Parity	Even		
Character Code	ASCII, 7 bits		
Data Format	Refer to Data Format of PAO Signal on	Refer to Data Format of PSO Signal on	
Data i Offilat	page 6-93.	page 6-93.	
Data Output Period	Using the SEN Signal Each time the SEN signal is input after the control power supply is turned ON Not Using the SEN Signal Only once after the control power supply is turned ON	40 ms	

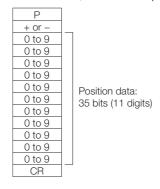
Data Format of PAO Signal

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).



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).



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.

Encoder Divided Pulse Output (PAO and PBO) Signals

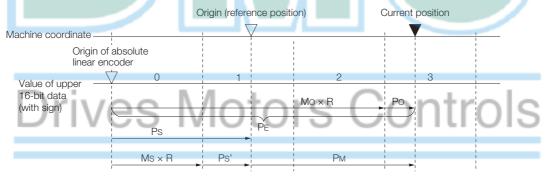
For the upper 16-bit data (with sign), the upper bits (16 bits, including the sign) of the current position after dividing by the setting of Pn281 are output with serial communications according to the transmission specifications.

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.

Absolute Encoder Position Output (PSO) Signal

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:

$$P_M = P_E - P_S$$

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

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

		Setting or Unit		
Symbol	Meaning	Encoder Divided Pulse Output (PAO and PBO) Signals	Absolute Encoder Position Output (PSO) Signal	
PE	Position data for the current position of the absolute linear encoder	Encoder Output Resolution (Pn281)	Encoder pulses	
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	Encoder Output Resolu-	Encoder pulses	
P _S	Position data of the origin	tion (Pn281)		
M _S	Upper 16 bits (with sign) of the position data of the origin	-	-	

Continued on next page.

6.13.7 Alarm Output from the Output Ports for the Position Data from the Absolute Linear Encoder

Continued from previous page.

		Setting or Unit		
Symbol	Meaning	Encoder Divided Pulse Output (PAO and PBO) Signals	Absolute Encoder Position Output (PSO) Signal	
P _S '	Lower 20 bits of the position data of the origin			
P _M	Current position in machine coordinate system	Encoder Output Resolu- tion (Pn281)	Encoder pulses	
R	1048576 (=220)			

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

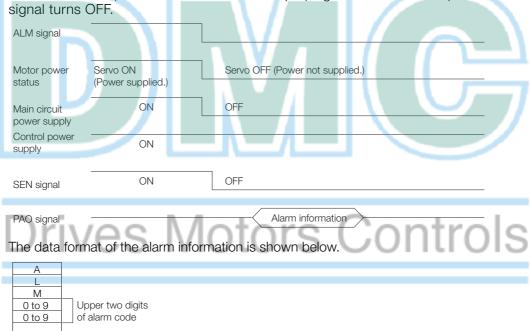
Information

CR

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) signal turns OFF.



6.14.1 Preparations

6.14

Software Reset

You can reset the SERVOPACK internally with the software. A software reset is used when resetting alarms and changing the settings of parameters that normally require turning the power supply to the SERVOPACK OFF and ON again. This can be used to change those parameters without turning the power supply to the SERVOPACK OFF and ON again.

Information

- 1. Always confirm that the servo is OFF and that the Servomotor is stopped before you start a software reset.
- This function resets the SERVOPACK independently of the host controller. The SERVO-PACK carries out the same processing as when the power supply is turned ON and outputs the ALM (Servo Alarm) signal. The status of other output signals may be forcibly changed.
- 3. When you execute a software reset, the SERVOPACK will not respond for approximately five seconds.
 - Before you execute a software reset, check the status of the SERVOPACK and Servomotor and make sure that no problems will occur.

6.14.1 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 and the applicable tool functions.

Tool Function		Operating Procedure Reference		
Panel Operator	Fn030	13.4.25 Software Reset (Fn030) on page 13-29		
Digital Operator	Fn030	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)		
SigmaWin+	Setup - Software Reset	6.14.3 Operating Procedure on page 6-96		

6.14.3 Operating Procedure

Use the following procedure to perform a software reset.

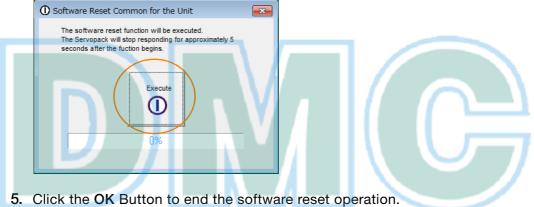
- 1. Click the 🏴 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Software Reset in the Menu Dialog Box. The Software Reset Dialog Box will be displayed.

3. Click the Execute Button.

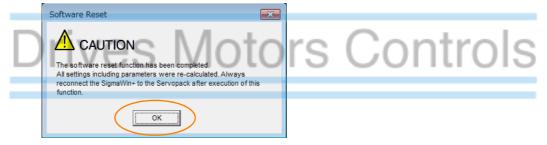


Click the Cancel Button to cancel the software reset. The Main Window will return.

4. Click the Execute Button.



All settings including parameters will have been re-calculated. When you finish this operation, disconnect the SigmaWin+ from the SERVOPACK, and then connect it again.



This concludes the procedure to reset the software.

6.15.1 Preparations

6.15

Initializing the Vibration Detection Level

You can detect machine vibration during operation to automatically adjust the settings of Pn312 or Pn384 (Vibration Detection Level) to detect A.520 alarms (Vibration Alarm) and A.911 warnings (Vibration) more precisely.

This function detects specific vibration components in the Servomotor speed.

Parameter		Meaning	When Enabled	Classification
D-040	n.□□□0 (default setting)	Do not detect vibration.	lanca a Ratalia	0 - 1
Pn310	n.□□□1	Output a warning (A.911) if vibration is detected.	Immediately	Setup
	n.□□□2	Output an alarm (A.520) if vibration is detected.		

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

· Rotary Servomotors

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

Linear Servomotors

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

Use this function only if A.520 or A.911 alarms are not output at the correct times when vibration is detected with the default vibration detection level (Pn312 or Pn384).

There will be discrepancies in the detection sensitivity for vibration alarms and warnings depending on the condition of your machine. If there is a discrepancy, use the above formula to adjust Pn311 (Vibration Detection Sensitivity).

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

Information

- 1. Vibration may not be detected because of unsuitable servo gains. Also, not all kinds of vibrations can be detected.
- 2. Set a suitable moment of inertia ratio (Pn103). An unsuitable setting may result in falsely detecting or not detecting vibration alarms or vibration warnings.
- To use this function, you must input the actual references that will be used to operate your system.
- 4. Execute this function under the operating conditions for which you want to set the vibration detection level.
- 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.
- The test without a motor function must be disabled (Pn00C = n.□□□0).

6.15.2 Applicable Tools

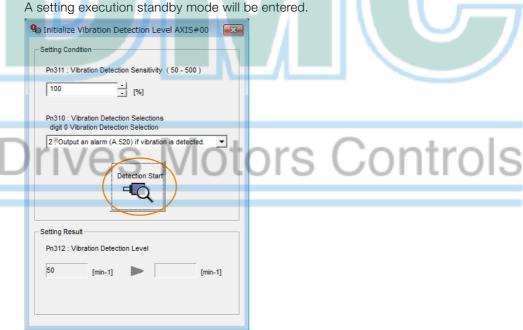
The following table lists the tools that you can use to initialize the vibration detection level and the applicable tool functions.

Tool	Function	Operating Procedure Reference	
Panel Operator	Fn01B	3.4.20 Initialize Vibration Detection Level (Fn01B) on page 13-27	
Digital Operator	Fn01B	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)	
SigmaWin+	Setup – Initialize Vibra- tion Detection Level	6.15.3 Operating Procedure on page 6-99	

6.15.3 Operating Procedure

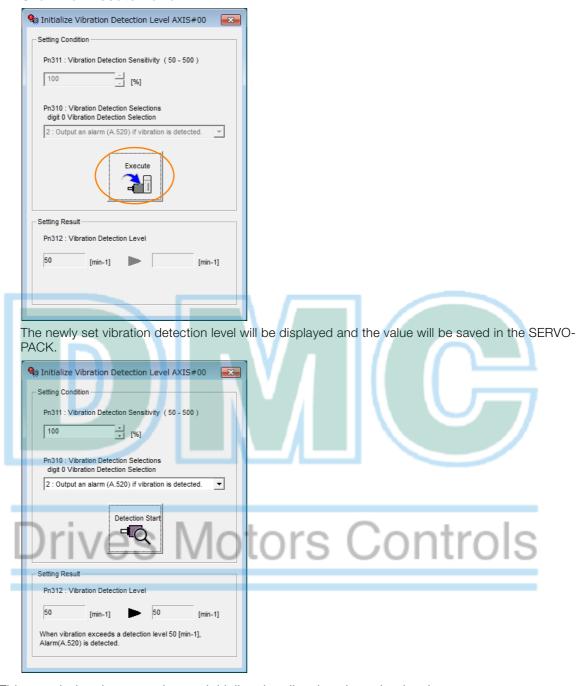
Use the following procedure to initialize the vibration detection level.

- 1. Click the P Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Initialize Vibration Detection Level in the Menu Dialog Box. The Initialize Vibration Detection Level Dialog Box will be displayed.
- 3. Select Pn311: Vibration Detection Sensitivity and Pn310: Vibration Detection Selections and then click the Detection Start Button.



6.15.3 Operating Procedure

4. Click the Execute Button.



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



6.16.1 Automatic Adjustment

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.



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

Information

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

Preparations

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

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

Applicable Tools

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

Tool	Function	Operating Procedure Reference
Panel Operator	Fn00E	13.4.13 Autotune Motor Current Detection Signal Off- set (Fn00E) on page 13-21
Digital Operator	Fn00E	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
Setup – Adjust Offset – SigmaWin+ Adjust the Motor Current Detection Signal Offsets		Operating Procedure on page 6-102

Operating Procedure

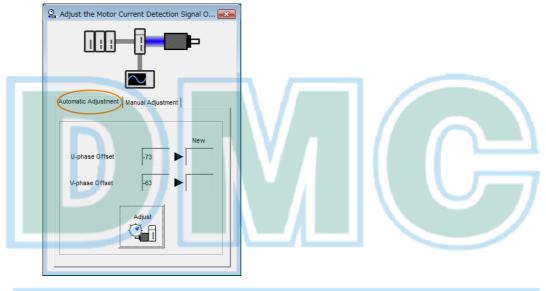
Use the following procedure to automatically adjust the motor current detection signal offset.

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

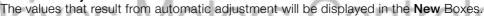
3. Click the Continue Button.

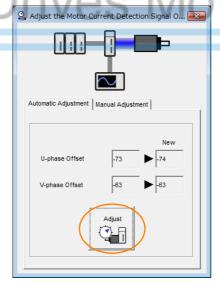


4. Click the **Automatic Adjustment** Tab in the Adjust the Motor Current Detection Signal Offsets Dialog Box.



5. Click the Adjust Button.





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

6.16.2 Manual Adjustment

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.



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.

Preparations

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

· The parameters must not be write prohibited.

Applicable Tools

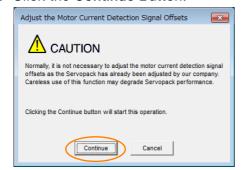
The following table lists the tools that you can use to manually adjust the offset and the applicable tool functions.

Tool	Function	Operating Procedure Reference
Panel Operator	Fn00F	3.4.14 Manually Adjust Motor Current Detection Signal Offset (Fn00F) on page 13-22
Digital Operator	Fn00F	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup – Adjust Offset – Adjust the Motor Current Detection Signal Offsets	© Operating Procedure on page 6-104

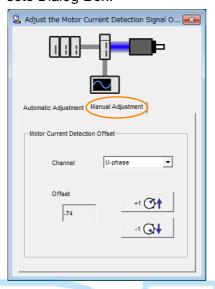
Operating Procedure

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

- 1. Operate the Servomotor at approximately 100 min⁻¹.
- 2. Click the 🔎 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **3.** Select Adjust the Motor Current Detection Signal Offsets in the Menu Dialog Box. The Adjust the Motor Current Detection Signal Offsets Dialog Box will be displayed.
- 4. Click the Continue Button.



5. Click the Manual Adjustment Tab in the Adjust the Motor Current Detection Signal Offsets Dialog Box.



- 6. Set the Channel Box in the Motor Current Detection Offset Area to U-phase.
- 7. Use the +1 and -1 Buttons to adjust the offset for phase U.

 Change the offset by about 10 in the direction that reduces the torque ripple.

 Adjustment range: -512 to +511
- 8. Set the Channel Box in the Motor Current Detection Offset Area to V-phase.
- 9. Use the +1 and -1 Buttons to adjust the offset for phase V.

 Change the offset by about 10 in the direction that reduces the torque ripple.
- **10.** Repeat steps 6 to 9 until the torque ripple cannot be decreased any further regardless of whether you increase or decrease the offsets.
- 11. Reduce the amount by which you change the offsets each time and repeat steps 6 to 9.

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

6.17.1 FSTP (Forced Stop Input) Signal

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

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

Information

Panel Display and Digital Operator Display

When a forced stop is performed, the panel 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

Classifica tion	Signal	Connector Pin No.	Signal Status	Description
Input	FSTP	Must be allocated.	ON (closed)	Drive is enabled (normal operation).
πραι	1315		OFF (open)	The motor is stopped.

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

6.1.1 Input Signal Allocations on page 6-5

6.17.2 Stopping Method Selection for Forced Stops

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

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

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

Stopping the Servomotor by Setting Emergency Stop Torque (Pn406)

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

If $Pn001 = n.\square\squareX\square$ is set to 1 or 2, the Servomotor will be decelerated to a stop using the torque set in Pn406 as the maximum torque.

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

		Emergency Stop Torque			Speed Positio	n
Pn	406	Setting Range Setting Unit		Default Setting	When Enabled	Classification
		0 to 800	1%*	800	Immediately	Setup

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

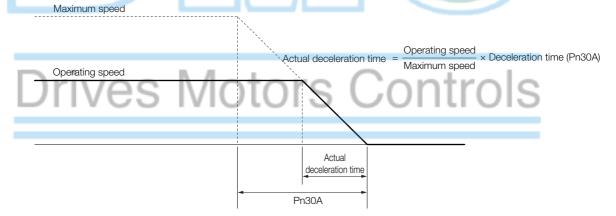
Stopping the Servomotor by Setting the Deceleration Time for Servo OFF and Forced Stops (Pn30A)

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

	Deceleration Time f	or Servo OFF and Fo	rced Stops	Speed Position	ו
Pn30A	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup

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

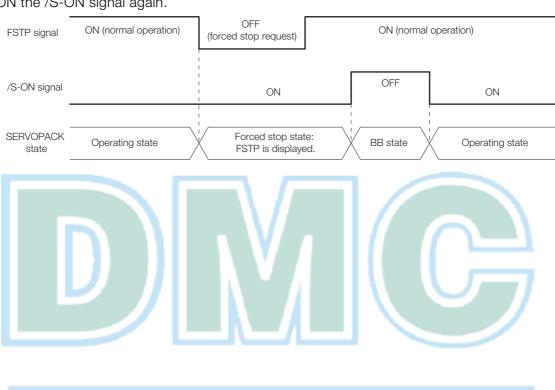
The deceleration time that you set in Pn30A is the time to decelerate the Servomotor from the maximum motor speed.



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.



Drives Motors Controls

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.

SERVOPACKs with software version 0023 or higher support overheat protection.

When you use overheat protection, you must wire the overheat protection input (TH) signal and select overheat protection ($Pn61A = n.\square\square\squareX$).

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.

Using Overheat Protection in the Linear Servomotor

- If you use a Serial Converter Unit, connect the connector for the polarity sensor and thermostat cable of the Linear Servomotor to the Serial Converter Unit.
- If you do not use a Serial Converter Unit, connect the thermostat cable of the Linear Servomotor to CN1-50 on the SERVOPACK.

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.

6.18.2 Overheat Protection Selection

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

	Parameter	Meaning	When Enabled	Classification
	n.□□□0 (default setting)	Disable overheat protection.		Setup
Pn61A	n.□□□1	Use overheat protection in the Yaskawa Linear Servomotor.*		
	n.□□□2	Monitor a negative voltage input from a sensor attached to the machine and use overheat protection.	After restart	
	n.□□□3	Monitor a positive voltage input from a sensor attached to the machine and use overheat protection.		

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

6.18.2 Overheat Protection Selection

Using Overheat Protection in the Yaskawa Linear Servomotor

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

An A.93B warning (Overheat Warning) will be detected if the overheat protection input (TH) signal from the Yaskawa SGLFW2 Linear Servomotor exceeds the warning temperature.

An A.862 alarm (Overheat Alarm) will be detected if the overheat protection input (TH) signal from the Yaskawa SGLFW2 Linear Servomotor exceeds the alarm temperature.



- If the overheat protection input signal line is disconnected or short-circuited, an A.862 alarm will occur.
- If you set Pn61A to n. \(\sigma\) \(\sigma\) (Use overheat protection in the Yaskawa Linear Servomotor), the parameters in the Servomotor are enabled and the following parameters are disabled.
 - Overheat Alarm Level (Pn61B)
 - Overheat Warning Level (Pn61C)
 - Overheat Alarm Filter Time (Pn61D)

Monitoring the Machine's Temperature and Using Overheat Protection

Set $Pn61A = n. \square \square \square \square X$ to 2 or 3 to use overheat protection for the machine.

Set the following parameters as required.

	Overheat Alarm Leve	el	Speed Positi	on Torque	
Pn61B	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 500	0.01 V	250	Immediately	Setup
	Overheat Warning Le	evel		Speed Positi	on Torque
Pn61C	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	1%	100	Immediately	Setup
	Overheat Alarm Filte	r Time		Speed Positi	on Torque
Pn61D	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	1 s	0	Immediately	Setup



- When Pn61A is set to n.□□□2, an A.862 alarm will occur if the overheat protection input signal line is disconnected or short-circuited.
- When Pn61A is set to n.□□□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).

Trial Operation and Actual Operation

7

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

7.1	Flow	of Trial Operation7-2				
	7.1.1 7.1.2	Flow of Trial Operation for Rotary Servomotors 7-2 Flow of Trial Operation for Linear Servomotors 7-4				
7.2	Inspections and Confirmations before Trial Operation 7-6					
7.3	Trial Operation for the Servomotor without a Load 7-7					
	7.3.1 7.3.2 7.3.3	Preparations				
7.4	Trial Oper	ration from the Host Controller for the Servomotor without a Load 7-10				
	7.4.1 7.4.2 7.4.3	Preparing the Servomotor for Trial Operation 7-11 Trial Operation for Speed Control				
7.5	Trial Ope	eration with the Servomotor Connected to the Machine7-17				
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7.6	Conve	nient Function to Use during Trial Operation7-20				
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7.1.1 Flow of Trial Operation for Rotary Servomotors

7.1 Flow of Trial Operation

7.1.1 Flow of Trial Operation for Rotary Servomotors

The procedure for trial operation is given below.

• Preparations for Trial Operation

Step	Meaning	Reference	
1	Installation Install the Servomotor and SERVOPACK according to the installation conditions. First, operation is checked with no load. Do not connect the Servomotor to the machine.	Chapter 3 SERVOPACK Installation	
2	Wiring and Connections Wire and connect the SERVOPACK. First, Servomotor operation is checked without a load. Do not connect the CN1 connector on the SERVOPACK.	Chapter 4 Wiring and Connecting SERVOPACKs	
3	Confirmations before Trial Operation	7.2 Inspections and Confirmations before Trial Operation on page 7-6	
4	Power ON		
5	Resetting the Absolute Encoder This step is necessary only for a Servomotor with an Absolute Encoder.	5.17 Resetting the Absolute Encoder on page 5-51	

Drives Motors Controls

7.1.1 Flow of Trial Operation for Rotary Servomotors

• Trial Operation

Ī	Step	Meaning	Reference
	1	Trial Operation for the Servomotor without a Load To power supply Secure the motor flange to the machine. Do not connect the motor shaft to the load shaft.	7.3 Trial Operation for the Servomotor without a Load on page 7-7
	2	Trial Operation from the Host Controller for the Servomotor without a Load To power CN1 To host controller Secure the motor flange to the machine. Do not connect the motor shaft to the load shaft.	7.4 Trial Operation from the Host Controller for the Servo- motor without a Load on page 7-10
	3	Trial Operation with the Servomotor Connected to the Machine To power To host controller Secure the motor flange to the machine, and connect the motor shaft to the load shaft with a coupling or other means.	7.5 Trial Operation with the Servomotor Connected to the Machine on page 7-17
		with a coupling of other fried is.	

7.1.2 Flow of Trial Operation for Linear Servomotors

The procedure for trial operation is given below.

· Preparations for Trial Operation

• Pre	Preparations for Irial Operation					
Step		Meaning			Reference	
1	Installation Install the Servomotor and SERVOPACK according to the installation conditions. First, operation is checked with no load. Do not connect the Servomotor to the machine.			Chapter 3 SERVOPACK Installation		
2	Wiring and Connections Wire and connect the SERVOPACK. First, Servomotor operation is checked without a load. Do not connect the CN1 connector on the SERVOPACK.			Chapter 4 Wiring and Connecting SERVOPACKs		
3	Confirn	nations before Trial Ope	eration	7.2 In	spections and Confirmations before page 7-6	ore Trial Operation
4	Power	ON		_		
	Setting	Parameters in the SER	VOPACK			
	Step	No. of Parameter to Set	Description	on	Remarks	Reference
	5-1	Pn282	Linear Encode Scale Pitch	er	Set this parameter only if you are using a Serial Converter Unit.	page 5-19
	5-2	4 //	Writing Param to the Linear S motor		Set this parameter only if you are not using a Serial Converter Unit.	page 5-20
5	5-3	Pn080 = n.□□X□	Motor Phase Sequence Sel tion			page 5-24
	5-4	Pn080 = n.□□□X	Polarity Sensor Selection		-	page 5-26
	5-5	ves V	Polarity Detec	tion	This step is necessary only for a Linear Servomotor with a Polarity Sensor.	page 5-27
	5-6	Pn50A = n.X□□□ and Pn50B = n.□□□X	Overtravel Sig Allocations	nal	_	page 5-31
	5-7	Pn483, Pn484	Force Control		_	page 6-63
6	Setting the Origin of the Absolute Linear Encoder This step is necessary only for the following Absolute Linear Encoders. • Mitutoyo Corporation ABS ST780A Series or ST1300 Series Models: ABS ST78\(\text{DA}\/\ST78\(\text{DA}\/\ST13\(\text{DD}\)\) • Renishaw PLC EVOLUTE Series Models: EL36Y-\(\text{DD}\(\text{DD}\)\)\(\text{DD}\(\text{DD}\)\(\text{DD}\			5.18.1 F	Setting the Origin of the Absolut page 5-54	e Linear Encoder on

• Trial Operation

Step	Meaning	Reference
1	Trial Operation for the Servomotor without a Load	7.3 Trial Operation for the Servomotor without a Load on page 7-7
2	Trial Operation from the Host Controller for the Servomotor without a Load To power Supply To host controller	7.4 Trial Operation from the Host Controller for the Servo- motor without a Load on page 7-10
D		s Controls
3	Trial Operation with the Servomotor Connected to the Machine To power Supply To host controller	7.5 Trial Operation with the Servomotor Connected to the Machine on page 7-17

7.2

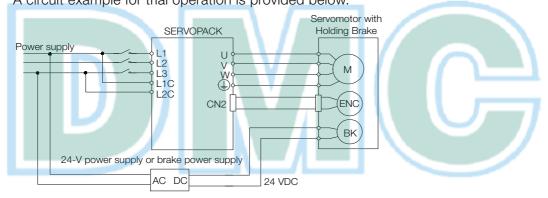
Inspections and Confirmations before Trial Operation

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.



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7.3 Trial Operation for the Servomotor without a Load

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

Jogging is used to check the operation of the Servomotor without connecting the SERVOPACK to the host controller. The Servomotor is moved at the preset jogging speed.

⚠ CAUTION

 During jogging, the overtravel function is disabled. Consider the range of motion of your machine when you jog the Servomotor.

7.3.1 Preparations

Always check the following before you execute jogging.

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

	Jogging Speed			Speed Po	osition Torque	
Pn304	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	1 min ⁻¹	500	Immediately	Setup	
	Soft Start Acceleration Time			Speed		
Pn305	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	1 ms	0	Immediately	Setup	
riv /	Soft Start Deceleration Time			Speed	0	
Pn306	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	1 ms	0	Immediately	Setup	

· Direct Drive Servomotors

Pn304	Jogging Speed			Speed Position Torque	
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	0.1 min ⁻¹	500	Immediately	Setup
Pn305	Soft Start Acceleration Time Speed				
	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup
	Soft Start Deceleration Time			Speed	
Pn306	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup
	0 to 10,000	1 ms	0	Immediately	Setup

7.3.2 Applicable Tools

Linear Servomotors

	Jogging Speed			Speed Position Force	
Pn383	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 mm/s	50	Immediately	Setup
	Soft Start Acceleration Time			Speed	
Pn305	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup
	Soft Start Deceleration Time			Speed	
Pn306	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	0	Immediately	Setup

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 and the applicable tool functions.

Tool	Function	Operating Procedure Reference
Panel Operator	Fn002	13.4.2 Jog (Fn002) on page 13-13
Digital Operator	Fn002	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Test Run - Jog	Operating Procedure on page 7-8

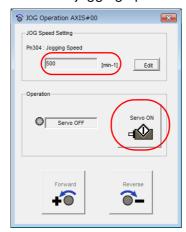
7.3.3 Operating Procedure

Use the following procedure to jog the motor.

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

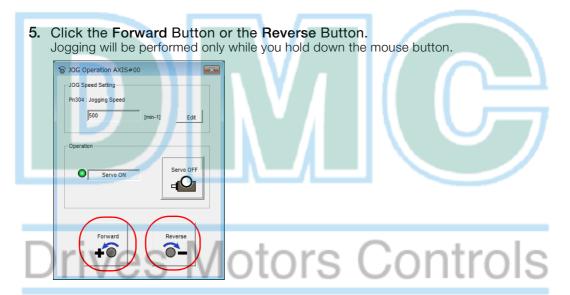


4. Check the jogging speed and then click the Servo ON Button.



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

Information To change the speed, click the Edit Button and enter the new speed.



6. After you finish jogging, turn the power supply to the SERVOPACK OFF and ON again.

This concludes the jogging procedure.

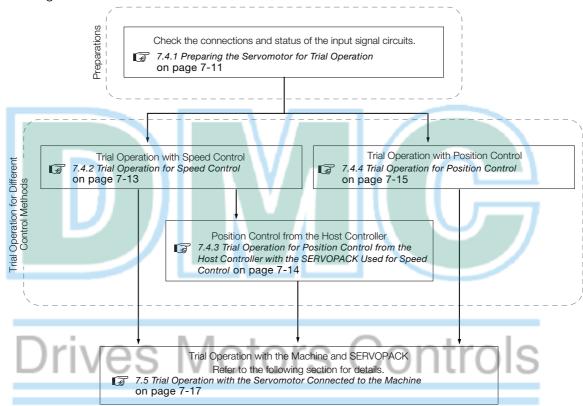
7.4

Trial Operation 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.

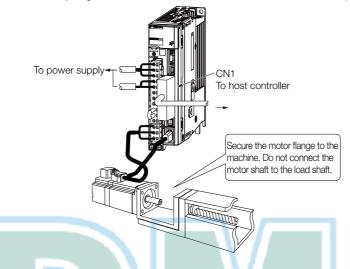
- Make sure that the Servomotor operation reference from the host controller to the SERVO-PACK and the I/O signals are set up properly.
- Make sure that the wiring between the host controller and SERVOPACK and the polarity of the wiring are correct.
- Make sure that all operation settings for the SERVOPACK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

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



CAUTION

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



7.4.1 Preparing the Servomotor for Trial Operation

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

Preparations

Always confirm the following before you perform the procedure to prepare the Servomotor for trial operation.

- Make sure that the preparations given in 7.1 Flow of Trial Operation on page 7-2 have been completed.
- Make sure that the trial operation described in 7.3 Trial Operation for the Servomotor without a Load on page 7-7 has been completed.

Operating Procedure

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

4.2 Basic Wiring Diagrams on page 4-9

 Wire the I/O signals from the host controller. Refer to the following section for details.
 4.2 Basic Wiring Diagrams on page 4-9

- 2. Check the following items.
 - ① Make sure that the /S-ON (Servo ON) signal can be input.
 - @Make sure that the P-OT (Forward Drive Prohibit) and N-OT (Reverse Drive Prohibit) 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).

7.4.1 Preparing the Servomotor for Trial Operation

- 3 Make sure that a reference is not being input.
- If you are using a safety function, make sure that the safety function device is connected to CN8.

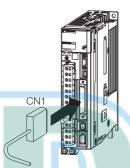
Refer to the following section for the safety function device connection method.

*** 4.6 Connecting Safety Function Signals on page 4-49



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 supplies 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.

This step is not necessary if you are using 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 of the input signals are given in the following table.

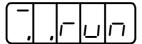
The correct states of the input signals are given in the following table. If the actual states do not agree with those given in the following table, correct the I/O signals.

Signal	Correct State
/S-ON (Servo ON) Signal	OFF
/P-CON (Proportional Control) Signal	OFF
P-OT (Forward Drive Prohibit) Signal	ON
N-OT (Reverse Drive Prohibit) Signal	ON
/ALM-RST (Alarm Reset) Signal	OFF
/P-CL (Forward External Torque Limit) Signal	OFF
/N-CL (Reverse External Torque Limit) Signal	OFF
SEN (Absolute Data Request) Signal	When using an absolute encoder: ON When not using an absolute encoder: OFF

8. Input the /S-ON (Servo ON) signal. The servo will turn ON.

Trial Operation and Actual Operation

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.

12.2.3 Resetting Alarms on page 12-42

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 7-13

7.4.4 Trial Operation for Position Control on page 7-15

7.4.2 Trial Operation for Speed Control

This section describes trial operation with speed control.

Preparations

Always confirm the following before you perform the procedure for trial operation with speed control.

 Make sure that the procedure to prepare the Servomotor for trial operation described in 7.4.1
 Preparing the Servomotor for Trial Operation on page 7-11 has been completed.

Operating Procedure

1. Adjust the speed reference input gain (Pn300).

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 6-17

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 shaft is rotating slightly, refer to the following section and adjust the reference offset so that the shaft does not rotate.

Adjusting the Speed Reference Offset on page 6-19

- **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 operating in the correct direction.

If the Servomotor direction is not correct, refer to the following section and change the Servomotor direction.

5.6 Motor Direction Setting on page 5-18

7.4.3 Trial Operation for Position Control from the Host Controller with the SERVOPACK Used for Speed Control

- 7. Gradually reduce the speed reference input from the host controller back to 0 V.
- **8.** Turn OFF the power supplies 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 7-14

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 7-17

7.4.3 Trial Operation for Position Control from the Host Control troller 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.

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 7.4.2 Trial Operation for Speed Control on page 7-13 has been completed.

Operating Procedure

- 1. Turn ON the power supplies 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 6-52
- 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 either visually or with a monitor function. To use a monitor function, perform one of the following.

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. Gradually reduce the speed reference input from the host controller back to 0 V.
- 5. Turn OFF the power supplies 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 7-17

7.4.4 Trial Operation for Position Control

This section describes the procedure for trial operation for position control.

Preparations

Always confirm the following before you perform the procedure for trial operation with position control.

• Make sure that the procedure to prepare the Servomotor for trial operation described in 7.4.1 Preparing the Servomotor for Trial Operation on page 7-11 has been completed.

Operating Procedure

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

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

Use a travel distance (number of reference pulses) that is easy to check (for example, the number of pulses for one rotation).

For safety, set the number of references pulses 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 number of Servomotor 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 input reference pulse counter = Change in feedback pulse counter x (Pn20E/Pn210)
- **10.** Confirm that the Servomotor shaft is rotating in the direction specified by the reference. If the rotation direction does not agree with the reference direction, refer to the following section and change the rotation direction.
 - 5.6 Motor Direction Setting on page 5-18
- **11.** Input a pulse reference for a comparatively large number of Servomotor rotations from the host controller so that the Servomotor will operate at a constant speed.

7.4.4 Trial Operation for Position Control

- **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 monitor uses the following formula.

· Rotary Servomotor with a 20-bit Encoder

Input reference pulse speed monitor = Input reference pulse speed [pulses/s]
$$\times$$
 60 \times $\frac{Pn20E}{Pn210}$ \times $\frac{1}{2^{20}(=1,048,576)}$

Reference input pulse speed/min Electronic gear ratio

· Linear Servomotors

Input reference pulse speed monitor = Input reference pulse speed [pulses/s]
$$\times \frac{\text{Pn20E}}{\text{Pn210}} \times \frac{\text{Linear encoder pitch } [\mu\text{m}]}{\text{Resolution}} \times \frac{1}{1,000}$$

Electronic gear ratio

- **13.** Check the motor speed monitor.
 - Using the SigmaWin+: Monitor Monitor Motion Monitor, Motor Speed
 - Using the Panel Operator or Digital Operator: Un008 (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) 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 7-17

7.5 Trial Operation with the Servomotor Connected to the Machine

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

7.5.1 Precautions

MARNING

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



If you disabled the overtravel function for trial operation of the Servomotor without a load, enable the overtravel function (P-OT and N-OT signal) before you preform trial operation with the Servomotor connected to the machine in order to provide protection.

If you will use a brake, observe the following precautions during trial operation.

- Before you check the operation of the brake, implement measures to prevent vibration from being caused by the machine falling due to gravity or an external force.
- First check the Servomotor operation and brake operation with the Servomotor uncoupled from the machine. If no problems are found, connect the Servomotor to the machine and perform trial operation again.

Control the operation of the brake with the /BK (Brake) signal output from the SERVOPACK.

Refer to the following sections for information on wiring and the related parameter settings.

A4.4 Wiring the SERVOPACK to the Holding Brake on page 4-33

5.13 Holding Brake on page 5-36



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 7.4 Trial Operation from the Host Controller for the Servomotor without a Load on page 7-10 has been completed.
- Make sure that the SERVOPACK is connected correctly to both the host controller and the peripheral devices.
 - Safety Function Wiring
 - If you are not using the safety function, leave the Safety Jumper Connector (provided as an accessory with the SERVOPACK) connected to CN8.
 - If you are using the safety function, remove the Safety Jumper Connector from CN8 and connect the safety function device.
 - Overtravel wiring
 - Brake wiring
 - Allocation of the /BK (Brake) signal to a pin on the I/O signal connector (CN1)
 - · Emergency stop circuit wiring
 - · Host controller wiring

Refer to the following section and change the wiring to match the system configuration.

15.1 Examples of Connections to Host Controllers on page 15-2

7.5.3 Operating Procedure

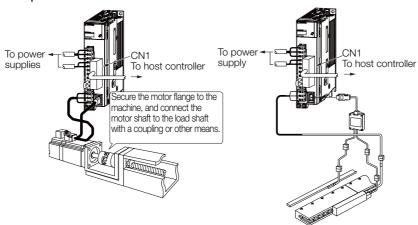
1. Enable the overtravel signals.

5.12.2 Setting to Enable/Disable Overtravel on page 5-32

- 2. Make the settings for the protective functions, such as the safety function, overtravel, and the brake.
 - 4.6 Connecting Safety Function Signals on page 4-49
 - 5.12 Overtravel and Related Settings on page 5-31
 - 5.13 Holding Brake on page 5-36
- 3. Set the parameters that are required for the control method you will use.
 - 6.5 Speed Control on page 6-17
 - 6.6 Position Control on page 6-30
 - 6.7 Torque Control on page 6-40
- 4. Turn OFF the power supplies to the SERVOPACK.

The control power supply and main circuit power supply will turn OFF.

5. Couple the Servomotor to the machine.



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

7. Check the protective functions, such 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 *7.4 Trial Operation from the Host Controller for the Servomotor without a Load* on page 7-10 and confirm that the same results are obtained as when trial operation was performed on the Servomotor without a load.
- **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.
 - Use the Parameter Copy Mode of the Digital Operator.
 - · Record the settings manually.

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



7.6.1 Program Jogging

7.6

Convenient Function to Use during Trial Operation

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

7.6.1 Program Jogging

You can use program jogging to perform continuous operation with a preset operation pattern, travel distance, movement speed, acceleration/deceleration time, waiting time, and number of movements.

You can use this operation when you set up the system in the same way as for normal jogging to move the Servomotor without connecting it to the host controller in order to check Servomotor operation and execute simple positioning operations.

Preparations

Always check the following before you execute program jogging.

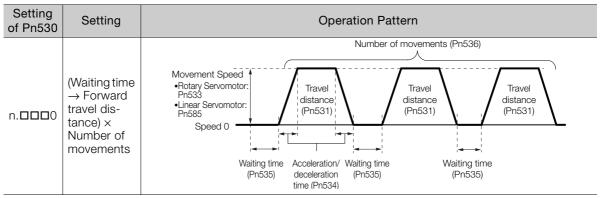
- The parameters must not be write prohibited.
- The main circuit power supply must be ON.
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- · The servo must be OFF.
- The range of machine motion and the safe movement speed of your machine must be considered when you set the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

Additional Information

- 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.

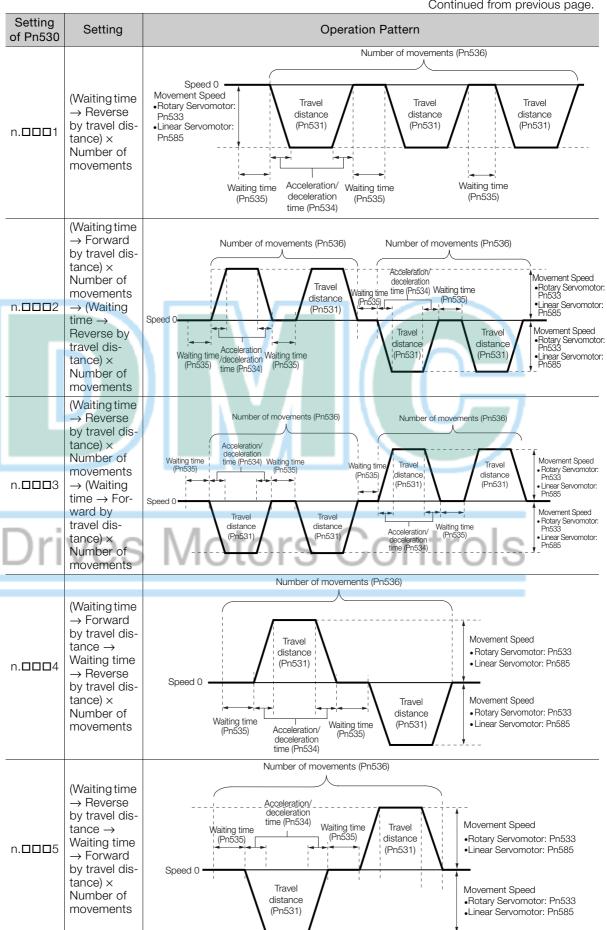
Program Jogging Operation Pattern

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



Continued on next page.

Continued from previous page.



7.6.1 Program Jogging

Information

Related Parameters

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

Rotary Servomotors

	Program Jogging-R	elated Selections	Speed Posit	ion Torque		
Pn530	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0000 to 0005	-	0000	Immediately	Setup	
	Program Jogging Tr	avel Distance		Speed Posit	ion Torque	
Pn531	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	1 to 1,073,741,824	1 reference unit	32,768	Immediately	Setup	
	Program Jogging M	lovement Speed		Speed Po	sition Torque	
Pn533	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	1 to 10,000	1 min ⁻¹	500	Immediately	Setup	
	Program Jogging Acceleration/Deceleration Time		Speed Position Torque			
Pn534	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	2 to 10,000	1 ms	100	Immediately	Setup	
	Program Jogging W	aiting Time		Speed Position Torque		
Pn535	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	1 ms	100	Immediately	Setup	
	Program Jogging N	gram Jogging Number of Movements		Speed Po	sition Torque	
Pn536	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 1,000	1 time	1	Immediately	Setup	

Direct Drive Servomotors

	Program Jogging-Related Selections			Speed Po	sition Torque	
Pn530	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0000 to 0005	_	0000	Immediately	Setup	
	Program Jogging Tr	avel Distance		Speed Po	sition Torque	
Pn531	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	1 to 1,073,741,824	1 reference unit	32,768	Immediately	Setup	
	Program Jogging M	ovement Speed		Speed Po	sition Torque	
Pn533	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	1 to 10,000	0.1 min ⁻¹	500	Immediately	Setup	
	Program Jogging Ad	cceleration/Deceler	ation Time	Speed Position Torque		
Pn534	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	2 to 10,000	1 ms	100	Immediately	Setup	
	Program Jogging W	aiting Time		Speed Po	sition Torque	
Pn535	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	1 ms	100	Immediately	Setup	
	Program Jogging No	umber of Movemer	its	Speed Po	sition Torque	
Pn536	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 1,000	1 time	1	Immediately	Setup	

• Linear Servomotors

	Program Jogging-R	elated Selections		Speed	sition Force
Pn530	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0000 to 0005	_	0000	Immediately	Setup
	Program Jogging Tr	avel Distance		Speed	sition Force
Pn531	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,824	1 reference unit	32,768	Immediately	Setup
	Program Jogging M	ovement Speed		Speed	sition Force
Pn585	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 10,000	1 mm/s	50	Immediately	Setup
	Program Jogging Ad	cceleration/Deceler	ration Time	Speed	sition Force
Pn534	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	2 to 10,000	1 ms	100	Immediately	Setup
	Program Jogging W	aiting Time		Speed	sition Force
Pn535	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 ms	100	Immediately	Setup
	Program Jogging N	Number of Movements		Speed	sition Force
Pn536	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,000	1 time	1 /	Immediately	Setup
	0 10 1,000				Cottap

Applicable Tools

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

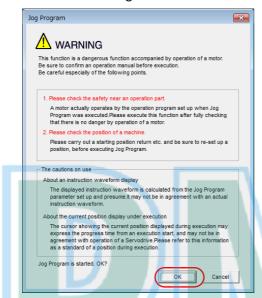
Tool	Function	Reference
Panel Operator	Fn004	3.4.4 Jog Program (Fn004) on page 13-15
Digital Operator Fn004		Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Test Run - Program JOG Operation	@ Operating Procedure on page 7-24

7.6.1 Program Jogging

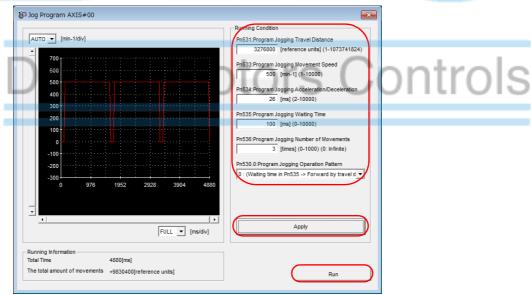
Operating Procedure

Use the following procedure for a program jog operation.

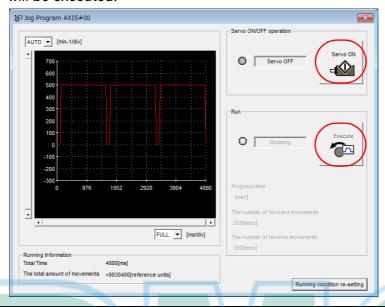
- 1. Click the 🔑 Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select JOG Program in the Menu Dialog Box. The Jog Program Dialog Box will be displayed.
- 3. Read the warnings and then click the OK Button.



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



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



CAUTION

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

This concludes the program jogging procedure.

7.6.2 Origin Search

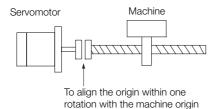
The origin search operation positions the motor to the origin within one rotation and the clamps it there.

CAUTION

Make sure that the load is not coupled when you execute an origin search.
 The Forward Drive Prohibit (P-OT) signal and Reverse Drive Prohibit (N-OT) signal are disabled during an origin search.

Use an origin search when it is necessary to align the origin within one rotation with the machine origin. The following speeds are used for origin searches.

- Rotary Servomotors: 60 min⁻¹
- Direct Drive Servomotors: 6 min⁻¹
- Linear Servomotors: 15 mm/s



7.6.2 Origin Search

Preparations

Always check the following before you execute an origin search.

- The parameters must not be write prohibited.
- The main circuit power supply must be ON.
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- The servo must be OFF.

Applicable Tools

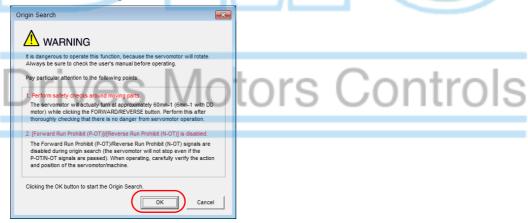
The following table lists the tools that you can use to perform an origin search and the applicable tool functions.

Tool	Function	Reference
Panel Operator	Fn003	13.4.3 Origin Search (Fn003) on page 13-14
Digital Operator	Fn003	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Origin Search	© Operating Procedure on page 7-26

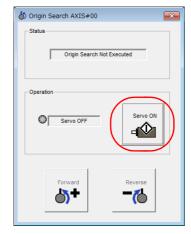
Operating Procedure

Use the following procedure to perform an origin search.

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

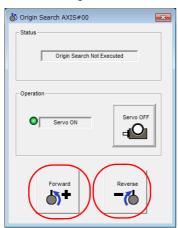


4. Click the Servo ON Button.



5. Click the Forward Button or the Reverse Button.

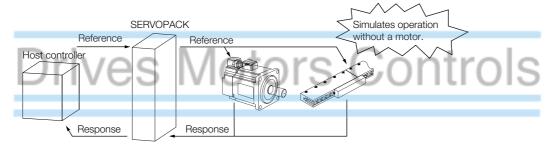
An origin search will be performed only while you hold down the mouse button. The motor will stop when the origin search has been completed.



This concludes the origin search procedure.

7.6.3 Test without a Motor

A test without a motor is used to check the operation of the host controller and peripheral devices by simulating the operation of the Servomotor in the SERVOPACK, i.e., without actually operating a Servomotor. This test allows you to check wiring, debug the system, and verify parameters to shorten the time required for setup work and to prevent damage to the machine that may result from possible malfunctions. The operation of the Servomotor can be checked with this test regardless of whether the Servomotor is actually connected or not.



Use $Pn00C = n \square \square \square \square X$ to enable or disable the test without a motor.

Parameter		Meaning	When Enabled	Classification
Pn00C	n.□□□0 (default setting)	Disable tests without a motor.	After restart	Setup
	n.□□□1	Enable tests without a motor.		

Information

- While the test without a motor is being executed, the display on the Panel Operate will alternate between tSt and the status of the SERVOPACK.
 Refer to the following section for information SERVOPACK status displays.
 13.1.3 Status Displays on page 13-4
- An asterisk is displayed on the status display of the Digital Operator while a test without a motor is being executed.

7.6.3 Test without a Motor

Motor Information and Encoder Information

The motor and encoder information is used during tests without a motor. The source of the information depends on the device connection status.

· Rotary Servomotor

Motor Connection Status	Information That Is Used	Source of Information		
Connected	Motor information • Rated motor speed • Maximum motor speed	Information in the Converse to that is connected		
Connected	Encoder informationEncoder resolutionEncoder type	Information in the Servomotor that is connected		
Not connected	Motor information • Rated motor speed • Maximum motor speed	 Setting of Pn000 = n.X□□□ (Rotary/Linear Servomotor Startup Selection When Encoder Is Not Connected) Rated motor speed and maximum motor speed The values previously saved in the SERVOPACK will be used for the rated motor speed and maximum motor speed. Use the motor displays (Un020: Rated Motor Speed and Un021: Maximum Motor Speed) to check the values. 		
	Encoder information • Encoder resolution • Encoder type	 Encoder resolution: Setting of Pn00C = n.□□X□ (Encoder Resolution for Tests without a Motor) Encoder type: Setting of Pn00C = n.□X□□ (Encoder Type Selection for Tests without a Motor) 		

If you use fully-closed loop control, the external encoder information is also used.

External Encoder Connection Status	Information That Is Used	Source of Information		
Connected	External encoder information	Information in the external encoder that is connected		
• Resolution • Encoder type		Resolution: 256 Encoder type: Incremental encoder		

Linear Servomotors

Motor Connection Status	Information That Is Used	Source of Information
	Motor information	Information in the motor that is connected
Connected	Linear encoder information Resolution Encoder pitch Encoder type	Information in the linear encoder that is connected
	Motor information	Setting of Pn000 = n.X□□□ (Rotary/Linear Servomotor Startup Selection When Encoder Is Not Connected)
Not connected	Linear encoder information Resolution Encoder pitch Encoder type	 Resolution: 256 Encoder pitch: Setting of Pn282 (Linear Encoder Scale Pitch) Encoder type: Setting of Pn00C = n.□X□□ (Encoder Type Selection for Tests without a Motor)

Related Parameters

Parameter		Meaning	When Enabled	Classification
Pn000	n.0□□□ (default setting)	When an encoder is not connected, start as SERVOPACK for Rotary Servomotor.	After restart	Cotus
Phoo	n.1□□□	When an encoder is not connected, start as SERVOPACK for Linear Servomotor.	Alter restart	Setup

	Linear Encoder Sc	ale Pitch	Speed	Position Force	
Pn282	Setting Range Setting Unit Default Setting		Default Setting	When Enabled Classificatio	
	0 to 6,553,600	0.01 μm	0	After restart	Setup

Parameter		Meaning	When Enabled	Classification
	n.□□0□ (default setting)	Use 13 bits as encoder resolution for tests without a motor.		Setup
	n.□□1□	Use 20 bits as encoder resolution for tests without a motor.		
Pn00C	n.□□2□	Use 22 bits as encoder resolution for tests without a motor.	After restart	
n.□□3□		Use 24 bits as encoder resolution for tests without a motor.	Arter restart	Getup
	n.□0□□ (default setting)	Use an incremental encoder for tests without a motor.		
	n.🗆1🗆 🗆	Use an absolute encoder for tests without a motor.		

Motor Position and Speed Responses

For a test without a motor, the following responses are simulated for references from the host controller according to the gain settings for position or speed control.

- Servomotor position
- Motor speed
- External encoder position

The load model will be for a rigid system with the moment of inertia ratio that is set in Pn103.

7.6.3 Test without a Motor

Restrictions

The following functions cannot be used during the test without a motor.

- Regeneration and dynamic brake operation
- Brake output signal
 Refer to the following section for information on confirming the brake output signal.

 9.2.3 I/O Signal Monitor on page 9-7
- Items marked with "x" in the following utility function table

SigmaWin+		Panel Operator or Digital Operator		Execu	Executable?	
Button in Menu Dialog Box	Menu Dialog Box SigmaWin+Function Name		Utility Function Name	Motor Not Connected	Motor Connected	Reference
	Origin Search	Fn003	Origin Search	0	0	page 7-25
	Absolute Encoder Reset	Fn008	Reset Absolute Encoder	×	0	page 5-52
	Cross/Toursus Defeu	Fn009	Autotune Analog (Speed/Torque) Reference Offset	0	0	page 6-24, page 6-41
	Speed/Torque Reference Offset Adjustment	Fn00A	Manually Adjust Speed Reference Offset	0	0	page 6-24
	mont	Fn00B	Manually Adjusting the Torque Reference Offset	0	0	page 6-41
	Analog Monitor Out-	Fn00C	Adjust Analog Monitor Output Offset	0	0	page 9-10
	put Adjustment	Fn00D	Adjust Analog Monitor Output Gain	0	0	page 9-10
	Motor Current Detection Offset Adjust-	Fn00E	Autotune Motor Cur- rent Detection Signal Offset	×	0	page 6-102
Setup	ment	Fn00F	Manually Adjust Motor Current Detection Sig- nal Offset	×	0	page 0-102
Dri	Parameter Write Pro- hibition Setting	Fn010	Write Prohibition Set- ting	opt	0	page 5-8
ווע	Multiturn Limit Setting	Fn013	Multiturn Limit Setting after Multiturn Limit Disagreement Alarm	×	1013	page 6-84
	Reset Configuration Error of Option Mod- ule	Fn014	Reset Option Module Configuration Error	0	0	page 12-45
	Initializing the Vibra- tion Detection Level	Fn01B	Initialize Vibration Detection Level	×	×	page 6-98
	Set Origin	Fn020	Set Absolute Linear Encoder Origin	×	0	page 5-54
	Reset Motor Type Alarm	Fn021	Reset Motor Type Alarm	0	0	_
	Software Reset	Fn030	Software Reset	0	0	page 6-96
	Polarity Detection	Fn080	Polarity Detection	×	×	page 5-27
	Tuning-less Level Setting	Fn200	Tuning-less Level Set- ting	×	×	page 8-16
	Easy FFT	Fn206	Easy FFT	×	×	page 8-94
Parameter	Initialize*	Fn005	Initialize Parameters	0	O Continued or	page 5-11

Continued on next page.

Continued from previous page.

SigmaWin+		Panel Operator or Digital Operator		Executable?		
Button in Menu Dialog Box	SigmaWin+ Function Name	En No. Utility Function Name		Motor Not Connected	Motor Connected	Reference
	Autotuning without Host Reference	Fn201	Advanced Autotuning without Reference	×	×	page 8-24
	Autotuning with Host Reference	Fn202	Advanced Autotuning with Reference	×	×	page 8-35
Tuning	Custom Tuning	Fn203	One-Parameter Tuning	×	×	page 8-42
	Adjust Anti-reso- nance Control	Fn204	Adjust Anti-resonance Control	×	×	page 8-51
	Vibration Suppression	Fn205	Vibration Suppression	×	×	page 8-56
		Fn011	Display Servomotor Model	0	0	page 9-2
		Fn012	Display Software Version	0	0	page 9-2
Monitoring	Product Information	Fn01E	Display SERVOPACK and Servomotor IDs	0	0	
		Fn01F	Display Servomotor ID from Feedback Option Module	0	0	page 9-2
Test Oper-	Jogging	Fn002	Jogging	0	0	page 7-7
ation	Program Jogging	Fn004	Program Jogging	0	0	page 7-20
Alarms	Alarm Display	Fn000	Display Alarm History	0	0	page 12-43
Alaillis	Alaim Display	Fn006	Clear Alarm History	0	0	page 12-44

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

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

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8.1

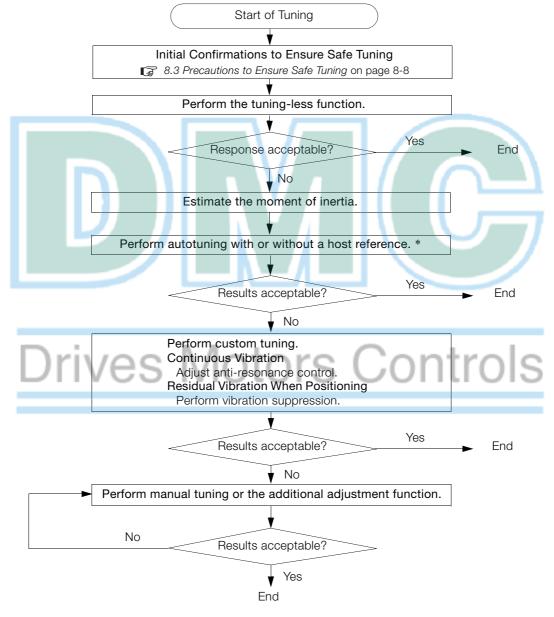
Overview and Flow of Tuning

Tuning is performed to optimize response by adjusting the servo gains in the SERVOPACK.

The servo gains are set using a combination of parameters, such as parameters for the speed loop gain, position loop gain, filters, friction compensation, and moment of inertia ratio. These parameters influence each other, so you must consider the balance between them.

The servo gains are set to stable settings by default. Use the various tuning functions to increase the response even further for the conditions of your machine.

The basic tuning procedure is shown in the following flowchart. Make suitable adjustments considering the conditions and operating requirements of your machine.



^{*} If possible, perform autotuning with a host reference.

If a host controller is not available, set an operation pattern that is as close as possible to the host reference and perform autotuning without a host reference.

If an operation pattern that is close to the host reference is not possible, perform autotuning with a host reference while performing program jogging.

8.1.1 Tuning Functions

The following table provides an overview of the tuning functions.

Tuning Function	Outline	Applicable 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	page 8-12
Moment of Inertia Estimation	The moment of inertia ratio is calculated by operating the Servomotor a few times. The moment of inertia ratio that is calculated here is used in other tuning functions.	Speed control, position control, or torque control	page 8-16
Autotuning without Host Reference	The following parameters are automatically adjusted in the internal references in the SERVO-PACK during automatic operation. • Gains (e.g., position loop gain and speed loop gain) • Filters (torque reference filter and notch filters) • Friction compensation	Speed control or position control	page 8-24
	Anti-resonance control Vibration suppression		
Autotuning with Host Reference	The following parameters are automatically adjusted with the position reference input from the host controller while the machine is in operation. You can use this function for fine-tuning after you perform autotuning without a host reference. • Gains (e.g., position loop gain and speed loop gain) • Filters (torque reference filter and notch filters) • Friction compensation • Anti-resonance control • Vibration suppression	Position control	page 8-35
Custom Tuning	The following parameters are adjusted with the position reference or speed reference input from the host controller while the machine is in operation. Gains (e.g., position loop gain and speed loop gain) Filters (torque reference filter and notch filters) Friction compensation Anti-resonance control	Speed control or position control	page 8-42
Anti-resonance Control Adjustment	This function effectively suppresses continuous vibration.	Speed control or position control	page 8-51
Vibration Suppression	This function effectively suppresses residual vibration if it occurs when positioning.	Position control	page 8-56
Speed Ripple Compensation	This function reduces the ripple in the motor speed.	Speed control, position control, or torque control	page 8-60
Additional Adjustment Function	This function combines autotuning with custom tuning. You can use it to improve adjustment results.	Depends on the functions that you use.	page 8-66
Manual Tuning	You can manually adjust the servo gains to adjust the response.	Speed control, position control, or torque control	page 8-76

8.1.2 Diagnostic Tool

You can use the following tools to measure the frequency characteristics of the machine and set notch filters.

Diagnostic Tool	Outline	Applicable Control Methods	Reference
Mechanical Analysis	The machine is subjected to vibration to detect resonance frequencies. The measurement results are displayed as waveforms or numeric data.	Speed control, position control, or torque control	page 8-92
Easy FFT	The machine is subjected to vibration to detect resonance frequencies. The measurement results are displayed only as numeric data.	Speed control, position control, or torque control	page 8-94



8.2

Monitoring Methods

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

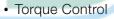
Check the adjustment results with the following response waveforms.

Position Control

Item	Unit			
ILGIII	Rotary Servomotor	Linear Servomotor		
Torque reference	%			
Feedback speed	min ⁻¹	mm/s		
Position reference speed	min ⁻¹ mm/s			
Position deviation	Reference units			

 Speed 	Contro
---------------------------	--------

Item	Unit			
Item	Rotary Servomotor	Linear Servomotor		
Torque reference		%		
Feedback speed	min ⁻¹	mm/s		
Reference speed	min ⁻¹	mm/s		



Item	L		
пеш	Rotary Servomotor	Linear Servomotor	
Torque reference		%	
Feedback speed	min ⁻¹	mm/s	ntrol
DIIVES	IVIULU	1500	ii ili Oi

8.3.1 Overtravel Settings

8.3

Precautions to Ensure Safe Tuning

M CAUTION

- Observe the following precautions when you perform tuning.
 - Do not touch the rotating parts of the motor when the servo is ON.
 - Before starting the Servomotor, make sure that an emergency stop can be performed at any time.
 - Make sure that trial operation has been successfully performed without any problems.
 - Provide an appropriate stopping device on the machine to ensure safety.

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

8.3.1 Overtravel Settings

Overtravel settings are made to force the Servomotor to stop for a signal input from a limit switch when a moving part of the machine exceeds the safe movement range.

Refer to the following section for details.

5.12 Overtravel and Related Settings on page 5-31

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 6-63

8.3.3 Setting the Position Deviation Overflow Alarm Level

The position deviation overflow alarm is a protective function that is enabled when the SERVO-PACK is used in position control.

If the alarm level is set to a suitable value, the SERVOPACK will detect excessive position deviation and will stop the Servomotor if the Servomotor operation does not agree with the reference

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

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

· Rotary Servomotors

Position deviation [reference units] =
$$\frac{\text{Motor speed [min}^{-1}]}{60} \times \frac{\text{Encoder resolution}^{*1}}{\text{Pn102 [0.1/s]/10}^{*2,*3}} \times \frac{\text{Pn210 pn20E}}{\text{Pn20E}}$$

Linear Servomotors

$$Position \ deviation \ [reference \ units] = \frac{Motor \ speed \ [mm/s]}{Pn102 \ [0.1/s]/10^{*2}, *3} \ \times \ \frac{Resolution}{Linear \ encoder \ pitch \ [\mu m]/1,000} \ \times \ \frac{Pn210}{Pn20E}$$

· Rotary Servomotors

$$Pn520 > \frac{\text{Maximum motor speed [min^-1]}}{60} \times \frac{\text{Encoder resolution}^{*1}}{Pn102 [0.1/s]/10^{*2,*3}} \times \frac{Pn210}{Pn20E} \times \underbrace{\frac{(1.2 \text{ to } 2)^{*4}}{Pn20E}}_{}$$

Linear Servomotors

$$Pn520 > \frac{\text{Maximum motor speed [mm/s]}}{\text{Pn102 [0.1/s]/10}^{*2,*3}} \times \frac{\text{Resolution}}{\text{Linear encoder pitch [µm]/1,000}} \times \frac{\text{Pn210}}{\text{Pn20E}} \times \frac{\text{(1.2 to 2)}^{*4}}{\text{(1.2 to 2)}^{*4}} \times \frac{\text{Pn210}}{\text{Pn20E}} \times \frac{\text{(1.2 to 2)}^{*4}}{\text{(1.2 to 2)}^{*4}} \times \frac{\text{Pn210}}{\text{(1.2 to 2)}^{*4}} \times \frac{\text{(1.2 to 2)}^{*4}}{\text{(1.2 to 2)}^{*4}} \times \frac{\text{Pn210}}{\text{(1.2 to 2)}^{*4}} \times \frac{$$

*1. Refer to the following section for details.

5.16 Electronic Gear Settings on page 5-46

- *2. When model following control (Pn140 = n.□□□1) is enabled, use the setting of Pn141 (Model Following Control Gain) instead of the setting of Pn102 (Position Loop Gain).
- *3. To check the setting of Pn102 on the Digital Operator, change the parameter display setting to display all parameters (Pn00B = n.□□□1).
- *4. The underlined coefficient "× (1.2 to 2)" adds a margin to prevent an A.d00 alarm (Position Deviation Overflow) from occurring too frequently.

If you set a value that satisfies the formula, an A.d00 alarm (Position Deviation Overflow) should not occur during normal operation.

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

The following calculation example uses a Rotary Servomotor with a maximum motor speed of

6,000 and an encoder resolution of 16,777,216 (24 bits). Pn102 is set to 400.
$$\frac{Pn210}{Pn20E} = \frac{1}{16}$$

$$Pn520 = \frac{6,000}{60} \times \frac{16,777,216}{400/10} \times \frac{1}{16} \times 2$$
$$= 2,621,440 \times 2$$

= 5,242,880 (default setting of Pn520)

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

Related Parameters

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

Related Alarms

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

Related Warnings

Warning Number	Warning Name	Meaning
A.900	Position Deviation Overflow	This warning occurs if the position deviation exceeds the specified percentage (Pn520 \times Pn51E/100).

8.3.4 Vibration Detection Level Setting

You can set the vibration detection level (Pn312) to more accurately detect A.520 alarms (Vibration Alarm) and A.911 warnings (Vibration) 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 Initializing the Vibration Detection Level on page 6-98

8.3.5 Setting the Position Deviation Overflow Alarm Level at Servo ON

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

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

Related Parameters

	Position Deviation Overflow Alarm Level at Servo ON			Position	
Pn526	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,073,741,823	1 reference unit	5,242,880	Immediately	Setup
	Position Deviation Overflow Warning Level at Servo ON			Posit	ion
Pn528	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
_	10 to 100	1%	100	Immediately	Setup

· Rotary Servomotors

	Speed Limit Level at Servo ON			Positi	on
Pn529	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
1 (0 to 10,000	1 min⁻¹	10,000	Immediately	Setup

· Linear Servomotors

	Speed Limit Level a	at Servo ON	Position		
Pn584	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 mm/s	10,000	Immediately	Setup

Related Alarms

Alarm Number	Alarm Name	Alarm Meaning
A.d01	Position Deviation Overflow Alarm at Servo ON	This alarm occurs if the servo is turned ON after the position deviation exceeded the setting of Pn526 (Position Deviation Overflow Alarm Level at Servo ON) while the servo was OFF.
A.d02	Position Deviation Overflow Alarm for Speed Limit at Servo ON	If position deviation remains in the deviation counter, the setting of Pn529 or Pn584 (Speed Limit Level at Servo ON) will limit the speed when the servo is turned ON. This alarm occurs if reference pulses are input and the setting of Pn520 (Position Deviation Overflow Alarm Level) is exceeded.

Refer to the following section for information on troubleshooting alarms.

12.2.3 Resetting Alarms on page 12-42

Related Warnings

Warning Number	Warning Name	Meaning
A.901	Position Deviation Overflow Warning at Servo ON	This warning occurs if the servo is turned ON while the position deviation exceeds the specified percentage (Pn526 × Pn528/100).



8.4.1 Application Restrictions

8.4

Tuning-less Function

The tuning-less function performs autotuning to obtain a stable response regardless of the type of machine or changes in the load. Autotuning is started when the servo is turned ON.

CAUTION

- The tuning-less function is disabled during torque control.
- The Servomotor may momentarily emit a sound the first time the servo is turned ON after the Servomotor is connected to the machine. This sound is caused by setting the automatic notch filter. It does not indicate a problem. The sound will not be emitted from the next time the servo is turned ON.
- The Servomotor may vibrate if it exceeds the allowable load moment of inertia.
 If that occurs, set the tuning-less load level to 2 (Pn170 = n.2□□□) or reduce the tuning-less rigidity level (Pn170 = n.□X□□).
- To ensure safety, make sure that you can perform an emergency stop at any time when you execute the tuning-less function.

8.4.1 Application Restrictions

The following application restrictions apply to the tuning-less function.

Function	Executable?	Remarks
Vibration Detection Level Initialization	0	
Moment of Inertia Estimation	×	Disable the tuning-less function (Pn170 = n.□□□0) before you execute moment of inertia estimation.
Autotuning without Host Reference	×	Disable the tuning-less function (Pn170 = n.□□□0) before you execute autotuning without a host reference.
Autotuning with Host Reference	×	_
Custom Tuning	×	_
Anti-Resonance Control Adjustment	// (×) † (ors Controls
Vibration Suppression	×	7.0 001111010
Easy FFT	0	The tuning-less function is disabled while you execute Easy FFT and then it is enabled when Easy FFT has been completed.
Friction Compensation	×	-
Gain Selection	×	-
Mechanical Analysis	0	The tuning-less function is disabled while you execute mechanical analysis and then it is enabled when mechanical analysis has been completed.

^{*} O: Yes x: No

8.4.2 Operating Procedure

The tuning-less function is enabled in the default settings. No specific procedure is required. You can use the following parameter to enable or disable the tuning-less function.

Parameter		Meaning	When Enabled	Classification
	n.□□□0	□□□0 Disable tuning-less function.		
n.□□□1 (default setting) Pn170 n.□□□□ (default setting)		Enable tuning-less function.		
		Use for speed control.	After restart	Setup
	n.□□1□	Use for speed control and use host controller for position control.		

When you enable the tuning-less function, you can select the tuning-less type. Normally, set Pn14F to $n.\square\square2\square$ (Use tuning-less type 3) (default setting). If compatibility with previous models is required, set Pn14F to $n.\square\square0\square$ (Use tuning-less type 1) or $n.\square\square1\square$ (Use tuning-less type 2).

Parameter		Meaning	When Enabled	Classification
	n.□□0□	Use tuning-less type 1.		
Pn14F	n.□□1□	Use tuning-less type 2. (The noise level is improved more than with tuning-less type 1.)		Tuning
	n.□□2□ (default setting)	Use tuning-less type 3.		_

Tuning-less Level Settings

If vibration or other problems occur, change the tuning-less levels. To change the tuning-less levels, use the SigmaWin+.

Preparations

Always check the following before you set the tuning-less levels.

- The tuning-less function must be enabled (Pn170 = n.□□□1).
- The test without a motor function must be disabled (Pn00C = n.□□□0).

◆ Procedure

Use the following procedure to set the tuning-less levels.

In addition to the following procedure, you can also set the parameters directly. Refer to *Related Parameters*, below, for the parameters to set.

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

8.4.3 Troubleshooting Alarms

2. Select Response Level Setting in the Menu Dialog Box.

The Response Level Setting Dialog Box will be displayed.

3. Click the ▲ or ▼ Button to adjust the response level setting. Increase the response level setting to increase the response. Decrease the response level setting to suppress vibration.

The default response level setting is 4.

Response Level Setting	Description	Remarks
7	Response level: High	V
6		You cannot select these levels if tuning-less type 1 or 2 (Pn14F = n.□□0□ or n.□□1□) is used.
5		
4 (default setting)		
3		
2		-
1		
0	Response level: Low	

4. Click the Completed Button.

The adjustment results will be saved in the SERVOPACK.

Related Parameters

■ Tuning-less Rigidity Level

If you use tuning-less type 1 or 2 (Pn14F = n. $\square\square\square\square$) or n. $\square\square\square\square$), set the tuning-less level to between 0 and 4 (Pn170 = n. $\square\square\square\square\square$) to n. $\square4\square\square\square$). Do not set the tuning-less level to between 5 and 7 (Pn170 = n. $\square5\square\square$ to n. $\square7\square\square$).

Parameter		Description	When Enabled	Classification
	n.□0□□	Tuning-less rigidity level 0 (low rigidity)		
	n.🗆 1 🗆 🗆	Tuning-less rigidity level 1		
	n.□2□□	Tuning-less rigidity level 2		
	n.□3□□	Tuning-less rigidity level 3		
Pn170	n.□4□□ (default setting)	Tuning-less rigidity level 4	Immediately	Setup
	n.□5□□	Tuning-less rigidity level 5		
	n.□6□□	Tuning-less rigidity level 6		
	n.0700	Tuning-less rigidity level 7 (high rigidity)		

■ Tuning-less Load Level

Parameter		Description	When Enabled	Classification
	n.0□□□	Tuning-less load level 0		
Pn170	n.1□□□ (default setting)	Tuning-less load level 1	Immediately	Setup
	n.2000	Tuning-less load level 2		

8.4.3 Troubleshooting Alarms

An A.521 alarm (Autotuning Alarm) will occur if a resonant sound occurs or if excessive vibration occurs during position control. If an alarm occurs, implement the following measures.

- · Resonant Sound
 - Decrease the setting of Pn170 = $n.X\square\square\square$ or the setting of Pn170 = $n.\square X\square\square$.
- Excessive Vibration during Position Control Increase the setting of Pn170 = n.X□□□ or decrease the setting of Pn170 = n.□X□□.

Ē

Parameters Disabled by Tuning-less Function

When the tuning-less function is enabled (Pn170 = $n.\Box\Box\Box$ 1) (default setting), the parameters in the following table are disabled.

Item	Parameter Name	Parameter Number
	Speed Loop Gain Second Speed Loop Gain	Pn100 Pn104
Gain-Related Parameters	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
Advanced Control-Related	Friction Compensation Function Selection	Pn408 = n.X□□□
Parameters	Anti-Resonance Control Selection	Pn160= n.□□□X
Gain Selection-Related Parameters	Gain Switching Selection	Pn139= n.□□□X

The tuning-less function is disabled during torque control, Easy FFT, and mechanical analysis for a vertical axis. The gain-related parameters in the above table are enabled for torque control, Easy FFT, and mechanical analysis. Of these, Pn100, Pn103, and Pn104 are enabled for torque control.

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. $\square 0 \square \square$ (Do not adjust automatically) only if you do not change the setting of the notch filter before you execute the tuning-less function.

Parameter		Meaning	When Enabled	Classification
Pn460	n.□0□□	Do not adjust the second stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately	Tuning
111400	n.□1□□ (default setting)	Adjust the second stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	-	

8.4.6 Related Parameters

8.4.4

The following parameters are automatically adjusted when you execute the tuning-less function.

Do not manually change the settings of these parameters after you have enabled the tuningless function.

Parameter	Name	
Pn401	First Stage First Torque Reference Filter Time Constant	
Pn40C	Second Stage Notch Filter Frequency	
Pn40D	Second Stage Notch Filter Q Value	

8.5.1 Outline

8.5

Estimating the Moment of Inertia

This section describes how the moment of inertia is calculated.

The moment of inertia ratio that is calculated here is used in other tuning functions. You can also estimate the moment of inertia during autotuning without a host reference. Refer to the following section for the procedure.

8.6.4 Operating Procedure on page 8-26

8.5.1 Outline

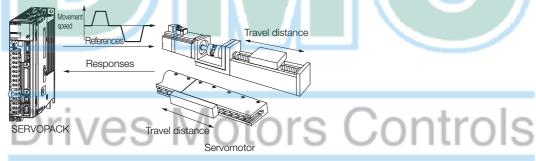
The moment of inertia during operation is automatically calculated by the SERVOPACK for round-trip (forward and reverse) operation. A reference from the host controller is not used.

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

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

The Servomotor is operated with the following specifications.

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



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

8.5.2 Restrictions

The following restrictions apply to estimating the moment of inertia.

Systems for which Execution Cannot Be Performed

- When the machine system can move only in one direction
- When the range of motion is 0.5 rotations or less

Systems for Which Adjustments Cannot Be Made Accurately

- When a suitable range of motion is not possible
- When the moment of inertia changes within the set operating range
- · When the machine has high dynamic friction
- When the rigidity of the machine is low and vibration occurs when positioning is performed
- · When the position integration function is used
- · When proportional control is used

Note:If you specify calculating the moment of inertia, an error will occur if the /P-CON (Proportional Control) 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

Preparations

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

- The main circuit power supply must be ON.
- There must be no overtravel.
- · The servo must be OFF.
- The control method must not be set to torque control.
- The gain selection switch must be set to manual gain selection (Pn139 = n.□□□0).
- The first gains must be selected.
- The test without a motor function must be disabled (Pn00C = n.□□□□0).
- There must be no alarms or warnings.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.
- The tuning-less function must be disabled (Pn170 = $n.\square\square\square\square$ 0).

8.5.3 Applicable Tools

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

Tool	Function	Operating Procedure Reference	
Panel Operator	You cannot estimate the moment of inertia from the Panel Operator.		
Digital Operator	You cannot estimate the moment of inertia from the Digital Operator.		
SigmaWin+	Tuning - Tuning	8.5.4 Operating Procedure on page 8-18	

8.5.4 Operating Procedure

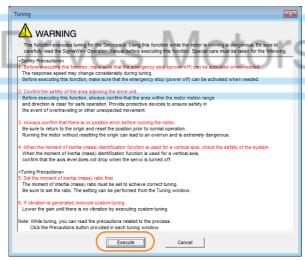
Use the following procedure to estimate the moment of inertia ratio.

MARNING

- Estimating the moment of inertia requires operating the Servomotor and therefore presents hazards. Observe the following precautions.
 - Confirm safety around moving parts.
 This function involves automatic operation with vibration. Make sure that you can perform an emergency stop (to turn OFF the power supply) at any time. There will be movement in both directions within the set range of movement. Check the range of movement and the directions and implement protective controls for safety, such as the overtravel functions.

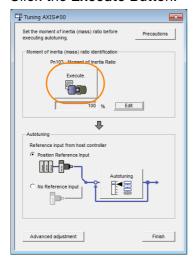
M CAUTION

- Be aware of the following points if you cancel the moment of inertia estimation while the Servomotor is operating.
 - If you cancel operation with the Servo OFF Button, the Servomotor will stop according to setting
 of the Servo OFF stopping method (Pn001 = n.□□□□X).
 - If you cancel operation with the **Cancel** Button, the Servomotor will decelerate to a stop and then enter a zero-clamped state.
- Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Tuning in the Menu Dialog Box. The Tuning Dialog Box will be displayed. Click the Cancel Button to cancel tuning.
- 3. Click the Execute Button.

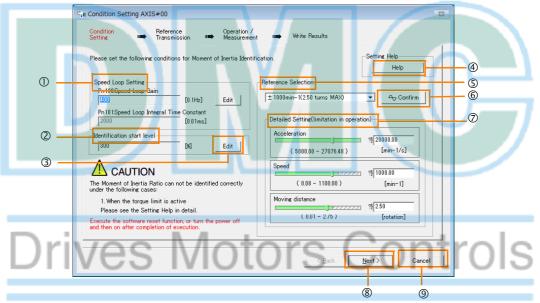


Controls

4. Click the Execute Button.



5. Set the conditions as required.



① Speed Loop Setting Area

Make the speed loop settings in this area.

If the speed loop response is too bad, it will not be possible to measure the moment of inertia ratio accurately.

The values for the speed loop response that are required for moment of inertia estimation are set for the default settings. It is normally not necessary to change these settings. If the default speed loop gain is too high for the machine (i.e., if vibration occurs), lower the setting. It is not necessary to increase the setting any farther.

2 Identification Start Level Group

This is the setting of the moment of inertia calculation starting level.

If the load is large or the machine has low rigidity, the torque limit may be applied, causing moment of inertia estimation to fail.

If that occurs, estimation may be possible if you double the setting of the start level.

3 Edit Buttons

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

8.5.4 Operating Procedure

4 Help Button

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

- · Operate the Servomotor to measure the load moment of inertia of the machine in comparison with the rotor moment of inertia.
- Set the operation mode, reference pattern (maximum acceleration rate, maximum speed, and maximum travel distance), and speed loop-related parameters.
- Correct measurement of the moment of inertia ratio may not be possible depending on the settings. Set suitable settings using the measurement results as reference.

S Reference Selection Area

Either select the reference pattern for estimation processing from the box, or set the values in the **Detailed Setting** Group. Generally speaking, the larger the maximum acceleration rate is, the more accurate the moment of inertia estimation will be.

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

© Confirm Button

Click this button to display the Reference Confirmation Dialog Box.



You can change the settings by moving the bars or directly inputting the settings to create the required reference pattern.

® Next Button

Click this button to display the Reference Transmission Dialog Box.

Click this button to return to the Tuning Dialog Box.

- The travel distance is the distance for one operation in the forward or reverse direction. During multiple operations, the operation starting position may move in one direction or the other. Confirm the possible operating range for each measurement or operation.
- Depending on the parameter settings and the moment of inertia of the machine, overshooting and undershooting may occur and may cause the maximum speed setting to be exceeded temporarily. Allow sufficient leeway in the settings.

Information

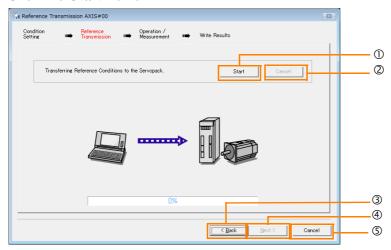
When Measurement Is Not Correct

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

6. Click the Next Button.

The Reference Transmission Dialog Box will be displayed.

7. Click the Start Button.



① Start Button

The reference conditions will be transferred to the SERVOPACK. A progress bar will show the progress of the transfer.

② Cancel Button

The **Cancel** Button is enabled only while data is being transferred to the SERVOPACK. You cannot use it after the transfer has been completed.

3 Back Button

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

4 Next Button

This button is enabled only when the data has been transferred correctly. You cannot use it if an error occurs or if you cancel the transfer before it is completed. Click the **Next** Button to display the Operation/Measurement Dialog Box.

S Cancel Button

This button cancels processing and returns you to the Tuning Dialog Box.

8. Click the Next Button.

The Operation/Measurement Dialog Box will be displayed.

Click the Servo On Button.



10. Click the Forward Button.

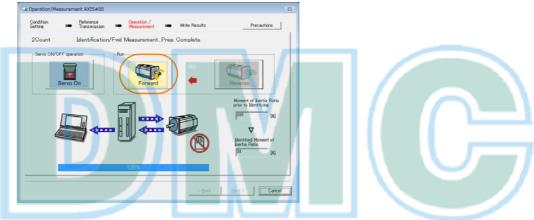
The Servomotor shaft will rotate in the forward direction and the measurement will start. After the measurement and data transfer have been completed, the **Reverse** Button will be displayed in color.

8.5.4 Operating Procedure

11. Click the Reverse Button.



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



12. Repeat steps 9 to 11 until the Next Button is enabled.

Measurements are performed from 2 to 7 times and then verified. The number of measurements is displayed in upper left corner of the dialog box. A progress bar at the bottom of the dialog box will show the progress of the transfer each time.

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

14. Click the Next Button.

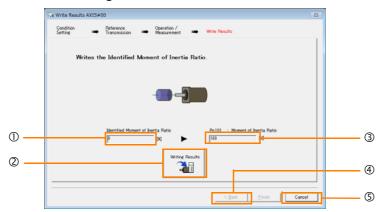
The Write Results Dialog Box will be displayed.

Information

If you click the $\bf Next$ Button before you turn OFF the servo, the following Dialog Box will be displayed. Click the $\bf OK$ Button to turn OFF the servo.



15. Click the Writing Results Button.



① Identified Moment of Inertia Ratio Box

The moment of inertia ratio that was found with operation and measurements is displayed here.

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

The value that is set for the parameter is displayed here.

After you click the **Writing Results** Button, the value that was found with operation and measurements will be displayed as the new setting.

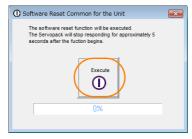
- Back Button
 - This button is disabled.
- © Cancel Button

This button will return you to the Tuning Dialog Box.

- 16. Confirm that the Identified Moment of Inertia Ratio Box and the Pn103: Moment of Inertia Ratio Box show the same value and then click the Finish Button.
- 17. Click the OK Button.



18. Click the Execute Button.



If the setting of the moment of inertia ratio (Pn103) was changed, the new value will be saved and the Tuning Dialog Box will be displayed again.

This concludes the procedure to estimate the moment of inertia ratio.

8.6.1 Outline

8.8

Autotuning without Host Reference

This section describes autotuning without a host reference.



- Autotuning without a host reference performs adjustments based on the setting of the speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when adjustments are started. Make adjustments after lowering the speed loop gain (Pn100) until vibration is eliminated.
- You cannot execute autotuning without a host reference if the tuning-less function is enabled (Pn170 = n.□□□1 (default setting)). Disable the tuning-less function (Pn170 = n.□□□0) 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.

 $Pn140 = n.\square\square\square\square0$ (Do not use model following control.)

 $Pn160 = n.\Box\Box\Box\Box$ (Do not use anti-resonance control.)

 $Pn408 = n.00 \square 0$ (Disable friction compensation, first stage notch filter, and second stage notch filter.)

Note: If you are using the Digital Operator and the above parameters are not displayed, change the parameter display setting to display all parameters (Pn00B = n.□□□1) and then turn the power supply OFF and ON again.

8.6.1 Outline

For autotuning without a host reference, operation is automatically performed by the SERVO-PACK for round-trip (forward and reverse) operation to adjust for machine characteristics during operation. A reference from the host controller is not used.

The following items are adjusted automatically.

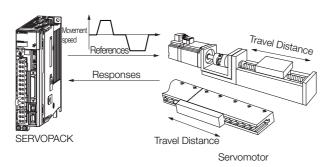
- · Moment of inertia ratio
- Gains (e.g., speed loop gain and position loop gain)
- Filters (torque reference filter and notch filters)
- Friction compensation
- Anti-resonance control
- Vibration suppression (only for mode 2 or 3)

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

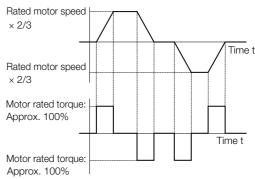
8.6.7 Related Parameters on page 8-34

The Servomotor is operated with the following specifications.

Maximum speed	Rated motor speed $\times \frac{2}{3}$		
Acceleration Torque	Rated motor torque: Approx. 100% Note: The acceleration torque depends on the setting of the influence of the moment of inertia ratio (Pn103), machine friction, and external disturbance.		
Travel Distance	Rotary Servomotors	You can set the desired travel distance. The default setting is for a value equivalent to 3 Servomotor shaft rotations.	
	Direct Drive Servomotors	You can set the desired travel distance. The default setting is for a value equivalent to 0.3 rotations.	
	Linear Servomotors	You can set the desired travel distance in increments of 1,000 reference units. (The default setting is for 90 mm.)	



Note: Execute autotuning without a host reference after jogging to a position that ensures a suitable range of motion.



Example of Automatic Operation Pattern

MARNING

- Autotuning without a host reference requires operating the Servomotor and therefore presents hazards. Observe the following precaution.
 - Confirm safety around moving parts.
 This function involves automatic operation with vibration. Make sure that you can perform an emergency stop (to turn OFF the power supply) at any time. There will be movement in both directions within the set range of movement. Check the range of movement and the directions and implement protective controls for safety, such as the overtravel functions.

8.6.2 Restrictions

The following restrictions apply to autotuning without a host reference.

If you cannot use autotuning without a host reference because of these restrictions, use autotuning with a host reference or custom tuning. Refer to the following sections for details.

8.7 Autotuning with a Host Reference on page 8-35

8.8 Custom Tuning on page 8-42

Systems for Which Execution Cannot Be Performed

- When the machine system can move only in one direction
- When the range of motion is 0.5 rotations or less

Systems for Which Adjustments Cannot Be Made Accurately

- When a suitable range of motion is not possible
- When the moment of inertia changes within the set operating range
- When the machine has high friction
- When the rigidity of the machine is low and vibration occurs when positioning is performed
- · When the position integration function is used
- When proportional control is used

Note: If you specify calculating the moment of inertia, an error will occur if the /P-CON (Proportional Control) 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 positioning completed width (Pn522) is too narrow

8.6.3 Applicable Tools

Preparations

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

- The main circuit power supply must be ON.
- There must be no overtravel.
- The servo must be OFF.
- The control method must not be set to torque control.
- The gain selection switch must be set to manual gain selection (Pn139 = n.□□□□0).
- The first gains must be selected.
- The test without a motor function must be disabled (Pn00C = n.□□□0).
- There must be no alarms or warnings.
- There must be no hard wire base block (HWBB).
- The parameters must not be write prohibited.
- The tuning-less function must be disabled (Pn170 = n.□□□0), or the tuning-less function must be enabled (Pn170 = n.□□□1) and moment of inertia estimation must be specified.
- If you execute autotuning without a host reference during speed control, set the mode to 1.

Information

- If you start autotuning without a host reference while the SERVOPACK is in speed control
 for mode 2 or 3, the SERVOPACK will change to position control automatically to perform
 autotuning without a host reference. The SERVOPACK will return to speed control after
 autotuning has been completed.
- Reference pulse input multiplication switching is disabled during autotuning without a host reference.

8.6.3 Applicable Tools

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

Tool	Function	Operating Procedure Reference
Panel Operator	_	You cannot perform autotuning without a host reference from the Panel Operator.
Digital Operator	Fn201	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Tuning - Tuning	8.6.4 Operating Procedure on page 8-26

8.6.4 Operating Procedure

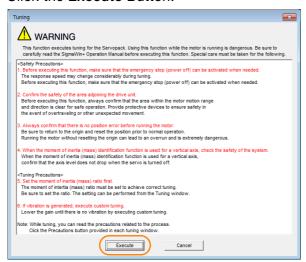
Use the following procedure to perform autotuning without a host reference.

CAUTION

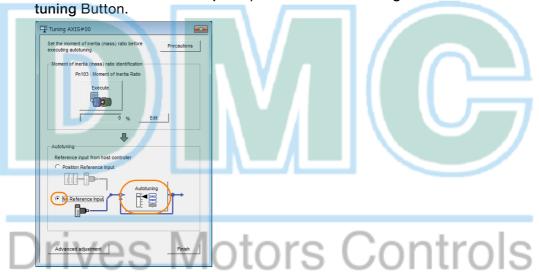
- If you specify not estimating the moment of inertia, set the moment of inertia ratio (Pn103) correctly. If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.
- If you are using an MP3000-series Controller 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 moment of inertia ratio (Pn103) is set correctly.
- 2. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **3.** Select Tuning in the Menu Dialog Box. The Tuning Dialog Box will be displayed. Click the **Cancel** Button to cancel tuning.

4. Click the Execute Button.

Information



5. Select the No Reference Input Option in the Autotuning Area and then click the Auto-

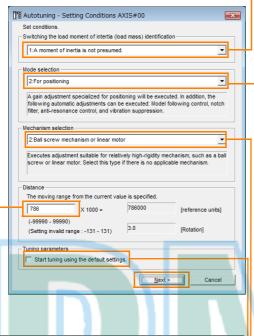


When the following dialog box is displayed, click the **OK** Button and then confirm that the correct moment of inertia ratio is set in Pn103 (Moment of Inertia Ratio).



8.6.4 Operating Procedure

6. Set the conditions in the Switching the load moment of inertia (load mass) identification Box, the Mode selection Box, the Mechanism selection Box, and the Distance Box, and then click the Next Button.



Distance Box

Set the travel distance.

Movement range: -99,990,000 to +99,990,000 [reference units]

Minimum setting increment for travel distance: 1,000 [reference units]

Negative values are for reverse operation and positive values are for forward operation from the current position.

Default settings:

Rotary Servomotors: Approx. 3 rotations Direct Drive Servomotors: Approx. 0.3 rotations

Linear Servomotors: Approx 90 mm Set the distance to the following values or higher. To ensure tuning precision, we recommend that you use approximately the default distance setting.

Rotary Servomotors: 0.5 rotations Direct Drive Servomotors: 0.05 rotations Linear Servomotors: 5 mm

Switching the load moment of inertia (load mass) identification Box

Specify whether to estimate the moment of inertia. 0: A moment of inertia is presumed. (default setting)

1: A moment of inertia is not presumed.

Mode selection Box

Set the mode.

Mode Selection	Description	
1: Standard	Standard gain adjustment is per- formed. In addition to gain adjust- ment, notch filters and anti-resonance control are automatically adjusted.	
2: For positioning	Tuning is performed for positioning applications. In addition to gain adjustment, model following control, notch filters, anti-resonance control, and vibration suppression are automatically adjusted.	
3: For positioning especially to prevent overshooting	Tuning is performed for positioning applications with emphasis on eliminating overshooting. In addition to gain adjustment, notch filters, antiresonance control, and vibration suppression are automatically adjusted.	

Mechanism selection Box

Select the type according to the machine element to

If there is noise or if the gain does not increase, better results may be obtained by changing the rigidity type. Select the type according to the following guidelines.

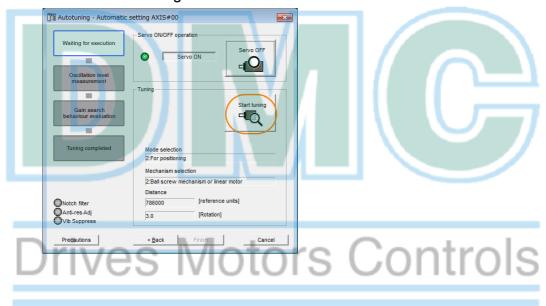
	Mechanism Selection	Description
)	1: Belt mechanism	Tuning is performed for a mechanism with relatively low rigidity, e.g., a belt.
	2: Ball screw mech- anism or linear motor	Tuning is performed for a mechanism with relatively high rigidity, e.g., a ball screw or Linear Servomotor. Use this setting if there is no other appropriate setting.
	3: Rigid model	Tuning is performed for a mechanism with high rigidity, e.g., a rigid body system.

Tuning parameters Box

Specify the parameters to use for tuning. If you select the Start tuning using the default settings Check Box, the tuning parameters will be returned to the default settings before tuning is started.



8. Click the Start tuning Button.



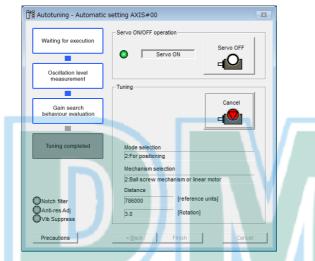
8.6.4 Operating Procedure

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



The Servomotor will start operating and tuning will be executed.

Vibration that occurs during tuning will be detected automatically and suitable settings will be made for that vibration. When the settings have been completed, the indicators for the functions that were used will light at the lower left of the dialog box.



10. When tuning has been completed, click the Finish Button.

The results of tuning will be set in the parameters and you will return to the Tuning Dialog Box.

This concludes the procedure to perform autotuning without a host reference.

Drives Motors Controls

8.6.5 Troubleshooting Problems in Autotuning without a Host Reference

The following tables give the causes of and corrections for problems that may occur in autotuning without a host reference.

◆ Autotuning without a Host Reference Was Not Performed

Possible Cause	Corrective Action	
Main circuit power supply is OFF.	Turn ON the main circuit power supply.	
An alarm or warning occurred.	Remove the cause of the alarm or warning.	
Overtraveling occurred.	Remove the cause of overtraveling.	
The second gains were selected with the gain selection.	Disable automatic gain switching.	
The HWBB was activated.	Release the HWBB.	
The setting of the travel distance is too small.	Set the travel distance again in step 6 of the procedure.	
	• Disable the tuning-less function (Pn170 = n.□□□0).	
The settings for the tuning-less function are not correct.	 Enable the tuning-less function (Pn170 = n.□□□1) and specify moment of inertia estimation. 	

When an Error Occurs during Execution of Autotuning without a Host Reference

Error	Possible Cause	Corrective Action
The gain adjustments were not successfully completed.	Machine vibration occurs or the positioning completion signal is not stable when the Servomotor stops.	 Increase the setting of the positioning completed width (Pn522). Change the mode from 2 to 3. If machine vibration occurs, suppress the vibration with the anti-resonance control function and the vibration suppression function.
An error occurred during calculation of the moment of inertia.	Refer to the following section for trouble When an Error Occurs during Calcu	eshooting information. Ilation of Moment of Inertia on page 8-31
Positioning was not		
completed within approximately 10 seconds after position adjustment was completed.	The positioning completed width is too narrow or proportional control is being used.	 Increase the setting of the positioning completed width (Pn522). Turn OFF the /P-CON (Proportional Control) signal.

◆ When an Error Occurs during Calculation of Moment of Inertia

Possible Cause	Corrective Action
The SERVOPACK started calculating the moment of inertia but the calculation was not completed.	 Increase the setting of the speed loop gain (Pn100). Increase the stroke (travel distance).
The moment of inertia fluctuated greatly and did not converge within 10 tries.	Set Pn103 (Moment of Inertia Ratio) from the machine specifications and specify not estimating the moment of inertia.
Low-frequency vibration was detected.	Double the setting of moment of inertia calculation starting level (Pn324).
The torque limit was reached.	 If you are using the torque limit, increase the torque limit. Double the setting of moment of inertia calculation starting level (Pn324).
The speed control section changed to proportional control during calculation of the moment of inertia, e.g., the /P-CON (Proportional Control) signal was input.	Use PI control when calculating the moment of inertia.

8.6.6 Automatically Adjusted Function Settings

◆ Adjustment Results Are Not Satisfactory for Position Control

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

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

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

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

8.6.6 Automatically Adjusted Function Settings

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

Automatic Notch Filters

Normally, set Pn460 to n.□1□□ (Adjust automatically) (default setting).

Vibration will be detected during autotuning without a host reference and a notch filter will be adjusted.

Set Pn460 to n. $\square 0 \square \square$ (Do not adjust automatically) only if you do not change the setting of the notch filter before you execute this function.

F	Parameter	Function	When Enabled	Classification
Pn460	n.□□□0	Do not adjust the first stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.		
	n.□□□1 (default setting)	Adjust the first stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately	ls
	n.□0□□	Do not adjust the second stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately	Tuning
	n.□1□□ (default setting)	Adjust the second stage notch filter automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.		

◆ Anti-Resonance Control Adjustment

This function reduces low vibration frequencies, for which the notch filters cannot be used.

Normally, set Pn160 to n. □□1□ (Adjust automatically) (default setting).

Vibration will be detected during autotuning without a host reference and anti-resonance control will be automatically adjusted.

Parameter		Function	When Enabled	Classification
Pn160	n.□□0□	Do not adjust anti-resonance control automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately	Tuning
	n.□□1□ (default setting)	Adjust anti-resonance control automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	ininediately	Tuning

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 $Pn140 = n.\Box 0\Box\Box$ (Do not adjust automatically) only if you do not change the settings for vibration suppression before you execute autotuning without a host reference.

Note: Autotuning without a host reference uses model following control. Therefore, it can be executed only if the mode is set to 2 or 3.

Parameter		Function	When Enabled	Classification
Pn140	n.□0□□	Do not adjust vibration suppression automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	Immediately	Tuning
F11140	n.□1□□ (default setting)	Adjust vibration suppression automatically during execution of autotuning without a host reference, autotuning with a host reference, and custom tuning.	immediately	Turning

Friction Compensation

Friction compensation compensates for changes in the following conditions.

- Changes in the viscous resistance of the lubricant, such as grease, on the sliding parts of the machine
- Changes in the friction resistance resulting from variations in the machine assembly
- Changes in the friction resistance due to aging

The conditions for applying friction compensation depend on the mode selection.

Mode Selection Settings		Friction Compensation			
1: Standard		Based on the setting of Pn408 = n.X□□□ (Friction Compensation Function Selection)*			
2: For position control		Adjusted with friction	componention		
3: For po	3: For position control (emphasis on overshooting)		Adjusted with inction	compensation.	_
Parameter Funct		ion	When Enabled	Classification	
Pn408	n. 0□□□ (default setting)	Disable friction compens	sation.	Immediately	Setup
	n. 1□□□	Enable friction compensation.			

^{*} Refer to the following section for details.

◆ Feedforward

If Pn140 is set to n.0 \(\sigma\) (Do not use model following control and speed/torque feedforward together (default setting)) and tuning is performed with the mode selection set to 2 or 3, feedforward (Pn109), the speed feedforward input (V-REF), and the torque feedforward input (T-REF) will be disabled.

To use the speed feedforward input (V-REF), the torque feedforward input (T-REF), and model following control from the host controller in the system, set Pn140 to n.1 \(\sigma\sup \square\$ (Use model following control and speed/torque feedforward together).

	Parameter		Function	When Enabled	Classification
Dn	140	n.0□□□ (default setting)	Do not use model following control and speed/torque feedforward together.	Immediately	Tuning
Pn140	n.1□□□	Use model following control and speed/torque feedforward together.	IIIIIIediately	rumig	

Refer to the following section for information on the torque feedforward input (T-REF) and the speed feedforward input (V-REF).

Torque Feedforward and Speed Feedforward on page 8-87, ■ Speed Feedforward on page 8-88

Required Parameter Settings on page 8-70

8.6.7 Related Parameters



When model following control is used with the feedforward function, it is used to make optimum feedforward settings in the SERVOPACK. Therefore, model following control is not normally used together with either the speed feedforward input (V-REF) or torque feedforward input (T-REF) from the host controller. However, model following control can be used with the speed feedforward input (V-REF) or torque feedforward input (T-REF) if required. An unsuitable feedforward input may result in overshooting.

8.6.7 Related Parameters

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

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

Parameter	Name	Automatic Changes
Pn100	Speed Loop Gain	Yes
Pn101	Speed Loop Integral Time Constant	Yes
Pn102	Position Loop Gain	Yes
Pn103	Moment of Inertia Ratio	Yes
Pn121	Friction Compensation Gain	Yes
Pn123	Friction Compensation Coefficient	Yes
Pn124	Friction Compensation Frequency Correction	No
Pn125	Friction Compensation Gain Correction	Yes
Pn401	First Stage First Torque Reference Filter Time Constant	Yes
Pn408	Torque-Related Function Selections	Yes
Pn409	First Stage Notch Filter Frequency	Yes
Pn40A	First Stage Notch Filter Q Value	Yes
Pn40C	Second Stage Notch Filter Frequency	Yes
Pn40D	Second Stage Notch Filter Q Value	Yes
Pn140	Model Following Control-Related Selections	Yes
Pn141	Model Following Control Gain	Yes
Pn142	Model Following Control Gain Correction	Yes
Pn143	Model Following Control Bias in the Forward Direction	Yes
Pn144	Model Following Control Bias in the Reverse Direction	Yes
Pn145	Vibration Suppression 1 Frequency A	Yes
Pn146	Vibration Suppression 1 Frequency B	Yes
Pn147	Model Following Control Speed Feedforward Compensation	Yes
Pn160	Anti-Resonance Control-Related Selections	Yes
Pn161	Anti-Resonance Frequency	Yes
Pn163	Anti-Resonance Damping Gain	Yes
Pn531	Program Jogging Travel Distance	No
Pn533	Program Jogging Movement Speed for Rotary Servomotor	No
Pn585	Program Jogging Movement Speed for Linear Servomotor	No
Pn534	Program Jogging Acceleration/Deceleration Time	No
Pn535	Program Jogging Waiting Time	No
Pn536	Program Jogging Number of Movements	No

Yes: The parameter is automatically set.

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

8

8.7 Autotuning with a Host Reference

This section describes autotuning with a host reference.



Autotuning with a host reference makes adjustments based on the set speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when adjustments are started. Make adjustments after lowering the speed loop gain (Pn100) until vibration is eliminated.

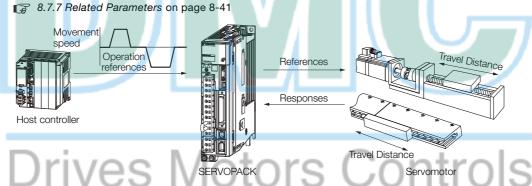
8.7.1 Outline

Autotuning with a host reference automatically makes optimum adjustments for operation references from the host controller.

The following items are adjusted automatically.

- Gains (e.g., speed loop gain and position loop gain)
- Filters (torque reference filter and notch filters)
- Friction compensation
- Anti-resonance control
- Vibration suppression

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



CAUTION

 Because autotuning with a host reference adjusts the SERVOPACK during automatic operation, vibration or overshooting may occur. To ensure safety, make sure that you can perform an emergency stop at any time.

8.7.2 Restrictions

Systems for Which Adjustments Cannot Be Made Accurately

Adjustments will not be made correctly for autotuning with a host reference in the following cases. Use custom tuning.

- When the travel distance for the reference from the host controller is equal to or lower than the setting of the positioning completed width (Pn522)
- Rotary Servomotors: When the movement speed for the reference from the host controller is equal to or lower than the setting of the rotation detection level (Pn502)
- Linear Servomotors: When the movement speed for the reference from the host controller is equal to or lower than the setting of the zero speed level (Pn581)
- When the time required to stop is 10 ms or less

8.7.3 Applicable Tools

- When the rigidity of the machine is low and vibration occurs when positioning is performed
- When the position integration function is used
- When proportional control is used
- When mode switching is used
- When the positioning completed width (Pn522) is too narrow

Refer to the following sections for details on custom tuning.

8.8 Custom Tuning on page 8-42

Preparations

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

- The servo must be in ready status.
- There must be no overtravel.
- The servo must be OFF.
- Position control must be selected if power is supplied to the motor (i.e., when the servo is ON).
- The gain selection switch must be set to manual gain selection (Pn139 = n.□□□0).
- The first gains must be selected.
- The test without a motor function must be disabled (Pn00C = n.□□□0).
- There must be no warnings.
- The tuning-less function must be disabled (Pn170 = n.□□□0).
- · The parameters must not be write prohibited.

8.7.3 Applicable Tools

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

Tool	Function	Operating Procedure Reference
Panel Operator	_ ———	You cannot perform autotuning with a host reference from the Panel Operator.
Digital Operator	Fn202	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Tuning - Tuning	8.7.4 Operating Procedure on page 8-36

8.7.4 Operating Procedure

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

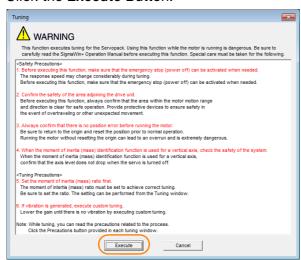
↑ CAUTION

- 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 moment of inertia ratio (Pn103) is set correctly.
- 2. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **3.** Select Tuning in the Menu Dialog Box. The Tuning Dialog Box will be displayed.

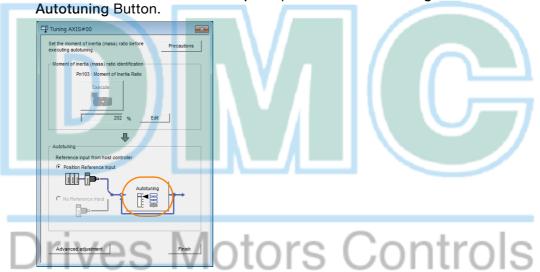
Click the **Cancel** Button to cancel tuning.

4. Click the Execute Button.

Information



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



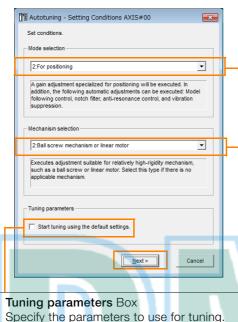
When the following dialog box is displayed, click the **OK** Button and then confirm that the correct moment of inertia ratio is set in Pn103 (Moment of Inertia Ratio).



8.7.4 Operating Procedure

6. Set the conditions in the **Mode selection** Box and the **Mechanism selection** Box, and then click the **Next** Button.

If you select the **Start tuning using the default settings** Check Box in the **Tuning parameters** Area, the tuning parameters will be returned to the default settings before tuning is started.



Tuning parameters Box
Specify the parameters to use for tuning.
If you select the Start tuning using the default settings Check Box, the tuning parameters will be returned to the default settings before tuning is started.

• Mode selection Box Set the mode.

Mode Selection	Description
1: Standard	Standard gain adjustment is per- formed. In addition to gain adjust- ment, notch filters and anti- resonance control are automatically adjusted.
2: For positioning	Tuning is performed for positioning applications. In addition to gain adjustment, model following control, notch filters, anti-resonance control, and vibration suppression are automatically adjusted.
3: For positioning especially to prevent overshooting	Tuning is performed for positioning applications with emphasis on eliminating overshooting. In addition to gain adjustment, notch filters, antiresonance control, and vibration suppression are automatically adjusted.

Mechanism selection Box

Select the type according to the machine element to drive.

If there is noise or if the gain does not increase, better results may be obtained by changing the rigidity type. Select the type according to the following guidelines.

Mechanism Selection	Description
1: Belt mechanism	Tuning is performed for a mechanism with relatively low rigidity, e.g., a belt.
2: Ball screw mechanism or linear motor	Tuning is performed for a mechanism with relatively high rigidity, e.g., a ball screw or Linear Servomotor. Use this setting if there is no other appropriate setting.
3: Rigid model	Tuning is performed for a mechanism with high rigidity, e.g., a rigid body system.

Drives Moto

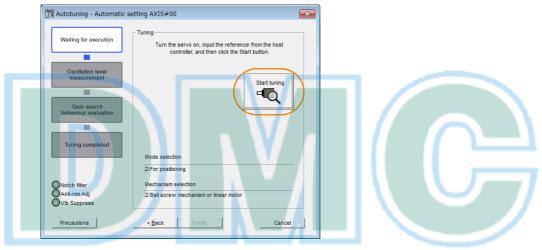
7. Click the Yes Button.



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



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



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



The Servomotor will start operating and tuning will be executed.

Vibration that occurs during tuning will be detected automatically and suitable settings will be made for that vibration. When the settings have been completed, the indicators for the functions that were used will light at the lower left of the dialog box.



8.7.5 Troubleshooting Problems in Autotuning with a Host Reference

11. When tuning has been completed, click the **Finish** Button.

The results of tuning will be set in the parameters and you will return to the Tuning Dialog Box.

This concludes the procedure to perform autotuning with a host reference.

8.7.5 Troubleshooting Problems in Autotuning with a Host Reference

The following tables give the causes of and corrections for problems that may occur in autotuning with a host reference.

◆ Autotuning with a Host Reference Was Not Performed

Possible Cause	Corrective Action	
Main circuit power supply is OFF.	Turn ON the main circuit power supply.	
An alarm or warning occurred.	Remove the cause of the alarm or warning.	
Overtraveling occurred.	Remove the cause of overtraveling.	
The second gains were selected with the gain selection.	Disable automatic gain switching.	
The HWBB was activated.	Release the HWBB.	

◆ Troubleshooting Errors

Error	Possible Cause	Corrective Action
The gain adjustments were not successfully completed.	Machine vibration occurs or positioning completion is not stable when the Servomotor stops.	 Increase the setting of the positioning completed width (Pn522). Change the mode from 2 to 3. If machine vibration occurs, suppress the vibration with the anti-resonance control function and the vibration suppression function.
Positioning was not completed within approximately 10	The positioning completed width is too nar-	 Increase the setting of the positioning completed width (Pn522).
seconds after position adjustment was completed.	row or proportional control is being used.	Turn OFF the /P-CON (Proportional Control) signal.

◆ Adjustment Results Are Not Satisfactory for Position Control

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

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

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

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

8.7.6 Automatically Adjusted Function Settings

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

8.6.6 Automatically Adjusted Function Settings on page 8-32

8.7.7 Related Parameters

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

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

Parameter	Name	Automatic Changes
Pn100	Speed Loop Gain	Yes
Pn101	Speed Loop Integral Time Constant	Yes
Pn102	Position Loop Gain	Yes
Pn103	Moment of Inertia Ratio	No
Pn121	Friction Compensation Gain	Yes
Pn123	Friction Compensation Coefficient	Yes
Pn124	Friction Compensation Frequency Correction	No
Pn125	Friction Compensation Gain Correction	Yes
Pn401	First Stage First Torque Reference Filter Time Constant	Yes
Pn408	Torque-Related Function Selections	Yes
Pn409	First Stage Notch Filter Frequency	Yes
Pn40A	First Stage Notch Filter Q Value	Yes
Pn40C	Second Stage Notch Filter Frequency	Yes
Pn40D	Second Stage Notch Filter Q Value	Yes
Pn140	Model Following Control-Related Selections	Yes
Pn141	Model Following Control Gain	Yes
Pn142	Model Following Control Gain Correction	Yes
Pn143	Model Following Control Bias in the Forward Direction	Yes
Pn144	Model Following Control Bias in the Reverse Direction	Yes
Pn145	Vibration Suppression 1 Frequency A	Yes
Pn146	Vibration Suppression 1 Frequency B	Yes
Pn147	Model Following Control Speed Feedforward Compensation	Yes
Pn160	Anti-Resonance Control-Related Selections	Yes
Pn161	Anti-Resonance Frequency	Yes
Pn163	Anti-Resonance Damping Gain	Yes

Yes: The parameter is automatically set.

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

8.8.1 Outline

8.8

Custom Tuning

This section describes custom tuning.

8.8.1 Outline

You can use custom tuning to manually adjust the servo during operation using a speed or position reference input from the host controller. You can use it to fine-tune adjustments that were made with autotuning.

The following items are adjusted automatically.

- Gains (e.g., speed loop gain and position loop gain)
- Filters (torque reference filter and notch filters)
- Friction compensation
- Anti-resonance control

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

8.8.7 Related Parameters on page 8-50

There are two adjustment methods that you can use for custom tuning.

■ Tuning Mode 0 (Setting Servo Gains Giving Priority to Stability) or 1 (Setting Servo Gains Giving Priority to Good Response)

These modes allow you to set stable control conditions for multiple servo gains by manipulating only one tuning level. Automatic setting of notch filters and anti-resonance control is provided if vibration is detected. Manual anti-resonance control adjustment is also possible during custom tuning.

 Tuning Mode 2 (Setting Servo Gains Giving Priority to Position Control Applications) or 3 (Setting Servo Gains Giving Priority to Preventing Overshooting in Position Control Applications)

Two tuning levels are manipulated to reduce positioning time even further and set multiple servo gains.

Model following control is used to reduce the positioning time. If vibration is detected, notch filters and anti-resonance control are automatically adjusted, and friction compensation is automatically set. Manual anti-resonance control adjustment and vibration suppression are also possible during custom tuning.

M CAUTION

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

8.8.2 Preparations

Always check the following before you execute custom tuning.

- The test without a motor function must be disabled (Pn00C = n.□□□□0).
- The tuning-less function must be disabled (Pn170 = n.□□□0).
- If speed control is used, tuning mode 0 or 1 must be set.
- The parameters must not be write prohibited.

8.8.3 Applicable Tools

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

Tool	Function	Operating Procedure Reference
Panel Operator	_	You cannot perform custom tuning from the Panel Operator.
Digital Operator	Fn203	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Tuning – Tuning	8.8.4 Operating Procedure on page 8-43

8.8.4 Operating Procedure

Use the following procedure to perform custom tuning.

⚠ WARNING

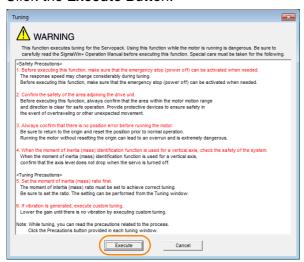
- Before you execute custom tuning, check the information provided in the SigmaWin+ operating manual.
 - Observe the following precautions.
 - Make sure that you can perform an emergency stop at any time.
 When custom tuning is started, several parameters will be overwritten with the recommended settings,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

M CAUTION

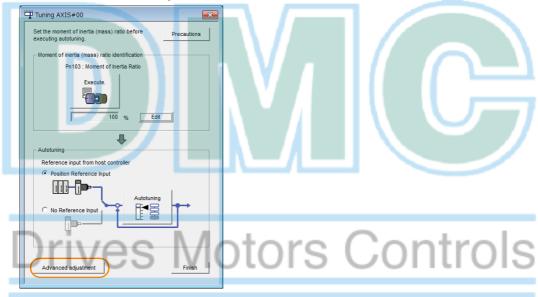
- If you are using an MP3000-series Controller for phase control, set the tuning mode to 0 or
 If 2 or 3 is selected for the tuning mode, correct phase control may not be possible.
- 1. Confirm that the moment of inertia ratio (Pn103) is set correctly.
- 2. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **3.** Select Tuning in the Menu Dialog Box. The Tuning Dialog Box will be displayed. Click the **Cancel** Button to cancel tuning.

8.8.4 Operating Procedure

4. Click the Execute Button.



5. Click the Advanced adjustment Button.

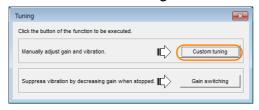


Information

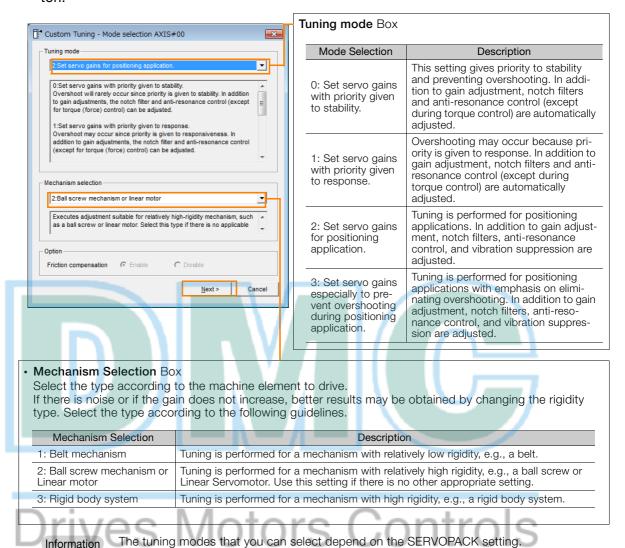
When the following dialog box is displayed, click the $\bf OK$ Button and then confirm that the correct moment of inertia ratio is set in Pn103 (Moment of Inertia Ratio).



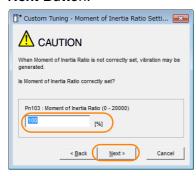
6. Click the Custom tuning Button.



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



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



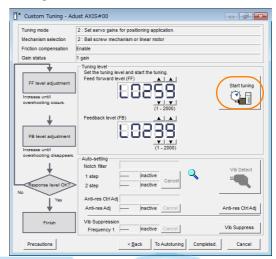
8.8.4 Operating Procedure

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

Tuning Mode 0 or 1



Tuning Mode 2 or 3

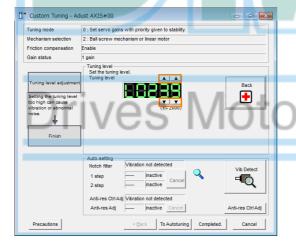


10. Use the ▲ and ▼ Buttons to change the tuning level.

Click the **Back** Button during tuning to restore the setting to its original value. The tuning level will return to the value from before when custom tuning was started.

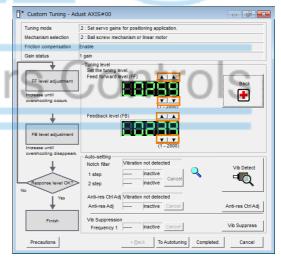
Tuning Mode 0 or 1

Increase the tuning level until overshooting occurs.



Tuning Mode 2 or 3

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



Information

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

11. You can set the functions to suppress vibration (notch filters, automatic anti-resonance setting, anti-resonance control adjustment, and autotuning with a host reference) as required.

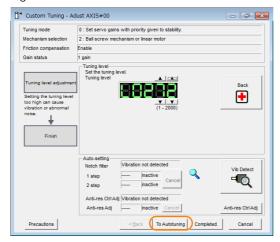
Refer to the following section for details.

Vibration Suppression Functions on page 8-48

8

12. When tuning has been completed, click the **Completed** Button.

The values that were changed will be saved in the SERVOPACK and you will return to the Tuning Dialog Box.



This concludes the procedure to set up custom tuning.



Drives Motors Controls

8.8.4 Operating Procedure

Vibration Suppression Functions

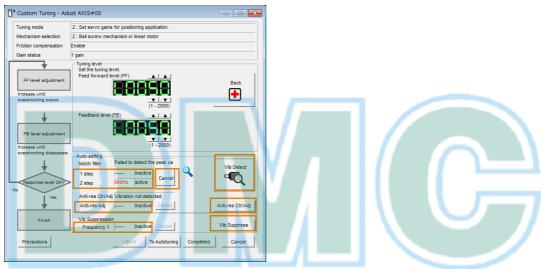
◆ Notch Filters and Automatic Anti-resonance Setting

If the vibration frequency that occurs when you increase the servo gains is at 1,000 Hz or higher, notch filters are effective to suppress vibration. If the vibration is between 100 Hz and 1,000 Hz, anti-resonance control is effective.

Automatic Setting

To set vibration suppression automatically, use the parameters to enable notch filters and automatic anti-resonance control setting.

The notch filter frequency (stage 1 or 2) or anti-resonance control frequency that is effective for the vibration that was detected during tuning will be automatically set.



Auto-setting Cancel Buttons

The automatically set notch filter frequencies or the anti-resonance control frequencies may not always suppress vibration. Click the **Cancel** Button to reset the notch filter frequencies or the anti-resonance control frequencies to the values from just before these frequencies were set automatically. When they are reset, vibration detection will start again.

Vib Detect Button

While the notch filter or anti-resonance control adjustment automatic setting function is enabled, you can click the **Vib Detect** Button to manually detect vibration. When you click the **Vib Detect** Button, the SERVOPACK will detect vibration at that time, and set the notch filter frequency (stage 1 or 2) or anti-resonance control frequency that is effective for the detected vibration. You can also perform manual vibration detection even when the SERVOPACK does not detect vibration.

· Anti-res Ctrl Adj Button

You can use the **Anti-res Ctrl Adj** Button to execute the anti-resonance control function if fine-tuning is required. Refer to the following section.

8.9 Anti-Resonance Control Adjustment on page 8-51

• Vib Suppress Button

Click the **Vib Suppress** Button to suppress low and transient vibration (oscillation) of approximately 1 Hz to 100 Hz that occurs during positioning. Refer to the following section.

8.10 Vibration Suppression on page 8-56

◆ Autotuning with a Host Reference

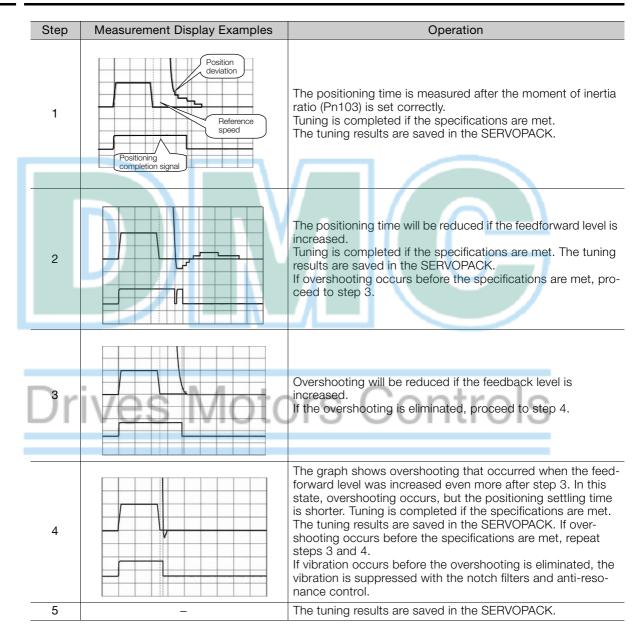
You can perform autotuning with a host reference. Refer to the following section for details. 8.7 Autotuning with a Host Reference on page 8-35

8.8.5 Automatically Adjusted Function Settings

You cannot use vibration suppression functions at the same time. Other automatic function settings are the same as for autotuning without a host reference. Refer to the following section.

8.6.6 Automatically Adjusted Function Settings on page 8-32

8.8.6 Tuning Example for Tuning Mode 2 or 3



8.8.7 Related Parameters

The following parameters are automatically adjusted or used as reference when you execute custom tuning.

Do not change the settings while custom tuning is being executed.

Parameter	Name	Automatic Changes
Pn100	Speed Loop Gain	Yes
Pn101	Speed Loop Integral Time Constant	Yes
Pn102	Position Loop Gain	Yes
Pn103	Moment of Inertia Ratio	No
Pn121	Friction Compensation Gain	Yes
Pn123	Friction Compensation Coefficient	Yes
Pn124	Friction Compensation Frequency Correction	No
Pn125	Friction Compensation Gain Correction	Yes
Pn401	First Stage First Torque Reference Filter Time Constant	Yes
Pn408	Torque-Related Function Selections	Yes
Pn409	First Stage Notch Filter Frequency	Yes
Pn40A	First Stage Notch Filter Q Value	Yes
Pn40C	Second Stage Notch Filter Frequency	Yes
Pn40D	Second Stage Notch Filter Q Value	Yes
Pn140	Model Following Control-Related Selections	Yes
Pn141	Model Following Control Gain	Yes
Pn142	Model Following Control Gain Correction	Yes
Pn143	Model Following Control Bias in the Forward Direction	Yes
Pn144	Model Following Control Bias in the Reverse Direction	Yes
Pn145	Vibration Suppression 1 Frequency A	No
Pn146	Vibration Suppression 1 Frequency B	No
Pn147	Model Following Control Speed Feedforward Compensation	Yes
Pn160	Anti-Resonance Control-Related Selections	Yes
Pn161	Anti-Resonance Frequency	Yes
Pn163	Anti-Resonance Damping Gain	Yes

Yes: The parameter is automatically set.

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

8.9

Anti-Resonance Control Adjustment

This section describes anti-resonance control.

8.9.1 Outline

Anti-resonance control increases the effectiveness of vibration suppression after custom tuning.

Anti-resonance control is effective for suppression of continuous vibration frequencies from 100 to 1,000 Hz that occur when the control gain is increased. Vibration can be eliminated by setting vibration frequencies through automatic detection or by manually setting them to adjust the damping gain. Input an operation reference and execute this anti-resonance control adjustment when there is vibration.

Anti-resonance control is automatically set by autotuning without a host reference or autotuning with a host reference. Use anti-resonance control adjustment only if fine-tuning is required or readjustment is required as a result of a failure to detect vibration.

Perform custom tuning if required to increase the response after performing anti-resonance control adjustment. If the control gain is increased, e.g., when custom tuning is performed, vibration may occur again. If that occurs, perform anti-resonance control adjustment again to fine-tune the parameters.

CAUTION

- Related parameters will be set automatically when anti-resonance control adjustment is executed. This may greatly affect the response before and after execution. Make sure that you can perform an emergency stop at any time.
- Before you execute anti-resonance control adjustment, set the correct moment of inertia ratio (Pn103). If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may occur.



- Anti-resonance control adjustment detects vibration frequencies between 100 Hz and 1,000 Hz. If the vibration frequency is not within this range, use custom tuning with tuning mode 2 selected to automatically set a notch filter or use vibration suppression.
- Vibration reduction can be made more effective by increasing the anti-resonance damping gain (Pn163), but the vibration may become larger if the damping gain is too high. Increase the damping gain by approximately 0% to 200% in 10% increments while checking the effect on vibration. If vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain by using a different method, such as custom tuning.

8.9.2 Preparations

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

- The tuning-less function must be disabled (Pn170 = $n.\Box\Box\Box$ 0).
- The test without a motor function must be disabled (Pn00C = n.□□□□0).
- The control method must not be set to torque control.
- The parameters must not be write prohibited.

8.9.3 Applicable Tools

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

Tool	Function	Operating Procedure Reference	
Panel Operator	You cannot execute anti-resonance control adjustment from the Panel Operator.		
Digital Operator	Fn204	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)	
SigmaWin+	Tuning - Tuning	8.9.4 Operating Procedure on page 8-52	

8.9.4 Operating Procedure

To execute anti-resonance control adjustment, an operation reference is input, and the adjustment is executed while vibration is occurring.

The following methods can be used to execute anti-resonance control adjustment.

- To automatically detect the vibration frequency
- To manually set the vibration frequency

Use the following procedure to perform anti-resonance control.

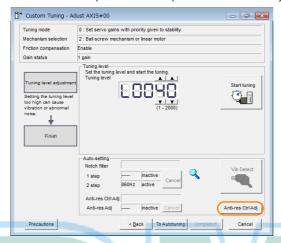
A CAUTION

- Before you execute anti-resonance control adjustment, check the information provided in the SigmaWin+ operating manual.
 Observe the following precautions.
 - Make sure that you can perform an emergency stop at any time.
 Parameters will be set automatically when anti-resonance control adjustment is executed. This may greatly affect the response before and after execution. Make sure that you can perform an emergency stop (to turn OFF the power supply) at any time.
 - Set the moment of inertia correctly before you execute anti-resonance control adjustment. If the setting greatly differs from the actual moment of inertia, effective vibration reduction may not be possible.
 - If you have already performed anti-resonance control adjustment and then you change the frequency, the current anti-resonance control effect may be lost. Caution is particularly required when automatically detecting the vibration frequency.
 - If effective vibration reduction is not achieved even after you execute anti-resonance control
 adjustment, cancel the function and lower the control gain by using a different method, such as
 custom tuning.
 - Perform custom tuning separately if required to increase the response after performing anti-resonance control adjustment.
 - If the servo gain is increased, e.g., when custom tuning is performed, vibration may occur again. If that occurs, perform anti-resonance control adjustment again to fine-tune the parameters.

8.8.4 Operating Procedure on page 8-43

2. Click the Anti-res Ctrl Adj Button.

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



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

To Manually Set the Vibration Frequency



- 4. Click the Start adjustment Button.
- 5. Use the ▲ and ▼ Buttons in the Adjustment Area to change the settings.

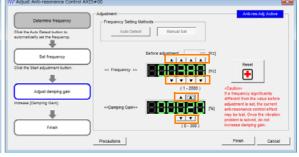
 Click the Reset Button during tuning to restore the setting to its original value. The tuning level will return to the value from before when custom tuning was started.

To Automatically Detect the Vibration Frequency

Change the setting of the damping gain.

To Manually Set the Vibration Frequency Change the settings of the frequency and damping gain.

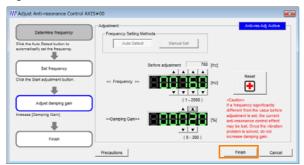




8.9.5 Related Parameters

6. When the adjustment has been completed, click the Finish Button.

The values that were changed will be saved in the SERVOPACK and you will return to the Tuning Dialog Box.



This concludes the procedure to set up anti-resonance control.

8.9.5 Related Parameters

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

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

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

Yes: The parameter is automatically set.

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

8.9.6 Suppressing Different Vibration Frequencies with Anti-resonance Control

When you use anti-resonance control and increase the control gain, for some mechanism, vibration can occur at a higher frequency than the frequency for which vibration was suppressed. If this occurs, you can suppress vibration for more than one frequency by adjusting Pn166 (Anti-Resonance Damping Gain 2).

Information

Guidelines for Vibration That Can Be Suppressed

Anti-resonance frequency (Pn161): fa [Hz], Another vibration frequency that occurs when the control gain is increased: fb [Hz]

- Vibration frequencies: 100 Hz to 1,000 Hz
- Range of different vibration frequencies: 1 < (fb/fa) ≤ 3 to 4

8.9.6 Suppressing Different Vibration Frequencies with Anti-resonance Control

Required Parameter Settings

The following parameter settings are required to use anti-resonance control for more than one vibration frequency.

Parameter		Description		When Enable	0.0000	
Pn160	n.□□□0 (default setting)	Do not use anti-resonance control.		After restar	Setup	
	n.□□□1	Use anti-resonance co	ntrol.		Testai	
	Anti-Resonance Fr	requency	quency			
Pn161	Setting Range	Setting Unit	Default Setting	When En	abled	Classification
	10 to 20,000	0.1 Hz	1000	Immedia	ately	Tuning
	Anti-Resonance G	ain Correction		Speed	Positio	n Torque
Pn162	Setting Range	Setting Unit	Default Setting	When En	abled	Classification
	1 to 1,000	1%	100	Immedia		Tuning
	Anti-Resonance Da	amping Gain		Speed	Positio	n Torque
Pn163	Setting Range	Setting Unit	Default Setting	When En	abled	Classification
	0 to 300	1%	0	Immedia	ately	Tuning
	Anti-Resonance Fi	Iter Time Constant 1 C	orrection	Speed	Positio	n Torque
Pn164	Setting Range	Setting Unit	Default Setting	When En	abled	Classification
	-1,000 to 1,000	0.01 ms	0	Immedia	ately	Tuning
	Anti-Resonance Fi	lter Time Constant 2 C	orrection	Speed	Positio	n Torque
Pn165	Setting Range	Setting Unit	Default Setting	When En	abled	Classification
	-1,000 to 1,000	0.01 ms	0	Immedia	ately	Tuning
	Anti-Resonance Da	amping Gain 2		Speed	Positio	n Torque
Pn166	Setting Range	Setting Unit	Default Setting	When En	abled	Classification
	0 to 1,000	1%	0	Immedia	ately	Tuning

Adjustment Procedure for Suppressing Different Vibration Frequencies with Anti-resonance Control

Use the following procedure to make adjustments to suppress different vibration frequencies with anti-resonance control.

Step	Operation
1	Use the gain adjustment and anti-resonance control. Refer to the following section for details. 8.9.4 Operating Procedure on page 8-52
2	If there is vibration at a higher frequency than the vibration suppressed with anti-resonance control in step 1, adjust Pn166 (Anti-Resonance Damping Gain 2).
3	Adjust Pn166 (Anti-Resonance Damping Gain 2) while checking to see if vibration reduction is effective. 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.

8.10.1 Outline

8.10

Vibration Suppression

This section describes vibration suppression.

8.10.1 Outline

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

Vibration suppression is automatically set by autotuning without a host reference or autotuning with a host reference. Use vibration suppression only if fine-tuning is required or readjustment is required as a result of a failure to detect vibration. To execute vibration suppression, input an operation reference and execute the function when there is vibration.

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

CAUTION

- Related parameters will be set automatically when vibration suppression is executed. This
 may greatly affect the response before and after execution. Make sure that you can perform
 an emergency stop at any time.
- Before you execute vibration suppression, set the correct moment of inertia ratio (Pn103) with autotuning without a host reference or another method. If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may occur.



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

Items That Influence Performance

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

Detection of Vibration Frequencies

Frequency detection may not be possible if vibration does not appear in the position deviation or the vibration that results from the position deviation is too small. You can adjust the detection sensitivity by changing the setting of the residual vibration detection width (Pn560), which is set as a percentage of the positioning completed width (Pn522). Perform the detection of vibration frequencies again after adjusting the setting of Pn560.

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

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

Information

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

8.10.2 Preparations

Always check the following before you execute vibration suppression.

- Position control must be used.
- The tuning-less function must be disabled (Pn170 = n.□□□0).
- The test without a motor function must be disabled ($Pn00C = n.\square\square\square\square0$).
- The parameters must not be write prohibited.

8.10.3 Applicable Tools

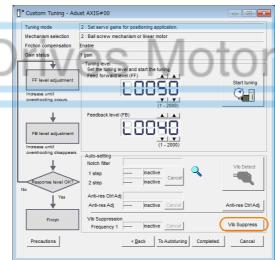
The following table lists the tools that you can use to perform vibration suppression and the applicable tool functions.

Tool	Function	Operating Procedure Reference
Panel Operator	You cannot execute vibration suppres	sion from the Panel Operator.
Digital Operator	Fn205	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+ Tuning - Tuning		8.10.4 Operating Procedure on page 8-57

8.10.4 Operating Procedure

Use the following procedure to perform vibration suppression.

- 1. Perform steps 1 to 8 of the procedure for custom tuning. Refer to the following section for details.
 - 8.8.4 Operating Procedure on page 8-43
- 2. Click the Vib Suppress Button.



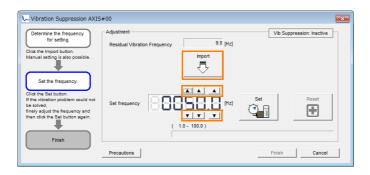
Controls

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



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

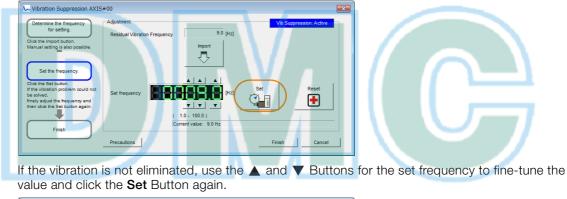
8.10.4 Operating Procedure



4. Click the Set Button.



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





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

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



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

This concludes the procedure to set up vibration suppression.

8.10.5 Setting Combined Functions

You can also use the feedforward function when you execute vibration suppression.

In the default settings, feedforward (Pn109), the speed feedforward input (V-REF), and the torque feedforward input (T-REF) are disabled.

To use the speed feedforward input (V-REF), the torque feedforward input (T-REF), and model following control from the host controller in the system, set Pn140 to n.1 \(\sigma\sup \square\) (Use model following control and speed/torque feedforward together).

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□ (default setting)	Do not use model following control and speed/torque feedforward together.	Immediately	Tuning
	n.1□□□	Use model following control and speed/torque feedforward together.	iriiriediately	Tuning

Refer to the following section for information on the torque feedforward input (T-REF) and the speed feedforward input (V-REF).

Torque Feedforward and Speed Feedforward on page 8-87, ■ Speed Feedforward on page 8-88



When model following control is used with the feedforward function, it is used to make optimum feedforward settings in the SERVOPACK. Therefore, model following control is not normally used together with either the speed feedforward input (V-REF) or torque feedforward input (T-REF) from the host controller. However, model following control can be used with the speed feedforward input (V-REF) or torque feedforward input (T-REF) if required. An unsuitable feedforward input may result in overshooting.

8.10.6 Related Parameters

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

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

Parameter	Name	Automatic Changes
Pn140	Model Following Control-Related Selections	Yes
Pn141	Model Following Control Gain	Yes
Pn142	Model Following Control Correction	No
Pn143	Model Following Control Bias in the Forward Direction	No
Pn144	Model Following Control Bias in the Reverse Direction	No
Pn145	Vibration Suppression 1 Frequency A	Yes
Pn146	Vibration Suppression 1 Frequency B	Yes
Pn147	Model Following Control Speed Feedforward Compensation	No
Pn14A	Vibration Suppression 2 Frequency	No
Pn14B	Vibration Suppression 2 Correction	No

Yes: The parameter is automatically set.

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

8.11.1 Outline

8.11

Speed Ripple Compensation

This section describes speed ripple compensation.

8.11.1 Outline

Speed ripple compensation reduces the amount of ripple in the motor speed due to torque ripple or cogging torque. You can enable speed ripple compensation to achieve smoother operation. To enable it, you must set up ripple compensation on the SigmaWin+.

WARNING

• Speed ripple compensation requires operating the Servomotor and therefore presents hazards. Observe the following precautions.

Confirm safety around moving parts.

This function involves automatic operation. Make sure that you can perform an emergency stop (to turn OFF the power supply) at any time.



Execute speed ripple compensation only after adjusting the gains.

- Reset speed ripple compensation after you replace the Servomotor or SERVOPACK.
- Execute speed ripple compensation after jogging to a position that ensures a suitable range of motion.

8.11.2 Setting Up Speed Ripple Compensation

Restrictions

The following restrictions apply to the setup for speed ripple compensation.

Systems for Which Execution Cannot Be Performed

There are no restrictions.

Systems for Which Adjustments Cannot Be Made Accurately

Systems for which there is not a suitable range of motion

Preparations

Always check the following before you set up speed ripple compensation.

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

≓

Applicable Tools

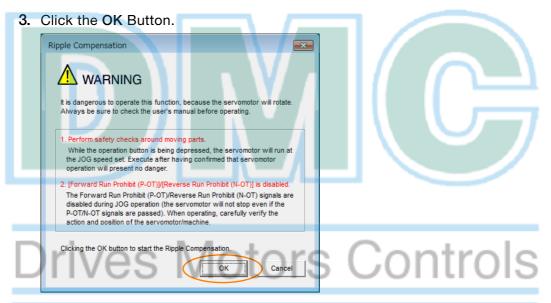
The following table lists the tools that you can use to set up speed ripple compensation and the applicable tool functions.

Tool	Function	Reference		
Panel Operator	You cannot set up speed ripple compensation from the Panel Operator.			
Digital Operator You cannot set up speed ripple comper		ensation from the Digital Operator.		
SigmaWin+	Solutions – Ripple Compensation	© Operating Procedure on page 8-61		

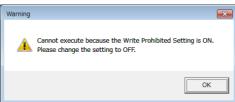
Operating Procedure

Use the following procedure to set up speed ripple compensation.

- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Ripple Compensation in the Menu Dialog Box. The Ripple Compensation Dialog Box will be displayed.



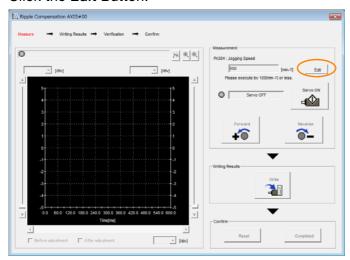
- Information
- 1. Click the Cancel Button to cancel ripple compensation. The Main Window will return.
- 2. If write protection is set, the following dialog box will be displayed.



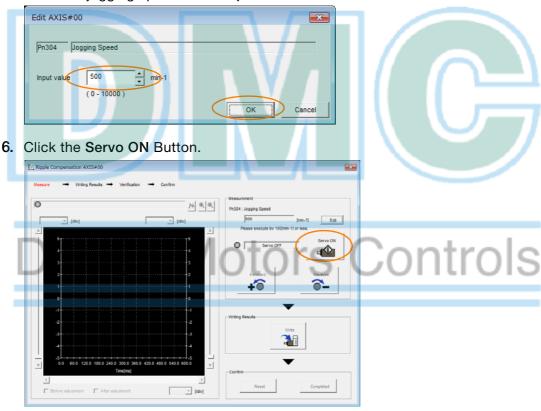
Click the **OK** Button to cancel write prohibition.

8.11.2 Setting Up Speed Ripple Compensation

4. Click the Edit Button.



5. Enter the jogging speed in the Input Value Box and click the OK Button.

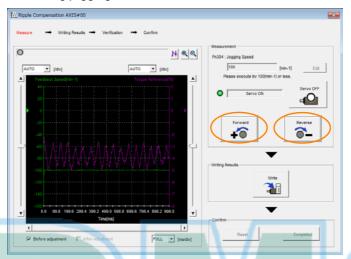


7. Click the Forward Button or the Reverse Button.

Measurement operation is started.

The Servomotor shaft will rotate at the preset jogging speed while you hold down the **Forward** or **Reverse** Button and the speed ripple will be measured.

The feedback speed and torque reference graph will be displayed in the Ripple Compensation Dialog Box during jogging.



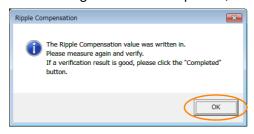


If the measurement time (i.e., the jogging time) for the speed ripple is too short, speed ripple measurement will not be completed. The following dialog box will be displayed if speed ripple measurement was not completed.

Click the **OK** Button and repeat the measurement.



- **8.** After speed ripple measurement has been completed, click the Write Button. The ripple compensation value will be written to the SERVOPACK.
- 9. After writing has been completed, click the OK Button.



8.11.3 Setting Parameters

10. Click the **Forward** Button or the **Reverse** Button.

Verification operation is started.

The Servomotor shaft will rotate at the preset jogging speed while you hold down the **Forward** or **Reverse** Button.

The waveform with speed ripple compensation applied to it will be displayed.



11. If the verification results are OK, click the Completed Button.

Information To discard the setup results, click the Reset Button.

This concludes the setup for speed ripple compensation.

8.11.3 Setting Parameters

The function is enabled when you perform the operating procedure on *Operating Procedure* on page 8-61. To cancel speed ripple compensation, use $Pn423 = n.\square\square\square\square0$ (Disable speed ripple compensation) to disable it.

Parameter		Description	When Enabled	Classifi- cation
	n.□□□0 (default setting)	Disable speed ripple compensation.	After restart	Setup
	n.□□□1	Enable speed ripple compensation.	restart	

If you enable speed ripple compensation, a compensation reference will be applied to reduce ripple even when stopped at a 0 speed reference. In speed control mode, this may result in the Servomotor moving slightly. To prevent this, set $Pn423 = n.\Box X\Box\Box$ (Speed Ripple Compensation Enable Condition Selection) and Pn427 or Pn49F (Speed Ripple Compensation Enable Speed).

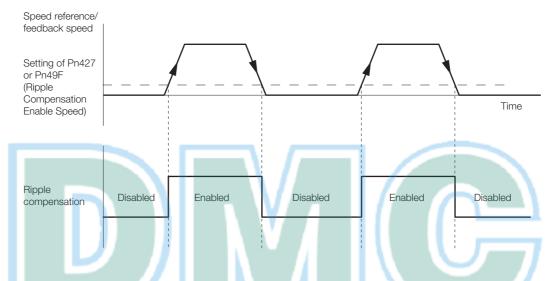
Parameter		Description	When Enabled	Classifi- cation
Pn423	n.□0□□ (default setting)	Speed reference	After restart	Setup
	n.🗆1 🗆 🗆	Motor Speed	restart	

• For Rotary Servomotors

	Speed Ripple Compensation Enable Speed			Speed Position Torque		
Pn427	Setting Range	ng Range Setting Unit Default Setting		When Enabled	Classification	
	0 to 10,000	1 min ⁻¹	0	Immediately	Tuning	

• For Linear Servomotors

	Speed Ripple Compensation Enable Speed			Speed Position Torque		
Pn49F	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	1 mm/s	0	Immediately	Tuning	



Speed Ripple Compensation Warnings

The speed ripple compensation value is specific to each Servomotor. If you replace the Servomotor while speed ripple compensation is enabled, an A.942 warning (Speed Ripple Compensation Information Disagreement) will occur to warn you.

You can use any of the following methods to clear A.942.

- Reset the speed ripple compensation value on the SigmaWin+.
- Disable speed ripple compensation (Pn423 = n.□□□0).
- Disable detection of A.942 (Pn423 = n.□□1□).

Parameter		Description	When Enabled	Classifi- cation
Pn423	n.□□0□ (default setting)	Detect A.942 alarms.	After restart	Setup
	n.□□1□	Do not detect A.942 alarms.	restart	

8.12.1 Gain Switching

8.12

Additional Adjustment Functions

This section describes the functions that you can use to make adjustments after you perform autotuning without a host reference, autotuning with a host reference, and custom tuning.

Function	Applicable Control Methods	Reference
Gain Switching	Position control, speed control, or torque control*	page 8-66
Friction Compensation	Position control or speed control	page 8-70
Current Control Mode Selection	Position control, speed control, or torque control	page 8-73
Current Gain Level Setting	Position control or speed control	page 8-73
Speed Detection Method Selection	Position control, speed control, or torque control	page 8-74
Proportional Control	Position control or speed control	page 8-74

^{*} Automatic gain switching is enabled only for position control.

8.12.1 Gain Switching

Two gain switching functions are available, manual selection 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.

F	Parameter Function		When Enabled	Classification
Pn139	n.□□□0 (default setting)	Use manual gain switching.	Immediately	Tuning
	n.□□□2	Use automatic gain switching pattern 1.		

Note: Pn139 = n.□□□1 is a reserved setting. Do not use this setting.

Refer to the following section for gain switching combinations.

Gain Switching Combinations on page 8-66

Refer to the following sections for information on manual and automatic gain switching.

Manual Gain Switching on page 8-67 and Automatic Gain Switching on page 8-67

Gain Switching Combinations

Selected Gains	Speed Loop Gain	Speed Loop Integral Time Constant	Position Loop Gain	Torque Reference Filter	Model Fol- lowing Con- trol Gain	Model Follow- ing Control Correction	Friction Compensa- tion Gain
Gain Set- tings 1	Speed Loop Gain (Pn100)	Speed Loop Integral Time Constant (Pn101)	Position Loop Gain (Pn102)	First Stage First Torque Reference Fil- ter Time Con- stant (Pn401)	Model Following Control Gain* (Pn141)	Model Follow- ing Control Correction* (Pn142)	Friction Compensa- tion Gain (Pn121)
Gain Set- tings 2	Second Speed Loop Gain (Pn104)	Second Speed Loop Integral Time Constant (Pn105)	Second Position Loop Gain (Pn106)	First Stage Second Torque Refer- ence Filter Time Con- stant (Pn412)	Second Model Fol- lowing Con- trol Gain* (Pn148)	Second Model Following Control Gain Correction* (Pn149)	Second Friction Compensa- tion Gain (Pn122)

^{*} 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

Manual Gain Switching

With manual gain switching, you use the /G-SEL (Gain Selection) signal to change between gain settings 1 and gain settings 2.

Type	Signal	Connector Pin No.	Setting	Meaning
Input	/G-SEL	Must be allocated.	OFF	Changes the gain settings to gain settings 1.
Input /G-SEL		iviust be allocated.	ON	Changes the gain settings to gain settings 2.

Automatic Gain Switching

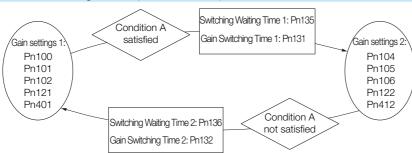
Automatic gain switching is enabled only for position control. The switching conditions are specified by using the following settings.

Para	ameter	Switching Condition	Selected Gains	Switching Waiting Time	Switching Time
Pn139	n.□□□2	Condition A satisfied	Gain settings 1 to gain settings 2	Gain Switching Waiting Time 1 Pn135	Gain Switching Time 1 Pn131
FIIIO9	11.0002	Condition A not satisfied	Gain settings 2 to gain settings 1	Gain Switching Waiting Time 2 Pn136	Gain Switching Time 2 Pn132

Select one of the following settings for switching condition A.

F	arameter	Position Control Gain Switching Condition A	For Control Methods Other Than Position Control (No Switching)	When Enabled	Classification
	n.□□0□ (default setting)	/COIN (Positioning Completion) signal ON	Gain settings 1 used.		
	n.□□1□	/COIN (Positioning Completion) signal OFF	Gain settings 2 used.		
	n.□□2□	/NEAR (Near) signal ON	Gain settings 1 used.		
Pn139	n.□□3□	/NEAR (Near) signal OFF	Gain settings 2 used.	Immediately	Tuning
		Position reference filter			
D 15	n.□□4□	output is 0 and reference pulse input is OFF.	Gain settings 1 used.	wo la	
Dr	n.□□5□	Position reference pulse input is ON.	Gain settings 2 used.	rois	

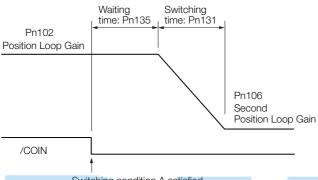




8.12.1 Gain Switching

Relationship between the Waiting Times and Switching Times for Gain Switching

In this example, an ON /COIN (Positioning Completion) signal is set as condition A for automatic gain switching. The position loop gain is changed from the value in Pn102 (Position Loop Gain) to the value in Pn106 (Second Position Loop Gain). When the /COIN signal turns ON, the switching operation begins after the waiting time (Pn135). The switching operation changes the position loop gain linearly from the gain set in Pn102 to the gain set in Pn106 over the switching time (Pn131).



Switching condition A satisfied.

Information You can use gain switching for either PI control or I-P control (Pn10B = n.□□0□ or □□1□).

Related Parameters

	Speed Loop Gain			Speed Posit	ion
Pn100	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1 Hz	400	Immediately	Tuning
	Speed Loop Integra	l Time Constant		Speed Posit	ion
Pn101	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	15 to 51,200	0.01 ms	2,000	Immediately	Tuning
	Position Loop Gain	B // _ L _		Posit	ion
Pn102	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1/s	400	Immediately	Tuning
	First Stage First Tor	que Reference Filter	Time Constant	Speed Posit	ion Torque
Pn401	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	100	Immediately	Tuning
	Model Following Co	ntrol Gain	Position		
Pn141	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1/s	500	Immediately	Tuning
	Model Following Co	ntrol Correction		Posit	ion
Pn142	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	500 to 2,000	0.1%	1,000	Immediately	Tuning
	Friction Compensat	ion Gain		Speed Posit	ion
Pn121	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 1,000	1%	100	Immediately	Tuning
	Second Speed Loop	Gain		Speed Posit	ion
Pn104	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1 Hz	400	Immediately	Tuning
	Second Speed Loop	Integral Time Cons	tant	Speed Posit	ion
Pn105	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	15 to 51,200	0.01 ms	2,000	Immediately	Tuning

Continued on next page.

Continued from previous page.

	Second Position Lo	op Gain		Posit	ion	
Pn106	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	10 to 20,000	0.1/s	400	Immediately	Tuning	
	First Stage Second	Torque Reference Fi	Iter Time Constant	Speed Posit	ion Torque	
Pn412	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 65,535	0.01 ms	100	Immediately	Tuning	
	Second Model Following Control Gain			Position		
Pn148	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	10 to 20,000	0.1/s	500	Immediately	Tuning	
	Second Model Following Control Gain Correction			Posit	ion	
Pn149	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	500 to 2,000	0.1%	1,000	Immediately	Tuning	
	Second Friction Co.	mpensation Gain		Speed Posit	ion	
Pn122	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	10 to 1,000	1%	100	Immediately	Tuning	

Parameters Related to Automatic Gain Switching

_					
	Gain Switching Time	e 1		Posit	tion
Pn131	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	1 ms	0	Immediately	Tuning
	Gain Switching Time	e 2		Posit	tion
Pn132	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	1 ms	0	Immediately	Tuning
	Gain Switching Wai	ting Time 1		Posit	tion
Pn135	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	1 ms	0	lina ina a all'attali i	Ti ve le e
	0 10 00,000	1 1115	U	Immediately	Tuning
	Gain Switching Wai		0	Posit	
Pn136	,		Default Setting	,	
Pn136	Gain Switching Wai	ting Time 2	Default Setting	Posi	tion

Related Monitoring

• SigmaWin+

You can monitor gain switching with the status monitor or with tracing.

Analog Monitors

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

8.12.2 Friction Compensation

Friction compensation is used to compensate for viscous friction fluctuations and regular load fluctuations.

You can automatically adjust friction compensation with autotuning without a host reference, autotuning with a host reference, or custom tuning, or you can manually adjust it with the following procedure.

Required Parameter Settings

The following parameter settings are required to use friction compensation.

Parameter		Function			When Enabled	Classification
n.0□□□ Pn408 (default setting)		Disable friction compensation.			Immediately	Setup
	n.1000	Enab	ole friction compens	sation.		
	Friction Compen	satior	n Gain		Speed Posit	tion
Pn121	Setting Range		Setting Unit	Default Setting	When Enabled	Classification
	10 to 1,000		1%	100	Immediately	Tuning
	Second Friction	Comp	ensation Gain		Speed Posit	tion
Pn122	Setting Range	/	Setting Unit	Default Setting	When Enabled	Classification
	10 to 1,000		1%	100	Immediately	Tuning
	Friction Compen	satior	Coefficient		Speed Posit	tion
Pn123	Setting Range	Ш	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100		1%	0	Immediately	Tuning
	Friction Compen	satior	Frequency Corre	ction	Speed Posit	tion
Pn124	Setting Range		Setting Unit	Default Setting	When Enabled	Classification
	-10,000 to 10,00	0	0.1 Hz	0	Immediately	Tuning
	Friction Compen	satior	Gain Correction		Speed Posit	tion
Pn125	Setting Range		Setting Unit	Default Setting	When Enabled	Classification
	1 to 1,000		1%	100	Immediately	Tuning
\cup	rives	5	DIOIVI	ors G	ontro	IS

Operating Procedure for Friction Compensation

Use the following procedure to perform friction compensation.

CAUTION

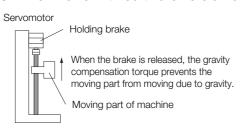
Before you execute friction compensation, set the moment of inertia ratio (Pn103) as accurately as possible. If the setting greatly differs from the actual moment of inertia, vibration may occur.

Step	Operation						
1	Set the following parameters related to friction compensation to their default settings. Friction compensation gain (Pn121): 100 Second friction compensation gain (Pn122): 100 Friction compensation coefficient (Pn123): 0 Friction compensation frequency correction (Pn124): 0 Friction compensation gain correction (Pn125): 100 Note: Always use the default settings for the friction compensation frequency correction (Pn124) and friction compensation gain correction (Pn125).						
	Gradually increase the friction compensation coefficient (Pn123) to check the effect of friction com-						
2	 pensation. Note: Usually, set the friction compensation coefficient (Pn123) to 95% or less. If the effect is insufficient, increase the friction compensation gain (Pn121) by 10% increments until vibration stops. Effect of Adjusted Parameters Pn121: Friction Compensation Gain and Pn122: Second Friction Compensation Gain These parameters set the response to external disturbances. The higher the setting is, the better the response will be. If the machine has a resonance frequency, however, vibration may occur if the setting is too high. Pn123: Friction Compensation Coefficient This parameter sets the effect of friction compensation. The higher the setting is, the more effective friction compensation will be. If the setting is too high, however, vibration will occur more easily. Usually, set the value to 95% or less. 						
	Effect of Adjustments						
	The following graphs show the response with and without adjustment.						
	Low friction Low friction Position deviation High friction Position reference speed Position reference speed						

8.12.3 Gravity Compensation

When the Servomotor is used with a vertical axis, gravity compensation prevents the moving part from falling due to the machine's own weight when the brake is released.

SERVOPACKs with software version 0023 or higher support gravity compensation.

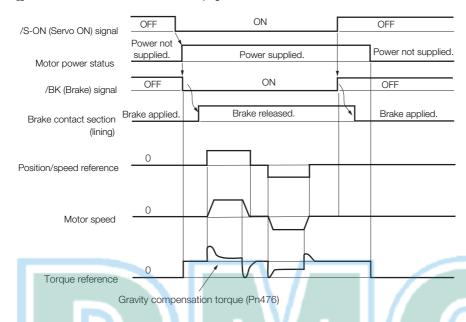


8.12.3 Gravity Compensation

A timing chart for when the moving part is raised then lowered is provided below.

Refer to the following section for details on brake operation timing.

5.13.1 Brake Operating Sequence on page 5-36



Required Parameter Settings

The following parameter settings are required to use gravity compensation.

Parameter		Description		When Enabled	Classification
Pn475	n.□□□0 (default setting)	Disable gravity compensation.		After restart	Setup
	n.□□□1	Enable gravity compensation.			
Gravity Compensation Torque Speed Position Torque					tion Torque
Pn476	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	-1,000 to 1,000	0.1%		Immediately	Tuning

Operating Procedure for Gravity Compensation

Use the following procedure to perform gravity compensation.

- 1. Set Pn475 to n.□□□1 (Enable gravity compensation).
- 2. To enable changes to the settings, turn the power supply to the SERVOPACK OFF and ON again.
- 3. Use SigmaWin+ or an analog monitor to find the torque reference value when the motor is stopped with the servo ON.
- 4. Set the torque reference value found in step 3 in Pn476 (Gravity Compensation Torque).
- **5.** Turn the servo ON and OFF a few times and fine-tune Pn476 so that the moving part of the machine does not fall.

8.12.4 Current Control Mode Selection

Current control mode selection reduces high-frequency noise while the Servomotor is being stopped.

The setting depends on the capacity of the SERVOPACK.

To use current control mode selection, use current control mode 2 (set Pn009 to $n.\Box\Box1\Box$ or $n.\Box\Box2\Box$).

• SERVOPACK Models SGD7S-R70A, -R90A, -1R6A, -2R8A, -3R8A, -5R5A, and -7R6A

Parameter		Meaning	When Enabled	Classification
	n. 🗆 🗆 🗆			Tuning
Pn009	n. 🗆 🗆 🗆 🗆	Use current control mode 1.	After restart	
	(default setting)			
	n. □□2□	Use current control mode 2 (low noise).		

SERVOPACK Models SGD7S-120A, -180A, -200A, -330A, -470A, -550A, -590A, and -780A

Parameter		Meaning	When Enabled	Classification
	n. □□0□	Use current control mode 1.		
Pn009	n. □□1□ (default setting) n. □□2□	Use current control mode 2 (low noise).	After restart	Tuning



If current control mode 2 is selected, the load ratio may increase while the Servomotor is being stopped.

8.12.5 Current Gain Level Setting

You can set the current gain level to reduce noise by adjusting the parameter for current control inside the SERVOPACK according to the speed loop gain (Pn100). The noise level can be reduced by decreasing the current gain level (Pn13D) from its default setting of 2,000% (disabled). However, if the setting is decreased, the level of noise will be lowered, but the response characteristic of the SERVOPACK will also be reduced. Adjust the current gain level within the range that maintains the SERVOPACK response characteristic. This function is always disabled during torque control (Pn000 = $n.\Box\Box2\Box$).

	Current Gain Level			Speed Posit	ion
Pn13D	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	100 to 2,000	1%	2,000	Immediately	Tuning



If the current gain level is changed, the response characteristic of the speed loop will also change. Servo tuning must therefore be performed again.

8.12.6 Speed Detection Method Selection

You can use the speed detection method selection to ensure smooth Servomotor speed changes during operation. To ensure smooth motor speed changes during operation, set Pn009 to $n.\Box 1\Box\Box$ (Use speed detection 2).

With a Linear Servomotor, you can reduce the noise level of the running motor when the linear encoder scale pitch is large.

Parameter		Meaning	When Enabled	Classification
Pn009	n. □0□□ (default setting)	Use speed detection 1.	After restart	Tuning
	n. 🗆 1 🗆 🗆	Use speed detection 2.		



If the speed detection method is changed, the response characteristic of the speed loop will also change. Servo tuning must therefore be performed again.

8.12.7 Speed Feedback Filter

You can set a first order lag filter for the speed feedback in the speed loop. This ensures smooth changes in the feedback speed to reduce vibration. If a large value is set, it will increase the delay and make response slower.

	Speed Feedback Filter	Time Constant	Speed Position		
Pn308	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535 (0.00 ms to 655.35 ms)	0.01 ms	0 (0.00 ms)	Immediately	Setup

8.12.8 Proportional Control (P Control)

You can input the /P-CON (Proportional Control) 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 $Pn000 = n.\square\square X\square$ and the /P-CON signal.

However, if Pn000 is set to n. \(\sigma\) (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.

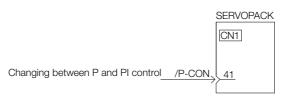
/P-CON (Proportional Control) Signal

The /P-CON signal is used to switch between P control and PI control.

Type	Signal	Connector Pin No.	Setting	Meaning
Input /P-CON	/P CON	CN1-41	ON (closed)	Changes to P control
	(default setting)	OFF (open)	Changes to PI control	

Example

When Using the Default Input Signal Allocations



Note: This example uses the default input signal allocations.

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	
	n.□□0□ (default setting)	Speed control with analog references	You can change to P control with the default setting (CN1-41 = /P-CON).	
	n.□□1□	Position control with pulse train references	You can also allocate the /P-CON signal to another connector pin.	
	n.□□2□	Torque control with analog references	You cannot change to P control.	
	n.□□3□	Internal set speed control with contact commands		
Driv	n.□□4□	Switching between internal set speed control with contact commands and speed control with analog references	ols	
Pn000	n.□□5□	Switching between internal set speed control with contact commands and position control with pulse train references		
	n.□□6□	Switching between internal set speed control with contact commands and torque control with analog references		
	n.□□7□	Switching between position control with pulse train references and speed control with analog references	You must allocate the /P-CON signal to CN1-40 to CN1-46.	
	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 changing the control method.

6.10 Selecting Combined Control Methods on page 6-58

8.13.1 Tuning the Servo Gains

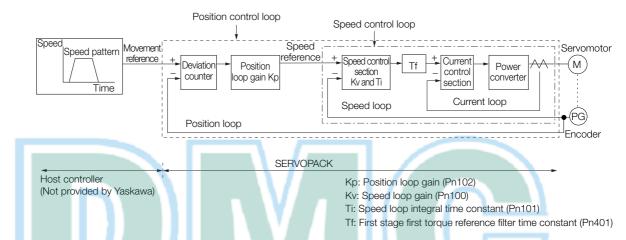
8.13 Mai

Manual Tuning

This section describes manual tuning.

8.13.1 Tuning the Servo Gains

Servo Gains



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

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

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

Outline

You can use manual tuning to set the servo gains in the SERVOPACK to increase the response characteristic of the SERVOPACK. For example, you can reduce the positioning time for position control.

Use manual tuning in the following cases.

- When tuning with autotuning without a host reference or autotuning with a host reference does not achieve the desired results
- When you want to increase the servo gains higher than the gains that resulted from autotuning without a host reference or autotuning with a host reference
- When you want to determine the servo gains and moment of inertia ratio yourself

You start manual tuning either from the default parameter settings or from the gain settings that resulted from autotuning without a host reference or autotuning with a host reference.

Applicable Tools

You can monitor the servo gains with the SigmaWin+ or with the analog monitor.

Precautions

Vibration may occur while you are tuning the servo gains. We recommend that you enable vibration alarms (Pn310 = $n.\Box\Box\Box$ 2) to detect vibration. Refer to the following section for information on vibration detection.

6.15 Initializing the Vibration Detection Level on page 6-98

Vibration alarms are not detected for all vibration. Also, an emergency stop method is necessary to stop the machine safely when an alarm occurs. You must provide an emergency stop device and activate it immediately whenever vibration occurs.

Tuning Procedure Example (for Position Control or Speed Control)

0.	, 				
Step	Description				
1	Adjust the first stage first torque reference filter time constant (Pn401) so that vibration does not occur.				
2	Increase the Speed loop gain (Pn100) and reduce the speed loop integral time constant (Pn101) as far as possible within the range that does not cause machine vibration.				
3	Repeat steps 1 and 2 and return the settings about 10% to 20% from the values that you set.				
4	For position control, increase the position loop gain (Pn102) within the range that does not cause vibration.				
Inform	 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 Reduce the torque reference filter time constant. Increase the speed loop gain. 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. 				
Dr	 Increase the speed loop integral time constant. Decrease the speed loop gain. Increase the torque filter time constant. 				

Adjusted Servo Gains

You can set the following gains to adjust the response characteristic of the SERVOPACK.

- Pn100: Speed Loop Gain
- Pn101: Speed Loop Integral Time Constant
- Pn102: Position Loop Gain
- Pn401: First Stage First Torque Reference Filter Time Constant

◆ Position Loop Gain

The position loop gain determines the response characteristic of the position loop in the SERVOPACK. If you can increase the setting of the position loop gain, the response characteristic will improve and the positioning time will be shortened. However, you normally cannot increase the position loop gain higher than the inherit vibration frequency of the machine system. Therefore, to increase the setting of the position loop gain, you must increase the rigidity of the machine to increase the inherit vibration frequency of the machine.

	Position Loop Gain			Position	
Pn102	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1/s	400	Immediately	Tuning

8.13.1 Tuning the Servo Gains

Information

For machines for which a high position loop gain (Pn102) cannot be set, overflow alarms can occur during high-speed operation. If that is the case, you can increase the setting of the following parameter to increase the level for alarm detection.

Use the following condition as a guideline for determining the setting.

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

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

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

◆ Speed Loop Gain

This parameter determines the response characteristic of the speed loop. If the response characteristic of the speed loop is low, it becomes a delay factor for the position loop located outside of the speed loop. This will result in overshooting and vibration in the speed reference. Therefore, setting the speed loop gain as high as possible within the range that will not cause the machine system to vibrate will produce a stable servo system with a good response characteristic.

	Speed Loop Gain			Speed Positi	on Torque
Pn100	Setting Range	Setting Unit	Default Setting	When Enabled	Classifica- tion
	10 to 20,000	0.1 Hz	400	Immediately	Tuning

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

The default setting of Pn103 (Moment of Inertia Ratio) is 100. Before you tune the servo, calculate the moment of inertia ratio with the above formula and set Pn103 to the calculation result.

1)	Moment of Inertia Ratio			Speed Positi	on Torque
Pn103	Setting Range	Setting Unit	Default Setting	When Enabled	Classifica- tion
	0 to 20,000	1%	100	Immediately	Tuning

◆ Speed Loop Integral Time Constant

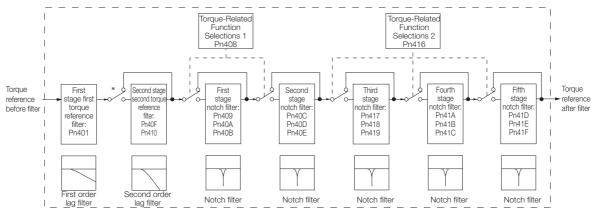
To enable response to even small inputs, the speed loop has an integral element. The integral element becomes a delay factor in the servo system. If the time constant is set too high, overshooting will occur, positioning settling time will increase, and the response characteristic will suffer.

	Speed Loop Integral Time Constant			Speed Position	
Pn101	Setting Range	Setting Unit	Default Setting	When Enabled	Classifica- tion
	15 to 51,200	0.01 ms	2,000	Immediately	Tuning

◆ Torque Reference Filter

As shown in the following diagram, the torque reference filter contains a first order lag filter and notch filters arranged in series, and each filter operates independently.

The notch filters can be enabled and disabled with $Pn408 = n.\Box X\Box X$ and $Pn416 = n.\Box XXX$.



^{*} The second stage second torque reference filter is disabled when Pn40F is set to 5,000 (default setting) and it is enabled when Pn40F is set to a value lower than 5,000.

■ Torque Reference Filter

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

	First Stage First Torque Reference Filter Time Constant			Speed Position Torque	
Pn401	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 65,535	0.01 ms	100	Immediately	Tuning
	Second Stage Seco	nd Torque Reference	Filter Frequency	Speed Posit	ion Torque
Pn40F	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	100 to 5,000	1 Hz	5000*	Immediately	Tuning
	Second Stage Second Torque Reference Filter Q Value			Speed Posit	ion Torque
Pn410	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 100	0.01	50	Immediately	Tuning

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

Notch Filters

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

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

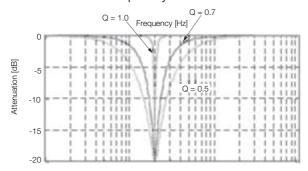
Notch filters are set with three parameters for the notch filter frequency, notch filter Q value, and notch filter depth. This section describes the notch filter Q value and notch filter depth.

8.13.1 Tuning the Servo Gains

· Notch filter Q Value

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

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



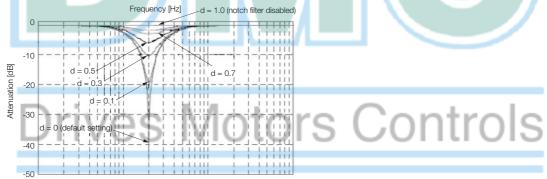
Note: The above notch filter frequency characteristics are based on calculated values and may be different from actual characteristics.

Notch Filter Depth

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

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

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



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

You can enable or disable the notch filter with Pn408 and Pn416.

Parameter		Meaning	When Enabled	Classification
	n.□□□0 (default setting)	Disable first stage notch filter.		
Pn408	n.□□□1	Enable first stage notch filter.		
PN408	n.□0□□ (default setting)	Disable second stage notch filter.		Setup
	n.🗆 1 🗆 🗆	Enable second stage notch filter.		
	n.□□□0 (default setting)	Disable third stage notch filter.	Immediately	
	n.□□□1	Enable third stage notch filter.	ı	
Pn416	n.□□0□ (default setting)	Disable fourth stage notch filter.		
	n.0010	Enable fourth stage notch filter.		
	n.□0□□ (default setting)	Disable fifth stage notch filter.		
	n.□1□□	Enable fifth stage notch filter.		

Set the machine vibration frequencies in the notch filter parameters.

	First Stage Notch F	ilter Frequency		Speed Posit	ion Torque
Pn409	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 5,000	1 Hz	5,000	Immediately	Tuning
	First Stage Notch F	ilter Q Value		Speed Posit	ion Torque
Pn40A	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 1,000	0.01	70	Immediately	Tuning
	First Stage Notch F	ilter Depth		Speed Posit	ion Torque
Pn40B	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,000	0.001	0	Immediately	Tuning
	Second Stage Notc	h Filter Frequency		Speed Posit	ion Torque
Pn40C	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 5,000	1 Hz	5,000	Immediately	Tuning
	Second Stage Notc	h Filter Q Value		Speed Posit	ion Torque
Pn40D	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 1,000	0.01	70	Immediately	Tuning
	Second Stage Notc	h Filter Depth		Speed Posit	ion Torque
Pn40E	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,000	0.001	0	Immediately	Tuning
	Third Stage Notch F	Filter Frequency		Speed Posit	Torque
Pn417	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 5,000	1 Hz	5,000	Immediately	Tuning
	Third Stage Notch F	ilter Q Value		Speed Posit	Torque
Pn418	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 1,000	0.01	70	Immediately	Tuning
	Third Stage Notch F	ilter Depth		Speed Posit	ion Torque
Pn419	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,000	0.001	0	Immediately	Tuning
	Fourth Stage Notch	Filter Frequency		Speed Posit	
Pn41A	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
)r	50 to 5,000	1 Hz	5,000	Immediately	Tuning
\cup	Fourth Stage Notch	Filter Q Value	3 00	Speed Posit	ion Torque
Pn41B	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 1,000	0.01	70	Immediately	Tuning
	Fourth Stage Notch			Speed Posit	
Pn41C	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,000	0.001	0	Immediately	Tuning
	Fifth Stage Notch F	ilter Frequency		Speed Posit	ion Torque
Pn41D	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 5,000	1 Hz	5,000	Immediately	Tuning
	Fifth Stage Notch F	ilter Q Value		Speed Posit	ion Torque
Pn41E	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	50 to 1,000	0.01	70	Immediately	Tuning
	Fifth Stage Notch F	ilter Depth		Speed Posit	ion Torque
Pn41F	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 1,000	0.001	0	Immediately	Tuning
	0 to 1,000	0.001	0	immediately	ranng



- Do not set notch filter frequencies (Pn409, Pn40C, Pn417, Pn41A, and Pn41D) that are close to the speed loop's response frequency. Set a frequency that is at least four times the speed loop gain (Pn100). (However, Pn103 (Moment of Inertia Ratio) must be set correctly. If the setting is not correct, vibration may occur and the machine may be damaged.
- Change the notch filter frequencies (Pn409, Pn40C, Pn417, Pn41A, and Pn41D) only while the Servomotor is stopped. Vibration may occur if a notch filter frequency is changed during operation.

8.13.1 Tuning the Servo Gains

Guidelines for Manually Tuning Servo Gains

When you manually adjust the parameters, make sure that you completely understand the information in the product manual and use the following conditional expressions as guidelines. The appropriate values of the parameter settings are influenced by the machine specifications, so they cannot be determined universally. When you adjust the parameters, actually operate the machine and use the SigmaWin+ or analog monitor to monitor operating conditions. Even if the status is stable while the Servomotor is stopped, an unstable condition may occur when an operation reference is input. Therefore, input operation references and adjust the servo gains as you operate the Servomotor.

Stable gain: Settings that provide a good balance between parameters.

However, if the load moment of inertia is large and the machine system contains elements prone to vibration, you must sometimes use a setting that is somewhat higher to prevent the machine from vibrating.

Critical gain: Settings for which the parameters affect each other

Depending on the machine conditions, overshooting and vibration may occur and operation may not be stable. If the critical gain condition expressions are not met, operation will become more unstable, and there is a risk of abnormal motor shaft vibration and round-trip operation with a large amplitude. Always stay within the critical gain conditions.

If you use the torque reference filter, second torque reference filter, and notch filters together, the interference between the filters and the speed loop gain will be superimposed. Allow leeway in the adjustments.



The following adjusted value guidelines require that the setting of Pn103 (Moment of Inertia Ratio) is correctly set for the actual machine.

♦ When Pn10B = n.□□0□ (PI Control)

Guidelines are given below for gain settings 1.

The same guidelines apply to gain settings 2 (Pn104, Pn105, Pn106, and Pn412).

• Speed Loop Gain (Pn100 [Hz]) and Position Loop Gain (Pn102 [/s])

Stable gain: Pn102 [/s] $\leq 2\pi \times \text{Pn100/4}$ [Hz] Critical gain: Pn102 [/s] $< 2\pi \times \text{Pn100}$ [Hz]

- Speed Loop Gain (Pn100 [Hz]) and Speed Loop Integral Time Constant (Pn101 [ms]) Stable gain: Pn101 [ms] \geq 4,000/($2\pi \times$ Pn100 [Hz]) Critical gain: Pn101 [ms] > 1,000/($2\pi \times$ Pn100 [Hz])
- Speed Loop Gain (Pn100 [Hz]) and First Stage First Torque Reference Filter Time Constant (Pn401 [ms])

Stable gain: Pn401 [ms] \leq 1,000/(2 π × Pn100 [Hz] × 4) Critical gain: Pn401 [ms] < 1,000/(2 π × Pn100 [Hz] × 1)

8

 Speed Loop Gain (Pn100 [Hz]) and Second Stage Second Torque Reference Filter Frequency (Pn40F [Hz])

Critical gain: Pn40F [Hz] $> 4 \times$ Pn100 [Hz]

Note: Set the Second Stage Second Torque Reference Filter Q Value (Pn410) to 0.70.

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

• Speed Loop Gain (Pn100 [Hz]) and Speed Feedback Filter Time Constant (Pn308 [ms]) Stable gain: Pn308 [ms] \leq 1,000/(2 π × Pn100 [Hz] × 4) Critical gain: Pn308 [ms] < 1,000/(2 π × Pn100 [Hz] × 1)

◆ When Pn10B = n.□□1□ (I-P Control)

Guidelines are given below for gain settings 1.

The same guidelines apply to gain settings 2 (Pn104, Pn105, Pn106, and Pn412).

For I-P control, the relationships between the speed loop integral time constant, speed loop gain, and position loop gain are different from the relationships for PI control. The relationship between other servo gains is the same as for PI control.

- Speed Loop Gain (Pn100 [Hz]) and Speed Loop Integral Time Constant (Pn101 [ms]) Stable gain: Pn100 [Hz] ≥ 320/Pn101 [ms]
- Position Loop Gain (Pn102 [/s]) and Speed Loop Integral Time Constant (Pn101 [ms]) Stable gain: Pn102 [/s] ≤ 320/Pn101 [ms]

Information

Selecting the Speed Loop Control Method (PI Control or I-P Control) Usually, I-P control is effective for high-speed positioning and high-speed, high-precision processing applications. With I-P control, you can use a lower position loop gain than for PI control to reduce the positioning time and reduce arc radius reduction. However, if you can use mode switching to change to proportional control to achieve the desired application, then using PI control would be the normal choice.

◆ Decimal Points in Parameter Settings

For the SGD7S SERVOPACKs, decimal places are given for the settings of parameters on the Digital Operator, Panel Operator, and in the manual. For example with Pn100 (Speed Loop Gain), Pn100 = 40.0 is used to indicate a setting of 40.0 Hz. In the following adjusted value guidelines, the decimal places are also given.

Example

Speed Loop Gain (Pn100 [Hz]) and Speed Loop Integral Time Constant (Pn101 [ms]) Stable gain: Pn101 [ms] \geq 4,000/(2 π × Pn100 [Hz]), therefore If Pn100 = 40.0 [Hz], then Pn101 = 4,000/(2 π × 40.0) \approx 15.92 [ms].

Model Following Control

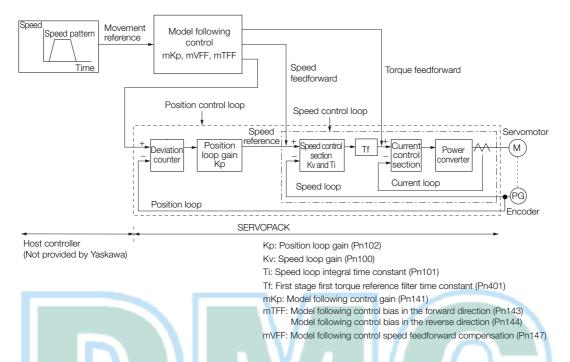
You can use model following control to improve response characteristic and shorten positioning time. You can use model following control only with position control.

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

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

8.13.1 Tuning the Servo Gains

The block diagram for model following control is provided below.



◆ Manual Tuning Procedure

Use the following tuning procedure for using model following control.

Step	Description
1	Friction compensation must also be used. Set the friction compensation parameters. Refer to the following section for the setting procedure. 8.12.2 Friction Compensation on page 8-70
	Adjust the servo gains. Refer to the following section for an example procedure. Tuning Procedure Example (for Position Control or Speed Control) on page 8-77
2	Note: 1. Set the moment of inertia ratio (Pn103) as accurately as possible. 2. Refer to the guidelines for manually tuning the servo gains and set a stable gain for the position loop gain (Pn102). Guidelines for Manually Tuning Servo Gains on page 8-82
3	Increase the model following control gain (Pn141) as much as possible within the range in which overshooting and vibration do not occur.
4	If overshooting occurs or if the response is different for forward and reverse operation, fine-tune model following control with the following settings: model following control bias in the forward direction (Pn143), model following control bias in the reverse direction (Pn144), and model following control speed feedforward compensation (Pn147).

◆ Related Parameters

Next we will describe the following parameters that are used for model following control.

- Pn140 (Model Following Control-Related Selections)
- Pn141 (Model Following Control Gain)
- Pn143 (Model Following Control Bias in the Forward Direction)
- Pn144 (Model Following Control Bias in the Reverse Direction)
- Pn147 (Model Following Control Speed Feedforward Compensation)

■ Model Following Control-Related Selections

Set $Pn140 = n.\square\square\square\square X$ to specify whether to use model following control.

If you use model following control with vibration suppression, set Pn140 to $n.\Box\Box1\Box$ or Pn140 = $n.\Box\Box2\Box$. When you also perform vibration suppression, adjust vibration suppression with custom tuning in advance.

Note: If you use vibration suppression (Pn140 = n.□□1□ or Pn140 = n.□□2□), always set Pn140 to n.□□□1 (Use model following control).

Parameter		Function	When Enabled	Classification
	n.□□□0 (default setting) Do not use model following control.			
	n.0001	Use model following control.		Tuning
Pn140	n.□□0□ (default setting)	Do not perform vibration suppression.	Immediately	
	n.□□1□	Perform vibration suppression for a specific frequency.		
	n.□□2□	Perform vibration suppression for two specific frequencies.		

■ Model Following Control Gain

The model following control gain determines the response characteristic of the servo system. If you increase the setting of the model following control gain, the response characteristic will improve and the positioning time will be shortened. The response characteristic of the servo system is determined by this parameter, and not by Pn102 (Position Loop Gain).

Model Following Control Gain			Posit	ion	
Pn141	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	10 to 20,000	0.1/s	500	Immediately	Tuning

Information

For machines for which a high model following control gain cannot be set, the size of the position deviation in model following control will be determined by the setting of the model following control gain. For a machine with low rigidity, in which a high model following control gain cannot be set, position deviation overflow alarms may occur during high-speed operation. If that is the case, you can increase the setting of the following parameter to increase the level for alarm detection.

Use the following conditional expression for reference in determining the setting.

Pn 520
$$\geq \frac{\text{Maximum feed speed [reference units/s]}}{\text{Pn 141/10 [1/s]}} \times 2.0$$

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

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.

8.13.2 Compatible Adjustment Functions

	Model Following Control Bias in the Forward Direction			Position		
Pn143	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	0.1%	1,000	Immediately	Tuning	
	Model Following Control Bias in the Reverse Direction			Position		
Pn144	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	0.1%	1,000	Immediately	Tuning	

■ Model Following Control Speed Feedforward Compensation

If overshooting occurs even after you adjust the model following control gain, model following control bias in the forward direction, and model following control bias in the reverse direction, you may be able to improve performance by setting the following parameter.

If you decrease the settings, the response characteristic will be lowered but overshooting will be less likely to occur.

	Model Following Control Speed Feedforward Compensation			Position	
Pn147	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	0.1%	1,000	Immediately	Tuning

■ Model Following Control Type Selection

When you enable model following control, you can select the model following control type. Normally, set Pn14F to n. \$\square\$ (Use model following control type 2) (default setting). If compatibility with previous models is required, set Pn14F to n. \$\square\$ (Use model following control type 1).

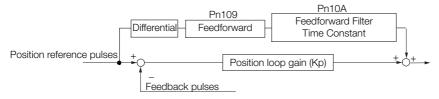
F	Parameter	Meaning	When Enabled	Classification
	n.□□□0	Use model following control type 1.		
Pn14F	n.□□□1 (default setting)	Use model following control type 2.	After restart	Tuning

8.13.2 Compatible Adjustment Functions

The compatible adjustment functions are used together with manual tuning. You can use these functions to improve adjustment results. These functions allow you to use the same functions as for Σ -III-Series SERVOPACKs to adjust Σ -7-Series SERVOPACKs.

Feedforward

The feedforward function applies feedforward compensation to position control to shorten the positioning time.



	Feedforward		Position		
Pn109	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 100	1%	0	Immediately	Tuning
	Feedforward Filter T	ime Constant	Position		
Pn10A	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 6,400	0.01 ms	0	Immediately	Tuning

Note: If you set the feedforward value too high, the machine may vibrate. As a guideline, use a setting of 80% or less.

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.

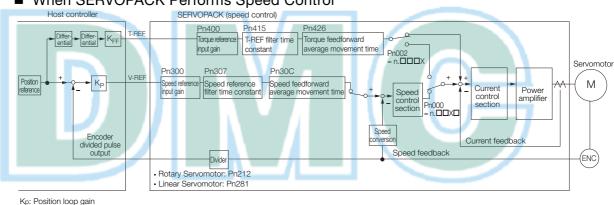
Torque feedforward: This is effective for speed control or position control. It is sent from the host controller along with the speed reference. Connect the speed reference from the host controller to the V-REF (CN1-5 and CN1-6) signal and the torque feedforward reference from the host controller to the T-REF (CN1-9 and CN1-10) signal.

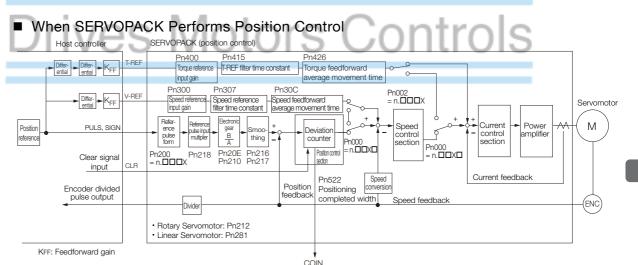
Speed feedforward: This is effective only for position control. It is sent to the SERVOPACK from the host controller along with the position reference. Connect the position reference from the host controller to the PULS and SIGN (CN1-7,CN1 -8, CN1-11, and CN1-12) signals and the speed feedforward reference from the host controller to the V-REF (CN1-5 and CN1-6) signal.

Examples of Connections to Host Controllers

■ When SERVOPACK Performs Speed Control

KFF: Feedforward gain





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8.13.2 Compatible Adjustment Functions

Related Parameters

■ Torque Feedforward

Torque feedforward is allocated to T-REF ($Pn002 = n.\Box\Box\Box X$) and it is set using the torque reference input gain (Pn400) and T-REF filter time constant (Pn415).

The default setting of Pn400 is 30. Therefore, if the torque feedforward value is ± 3 V, then the torque is limited to $\pm 100\%$ of the rated torque.

Parameter		Meaning			When Enabled	Classification	
Pn002	n.□□□0 (default setting)	Do not use T-REF.				Setup	
	n.□□□1	Use T-REF as an external torque limit input.			After restart		
1 11002	n.□□□2	Use T-REF as a torque feedback input.			Aiter restait		
	n.□□□3		T-REF as an exterr en /P-CL or /N-CL is	nal torque limit input s active.			
	Torque Reference Input Gain				Speed Position Torque		
Pn400	Setting Range		Setting Unit	Default Setting	When Enabled	Classification	
	10 to 100	(0.1 V/rated torque	30	Immediately	Setup	
	T-REF Filter Time Constant		Speed Positi	on Torque			
Pn415	Setting Range		Setting Unit	Default Setting	When Enabled	Classification	
	0 to 65,535		0.01 ms	0	Immediately	Setup	
	Torque feedforwa	ard a	verage movement	time			
Pn426	Setting Range		Setting Unit	Default Setting	When Enabled	Classification	
	0 to 5,100		0.1 ms	0	Immediately	Setup	

Note: 1. Overshooting will occur if you set the torque feedforward too high. Set the optimum value while monitoring the response.

■ Speed Feedforward

You set the speed feedforward function with the position control option ($Pn207 = n.\square\square X\square$) and the speed reference input gain (Pn300).

The default setting of Pn300 is 600. Therefore, if the speed feedforward value is ± 6 V, then it will indicate the rated speed.

Parameter		Mea	ning	When Enabled	Classification		
Pn207	n.□□0□ (default setting)	Do not use V-REF.		After restart	Setup		
	n.0010	Use V-REF as a speed	feedback input.				
	Speed Reference	Input Gain		Speed Position Torque			
Pn300	Setting Range	Setting Unit	Default Setting	When Enabled	Classification		
1 11000	150 to 3,000	0.01 V/Rated motor speed	600	Immediately	Setup		
	Speed Reference Filter Time Constant						
Pn307	Setting Range	Setting Unit	Default Setting	When Enabled	Classification		
	0 to 65,535	0.01 ms	40	Immediately	Setup		
	Speed Feedforwa	rd Average Movement					
Pn30C	Setting Range	Setting Unit	Default Setting	When Enabled	Classification		
	0 to 5,100	0.1 ms	0	Immediately	Setup		

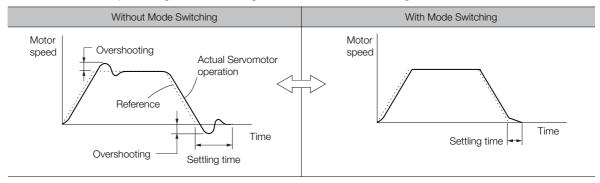
Note: Overshooting will occur if you set the feedforward too high. Set the optimum value while monitoring the response.

^{2.} You cannot use the torque feedforward function together with torque limiting with an analog voltage reference.

Mode Switching (Changing between Proportional and Pl Control)

You can use mode switching to automatically change between proportional control and PI control

Overshooting caused by acceleration and deceleration can be suppressed and the settling time can be reduced by setting the switching condition and switching levels.



Related Parameters

Select the switching condition for mode switching with $Pn10B = n.\Box\Box\Box X$.

	Parameter		Mode Switching Selection		that Sets the vel Linear Servomotor	When Enabled	Classification
-		n.□□□0 (default setting)	Use the internal torque reference as the condition.		10C		
		n.□□□1	Use the speed reference as the condition.	Pn10D	Pn181	Immediately	Setup
	Pn10B	n.□□□2 n.□□□3	Use the acceleration reference as the condition. Use the position deviation as the	Pn10E Pn	Pn182		
		n.□□□4	Do not use mode switching.	-	-		

■ Parameters That Set the Switching Levels

Rotary Servomotors

	Mode Switching L	evel for Torque Ref	Speed Position			
Pn10C	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 800	1%	200	Immediately	Tuning	
	Mode Switching L	evel for Speed Refe	Speed Position			
Pn10D	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	1 min ⁻¹	0	Immediately	Tuning	
	Mode Switching L	evel for Acceleration	Speed Position			
Pn10E	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 30,000	1 min ⁻¹ /s	0	Immediately	Tuning	
	Mode Switching Level for Position Deviation			Position		
Pn10F	Setting Range	Setting Unit	Default Setting	When Enabled	Classification	
	0 to 10,000	1 reference unit	0	Immediately	Tuning	

8.13.2 Compatible Adjustment Functions

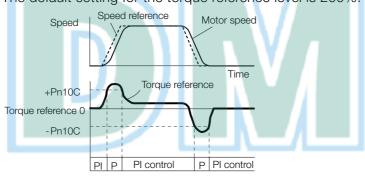
Linear Servomotors

	Mode Switching L	evel for Force Refe	Speed Position		
Pn10C	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 800	1%	200	Immediately	Tuning
	Mode Switching L	evel for Speed Ref	Speed Position		
Pn181	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 mm/s	0	Immediately	Tuning
	Mode Switching L	evel for Acceleration	Speed Position		
Pn182	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 30,000	1 mm/s ²	0	Immediately	Tuning
	Mode Switching L	ode Switching Level for Position Deviation		Position	
Pn10F	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 10,000	1 reference unit	0	Immediately	Tuning

■ Using the Torque Reference as the Mode Switching Condition (Default Setting)

When the torque reference equals or exceeds the torque set for the mode switching level for torque reference (Pn10C), the speed loop is changed to P control.

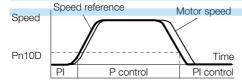




■ Using the Speed Reference as the Mode Switching Condition

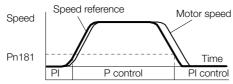
Rotary Servomotors

When the speed reference equals or exceeds the speed set for the mode switching level for a speed reference (Pn10D), the speed loop is changed to P control.



• Linear Servomotors

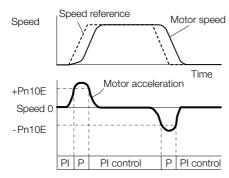
When the speed reference equals or exceeds the speed set for the mode switching level for a speed reference (Pn181), the speed loop is changed to P control.



Using the Acceleration as the Mode Switching Condition

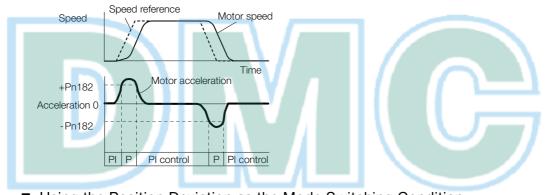
Rotary Servomotors

When the speed reference equals or exceeds the acceleration rate set for the mode switching level for acceleration (Pn10E), the speed loop is changed to P control.



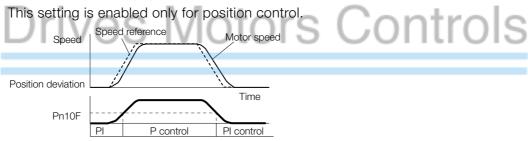
Linear Servomotors

When the speed reference equals or exceeds the acceleration rate set for the mode switching level for acceleration (Pn182), the speed loop is changed to P control.



■ Using the Position Deviation as the Mode Switching Condition

When the position deviation equals or exceeds the value set for the mode switching level for position deviation (Pn10F), the speed loop is changed to P control.



Position Integral

The position integral is the integral function of the position loop. It is used for the electronic cams and electronic shafts when using the SERVOPACK with a Yaskawa MP3000-Series Machine Controller.

	Position Integral Time Constant			Position	
Pn11F	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0 to 50,000	0.1 ms	0	Immediately	Tuning

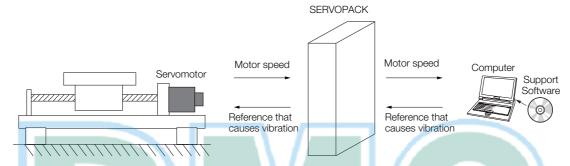
8.14

Diagnostic Tools

8.14.1 Mechanical Analysis

Overview

You can connect the SERVOPACK to a computer to measure the frequency characteristics of the machine. This allows you to measure the frequency characteristics of the machine without using a measuring instrument.



The Servomotor is used to cause machine vibration and then the speed frequency characteristics for the motor torque are measured. The measured frequency characteristics can be used to determine the machine resonance.

You determine the machine resonance for use in servo tuning and as reference for considering changes to the machine. The performance of the servo cannot be completely utilized depending on the rigidity of the machine. You may need to consider making changes to the machine. The information can also be used as reference for servo tuning to help you adjust parameters, such as the servo rigidity and torque filter time constant.

You can also use the information to set parameters, such as the notch filters.

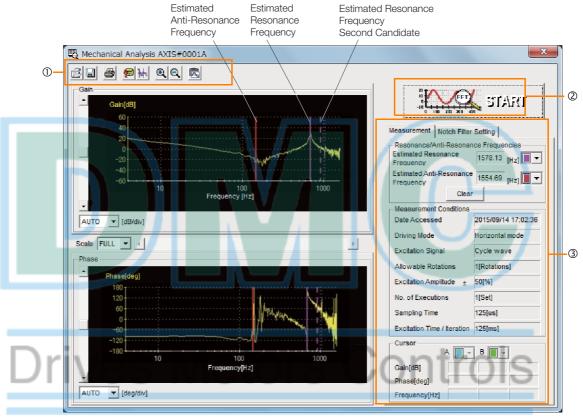
DIVES IV WARNING UTILIOIS

Mechanical analysis requires operating the Servomotor and therefore presents hazards.
 Before you execute mechanical analysis, check the information provided in the SigmaWin+operating manual.

Frequency Characteristics

The Servomotor is used to cause the machine to vibrate and the frequency characteristics from the torque to the motor speed are measured to determine the machine characteristics. For a normal machine, the resonance frequencies are clear when the frequency characteristics are plotted on graphs with the gain and phase (Bode plots). The Bode plots show the size (gain) of the response of the machine to which the torque is applied, and the phase delay (phase) in the response for each frequency. Also, the machine resonance frequency can be determined from the maximum frequency of the valleys (anti-resonance) and peaks (resonance) of the gain and the phase delay.

For a Servomotor without a load or for a rigid mechanism, the gain and phase change gradually in the Bode plots.



- ① Toolbar
- ② **START** Button Click the **START** Button to start analysis.
- ③ Measurement and Notch Filter Setting Tab Pages
 Measurement Tab Page: Displays detailed information on the results of analysis.
 Notch Filter Setting Tab Page: Displays the notch filter frequencies. You can set these values in the parameters.

8.14.2 Easy FFT

The machine is made to vibrate and a resonance frequency is detected from the generated vibration to set notch filters according to the detected resonance frequencies. This is used to eliminate high-frequency vibration and noise.

During execution of Easy FFT, a frequency waveform reference is sent from the SERVOPACK to the Servomotor to automatically cause the shaft to rotate multiple times within 1/4th of a rotation, thus causing the machine to vibrate.

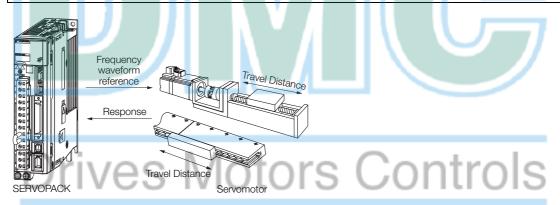
Execute Easy FFT after the servo is turned OFF if operation of the SERVOPACK results in high-frequency noise and vibration.

♠ WARNING

 Never touch the Servomotor or machine during execution of Easy FFT. Doing so may result in injury.

A CAUTION

Use Easy FFT when the servo gain is low, such as in the initial stage of servo tuning. If you
execute Easy FFT after you increase the gain, the machine may vibrate depending on the
machine characteristics or gain balance.



Easy FFT is built into the SERVOPACK for compatibility with previous products. Normally use autotuning without a host reference for tuning.

Preparations

Always check the following before you execute Easy FFT.

- The parameters must not be write prohibited.
- The main circuit power supply must be ON.
- The test without a motor function must be disabled ($Pn00C = n.\square\square\square\square0$).
- There must be no alarms.
- There must be no hard wire base block (HWBB).
- The servo must be OFF.
- There must be no overtravel.
- An external reference must not be input.

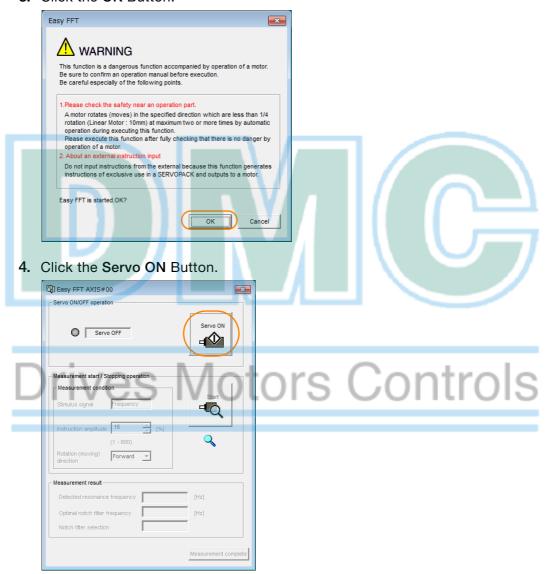
Operating Procedure

Use the following procedure for Easy FFT.

- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Easy FFT in the Menu Dialog Box.

The Easy FFT Dialog Box will be displayed. Click the **Cancel** Button to cancel Easy FFT. You will return to the main window.

3. Click the OK Button.



8.14.2 Easy FFT

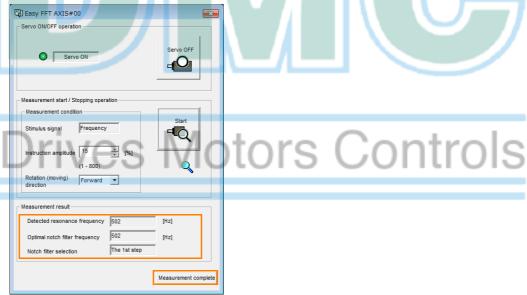
5. Select the instruction (reference) amplitude and the rotation direction in the Measurement condition Area, and then click the Start Button.

The Servomotor shaft will rotate and measurements will start.

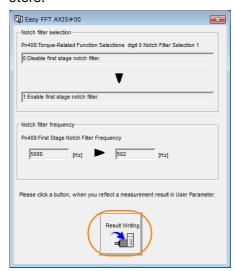


When measurements have been completed, the measurement results will be displayed.

6. Check the results in the **Measurement result** Area and then click the **Measurement complete** Button.



7. Click the Result Writing Button if you want to set the measurement results in the parameters.



This concludes the procedure to set up Easy FFT.

Related Parameters

The following parameters are automatically adjusted or used as reference when you execute Easy FFT.

Do not change the settings of these parameters during execution of Easy FFT.

Parameter	Name	Automatic Changes
Pn408	Torque-Related Function Selections	Yes
Pn409 First Stage Notch Filter Frequency		Yes
Pn40A	First Stage Notch Filter Q Value	No
Pn40C Second Stage Notch Filter Frequency		Yes
Pn40D	Second Stage Notch Filter Q Value	No
Pn456 Sweep Torque Reference Amplitude		No

Yes: The parameter is automatically set.

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

Monitoring

9

This chapter provides information on monitoring SERVO-PACK product information and SERVOPACK status.

9.1	Monit	oring Product Information9-2	
٦	9.1.1 9.1.2	Items That You Can Monitor	
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9.1

Monitoring Product Information

9.1.1 Items That You Can Monitor

The items that you can monitor in the SigmaWin+ Product Information Window are listed below.

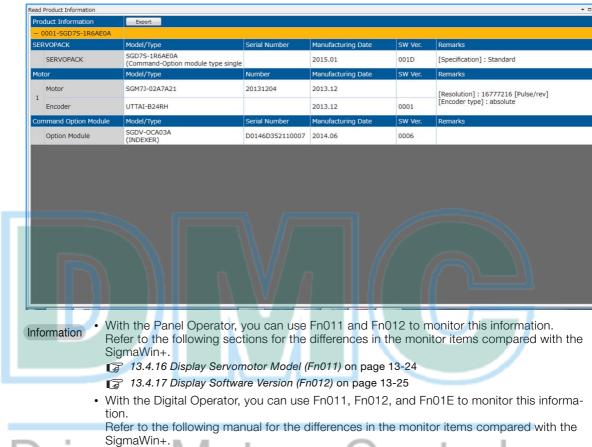
Monitor Items			
Information on SERVOPACKs	Model/TypeSerial NumberManufacturing DateSoftware version (SW Ver.)Remarks		
Information on Servomotors	 Model/Type Serial Number Manufacturing Date Remarks		
Information on Encoders	Model/TypeSerial NumberManufacturing DateSoftware version (SW Ver.)Remarks		
Information on Option Modules	 Model/Type Serial Number Manufacturing Date Software version (SW Ver.) Remarks 		

Drives Motors Controls

9.1.2 Operating Procedures

Use the following procedure to display the Servo Drive product information.

• Select *Read Product Information* in the Menu Dialog Box of the SigmaWin+. The Read Product Information Window will be displayed.



9.2.1 Servo Drive Status

9.2

Monitoring SERVOPACK Status

9.2.1 Servo Drive Status

Use the following procedure to display the Servo Drive status.

• Start the SigmaWin+. The Servo Drive status will be automatically displayed when you go online with a SERVOPACK.



The Servo Drive status is displayed.

The Servomotor type is displayed.



Drives Motors Controls

Monitoring Status and Operations

Items That You Can Monitor

The items that you can monitor on the Status Monitor Window and Motion Monitor Window are listed below.

· Status Monitor Window

9.2.2

Monitor Items · Main Circuit /S-ON (Servo ON Input Signal) ALM (Servo Alarm Output • Encoder (PGRDY) • /P-CON (Proportional Control Input Signal) • Motor Power (Request) · /COIN (Positioning Completion Output Signal) • /V-CMP (Speed Coinci- Motor Power ON • P-OT (Forward Drive Prohibit Input • Dynamic Brake (DB) Signal) Rotation (Movement) • N-OT (Reverse Drive Prohibit Input dence Detection Output Direction Signal) Signal) · Mode Switch • /P-CL (Forward External Torque Limit • /TGON (Rotation Detec-• Speed Reference (V-Ref) tion Output Signal) Signal) • /S-RDY (Servo Ready Out-• Torque Reference (T-Ref) • /N-CL (Reverse External Torque Limit Position Reference put Signal) /ALM-RST (Alarm Reset Input Signal) (PULS) /CLT (Torque Limit Detec- Position Reference • SEN (Absolute Data Request Input tion Output Signal) Direction Signal) /VLT (Speed Limit Detec- Clear Signal (CLR) tion Output Signal) /SPD-D (Motor Direction Signal) Surge Current Limiting • /SPD-A (Internal Set Speed Selection /BK (Brake Output Signal) Input Signal) Resistor Short Relay Status /WARN (Warning Output Regenerative Transistor • /SPD-B (Internal Set Speed Selection Signal) • /NEAR (Near Output Sig- Regenerative Error Input Signal) Signal Detection • /C-SEL (Control Selection Input Sig- AC Power ON ALO1 (Alarm Code Output • /ZCLAMP (Zero Clamping Input Sig- Overcurrent Signal) Origin Not Passed nal) ALO2 (Alarm Code Output • /INHIBIT (Reference Pulse Inhibit Signal) • ALO3 (Alarm Code Output Input Signal) /G-SEL (Gain Selection Input Signal) Signal) • /P-DET (Polarity Detection Input Sig-• PAO (Encoder Divided Pulse Output Phase A Sig-PULS (Pulse Reference Input Signal) SIGN (Sign Reference Input Signal) PBO (Encoder Divided • CLR (Position Deviation Clear Input Pulse Output Phase B Sig-Signal) nal) • /PSEL (Reference Pulse Input Multi-• PCO (Encoder Divided plication Input Signal) Pulse Output Phase C Sig- FSTP (Forced Stop Input Signal) • /PSELA (Reference Pulse Input Multiplication Switching Output Signal) /PM (Preventative Maintenance Output Signal)

Motion Monitor Window

Monitor Items

- Current Alarm State
- Motor Speed
- Speed Reference
- Internal Torque Reference
- Angle of Rotation 1 (number of encoder pulses from origin within one encoder rotation)
- Angle of Rotation 2 (angle from origin within one encoder rotation)
- Input Reference Pulse Speed
- Deviation Counter (Position Deviation)
- · Cumulative Load
- Regenerative Load

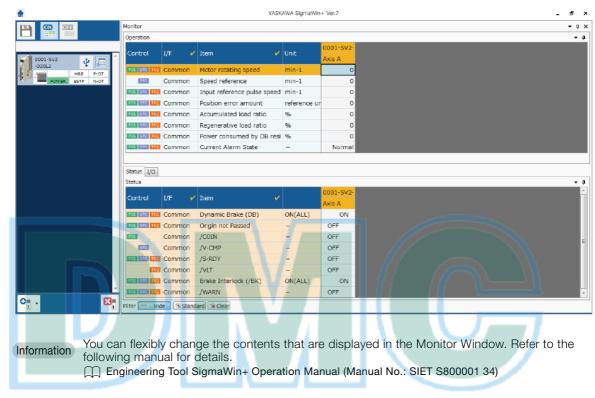
- Power Consumption
- Consumed Power
- Cumulative Power Consumption
- DB Resistor Consumption Power
- Absolute Encoder Multiturn Data
- Absolute Encoder Position within One Rotation
- Absolute Encoder (Lower)
- Absolute Encoder (Upper)
- Reference Pulse Counter
- Feedback Pulse Counter
- Fully Closed Feedback Pulse Counter
- Total Operating Time

9.2.2 Monitoring Status and Operations

Operating Procedure

Use the following procedure to display the Motion Monitor and Status Monitor for the SERVO-PACK.

Select Monitor in the SigmaWin+ Menu Dialog Box.
 The Operation Pane and Status Pane will be displayed in the Monitor Window.

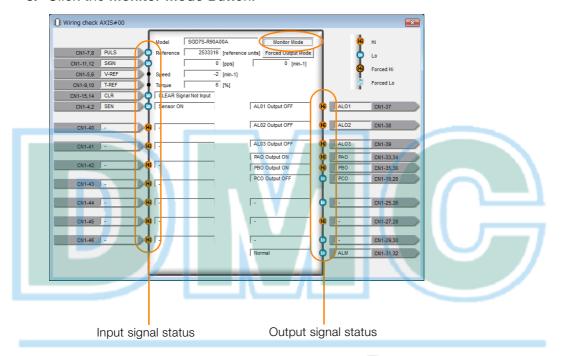


Drives Motors Controls

9.2.3 I/O Signal Monitor

Use the following procedure to check I/O signals.

- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Wiring Check in the Menu Dialog Box. The Wiring Check Dialog Box will be displayed.
- 3. Click the Monitor Mode Button.



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.

You cannot use the Force Output Mode Button while the servo is ON.

Checking Output Signal Wiring
 Click the Force Output Mode Button. This will force the output signal status to change. If
 the signal status at the host controller changes accordingly, then the wiring is correct.

9.3.1 Items That You Can Monitor

9.3

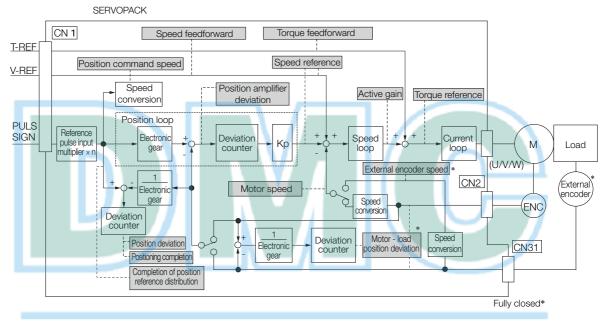
Monitoring Machine Operation Status and Signal Waveforms

To monitor waveforms, use the SigmaWin+ trace function or a measuring instrument, such as a memory recorder.

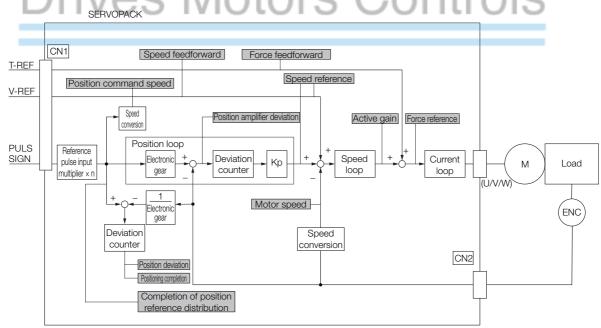
9.3.1 Items That You Can Monitor

You can use the SigmaWin+ or a measuring instrument to monitor the shaded items in the following block diagram.

· Rotary Servomotors



- * This speed is available when fully-closed loop control is being used.
- Linear Servomotors



Using the SigmaWin+

9.3.2

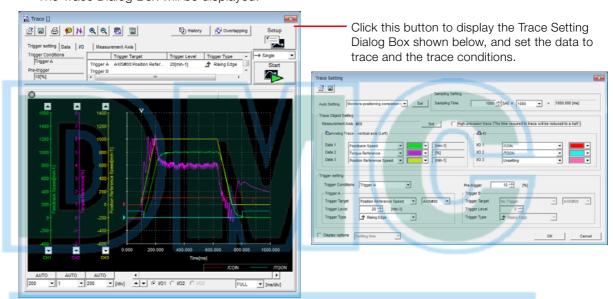
This section describes how to trace data and I/O with the SigmaWin+.

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

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

Operating Procedure

- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- Select Trace in the Menu Dialog Box. The Trace Dialog Box will be displayed.



Trace Objects Motors Controls

You can trace the following items.

Data Tracing

Trace Objects

- Torque Reference
- Feedback Speed
- Reference Speed
- Position Reference Speed
- Position Error (Deviation)
- Position Amplifier Error (Deviation)
- Motor Load Position Deviation
- Speed Feedforward
- Torque Feedforward
 Fffeeting (Asting) Cair
- Effective (Active) Gain
- Main Circuit DC Voltage
- External Encoder Speed
- Control Mode

9.3.3 Using the Analog Monitors

I/O Tracing

Trace Objects				
Input 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/Force Limit Input Signal) /N-CL (Reverse External Torque/Force Limit Input Signal) /SPD-D (Internal Set Speed Selection 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 Sig- 	Output Signals	 ALM (Servo Alarm Output Signal) /COIN (Positioning Completion Output Signal) /V-CMP (Speed Coincidence Detection Output Signal) /TGON (Rotation Detection Output Signal) /S-RDY (Servo Ready Output Signal) /CLT (Torque Limit Detection Output Signal) /VLT (Speed Limit Detection Output Signal) /KK (Brake Output Signal) /MARN (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) 	
L	nal) • /PSEL (Reference Pulse Input Multiplication Input Signal) • /HWBB1 (Hard Wire Base Block Input 1 Signal) • /HWBB2 (Hard Wire Base Block Input 2 Signal)	Internal Status	ACON (Main Circuit ON Signal) PDETCMP (Polarity Detection Completed Signal) DEN (Position Reference Distribution Completed Signal)	

9.3.3 Using the Analog Monitors

Connect a measuring instrument, such as a memory recorder, to the analog monitor connector (CN5) on the SERVOPACK to monitor analog signal waveforms. The measuring instrument is not provided by Yaskawa.

Refer to the following section for details on the connection.

4.7.3 Analog Monitor Connector (CN5) on page 4-51

Setting the Monitor Object

Use $Pn006 = n.\square\square XX$ and $Pn007 = n.\square\square XX$ (Analog Monitor 1 and 2 Signal Selections) to set the items to monitor.

Line Color	Signal	Parameter Setting
White	Analog monitor 1	Pn006 = n.□□XX
Red	Analog monitor 2	Pn007 = n.□□XX
Black (2 lines)	GND	-

Parameter		Description			
Par	ameter	Monitor Signal	Output Unit	Remarks	
	n.□□00 (default setting of Pn007)	Motor Speed	Rotary Servomotor: 1 V/1,000 min ⁻¹ Linear Servomotor: 1 V/1,000 mm/s	_	
	n.□□01	Speed Reference	 Rotary Servomotor:1 V/1,000 min⁻¹ Linear Servomotor:1 V/1,000 mm/s 	_	
	n.□□02 (default setting of Pn006)	Torque Reference	1 V/100% rated torque	_	
	n.□□03	Position Deviation	0.05 V/Reference unit	0 V for speed or torque control	
	n.□□04	Position Amplifier Deviation	0.05 V/encoder pulse unit	Position deviation after electronic gear conversion	
Pn006	n.□□05	Position Command Speed	Rotary Servomotor:1 V/1,000 min ⁻¹ Linear Servomotor:1 V/1,000 mm/s	The input reference pulses will be multiplied by n to output the position command speed.	
or Pn007	n.□□06	Reserved parameter (Do not change.)		-	
	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/1,000 min⁻¹ Linear Servomotor:1 V/1,000 mm/s 	_	
	n.□□0A	Torque Feedforward	1 V/100% rated torque	_	
Dri	n.□□0B	Active Gain*	1st gain: 1 V 2nd gain: 2 V	The gain that is active is indicated by the output voltage.	
	n.□□0C	Completion of Position Reference Distribution	Distribution completed: 5 V Distribution not completed: 0 V	Completion is indicated by the output voltage.	
	n.□□0D	External Encoder Speed	1 V/1,000 min ⁻¹	Value calculated at the motor shaft	
	n.□□10	Main Circuit DC Voltage	1 V/100 V (main circuit DC voltage)	_	
* Refer to t	the following se	ection for details.			

^{*} Refer to the following section for details.

**Befer to the following section for details.

**Befer to the following section for details.

**Befer to the following section for details.

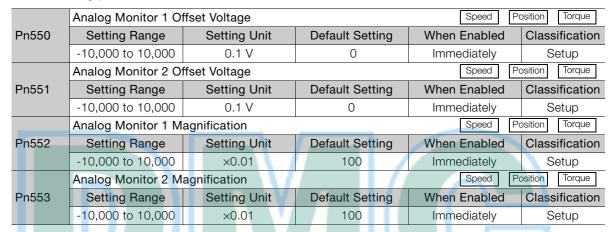
9.3.3 Using the Analog Monitors

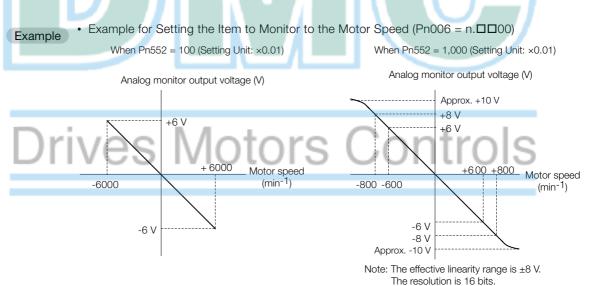
Changing the Monitor Factor and Offset

You can change the monitor factors and offsets for the output voltages for analog monitor 1 and analog monitor 2. The relationships to the output voltages are as follows:

Analog monitor 1 output voltage
$$= (-1) \times \left\{ \begin{array}{l} \text{Analog Monitor 1 Signal } \\ \text{Selection (Pn006} = n. \square \square XX) \times \text{Magnification (Pn552)}^+ \end{array} \right. \left. \begin{array}{l} \text{Analog Monitor 1 Analog Monitor 1 Analog Monitor 1 Analog Monitor 1 Analog Monitor 2 Analog Monitor 3 A$$

The following parameters are set.





Adjusting the Analog Monitor Output

You can manually adjust the offset and gain for the analog monitor outputs for the torque reference monitor and motor speed monitor.

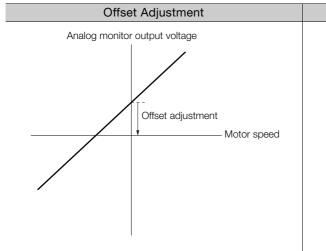
The offset is adjusted to compensate for offset in the zero point caused by output voltage drift or noise in the monitoring system.

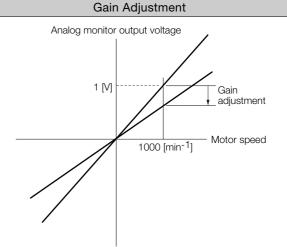
The gain is adjusted to match the sensitivity of the measuring system.

The offset and gain are adjusted at the factory. You normally do not need to adjust them.

◆ Adjustment Example

An example of adjusting the output of the motor speed monitor is provided below.





Item	Specification
Offset Adjustment Range	-2.4 V to 2.4 V
Adjustment Unit	18.9 mV/LSB
	$-\Lambda - \Lambda$

Item	Specification
Gain Adjustment Range	100 ±50%
Adjustment Unit	0.4%/LSB

The gain adjustment range is made using a 100% output value (gain adjustment of 0) as the reference value with an adjustment range of 50% to 150%.

A setting example is given below.

- Setting the Adjustment Value to -125 100 + (-125 × 0.4) = 50 [%]
 - Therefore, the monitor output voltage goes to 50% of the original value.
- Setting the Adjustment Value to 125 100 + (125 × 0.4) = 150 [%] Therefore, the monitor output voltage of

Therefore, the monitor output voltage goes to 150% of the original value.

Information

- The adjustment values do not use parameters, so they will not change even if the parameter settings are initialized.
- Adjust the offset with the measuring instrument connected so that the analog monitor output value goes to zero. The following setting example achieves a zero output.
 - While power is not supplied to the Servomotor, set the monitor signal to the torque reference.
 - In speed control, set the monitor signal to the position deviation.

Preparations

Always check the following before you adjust the analog monitor output.

• The parameters must not be write prohibited.

◆ Applicable Tools

You can use the following tools to adjust analog monitor outputs. The function that is used is given for each tool.

Offset Adjustment

Tool	Function	Operating Procedure Reference
Panel Operator	Fn00C	3.4.11 Adjust Analog Monitor Output Offset (Fn00C) on page 13-20
Digital Operator	Fn00C	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Analog Monitor Out- put Adjustment	◆ Operating Procedure on page 9-14

9.3.3 Using the Analog Monitors

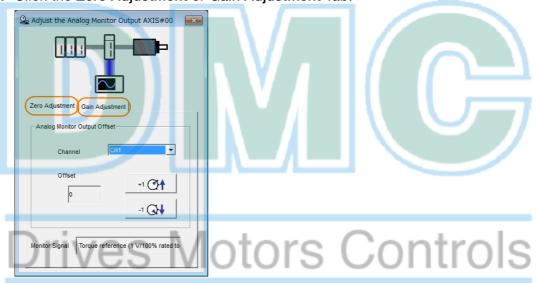
· Gain Adjustment

Tool	Function	Operating Procedure Reference
Panel Operator	Fn00D	13.4.12 Adjust Analog Monitor Output Gain (Fn00D) on page 13-20
Digital Operator	Fn00D	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Analog Monitor Output Adjustment	

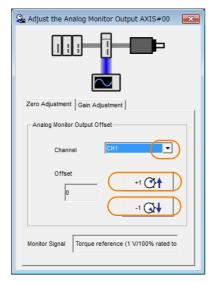
Operating Procedure

Use the following procedure to adjust the analog monitor output.

- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Adjust the Analog Monitor Output in the Menu Dialog Box. The Adjust the Analog Monitor Output Dialog Box will be displayed.
- 3. Click the Zero Adjustment or Gain Adjustment Tab.



4. While watching the analog monitor, use the +1 and -1 Buttons to adjust the offset. There are two channels: CH1 and CH2. If necessary, click the down arrow on the **Channel** Box and select the channel.



This concludes adjusting the analog monitor output.

9.4

Monitoring Product Life

9.4.1 Items That You Can Monitor

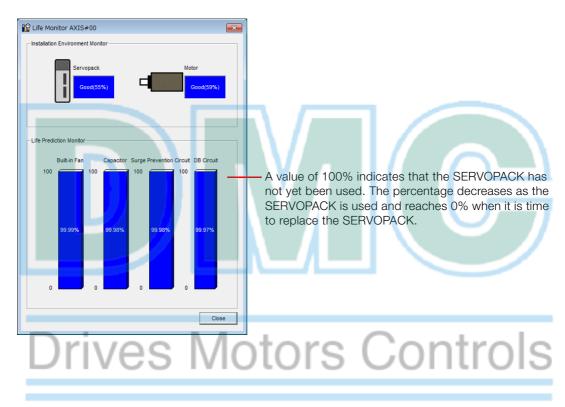
Monitor Item	Description
SERVOPACK Installation Envi- ronment	The operating status of the SERVOPACK in terms of the installation environment is displayed. Implement one or more of the following actions if the monitor value exceeds 100%. • Lower the surrounding temperature. • Decrease the load.
Servomotor Installation Environ- ment	The operating status of the SERVOPACK in terms of the installation environment is displayed. Implement one or more of the following actions if the monitor value exceeds 100%. • Lower the surrounding temperature. • Decrease the load.
Built-in Fan Service Life Prediction	The unused status of the SERVOPACK is treated as the 100% value. The value decreases each time the main circuit power supply is turned ON and each time the servo is turned OFF. Use a monitor value of 0% as a guideline for the replacement period. Refer to the following section for part replacement guidelines. 12.1.2 Guidelines for Part Replacement on page 12-2
Capacitor Service Life Prediction	The unused status of the SERVOPACK is treated as the 100% value. The value decreases each time the main circuit power supply is turned ON and each time the servo is turned OFF. Use a monitor value of 0% as a guideline for the replacement period. Refer to the following section for part replacement guidelines. 12.1.2 Guidelines for Part Replacement on page 12-2
Surge Prevention Circuit Service Life Prediction	The unused status of the SERVOPACK is treated as the 100% value. The value decreases each time the main circuit power supply is turned ON and each time the servo is turned OFF. Use a monitor value of 0% as a guideline for the replacement period. Refer to the following section for part replacement guidelines. [2] 12.1.2 Guidelines for Part Replacement on page 12-2
Dynamic Brake Circuit Service Life Prediction	The unused status of the SERVOPACK is treated as the 100% value. The value decreases each time the main circuit power supply is turned ON and each time the servo is turned OFF. Use a monitor value of 0% as a guideline for the replacement period. Refer to the following section for part replacement guidelines. 12.1.2 Guidelines for Part Replacement on page 12-2

9.4.2 Operating Procedure

Use the following procedure to display the installation environment and service life prediction monitor dialog boxes.

- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Life Monitor in the Menu Dialog Box. The Life Monitor Dialog Box will be displayed.

Information With the Panel Operator or Digital Operator, you can use Un025 to Un02A to monitor this information.



Preventative Maintenance

9.4.3

You can use the following functions for preventative maintenance.

- Preventative maintenance warnings
- /PM (Preventative Maintenance Output) signal

The SERVOPACK can notify the host controller when it is time to replace any of the main parts.

Preventative Maintenance Warning

An A.9b0 warning (Preventative Maintenance Warning) is detected when any of the following service life prediction values drops to 10% or less: SERVOPACK built-in fan life, capacitor life, inrush current limiting circuit life, and dynamic brake circuit life. You can change the setting of $PnOOF = n.\Box\Box\Box\Box X$ to enable or disable these warnings.

Parameter		Description	When Enabled	Classifi- cation
Pn00F	n.□□□0 (default setting)	Do not detect preventative maintenance warnings.	After restart	Setup
	n.□□□1	Detect preventative maintenance warnings.	restart	

/PM (Preventative Maintenance Output) Signal

The /PM (Preventative Maintenance Output) signal is output when any of the following service life prediction values reaches 10% or less: SERVOPACK built-in fan life, capacitor life, inrush current limiting circuit life, and dynamic brake circuit life. The /PM (Preventative Maintenance Output) signal must be allocated.

Even if detection of preventive maintenance warnings is disabled (Pn00F = $n.\Box\Box\Box$ 0), the /PM signal will still be output as long as it is allocated.

Classifi- cation	Signal	Connector Pin No.	Signal Status	Description
Output	/PM	Must be allocated.	ON (closed)	One of the following service life prediction values reached 10% or less: SERVOPACK built-in fan life, capacitor life, inrush current limiting circuit life, and dynamic brake circuit life. All of the following service life prediction values
			OFF (open)	are greater than 10%: SERVOPACK built-in fan life, capacitor life, inrush current limiting circuit life, and dynamic brake circuit life.

Note: You must allocate the /PM signal to use it. Use Pn514 = $n.\Box X\Box \Box$ (/PM (Preventative Maintenance Output) Signal Allocation) to allocate the signal to connector pins. Refer to the following section for details.

6.1.2 Output Signal Allocations on page 6-8

9.5.1 Data for Which Alarm Tracing Is Performed

Alarm Tracing

Alarm tracing records data in the SERVOPACK from before and after an alarm occurs. This data helps you to isolate the cause of the alarm.

You can display the data recorded in the SERVOPACK as a trace waveform on the SigmaWin+.

- Information
 Alarms that occur when the power supply is turned ON are not recorded.
 Alarms that occur during the recording of alarm trace data are not recorded.
 - · Alarms that occur while utility functions are being executed are not recorded.

9.5.1 **Data for Which Alarm Tracing Is Performed**

Two types of data are recorded for alarm tracing: numeric data and I/O signal ON/OFF data.

Numeric Data	ON/OFF Data
Torque reference	ALM
Feedback speed	Servo ON command (/S-ON)
Reference speed	Proportional control command (/P-CON)
Position reference speed	Forward torque command (/P-CL)
Position deviation	Reverse torque command (/N-CL)
Motor-load position deviation	G-SEL1 signal (/G-SEL1)
Main circuit bus voltage	ACON

9.5.2 **Applicable Tools**

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

Tool	Function	Operating Procedure Reference			
Panel Operator	You cannot display alarm tracing data from the Panel Operator.				
Digital Operator	You cannot display alarm	n tracing data from the Digital Operator.			
SigmaWin+	Alarm - Alarm Tracing	Engineering Tool SigmaWin+ Operation Manual (Manual No.: SIET S800001 34)			

Fully-Closed Loop Control

10

This chapter provides detailed information on performing fully-closed loop control with the SERVOPACK.

10.1	Fully-	Closed System10-2
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	10.3.2	3
	4000	Movement Direction
		Setting the Number of External Encoder Scale Pitches
	10.3.4	Setting the PAO, PBO, and PCO
		(Encoder Divided Pulse Output) Signals 10-7
	10.3.5	
		Sequence 10-8
	10.3.6	Electronic Gear Setting
	10.3.7	Alarm Detection Settings10-8
	10.3.8	Analog Monitor Signal Settings 10-10
	1039	Setting to Use an External Encoder

10.1

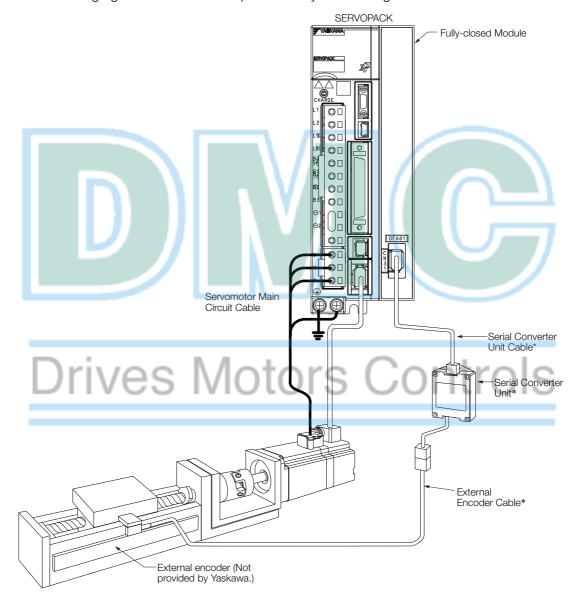
Fully-Closed System

With a fully-closed system, an externally installed encoder is used to detect the position of the controlled machine and the machine's position information is fed back to the SERVOPACK. High-precision positioning is possible because the actual machine position is fed back directly. With a fully-closed system, looseness or twisting of mechanical parts may cause vibration or oscillation, resulting in unstable positioning.

Refer to the following manual for details on Fully-closed Modules.

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

The following figure shows an example of the system configuration.



^{*} The connected devices and cables depend on the type of external linear encoder that is used.

Note: Refer to the following section for details on connections that are not shown above, such as connections to power supplies and peripheral devices.

2.4 Examples of Standard Connections between SERVOPACKs and Peripheral Devices on page 2-26

10.2 SERVOPACK Commissioning Procedure

First, confirm that the SERVOPACK operates correctly with semi-closed loop control, and then confirm that it operates correctly with fully-closed loop control.

The commissioning procedure for the SERVOPACK for fully-closed loop control is given below.

Step	Description	Operation	Required Parameter Settings	Con- trolling Device
1	Check operation of the entire sequence with semi-closed loop control and without a load. Items to Check • Power supply circuit wiring • Servomotor wiring • Wiring of I/O signal lines from the host controller • Servomotor rotation direction, motor speed, and multiturn data • Operation of safety mechanisms, such as the brakes and the overtravel mechanisms	Set the parameters so that the SERVOPACK operates correctly in semi-closed loop control without a load and check the following points. Set Pn002 to n.0□□□ to specify semi-closed loop control. • Are there any errors in the SERVOPACK? • Does jogging 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) 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, Pn50B, Pn511, Pn515, and Pn516 (Input Signal Selections) Pn50E, Pn50F, Pn510, Pn514, and Pn517 (Output Signal Selections)	SERVO- PACK or host con- troller
2 D1	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 con- troller
3	Check the external encoder. Items to Check Is the signal from the external encoder received correctly?	Set the parameters related to fully-closed loop control and move the machine with your hand without turning ON the power supply to the Servomotor. Check the following status with the 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	Con- trolling Device
4	Perform a program jog- ging operation. Items to Check Does the fully-closed system operate correctly for the SERVOPACK without a load?	Perform a program jogging operation and confirm that the travel distance is the same as the reference value in Pn531. When you perform program jogging, start from a low speed and gradually increase the speed.	Pn530 to Pn536 (program jogging-related parameters)	SERVO- PACK
5	Operate the SERVO-PACK. Items to Check Does the fully-closed system operate correctly, including the host controller?	Input a position reference and confirm that the SERVOPACK operates correctly. Start from a low speed and gradually increase the speed.	_	Host controller



Drives Motors Controls

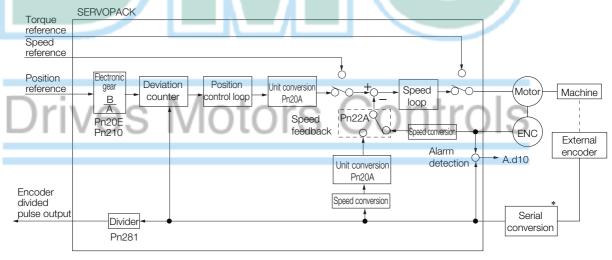
10.3 Parameter Settings for Fully-Closed Loop Control

This section describes the parameter settings that are related to fully-closed loop control.

Parameter to Set	Setting	Position Control	Speed Control	Torque Control	Reference
Pn000 = n.□□□X	Motor direction	√	√	√	2000 10 6
Pn002 = n.X□□□	External encoder usage method	√	√	√	page 10-6
Pn20A	Number of external encoder scale pitches	√	√	√	page 10-7
Pn281	Encoder divided pulse output signals (PAO, PBO, and PCO) from the SERVO-PACK	V	V	V	page 10-7
-	External absolute encoder data reception sequence	V	V	V	page 6-89
Pn20E and Pn210	Electronic gear ratio	√	_	_	page 5-46
Pn51B	Motor-load position deviation overflow detection level	√	-	_	page 10-8
Pn52A Multiplier per fully-closed rotation		√	_	_	
Pn006/Pn007	Analog monitor signal	V	$\sqrt{}$		page 10-10
Pn22A = n.X□□□ Speed feedback method during fully-closed loop control		V	-	-	page 10-10

10.3.1 Control Block Diagram for Fully-Closed Loop Control

The control block diagram for fully-closed loop control is provided below.



^{*} The connected device depends on the type of external encoder.

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).

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10.3.2 Setting the Motor Direction and the Machine Movement Direction

10.3.2 Setting the Motor Direction and the Machine Movement Direction

You must set the motor direction and the machine movement direction. To perform fully-closed loop control, you must set the motor rotation direction with both $Pn000 = n.\square\square\squareX$ (Direction Selection) and $Pn002 = n.X\square\square\square$ (External Encoder Usage).

Parameter			Pn002 = n.X□□□ (External Encoder Usage)			
			n.1□□□		n.3□□□	
		Reference direction	Forward reference	Reverse reference	Forward reference	Reverse reference
	n.□□□0	Motor direction	CCW	CW	CCW	CW
Pn000 =n.□□□X		External encoder	Forward movement	Reverse movement	Reverse movement	Forward movement
(Direction Selection)	n.0001	Reference direction	Forward reference	Reverse reference	Forward reference	Reverse reference
		Motor direction	CW	CCW	CW	CCW
		External encoder	Reverse movement	Forward movement	Forward movement	Reverse movement

- Phase B leads in the divided pulses for a forward reference regardless of the setting of Pn000 = n.□□□X.
- Forward direction: The direction in which the pulses are counted up.
- · Reverse direction: The direction in which the pulses are counted down.

Related Parameters

♦ Pn000 = n.□□□X

Refer to the following section for details.

5.6 Motor Direction Setting on page 5-18

◆ Pn002 = n.X□□□

When you perform fully-closed loop control, set Pn002 to n.1□□□ or n.3□□□.

P	arameter	Name	Meaning	When Enabled	Classifi- cation
	n.0□□□ (default set- ting)		Do not use an external encoder.		Setup
Pn002	n.1000	External Encoder Usage	External encoder moves in forward direction for CCW motor rotation.	After restart	
	n.2□□□		Reserved setting (Do not use.)		
	n.3□□□		External encoder moves in reverse direction for CCW motor rotation.		
	n.4000		Reserved setting (Do not use.)		

Information

Determine the setting of $Pn002 = n.X \square \square \square$ as described below.

- Set Pn000 to n.□□□□ (Use the direction in which the linear encoder counts up as the forward direction) and set Pn002 to n.1□□□ (The external encoder moves in the forward direction for CCW motor rotation).
- Manually rotate the motor shaft counterclockwise.
- If the fully-closed feedback pulse counter counts up, do not change the setting of Pn002 (Pn002 = n.1□□□).
- If the fully-closed feedback pulse counter counts down, set Pn002 to n.3 \(\square\$ \square\$.

10.3.3 Setting the Number of External Encoder Scale Pitches

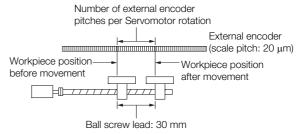
Set the number of external encoder scale pitches per Servomotor rotation in Pn20A.

Setting Example

Specifications

External encoder scale pitch: 20 μm

Ball screw lead: 30 mm



If the external encoder is connected directly to the Servomotor, the setting will be 1,500 (30 mm/0.02 mm = 1,500).

Note: 1. If there is a fraction, round off the digits below the decimal point.

2. If the number of external encoder scale pitches per Servomotor rotation is not an integer, there will be deviation in the position loop gain (Kp), feedforward, and position reference speed monitor. This is not relevant for the position loop and it therefore does not interfere with the position accuracy.

Related Parameters

	Number of Externa	I Encoder Scale Pito	ches	Pos	ition
Pn20A	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
111207	4 to 1,048,576	1 scale pitch/revo- lution	32,768	After restart	Setup

10.3.4 Setting the PAO, PBO, and PCO (Encoder Divided Pulse Output) Signals

Set the position resolution in Pn281 (Encoder Output Resolution).

Enter the number of phase A and phase B edges for the setting.

Setting Example

Specifications

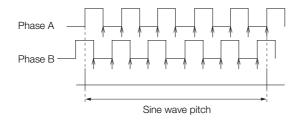
External encoder scale pitch: 20 μm

Ball screw lead: 30 mm Speed:1,600 mm/s

If a single pulse (multiplied by 4) is output for 1 μm, the setting would be 20.

If a single pulse (multiplied by 4) is output for 0.5 μ m, the setting would be 40.

The encoder divided pulse output would have the following waveform if the setting is 20.



"1" indicates the edge positions. In this example, the set value is 20 and therefore the number of edges is 20.

Note: The upper limit of the encoder signal output frequency (multiplied by 4) is 6.4 Mpps. Do not set a value that would cause the output to exceed 6.4 Mpps.

If the output exceeds the upper limit, an A.511 alarm (Encoder Output Pulse Overspeed) will be output.

10.3.5 External Absolute Encoder Data Reception Sequence

Example

If the setting is 20 and the speed is 1,600 mm/s, the output frequency would be 1.6 Mpps

 $\frac{1000 \text{ Hill/S}}{0.001 \text{ mm}} = 1,600,000 = 1.6 \text{ Mpps}$

Because 1.6 Mpps is less than 6.4 Mpps, this setting can be used.

Related Parameters

	Encoder Output Resolution Position				
Pn281	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	1 to 4,096	1 edge/pitch	20	After restart	Setup

Note: The maximum setting for the encoder output resolution is 4,096.

If the resolution of the external encoder exceeds 4,096, pulse output will no longer be possible at the resolution given in Feedback Resolution of Linear Encoder on page 5-49.

10.3.5 External Absolute Encoder Data Reception Sequence

Refer to the following section for details.

6.13.4 Reading the Position Data from the Absolute Linear Encoder on page 6-89

With fully-closed loop control, the same sequence as for a Linear Servomotor is used.

10.3.6 Electronic Gear Setting

Refer to the following section for details.

5.16 Electronic Gear Settings on page 5-46

With fully-closed loop control, the same setting as for a Linear Servomotor is used.

10.3.7 Alarm Detection Settings

This section describes the alarm detection settings (Pn51B and Pn52A)

Pn51B (Motor-Load Position Deviation Overflow Detection Level)

This setting is used to detect the difference between the feedback position of the Servomotor encoder and the feedback load position of the external encoder for fully-closed loop control. If the detected difference exceeds the setting, an A.d10 alarm (Motor-Load Position Deviation Overflow) will be output.

		Motor-Load Position	n Deviation Overflo	Position		
	Pn51B	Setting Range	Setting Unit	Default Setting	When Enabled	Classifica- tion
		0 to 1,073,741,824	1 reference unit	1000	Immediately	Setup

Note: If you set this parameter to 0, A.d10 alarms will not be output and the machine may be damaged.

Pn52A (Multiplier per Fully-closed Rotation)

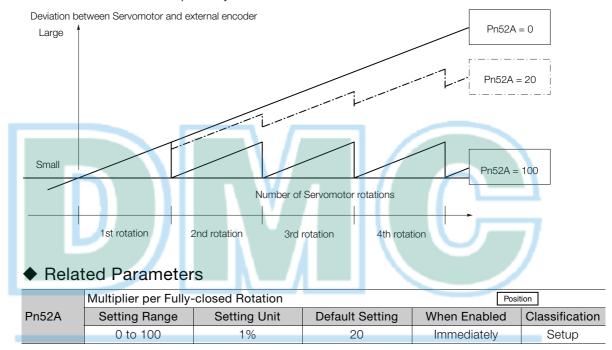
Set the coefficient of the deviation between the Servomotor and the external encoder per Servomotor rotation. This setting can be used to prevent the Servomotor from running out of control due to damage to the external encoder or to detect belt slippage.

Setting Example

Increase the value if the belt slips or is twisted excessively.

If this parameter is set to 0, the external encoder value will be read as it is.

If you use the default setting of 20, the second rotation will start with the deviation for the first Servomotor rotation multiplied by 0.8.



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10.3.8 Analog Monitor Signal Settings

You can monitor the position deviation between the Servomotor and load with an analog monitor.

Parameter		Name	Meaning	When Enabled	Classifi- cation
Pn006	n.□□07	Analog Monitor 1 Signal Selection	Position deviation between motor and load (output unit: 0.01 V/reference unit).	Immedi-	Setup
Pn007	n.□□07	Analog Monitor 2 Signal Selection	Position deviation between motor and load (output unit: 0.01 V/reference unit).	ately	

10.3.9 Setting to Use an External Encoder for Speed Feedback

For fully-closed loop control, you normally set a parameter to specify using the motor encoder speed ($Pn22A = n.0 \square \square \square$).

If you will use a Direct Drive Servomotor and a high-resolution external encoder, set the parameter to specify using the speed of the external encoder ($Pn22A = n.1 \square \square \square$).

Parameter		Meaning	When Enabled	Classification
Pn22A	n.0□□□ (default set- ting)	Use motor encoder speed.	After restart	Setup
	n.1□□□	Use external encoder speed.		

Note: This parameter cannot be used if Pn002 is set to n.0 \(\subseteq \subseteq \) (Do not use external encoder).

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Safety Functions

(11)

This chapter provides detailed information on the safety functions of the SERVOPACK.

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11.1.1 Safety Functions

11 1 Intr

Introduction to the Safety Functions

11.1.1 Safety Functions

Safety functions are built into the SERVOPACK to reduce the risks associated with using the machine by protecting workers from the hazards of moving machine parts and otherwise increasing the safety of machine operation.

Especially when working in hazardous areas inside guards, such as for machine maintenance, the safety function can be used to avoid hazardous moving machine parts.

Refer to the following section for information on the safety function and safety parameters. Compliance with UL Standards, EU Directives, and Other Safety Standards on page xxvi



Products that display the TÜV mark on the nameplate have met the safety standards.

11.1.2 Precautions for Safety Functions

WARNING

- To confirm that the HWBB function satisfies the safety requirements of the system, you
 must conduct a risk assessment of the system.
 Incorrect use of the safety function may cause injury.
- The Servomotor will move if there is an external force (e.g., gravity on a vertical axis) even
 when the HWBB function is operating. Use a separate means, such as a mechanical brake,
 that satisfies the safety requirements.
 Incorrect use of the safety function may cause injury.
- While the HWBB function is operating, the Servomotor may move within an electric angle of 180° or less as a result of a SERVOPACK failure. Use the HWBB function for an application only after confirming that movement of the Servomotor will not result in a hazardous condition.

Incorrect use of the safety function may cause injury.

- The dynamic brake and the brake signal are not safety-related elements. You must design
 the system so that SERVOPACK failures will not cause a hazardous condition while the
 HWBB function is operating.
 - Incorrect use of the safety function may cause injury.
- Connect devices that satisfy the safety standards for the signals for safety functions. Incorrect use of the safety function may cause injury.
- The HWBB function does not shut OFF the power to the SERVOPACK or electrically isolate it. Implement measures to shut OFF the power supply to the SERVOPACK before you perform maintenance on it.

There is a risk of electric shock.

11.2 Hard Wire Base Block (HWBB)

A hard wire base block (abbreviated as HWBB) is a safety function that is designed to shut OFF the current to the Servomotor with a hardwired circuit.

The drive signals to the Power Module that controls the motor current are controlled by the circuits that are independently connected to the two input signal channels to turn OFF the Power Module and shut OFF the motor current.



For safety function signal connections, the input signal is the 0-V common and the output signal is a source output.

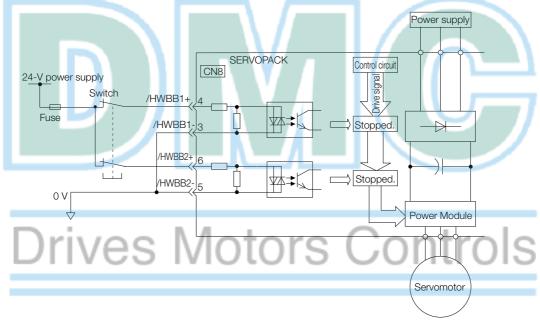
This is opposite to other signals described in this manual.

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

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

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

The input signal uses the 0-V common. The following figure shows a connection example.



11.2.1 Risk Assessment

When using the HWBB, you must perform a risk assessment of the servo system in advance to confirm that the safety level of the standards is satisfied. Refer to the following section for details on the standards.

Compliance with UL Standards, EU Directives, and Other Safety Standards on page xxvi

Note: To meet performance level e (PLe) in EN ISO 13849-1 and SIL3 in IEC 61508, the EDM1 signal must be monitored by the host controller. If the EDM1 signal is not monitored by the host controller, the level will be safety performance level c (PLc) and SIL1.

The following hazards exist even when the HWBB is operating. These hazards must be included in the risk assessment.

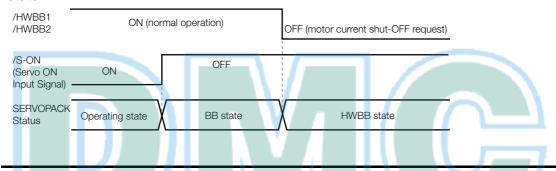
• The Servomotor will move if an external force is applied to it (for example, gravity on a vertical axis). Implement measures to hold the Servomotor, such as installing a separate mechanical brake.

11.2.2 Hard Wire Base Block (HWBB) State

- If a failure occurs such as a Power Module failure, the Servomotor may move within an electric angle of 180°. Ensure safety even if the Servomotor moves.
 - The rotational angle or travel distance depends on the type of Servomotor as follows:
 - Rotary Servomotor: 1/6 rotation max. (rotational angle calculated at the motor shaft)
 - Direct Drive Servomotor: 1/20 rotation max. (rotational angle calculated at the motor shaft)
 - · Linear Servomotor: 50 mm max.
- The HWBB does not shut OFF the power to the SERVOPACK or electrically isolate it. Implement measures to shut OFF the power supply to the SERVOPACK before you perform maintenance on it.

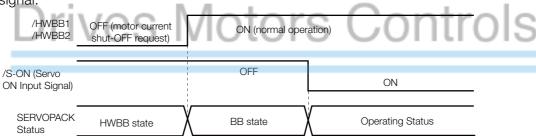
11.2.2 Hard Wire Base Block (HWBB) State

The SERVOPACK will be in the following state if the HWBB operates. If the /HWBB1 or /HWBB2 signal turns OFF, the HWBB will operate and the SERVOPACK will enter a HWBB state.

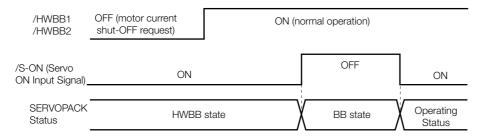


11.2.3 Resetting the HWBB State

Normally, after the /S-ON (Servo ON) 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 /HWBB1 and /HWBB2 signals are OFF and the /S-ON (Servo ON Input) signal is input, the HWBB state will be maintained even after the /HWBB1 and /HWBB2 signals are turned ON. Turn OFF the /S-ON signal to place the SERVOPACK in the BB state and then turn ON the /S-ON signal again.



Note: 1. If the SERVOPACK is placed in the BB state while the main circuit power supply is OFF, the HWBB state will be maintained until the /S-ON (Servo ON) signal is turned OFF.

- 2. If the /S-ON (Servo ON) signal is set to be always active (Pn50A = n.□□7□), you cannot reset the HWBB state.
 - Do not set this value if you are using the HWBB.

11.2.4 Detecting Errors in HWBB Signal

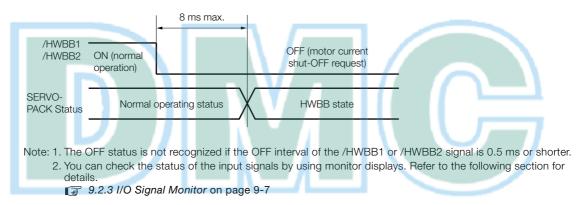
If only the /HWBB1 or the /HWBB2 signal is input, an A.Eb1 alarm (Safety Function Signal Input Timing Error) will occur unless the other signal is input within 10 seconds. This makes it possible to detect failures, such as disconnection of an HWBB signal.

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.

11.2.5 HWBB Input Signal Specifications

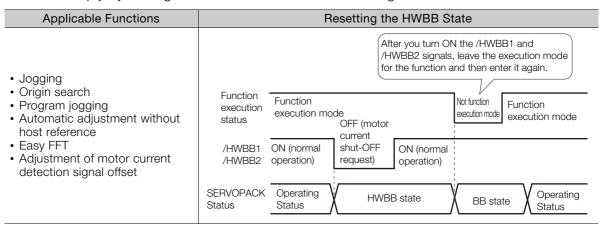
If an HWBB is requested by turning OFF the two HWBB input signal channels (/HWBB1 and / HWBB2), the power supply to the Servomotor will be turned OFF within 8 ms.



11.2.6 Operation without a Host Controller

The HWBB will operate even for operation without a host controller.

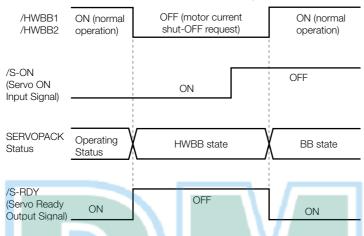
However, if the HWBB operates during execution of the following functions, leave the execution mode for the function and then enter it again to restart operation. Operation will not be restarted simply by turning OFF the /HWBB1 and /HWBB2 signals.



11.2.7 /S-RDY (Servo Ready Output) Signal

The /S-ON (Servo ON) 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 supply is ON and the SEN signal turns ON when there is no servo alarm. (An absolute encoder is used in this example.)



11.2.8 /BK (Brake Output) Signal

If the HWBB operates when the /HWBB1 or /HWBB2 signal is OFF, the /BK (Brake) signal will turn OFF. At that time, the setting in Pn506 (Brake Reference - Servo OFF Delay Time) will be disabled. Therefore, the Servomotor may be moved by external force until the actual brake becomes effective after the /BK signal turns OFF.



D

The brake signal is not a safety-related element. You must design the system so that a hazardous condition does not occur even if the brake signal fails in the HWBB state. Also, if a Servomotor with a Brake is used, keep in mind that the brake in the Servomotor is used only to prevent the moving part from being moved by gravity or an external force and it cannot be used to stop the Servomotor.

11.2.9 Stopping Methods

If the /HWBB1 or /HWBB2 signal turns OFF and the HWBB operates, the Servomotor will stop according to the stop mode that is set for stopping the Servomotor when the servo turns OFF (Pn001 = $n.\Box\Box\Box\Box$ X). However, if the dynamic brake is enabled (Pn001 = $n.\Box\Box\Box\Box$ 0 or $n.\Box\Box\Box\Box$ 1), observe the following precautions.

⚠ 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.

Safety Functions

11.2.10 Settings to Clear the Position Deviation

A position deviation in the HWBB state is cleared according to the setting of $Pn200 = n.\Box X\Box \Box$ (Clear Operation). If you specify not clearing the position deviation during position control ($Pn200 = n.\Box 1\Box \Box$), 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 specify not clearing the position deviation during position control ($Pn200 = n.\Box 1\Box\Box$), input the CLR (Position Deviation Clear) signal during the HWBB or BB state to clear the position deviation.

11.2.11 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.

11.3.1 EDM1 Output Signal Specifications

11.3 EDM1 (External Device Monitor)

The EDM1 (External Device Monitor) signal is used to monitor failures in the HWBB. Connect the monitor signal as a feedback signal, e.g., to the Safety Unit.

Note: To meet performance level e (PLe) in EN ISO 13849-1 and SIL3 in IEC 61508, the EDM1 signal must be monitored by the host controller. If the EDM1 signal is not monitored by the host controller, the level will be safety performance level c (PLc) and SIL1.

Failure Detection Signal for EDM1 Signal

The relationship between the EDM1, /HWBB1, and /HWBB2 signals is shown below.

Detection of failures in the EDM1 signal circuit can be achieved by using the status of the /HWBB1, /HWBB2, and EDM1 signals in the following table. A failure can be detected by checking the failure status, e.g., when the power supply is turned ON.

Signal	Logic				
/HWBB1	ON	ON	OFF	OFF	
/HWBB2	ON	OFF	ON	OFF	
EDM1	OFF	OFF	OFF	ON	

WARNING

• The EDM1 signal is not a safety output. Use it only for monitoring for failures.

11.3.1 EDM1 Output Signal Specifications

If an HWBB is requested by turning OFF the two HWBB input signal channels (/HWBB1 and /HWBB2) when the safety function is operating normally, the EDM1 output signal will be turned ON within 8 ms.

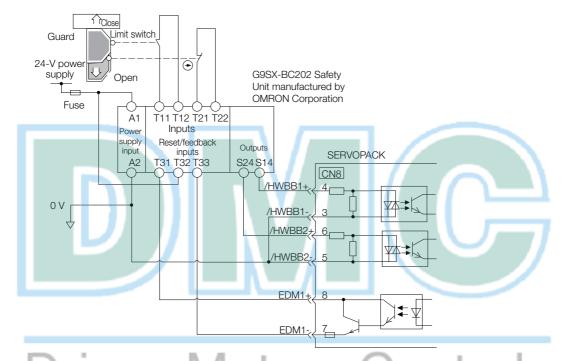


11.4 Applications Examples for Safety Functions

This section provides examples of using the safety functions.

11.4.1 Connection Example

In the following example, a Safety Unit is used and the HWBB operates when the guard is opened.



When the guard is opened, both the /HWBB1 and the /HWBB2 signals turn OFF, and the EDM1 signal turns ON. Because the feedback circuit is ON while the guard is closed, the Safety Unit is reset, the /HWBB1 and the / HWBB2 signals turn ON, and the operation is enabled.

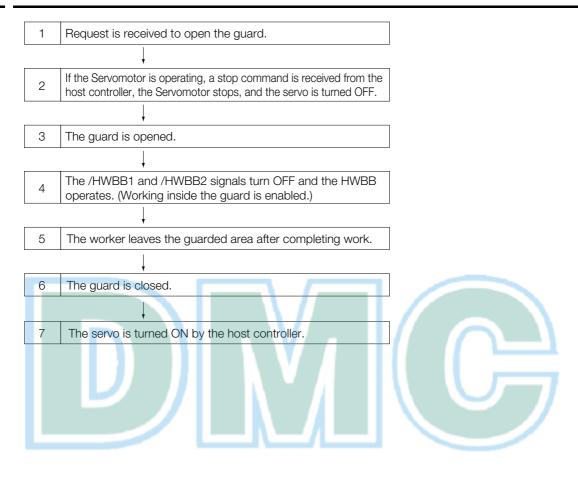
Note: The EDM1 signal is used as a source output. Connect the EDM1 so that the current flows from EMD1+ to EMD1-.

11.4.2 Failure Detection Method

If a failure occurs (e.g., the /HWBB1 or the /HWBB2 signal remains ON), the Safety Unit is not reset when the guard is closed because the EDM1 signal remains OFF. Therefore starting is not possible and a failure is detected.

In this case the following must be considered: an error in the external device, disconnection of the external wiring, short-circuiting in the external wiring, or a failure in the SERVOPACK. Find the cause and correct the problem.

11.4.3 Procedure



11.5 Validating Safety Functions

When you commission the system or perform maintenance or SERVOPACK replacement, you must always perform the following validation test on the HWBB 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 Operator or Digital Operator displays **Hbb** and that the Servomotor does not operate.
- Monitor the ON/OFF status of the /HWBB1 and /HWBB2 signals.
 If the ON/OFF status of the signals do not coincide with the display, the following must be considered: an error in the external device, disconnection of the external wiring, short-circuiting in the external wiring, or a failure in the SERVOPACK. Find the cause and correct the problem.

Refer to the following sections for details on the monitor.

9.2.3 I/O Signal Monitor on page 9-7

13.3.4 Safety Input Signal Monitor (Un015) on page 13-10

• Confirm that the EDM1 signal is OFF while in normal operation by using the feedback circuit input display of the connected device.

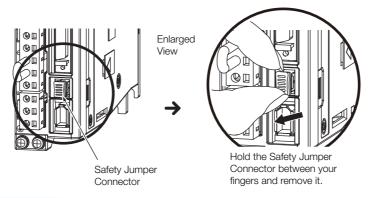


11.6

Connecting a Safety Function Device

Use the following procedure to connect a safety function device.

 Remove the Safety Jumper Connector from the connector for the safety function device (CN8).



2. Connect the safety function device to the connector for the safety function device (CN8).

Note: If you do not connect a safety function device, leave the Safety Jumper Connector connected to the connector for the safety function device (CN8). If the SERVOPACK is used without the Safety Jumper Connector connected to CN8, no current will be supplied to the Servomotor and no motor torque will be output. In this case, **Hbb** will be displayed on the Digital Operator.

Maintenance

12

This chapter provides information on the meaning of, causes of, and corrections for alarms and warnings.

12.1	Inspe	ctions and Part Replacement 12-2	
	12.1.1 12.1.2 12.1.3	Inspections	
12.2	Alarm	Displays12-5	
	12.2.1	List of Alarms	
	12.2.4 12.2.5	Displaying the Alarm History	-
	12.2.6	Resetting Alarms Detected in Option Modules	
	12.2.7		
12.3	Warni	ing Displays	
	12.3.1 12.3.2	List of Warnings	

Troubleshooting Based on the Operation and Conditions of the Servomotor ..12-56

12.1.1 Inspections

12.1

Inspections and Part Replacement

This section describes inspections and part replacement for SERVOPACKs.

12.1.1 Inspections

Perform the inspections given in the following table at least once every year for the SERVO-PACK. Daily inspections are not required.

Item	Frequency	Inspection	Correction
Exterior	At least once a	Check for dust, dirt, and oil on the surfaces.	Clean with compressed air or a cloth.
Loose Screws	year	Check for loose terminal block and connector screws and for other loose parts.	Tighten any loose screws or other loose parts.

12.1.2 Guidelines for Part Replacement

The following electric or electronic parts are subject to mechanical wear or deterioration over time. Use one of the following methods to check the standard replacement period.

- Use the service life prediction function of the SERVOPACK.
 Refer to the following section for information on service life predictions.
 9.4 Monitoring Product Life on page 9-15
- Use the following table.

Part	Standard Replace- ment Period	Remarks
Cooling Fan	4 years to 5 years	The standard replacement periods given on the left are for
Electrolytic Capacitor	10 years	 the following operating conditions. Surrounding air temperature: Annual average of 30°C Load factor: 80% max. Operation rate: 20 hours/day max.
Relays	100,000 power ON operations	Power ON frequency: Once an hour
Battery	3 years without power supplied	Surrounding temperature without power supplied: 20°C

When any standard replacement period is close to expiring, contact your Yaskawa representative. After an examination of the part in question, we will determine whether the part should be replaced.



The parameters of any SERVOPACKs that are sent to Yaskawa for part replacement are reset to the factory settings before they are returned to you. Always keep a record of the parameter settings. And, always confirm that the parameters are properly set before starting operation.

12.1.3 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.

Battery Replacement Procedure on page 12-3

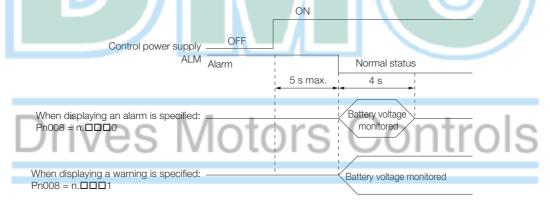
Battery Alarm/Warning Selection

Whether to display an alarm or a warning is determined by the setting of $Pn008 = n.\Box\Box\Box X$ (Low Battery Voltage Alarm/Warning Selection).

ı	Parameter	Meaning	When Enabled	Classification
Pn008	n.□□□0 (default setting)	Output alarm (A.830) for low battery voltage.	After restart	Setup
	n.□□□1	Output warning (A.930) for low battery voltage.		

- $Pn008 = n.\Box\Box\Box0$
- The ALM (Servo Alarm) signal is output for up to five seconds when the control power supply
 is turned ON, and then the battery voltage is monitored for four seconds.
 No alarm will be displayed even if the battery voltage drops below the specified value after
 these four seconds.
- Pn008 = n.□□□1

The ALM (Servo Alarm) signal is output for up to five seconds when the control power supply is turned ON, and then the battery voltage is monitored continuously.



Battery Replacement Procedure

- When Installing a Battery on the Host Controller
- **1.** Turn ON only the control power supply to the SERVOPACK.
- 2. Remove the old battery and mount a new battery.
- **3.** Turn OFF the control power supply to the SERVOPACK to clear the A.830 alarm (Encoder Battery Alarm).
- 4. Turn ON the control power supply to the SERVOPACK again.
- 5. Make sure that the alarm has been cleared and that the SERVOPACK operates normally.

12.1.3 Replacing the Battery

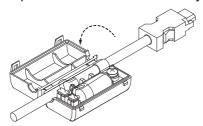
◆ When Using an Encoder Cable with a Battery Case

1. Turn ON only the control power supply to the SERVOPACK.



If you remove the Battery or disconnect the Encoder Cable while the control power supply to the SERVOPACK is OFF, the absolute encoder data will be lost.

2. Open the cover of the Battery Case.



3. Remove the old Battery and mount a new Battery. Absolute Encoder Cable SERVOPACK connector Mount a Lithium Battery.



4. Close the cover of the Battery Case.



- 5. Turn OFF the power supply to the SERVOPACK to clear the A.830 alarm (Encoder Battery Alarm).
- 6. Turn ON the power supply to the SERVOPACK.
- 7. Make sure that the alarm has been cleared and that the SERVOPACK operates normally.

12.2 Alarm Displays

If an error occurs in the SERVOPACK, an alarm number will be displayed on the panel display. However, if $\Box\Box\Box\Box\Box$ appears on the panel display, the display will indicate a SERVOPACK communications error. Replace the SERVOPACK.



This section provides a list of the alarms that may occur and the causes of and corrections for those alarms.

12.2.1 List of Alarms

The list of alarms gives the alarm name, alarm meaning, alarm stopping method, alarm reset possibility, and alarm code output in order of the alarm numbers.

Servomotor Stopping Method for Alarms

Refer to the following section for information on the stopping method for alarms 5.14.2 Servomotor Stopping Method for Alarms on page 5-42

Alarm Reset Possibility

Yes: You can use an alarm reset to clear the alarm. However, this assumes that the cause of the alarm has been removed.

No: You cannot clear the alarm.

List of Alarms

Alarm	ives Mi	m Name Alarm Meaning	Servo- motor	Alarm Reset	Alarm Code Output		
Number	Alarm Name	Alarm Meaning	Stop- ping Method	Possi- ble?	ALO1	ALO2	ALO3
A.020	Parameter Checksum Error	There is an error in the parameter data in the SERVOPACK.	Gr.1	No	Н	Н	Н
A.021	Parameter Format Error	There is an error in the parameter data format in the SERVOPACK.	Gr.1	No	Н	Н	Н
A.022	System Checksum Error	There is an error in the parameter data in the SERVOPACK.	Gr.1	No	Н	Н	Н
A.024	System Alarm	An internal program error occurred in the SERVO-PACK.	Gr.1	No	Н	Н	Н
A.025	System Alarm	An internal program error occurred in the SERVO-PACK.	Gr.1	No	Н	Н	Н
A.030	Main Circuit Detector Error	There is an error in the detection data for the main circuit.	Gr.1	Yes	Н	Η	Н
A.040	Parameter Setting Error	A parameter setting is outside of the setting range.	Gr.1	No	Н	Н	Н

12.2.1 List of Alarms

Continued from previous page.

Alarm	Alarm Name		Servo- motor	Alarm Reset	Alarm Co Outpu		ode
Number	Alarm Name	Alarm Meaning	Stop- ping Method	Possi- ble?	ALO1	ALO2	ALO3
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	Н	Н	Н
A.042	Parameter Combination Error	The combination of some parameters exceeds the setting range.	Gr.1	No	Н	I	Н
A.044	Semi-Closed/Fully-Closed Loop Control Parameter Setting Error	The settings of the Option Module and Pn002 = n.X□□□ (External Encoder Usage) do not match.	Gr.1	No	Н	I	Н
A.050	Combination Error	The capacities of the SERVOPACK and Servomotor do not match.	Gr.1	Yes	Н	I	Н
A.051	Unsupported Device Alarm	An unsupported device was connected.	Gr.1	No	Н	Н	Н
A.070	Motor Type Change Detected	The connected motor is a different type of motor from the previously connected motor.	Gr.1	No	Н	Ι	Н
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	Н	Н	Н
A.0b0	Invalid Servo ON Com- mand Alarm	The /S-ON (Servo ON) signal was input from the host controller after a utility function that turns ON the Servomotor was executed.	Gr.1	Yes	Н	Н	Н
A.100	Overcurrent Detected	An overcurrent flowed through the power transistor or the heat sink overheated.	Gr.1	No)[I	S	Н
A.101	Motor Overcurrent Detected	The current to the motor exceeded the allowable current.	Gr.1	No	L	I	Н
A.300	Regeneration Error	There is an error related to regeneration.	Gr.1	Yes	L	L	Н
A.320	Regenerative Overload	A regenerative overload occurred.	Gr.2	Yes	L	L	Н
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	Н
A.400	Overvoltage	The main circuit DC voltage is too high.	Gr.1	Yes	Н	Ι	L
A.410	Undervoltage	The main circuit DC voltage is too low.	Gr.2	Yes	Н	I	L
A.510	Overspeed	The motor exceeded the maximum speed.	Gr.1	Yes	L	I	L

Continued from previous page.

Alarm	AL.	Alexander 1	Servo- motor	Alarm Reset	Alarm Co Outpu			
Number	Alarm Name	Alarm Meaning	Stop- ping Method	Possi- ble?	ALO1	ALO2	ALO3	
A.511	Encoder Output Pulse Overspeed	 Rotary Servomotor: The pulse output speed for the setting of Pn212 (Number of Encoder Output Pulses) was exceeded. Linear Servomotor: The motor speed upper limit for the setting of Pn281 (Encoder Output Resolution) was exceeded. 	Gr.1	Yes	L	Н	L	
A.520	Vibration Alarm	Abnormal oscillation was detected in the motor speed.	Gr.1	Yes	L	Н	L	
A.521	Autotuning Alarm	Vibration was detected during autotuning for the tuning-less function.	Gr.1	Yes	L	Н	L	
A.550	Maximum Speed Setting Error	The setting of Pn385 (Maximum Motor Speed) is greater than the maximum motor speed.	Gr.1	Yes	L	Н	L	
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	
A.720	Continuous Overload	The Servomotor was operating continuously under a torque that exceeded the rating.	Gr.1	Yes	L	L	L	
A.730 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	S	L	L	
A.740	Inrush Current Limiting Resistor Overload	The main circuit power supply was frequently turned ON and OFF.	Gr.1	Yes	L	L	L	
A.7A1	Internal Temperature Error 1 (Control Board Tempera- ture Error)	The surrounding temperature of the control PCB is abnormal.	Gr.2	Yes	L	L	L	
A.7A2	Internal Temperature Error 2 (Power Board Tempera- ture Error)	The surrounding temperature of the power PCB 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 SERVO-PACK 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	Н	Н	Н	
A.820	Encoder Checksum Alarm	There is an error in the checksum results for encoder memory.	Gr.1	No	Н	Н	Н	
A.830	Encoder Battery Alarm	The battery voltage was lower than the specified level after the control power supply was turned ON.	Gr.1	Yes	Н	Н	Н	

12.2.1 List of Alarms

Continued from previous page.

Alarm			Servo- motor	Alarm Reset	Ala	ırm Co Outpu	ode
Number	Alarm Name	Alarm Meaning	Stop- ping Method	Possi- ble?	ALO1	ALO2	ALO3
A.840	Encoder Data Alarm	There is an internal data error in the encoder.	Gr.1	No	Н	Н	Н
A.850	Encoder Overspeed	The encoder was operating at high speed when the power was turned ON.	Gr.1	No	Н	Н	Н
A.860	Encoder Overheated	The internal temperature of the rotary encoder or linear encoder is too high.	Gr.1	No	Н	Н	Н
A.861	Motor Overheated	The internal temperature of motor is too high.	Gr.1	No	Н	Н	Н
A.862	Overheat Alarm	The input voltage (temperature) for the overheat protection input (TH) signal exceeded the setting of Pn61B (Overheat Alarm	Gr.1	Yes	Н	Н	Н
		Level).					
A.890	Encoder Scale Error	A failure occurred in the linear encoder.	Gr.1	No	Н	Н	Н
A.891	Encoder Module Error	An error occurred in the linear encoder.	Gr.1	No	Н	Н	Н
A.8A0	External Encoder Error	An error occurred in the external encoder.	Gr.1	Yes	Н	Н	Н
A.8A1	External Encoder Module Error	An error occurred in the Serial Converter Unit.	Gr.1	Yes	Н	Н	Н
A.8A2	External Incremental Encoder Sensor Error	An error occurred in the external encoder.	Gr.1	Yes	Н	Н	Н
A.8A3	External Absolute Encoder Position Error	An error occurred in the position data of the external encoder.	Gr.1	Yes	Н	Н	Н
A.8A5	External Encoder Over- speed	An overspeed error occurred in the external encoder.	Gr.1	Yes	HC:	S	Н
A.8A6	External Encoder Over- heated	An overheating error occurred in the external encoder.	Gr.1	Yes	Н	Н	Н
A.b10	Speed Reference A/D Error	An error occurred in the A/D converter for the speed reference input.	Gr.2	Yes	Н	Н	Н
A.b11	Speed Reference A/D Data Error	An error occurred in the A/D conversion data for the speed reference.	Gr.2	Yes	Н	Н	Н
A.b20	Torque Reference A/D Error	An error occurred in the A/D converter for the torque reference input.	Gr.2	Yes	Н	Н	Н
A.b33	Current Detection Error 3	An error occurred in the current detection circuit.	Gr.1	No	Η	Н	Н
A.bF0	System Alarm 0	Internal program error 0 occurred in the SERVO-PACK.	Gr.1	No	Н	Н	Н
A.bF1	System Alarm 1	Internal program error 1 occurred in the SERVO-PACK.	Gr.1	No	Н	Н	Н
A.bF2	System Alarm 2	Internal program error 2 occurred in the SERVO-PACK.	Gr.1	No	Н	Н	Н

Continued from previous page.

Alarm	Alarm Name	Jame Alarm Meaning	Servo- motor	Alarm Reset	()utput		
Number	Alarm Name	Alarm Meaning	Stop- ping Method	Possi- ble?	ALO1	ALO2	ALO3
A.bF3	System Alarm 3	Internal program error 3 occurred in the SERVO-PACK.	Gr.1	No	Н	Н	Н
A.bF4	System Alarm 4	Internal program error 4 occurred in the SERVO-PACK.	Gr.1	No	Н	Н	Н
A.bF5	System Alarm 5	Internal program error 5 occurred in the SERVO-PACK.	Gr.1	No	Н	Н	Н
A.bF6	System Alarm 6	Internal program error 6 occurred in the SERVO-PACK.	Gr.1	No	Н	Н	Н
A.bF7	System Alarm 7	Internal program error 7 occurred in the SERVO-PACK.	Gr.1	No	Н	Н	Н
A.bF8	System Alarm 8	Internal program error 8 occurred in the SERVO-PACK.	Gr.1	No	Н	Н	Н
A.C10	Servomotor Out of Control	The Servomotor ran out of control.	Gr.1	Yes		Н	L
A.C20	Phase Detection Error	The detection of the phase is not correct.	Gr.1	No	Ļ	Н	L
A.C21	Polarity Sensor Error	An error occurred in the polarity sensor.	Gr.1	No	L	Н	L
A.C22	Phase Information Disagreement	The phase information does not match.	Gr.1	No	L	Н	L
A.C50	Polarity Detection Failure	The polarity detection failed.	Gr.1	No	L	Н	L
A.C51	Overtravel Detected during Polarity Detection	The overtravel signal was detected during polarity detection.	Gr.1	Yes	L	Н	L
A.C52	Polarity Detection Not Completed	The servo was turned ON before the polarity was detected.	Gr.1	Yes	15	Н	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	Н	L
A.C54	Polarity Detection Failure 2	The polarity detection failed.	Gr.1	No	L	Н	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	Н	L
A.C90	Encoder Communications Error	Communications between the encoder and SERVO-PACK is not possible.	Gr.1	No	L	Н	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	Н	L
A.C92	Encoder Communications Timer Error	An error occurred in the communications timer between the encoder and SERVO-PACK.	Gr.1	No	L	Н	L
A.CA0	Encoder Parameter Error	The parameters in the encoder are corrupted.	Gr.1	No	L	Н	L

12.2.1 List of Alarms

Continued from previous page.

			Co	Continued from previous pag			
Alarm	Alarm Name	Alarm Meaning	Servo- motor Stop-	Alarm Reset		ırm Co Outpu	
Number	, uam rame	, warm incaming	ping Method	Possi- ble?	ALO1	ALO2	ALO3
A.Cb0	Encoder Echoback Error	The contents of communications with the encoder are incorrect.	Gr.1	No	L	Н	L
A.CC0	Multiturn Limit Disagree- ment	Different multiturn limits have been set in the encoder and the SERVOPACK.	Gr.1	No	L	Н	L
A.CF1	Reception Failed Error in Feedback Option Module Communications	Receiving data from the Feedback Option Module failed.	Gr.1	No	L	Н	L
A.CF2	Timer Stopped Error in Feedback Option Module Communications	An error occurred in the timer for communications with the Feedback Option Module.	Gr.1	No	L	Н	L
A.d00	Position Deviation Over- flow	The setting of Pn520 (Position Deviation Overflow Alarm Level) was exceeded by the position deviation while the servo was ON.	Gr.1	Yes	4	L	Н
A.d01	Position Deviation Over- flow 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	7	Н
A.d02	Position Deviation Over- flow 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	วไ	S	Н
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	Н
A.d30	Position Data Overflow	The position feedback data exceeded ±1,879,048,192.	Gr.1	No	L	L	Н
A.E71	Safety Option Module Detection Failure	Detection of the Safety Option Module failed.	Gr.1	No	Н	L	L
A.E72	Feedback Option Module Detection Failure	Detection of the Feedback Option Module failed.	Gr.1	No	Н	L	L
A.E74	Unsupported Safety Option Module	An unsupported Safety Option Module was connected.	Gr.1	No	Н	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	Н	L	L
A.EC8	Gate Drive Error 1	An error occurred in the gate drive circuit.	Gr.1	No	Н	L	L
A.EC9	Gate Drive Error 2	An error occurred in the gate drive circuit.	Gr.1	No	Н	L	L

Continued from previous page.

	Alarm	Alarm Name		Servo- motor	Alarm Reset	Output		
	Number		Alarm Meaning	Stop- ping Method	Possi- ble?	ALO1	ALO2	ALO3
,	A.F10	Power Supply Line Open Phase	The voltage was low for more than one second for phase R, S, or T when the main power supply was ON.	Gr.2	Yes	Н	L	Н
	A.F50	Servomotor Main Circuit Cable Disconnection	The Servomotor did not operate or power was not supplied to the Servomotor even though the /S-ON (Servo ON) signal was input when the Servomotor was ready to receive it.	Gr.1	Yes	Н	L	Н
	FL-1*		An internal program error occurred in the SERVO-					
	FL-2*			- No				
_	FL-3*	System Alarm			No	Undefined		ed.
-	FL-4*		PACK.					
_	FL-5* FL-6*							
ł	CPF00	Digital Operator Communications Error 1	Communications were not possible between the Digital					
	CPF01	Digital Operator Communications Error 2	Operator (model: JUSP- OP05A-1-E) and the SERVO- PACK (e.g., a CPU error occurred).		No	Ur	ndefine	ed.

^{*} These alarms are not stored in the alarm history. They are only displayed on the panel display.

Note: The A.Eb0, A.Eb2 to A.Eb9, and A.EC0 to A.EC2 alarms can occur when a Safety Module is connected. Refer to the following manual for details.

AC Servo Drive Σ-V-Series/Σ-V-Series for Large-Capacity Models/Σ-7-Series User's Manual Safety Module (Manual No.: SIEP C720829 06)

12.2.2 Troubleshooting Alarms

The causes of and corrections for the alarms are given in the following table. Contact your Yaskawa representative if you cannot solve a problem with the correction given in the table.

Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The power supply voltage suddenly dropped.	Measure the power supply voltage.	Set the power supply voltage within the specified range, and initialize the parameter settings.	page 5-11
	The power supply was shut OFF while writing parameter settings.	Check the timing of shutting OFF the power supply.	Initialize the parameter settings and then set the parameters again.	page
A.020: Parameter	The number of times that parameters were written exceeded the limit.	Check to see if the parameters were frequently changed from the host controller.	The SERVOPACK may be faulty. Replace the SERVOPACK. Reconsider the method for writing the parameters.	-
Checksum Error (There is an error in the parameter data in the SERVOPACK.)	A malfunction was caused by noise from the AC power supply, ground, static electricity, or other source.	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, noise may be the cause.	Implement countermeasures against noise.	page 4-5
	Gas, water drops, or cutting oil entered the SERVOPACK and caused failure of the internal components.	Check the installation conditions.	The SERVOPACK may be faulty. Replace the SERVOPACK.	_
Driv	A failure occurred in the SERVOPACK.	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may have failed.	The SERVOPACK may be faulty. Replace the SERVOPACK.	
A.021: Parameter Format Error (There is an error in the parameter data format in the	The software version of the SERVOPACK that caused the alarm is older than the software version of the parameters specified to write.	Read the product information to see if the software versions are the same. If they are different, it could be the cause of the alarm.	Write the parameters from another SERVOPACK with the same model and the same software version, and then turn the power OFF and ON again.	page 9-2
SERVOPACK.)	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SERVOPACK.	_
	The power supply voltage suddenly dropped.	Measure the power supply voltage.	The SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.022: System Check- sum Error (There is an error	The power supply was shut OFF while setting a utility function.	Check the timing of shutting OFF the power supply.	The SERVOPACK may be faulty. Replace the SERVOPACK.	_
in the parameter data in the SERVOPACK.)	A failure occurred in the SERVOPACK.	Turn the power supply to the SERVOPACK OFF and ON again. If the alarm still occurs, the SERVOPACK may have failed.	The SERVOPACK may be faulty. Replace the SERVOPACK.	-

Continued from previous page.

Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.024: System Alarm (An internal pro- gram error occurred in the SERVOPACK.)	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.025: System Alarm (An internal pro- gram error occurred in the SERVOPACK.)	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SERVOPACK.	_
A.030: Main Circuit Detector Error	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SERVOPACK.	-
	The SERVOPACK and Servomotor capacities do not match each other.	Check the combination of the SERVOPACK and Servomotor capacities.	Select a proper combination of SERVOPACK and Servomotor capacities.	page 1-9
A.040: Parameter Set-	The motor parameter file was not written to the linear encoder. (This applies only when not using a Serial Converter Unit.)	Check to see if the motor parameter file was written to the linear encoder.	Write the motor parameter file to the linear encoder.	page 5-20
ting Error (A parameter set- ting is outside of	A failure occurred in the SERVOPACK.	- /	The SERVOPACK may be faulty. Replace the SERVOPACK.	_
the setting range.)	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.	_
Drive	The electronic gear ratio is outside of the setting range.	Check the electronic gear ratio. The ratio must be within the following range: 0.001 < (Pn20E/Pn210) < 64,000.	Set the electronic gear ratio in the following range: 0.001 < (Pn20E/Pn210) < 64,000.	page 5-47
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.	Check the setting of Pn212 or Pn281.	Set Pn212 or Pn281 to an appropriate value.	page 6-47

12.2.2 Troubleshooting Alarms

Continued from previous page.

Alarm Number:			Continued from pro	
Alarm Name	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 to see if the detection conditions*1 are satisfied.	Decrease the setting of the electronic gear ratio (Pn20E/Pn210).	page 5-47
A.042: Parameter Com- bination Error	The speed of program jogging went below the setting range when Pn533 or Pn585 (Program Jogging Movement Speed) was changed.	Check to see if the detection conditions*1 are satisfied.	Increase the setting of Pn533 or Pn585.	page 7-20
	The movement speed of advanced autotuning went below the setting range when the electronic gear ratio (Pn20E/ Pn210) or the Servomotor was changed.	Check to see if the detection conditions*2 are satisfied.	Decrease the setting of the electronic gear ratio (Pn20E/Pn210).	page 5-47
A.044: Semi-Closed/ Fully-Closed Loop Control Parameter Setting Error	The setting of the Fully-Closed Module does not match the setting of Pn002 = n.XDDD (External Encoder Usage).	Check the setting of Pn002 = n.X□□□.	Make sure that the setting of the Fully-closed Module agrees with the setting of Pn002 = n.X□□□.	page 10-6
A.050: Combination Error	The SERVOPACK and Servomotor capacities do not match each other.	Confirm that the follow- ing condition is met: 1/4 ≤ (Servomotor capacity/SERVOPACK capacity) ≤ 4	Select a proper combination of the SERVOPACK and Servomotor capacities.	page 1-9
(The capacities of the SERVOPACK and Servomotor	A failure occurred in the encoder.	Replace the encoder and check to see if the alarm still occurs.	Replace the Servomotor or encoder.	ā
do not match.)	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SERVOPACK.	
A.051:	The motor parameter file was not written to the linear encoder. (This applies only when not using a Serial Converter Unit.)	Check to see if the motor parameter file was written to the linear encoder.	Write the motor parameter file to the linear encoder.	page 5-20
Unsupported Device Alarm	An unsupported Serial Converter Unit or encoder (e.g., an external encoder) is connected to the SERVOPACK.	Check the product combination specifications.	Change to a correct combination of models.	-

Continued from previous page.

Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.070: Motor Type Change Detected (The connected	A Rotary Servomotor was removed and a Linear Servomotor was connected.	_	Set the parameters for a Linear Servomotor and reset the motor type alarm. Then, turn the power supply to the SERVOPACK OFF and ON again.	page 12-47
motor is a different type of motor from the previously connected motor.)	A Linear Servomotor was removed and a Rotary Servomotor was connected.	_	Set the parameters for a Rotary Servomotor and reset the motor type alarm. Then, turn the power supply to the SERVOPACK OFF and ON again.	page 12-47
A.080: Linear Encoder Pitch Setting Error	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.	page 5-19
A.0b0: Invalid Servo ON Command Alarm	The /S-ON (Servo ON) signal was input from the host controller after a utility function that turns ON the Servomotor was executed.		Turn the power supply to the SERVOPACK OFF and ON again. Or, execute a software reset.	page 6-96
	The Main Circuit Cable is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	
Drive	There is a short-circuit or ground fault in a Main Circuit Cable.	Check for short-circuits across Servomotor phases U, V, and W, or between the ground and Servomotor phases U, V, and W.	The cable may be short-circuited. Replace the cable.	
A.100:		Check for short-circuits		
Overcurrent Detected (An overcurrent flowed through the power tran-	There is a short-circuit or ground fault inside the Servomotor.	across Servomotor phases U, V, and W, or between the ground and Servomotor phases U, V, or W.	The Servomotor may be faulty. Replace the Servomotor.	page 4-25
sistor or the heat sink overheated.)	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.	
	The regenerative resistor is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	page 4-21

12.2.2 Troubleshooting Alarms

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.100: Overcurrent Detected (An overcurrent flowed through the power transistor or the heat sink overheated.)	The dynamic brake (DB, emergency stop executed from the SERVOPACK) was frequently activated, or a DB overload alarm occurred.	Check the power consumed by the DB resistor to see how frequently the DB is being used. Or, check the alarm display to see if a DB overload alarm (A.730 or A.731) has occurred.	Change the SERVOPACK model, operating methods, or the mechanisms so that the dynamic brake does not need to be used so frequently.	-
	The regenerative processing capacity was exceeded.	Check the regenerative load ratio in the SigmaWin+ Motion Monitor Tab Page to see how frequently the regenerative resistor is being used.	Recheck the operating conditions and load.	*3
	The SERVOPACK regenerative resistance is too small.	Check the regenerative load ratio in the SigmaWin+ Motion Monitor Tab Page to see how frequently the regenerative resistor is being used.	Change the regenerative resistance to a value larger than the SERVO-PACK minimum allowable resistance.	**3
	A heavy load was applied while the Ser- vomotor was stopped or running at a low speed.	Check to see if the operating conditions exceed Servo Drive specifications.	Reduce the load applied to the Servomotor. Or, increase the operating speed.	7
	A malfunction was caused by noise.	Improve the noise envi- ronment, e.g. by improving the wiring or installation conditions, and check to see if the alarm still occurs.	Implement countermeasures against noise, such as correct wiring of the FG. Use an FG wire size equivalent to the SERVO-PACK's main circuit wire size.	-
Driv	A failure occurred in the SERVOPACK.	tors C	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	5

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The Main Circuit Cable is not wired correctly or there is faulty contact.	Check the wiring.	Correct the wiring.	
	There is a short-circuit or ground fault in a Main Circuit Cable.	Check for short-circuits across cable phases U, V, and W, or between the ground and cable phases U, V, and W.	The cable may be short-circuited. Replace the cable.	
	There is a short-circuit or ground fault inside the Servomotor.	Check for short-circuits across Servomotor phases U, V, and W, or between the ground and Servomotor phases U, V, or W.	The Servomotor may be faulty. Replace the Servomotor.	page 4-25
A.101: Motor Overcurrent Detected (The current to the motor exceeded the allowable cur-	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.	
rent.)	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.	-
Duite	A malfunction was caused by noise.	Improve the noise envi- ronment, e.g. by improving the wiring or installation conditions, and check to see if the alarm still occurs.	Implement countermea- sures against noise, such as correct wiring of the FG. Use an FG wire size equivalent to the SERVO- PACK's main circuit wire size.	-
Drive	A failure occurred in the SERVOPACK.	ors C	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

12.2.2 Troubleshooting Alarms

Continued from previous page.

Alarm Number:	Possible Cause	Confirmation	Continued from pre	Reference
Alarm Name		Committation	Correction	ricicience
	Pn600 (Regenerative Resistor Capacity) is not set to 0 and an External Regenerative Resistor is not con- nected to one of the following SERVO- PACKs: SGD7S- R70A, -R90A,-1R6A, -2R8A, -R70F, -R90F, -2R1F, or -2R8F.	Check to see if an External Regenerative Resistor is connected and check the setting of Pn600.	Connect an External Regenerative Resistor, or set Pn600 (Regenerative Resistor Capacity) to 0 (setting unit: ×10 W) if no Regenerative Resistor is required.	page 5-57
	An External Regenerative Resistor is not connected to one of the following SERVO-PACKs: SGD7S-470A, -550A, -590A, or -780A.	Check to see if an External Regenerative Resistor or a Regenerative Resistor Unit is connected and check the setting of Pn600.	Connect an External Regenerative Resistor and set Pn600 to an appropri- ate value, or connect a Regenerative Resistor Unit and set Pn600 to 0.	
A.300: Regeneration Error	The jumper between the regenerative resis- tor terminals (B2 and B3) was removed from one of the fol- lowing SERVOPACKs: SGD7S-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, or -330A.	Check to see if the jumper is connected between power supply terminals B2 and B3.	Correctly connect a jumper.	page 4-21
	The External Regenerative Resistor is not wired correctly, or was removed or disconnected.	Check the wiring of the External Regenerative Resistor.	Correct the wiring of the External Regenerative Resistor.	
Driv	A failure occurred in the SERVOPACK.	tors C	While the main circuit power supply is OFF, turn the control power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	6

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference	
	The power supply voltage exceeded the specified range.	Measure the power supply voltage.	Set the power supply voltage within the specified range.	_	
	The external regenerative resistance value or regenerative resistor capacity is too small, or there has been a continuous regeneration state.	Check the operating conditions or the capacity using the SigmaJunmaSize+ Capacity Selection Software or other means.	Change the regenerative resistance value or capacity. Reconsider the operating conditions using the SigmaJunmaSize+ Capacity Selection Software or other means.	*3	
	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.320: Regenerative Overload	The setting of Pn600 (Regenerative Resistor Capacity) is smaller than the capacity of the External Regenerative Resistor.	Check to see if a Regenerative Resistor is connected and check the setting of Pn600.	Correct the setting of Pn600.	page 5-57	
	The setting of Pn603 (Regenerative Resistance) is smaller than the capacity of the External Regenerative Resistor.	Check to see if a Regenerative Resistor is connected and check the setting of Pn603.	Correct the setting of Pn603.	page 5-57	
	The external regenerative resistance is too high.	Check the regenerative resistance.	Change the regenerative resistance to a correct value or use an External Regenerative Resistor of an appropriate capacity.	*3	
Drive	A failure occurred in the SERVOPACK.	ors Co	The SERVOPACK may be faulty. Replace the SERVOPACK.	_	
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12.2.2 Troubleshooting Alarms

Continued from previous page.

Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The regenerative resistor was disconnected when the SERVOPACK power supply voltage was high.	Measure the resistance of the regenerative resistor using a measuring instrument.	If you are using the regenerative resistor built into the SERVOPACK, replace the SERVOPACK. If you are using an External Regenerative Resistor, replace the External Regenerative Resistor.	-
4.000	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.	7070 F 14
A.330: Main Circuit Power Supply Wiring Error (Detected when	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.	page 5-14
the main circuit power supply is turned ON.)	Pn600 (Regenerative Resistor Capacity) is not set to 0 and an External Regenerative Resistor is not con- nected to one of the following SERVOPACKs: SGD7S-R70A, -R90A, -1R6A, -2R8A, -R70F, -R90F, -2R1F, or -2R8F.	Check to see if an External Regenerative Resistor is connected and check the setting of Pn600.	Connect an External Regenerative Resistor, or if an External Regenera- tive Resistor is not required, set Pn600 to 0.	page 4-21, page 5-57
	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The power supply voltage exceeded the specified range.	Measure the power supply voltage.	Set the AC/DC power supply voltage within the specified range.	-
	The power supply is not stable or was influenced by a lightning surge.	Measure the power supply voltage.	Improve the power supply conditions, install a surge absorber, and then turn the power supply OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.400: Overvoltage (Detected in the	The voltage for AC power supply was too high during acceleration or deceleration.	Check the power supply voltage and the speed and torque during operation.	Set the AC power supply voltage within the specified range.	_
main circuit power supply section of the SERVOPACK.)	The external regenerative resistance is too high for the operating conditions.	Check the operating conditions and the regenerative resistance.	Select a regenerative resistance value that is appropriate for the operating conditions and load.	*3
	The moment of inertia ratio or mass ratio exceeded the allowable value.	Check to see if the moment of inertia ratio or mass ratio is within the allowable range.	Increase the deceleration time, or reduce the load.	_
	A failure occurred in the SERVOPACK.		While the main circuit power supply is OFF, turn the control power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
Drive	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.410: Undervoltage (Detected in the main circuit power supply section of the SERVOPACK.)	A momentary power interruption occurred.	Measure the power supply voltage.	If you have changed the setting of Pn509 (Momentary Power Interruption Hold Time), decrease the setting.	page 6-13
	The SERVOPACK fuse is blown out.	_	Replace the SERVO- PACK and connect a reactor to the DC reactor terminals (⊝1 and ⊝2) on the SERVOPACK.	-
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SERVOPACK.	_

12.2.2 Troubleshooting Alarms

Continued from previous page.

Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The order of phases U, V, and W in the motor wiring is not correct.	Check the wiring of the Servomotor.	Make sure that the Servo- motor is correctly wired.	-
A.510: Overspeed (The motor	A reference value that exceeded the over- speed detection level was input.	Check the input reference.	Reduce the reference value. Or, adjust the gain.	
exceeded the maximum speed.)	The motor exceeded the maximum speed.	Check the waveform of the motor speed.	Reduce the speed reference input gain and adjust the servo gain. Or, reconsider the operating conditions.	† page 6-17
	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.511: Encoder Output	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 Out- put Resolution).	page 6-52
Pulse Overspeed	The encoder output pulse frequency exceeded the limit because the motor speed was too high.	Check the encoder output pulse setting and the motor speed.	Reduce the motor speed.	1 7
	Abnormal oscillation was detected in the motor speed.	Check for abnormal motor noise, and check the speed and torque waveforms during operation.	Reduce the motor speed. Or, reduce the setting of Pn100 (Speed Loop Gain).	page 8-76
A.520: Vibration Alarm	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.	page 8-16
	The vibration detection level (Pn312 or Pn384) is not suitable.	Check that the vibration detection level (Pn312 or Pn384) is suitable.	Set a suitable vibration detection level (Pn312 or Pn384).	page 6-98
A.521: Autotuning Alarm (Vibration was detected while executing the custom tuning, Easy FFT, or the tuning-less func- tion.)	The Servomotor vibrated considerably while performing the tuning-less function.	Check the waveform of the motor speed.	Reduce the load so that the moment of inertia ratio is within the allowable value. Or increase the load level or reduce the rigidity level in the tuningless level settings.	page 8-13
	The Servomotor vibrated considerably while performing custom tuning or Easy FFT.	Check the waveform of the motor speed.	Check the operating procedure of corresponding function and implement corrections.	page 8-42, page 8-94
A.550: Maximum Speed Setting Error	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.	page 6-16

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.710: Instantaneous Overload A.720: Continuous Overload	The wiring is not correct or there is a faulty contact in the motor or encoder wiring.	Check the wiring.	Make sure that the Servo- motor and encoder are correctly wired.	page 4-25
	Operation was performed that exceeded the overload protection characteristics.	Check the motor over- load characteristics and Run command.	Reconsider the load and operating conditions. Or, increase the motor capacity.	-
	An excessive load was applied during operation because the Servomotor was not driven due to mechanical problems.	Check the operation reference and motor speed.	Correct the mechanical problem.	-
	There is an error in the setting of Pn282 (Linear Encoder Scale Pitch).	Check the setting of Pn282.	Correct the setting of Pn282.	page 5-19
A.730 and A.731: Dynamic Brake Overload (An excessive power consumption by the dynamic brake was detected.)	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.	page 5-24
	A failure occurred in the SERVOPACK.	Y /	The SERVOPACK may be faulty. Replace the SERVOPACK.	_
	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 (The main circuit power supply was frequently turned ON and OFF.)	The allowable frequency of the inrush current limiting resistor was exceeded when the main circuit power supply was turned ON and OFF.	_	Reduce the frequency of turning the main circuit power supply ON and OFF.	-
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SERVOPACK.	-

12.2.2 Troubleshooting Alarms

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference	
A.7A1: Internal Temperature Error 1 (Control Board Temperature Error)	The surrounding temperature is too high.	Check the surrounding temperature using a thermostat. Or, check the operating status with the SERVOPACK installation environment monitor.	Decrease the surrounding temperature by improving the SERVO-PACK installation conditions.	page 3-7	
	An overload alarm was reset by turning OFF the power supply too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	-	
	There was an excessive load or operation was performed that exceeded the regenerative processing capacity.	Use the accumulated load ratio to check the load during operation, and use the regenerative load ratio to check the regenerative processing capacity.	Reconsider the load and operating conditions.	-	
	The SERVOPACK installation orientation is not correct or there is insufficient space around the SERVOPACK.	Check the SERVOPACK installation conditions.	Install the SERVOPACK according to specifications.	page 3-3, page 3-6	
	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SERVOPACK.	7	
	The surrounding temperature is too high.	Check the surrounding temperature using a thermostat. Or, check the operating status with the SERVOPACK installation environment monitor.	Decrease the surrounding temperature by improving the SERVO-PACK installation conditions.	page 3-7	
A.7A2: Internal Temperature Error 2 (Power Board Temperature Error)	An overload alarm was reset by turning OFF the power supply too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	9	
	There was an excessive load or operation was performed that exceeded the regenerative processing capacity.	Use the accumulated load ratio to check the load during operation, and use the regenerative load ratio to check the regenerative processing capacity.	Reconsider the load and operating conditions.	-	
	The SERVOPACK installation orientation is not correct or there is insufficient space around the SERVOPACK.	Check the SERVOPACK installation conditions.	Install the SERVOPACK according to specifications.	page 3-3, page 3-6	
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SERVOPACK.	_	
A.7A3: Internal Tempera- ture Sensor Error (An error occurred in the temperature sen- sor circuit.)	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SERVOPACK.	-	

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.7Ab: SERVOPACK Built-in Fan Stopped	The fan inside the SERVOPACK stopped.	Check for foreign matter inside the SERVOPACK.	Remove foreign matter from the SERVOPACK. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.810: Encoder Backup Alarm (Detected at the encoder, but only when an abso- lute encoder is used.)	The power to the absolute encoder was turned ON for the first time.	Check to see if the power supply was turned ON for the first time.	Set up the encoder.	page 5-51
	The Encoder Cable was disconnected and then connected again.	Check to see if the power supply was turned ON for the first time.	Check the encoder connection and set up the encoder.	
	Power is not being supplied both from the control power supply (+5 V) from the SERVOPACK and from the battery power supply.	Check the encoder connector battery and the connector status.	Replace the battery or implement similar measures to supply power to the encoder, and set up the encoder.	
	A failure occurred in the absolute encoder.	Y / (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. When Using an Abso-	-
			lute Encoder Set up the encoder again. If the alarm still occurs, the Servomotor may be faulty. Replace the Servo-	
A.820: Encoder Check- sum Alarm (Detected at the encoder.)	A failure occurred in the encoder.	ors C	motor. When Using a Singleturn Absolute Encoder or Incremental Encoder	page 5-51
			 The Servomotor may be faulty. Replace the Servomotor. The linear encoder may be faulty. Replace the linear encoder. 	
	A failure occurred in the SERVOPACK.	_	The SERVOPACK may be faulty. Replace the SERVOPACK.	_
A.830: Encoder Battery Alarm (The absolute encoder battery voltage was lower than the speci- fied level.)	The battery connection is faulty or a battery is not connected.	Check the battery connection.	Correct the battery connection.	page 4-26
	The battery voltage is lower than the specified value (2.7 V).	Measure the battery voltage.	Replace the battery.	page 12-3
	A failure occurred in the SERVOPACK.	-	The SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The encoder malfunctioned.	_	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the Servomotor or linear encoder may be faulty. Replace the Servo- motor or linear encoder.	-
1.040	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.	-
A.840: Encoder Data Alarm (Detected at the encoder.)	Excessive speed occurred in the linear encoder.	_	Control the motor speed within the range specified by the linear encoder manufacturer and then turn ON the control power supply.	-
	The encoder malfunctioned due to noise.		Correct the wiring around the encoder by separating the Encoder Cable from the Servomotor Main Cir- cuit Cable or by ground- ing the encoder.	1
	The polarity sensor is not wired correctly.	Check the wiring of the polarity sensor.	Correct the wiring of the polarity sensor.	7
	The polarity sensor failed.	-	Replace the polarity sensor.	/-
	Rotary Servomotor: The Servomotor speed was 200 min ⁻¹ or higher when the control power supply was turned ON.	Check the motor speed when the power supply is turned ON.	Reduce the Servomotor speed to a value less than 200 min ⁻¹ , and turn ON the control power supply.	-
A.850: Encoder Over-	Linear Servomotor: The Servomotor exceeded the specified speed when the control power supply	Check the motor speed when the power supply is turned ON.	Control the motor speed within the range specified by the linear encoder manufacturer and then turn ON the control power	5
speed (Detected at the encoder when the control power supply is turned ON.)	was turned ON. A failure occurred in the encoder.	_	supply. Turn the power supply to the SERVOPACK OFF and ON again. If an 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 supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.860: Encoder Over-	The surrounding air temperature around the Servomotor is too high.	Measure the surrounding air temperature around the Servomotor.	Reduce the surrounding air temperature of the Servomotor to 40°C or less.	-
heated (Detected when a Rotary Servomo- tor, Absolute Lin-	The Servomotor load is greater than the rated load.	Use the accumulated load ratio to check the load.	Operate the Servo Drive so that the motor load remains within the specified range.	page 9-4
ear Encoder, or Direct Drive Ser- vomotor is con- nected. However, this alarm is not detected for SGMCS Servomotors with	A failure occurred in the encoder.	_	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the Servomotor or absolute linear encoder may be faulty. Replace the Servomotor or absolute linear encoder.	-
Incremental Encoders.) (Detected at the encoder.)	A failure occurred in the SERVOPACK.		Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
	The surrounding temperature around the Servomotor is too high.	Measure the surrounding temperature around the Servomotor.	Reduce the surrounding air temperature of the Servomotor to 40°C or less.	-
	The motor load is greater than the rated load.	Check the load with the accumulated load ratio on the Motion Monitor Tab Page on the SigmaWin+.	Operate the Servo Drive so that the motor load remains within the specified range.	page 9-4
A.861: Motor Over- heated	A failure occurred in the Serial Converter Unit.	ors C	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the Serial Con- verter Unit may be faulty. Replace the Serial Con- verter Unit.	-
	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The surrounding temperature is too high.	Check the surrounding temperature using a thermostat.	Lower the surrounding temperature by improving the installation conditions of the Linear Servomotor or the machine.	-
	The overheat protection input signal line is disconnected or short-circuited.	Check the input voltage with the overheat protection input information on the Motion Monitor Tab Page on the SigmaWin+.	Repair the line for the overheat protection input signal.	-
A.862:	An overload alarm was reset by turning OFF the power supply too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	-
Overheat Alarm	Operation was per- formed under an excessive load.	Use the accumulated load ratio to check the load during operation.	Reconsider the load and operating conditions.	-
	A failure occurred in the SERVOPACK.	1 / / /	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.	7
A.890: Encoder Scale Error	A failure occurred in the linear encoder.	-	The linear encoder may be faulty. Replace the linear encoder.	-
A.891: Encoder Module Error	A failure occurred in the linear encoder.	tors C	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the linear encoder may be faulty. Replace the	6
A.8A0: External Encoder Error	Setting the origin of the absolute linear encoder failed because the motor moved.	Before you set the origin, use the fully-closed feedback pulse counter to confirm that the motor is not moving.	The motor must be stopped while setting the origin position.	page 5-54
	A failure occurred in the external encoder.	_	Replace the external encoder.	
A.8A1:	A failure occurred in the external encoder.	_	Replace the external encoder.	-
External Encoder Module Error	A failure occurred in the Serial Converter Unit.	_	Replace the Serial Converter Unit.	-
A.8A2: External Incremental Encoder Sensor Error	A failure occurred in the external encoder.	_	Replace the external encoder.	-
A.8A3: External Absolute Encoder Position Error	A failure occurred in the external absolute encoder.	_	The external absolute encoder may be faulty. Refer to the encoder manufacturer's instruction manual for corrections.	-

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.8A5: External Encoder Overspeed	An overspeed error was detected in the external encoder.	Check the maximum speed of the external encoder.	Keep the external encoder below its maximum speed.	-
A.8A6: External Encoder Overheated	An overheating error was detected in the external encoder.	-	Replace the external encoder.	-
A.b10: Speed Reference	A malfunction occurred in the speed reference input section.	_	Reset the alarm and restart operation.	page 12-4
A/D Error (Detected when the servo is turned ON.)	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.b11:	A malfunction occurred in the speed reference input section.		Reset the alarm and restart operation.	page 12-42
Speed Reference A/D Data Error	A failure occurred in the SERVOPACK.	Y // ((Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.b20: Torque Refer- ence A/D Error	A malfunction occurred in the reading section for the torque reference input.		Reset the alarm and restart operation.	page 12-4
(Detected when the servo is turned ON.)	A failure occurred in the SERVOPACK.	ors Co	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.b33: Current Detec- tion Error 3	A failure occurred in the current detection circuit.	-	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.bF0: System Alarm 0	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.bF1: System Alarm 1	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.bF2: System Alarm 2	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Number:			Continued from pre	1 0
Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.bF3: System Alarm 3	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	_
A.bF4: System Alarm 4	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	_
A.bF5: System Alarm 5	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.bF6: System Alarm 6	A failure occurred in the SERVOPACK.		Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	
A.bF7: System Alarm 7	A failure occurred in the SERVOPACK.		Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	7
A.bF8: System Alarm 8	A failure occurred in the SERVOPACK.	otore (Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	
DIIV	The order of phases U, V, and W in the motor wiring is not correct.	Check the Servomotor wiring.	Make sure that the Servo- motor is correctly wired.	=
A.C10:	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.	page 5-24
Servomotor Out of Control (Detected when the servo is turned ON.)	A failure occurred in the encoder.	_	If the motor wiring is correct and an alarm still occurs after turning the power supply OFF and ON again, the Servomotor or linear encoder may be faulty. Replace the Servomotor or linear encoder.	_
	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	_

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 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.	page 5-24
The polarity sensor signal is being affected by noise.	_	Correct the FG wiring. Implement countermea- sures against noise for the polarity sensor wiring.	-
The setting of Pn282 (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.	page 5-19
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.	_
The SERVOPACK phase information is different from the linear encoder phase information.		Perform polarity detection.	page 5-30
	The linear encoder signal level is too low. The count-up direction of the linear encoder does not match the forward direction of the Moving Coil in the motor. The polarity sensor signal is being affected by noise. The setting of Pn282 (Linear Encoder Scale Pitch) is not correct. The polarity sensor is protruding from the Magnetic Way of the motor. The polarity sensor is not wired correctly. The polarity sensor is not wired correctly. The SERVOPACK phase information is different from the linear encoder phase	The linear encoder signal level is too low. The count-up direction of the linear encoder does not match the forward direction of the Moving Coil in the motor. The polarity sensor signal is being affected by noise. The setting of Pn282 (Linear Encoder Scale Pitch) is not correct. The polarity sensor is protruding from the Magnetic Way of the motor. The polarity sensor is not wired correctly. The polarity sensor failed. The SERVOPACK phase information is different from the linear encoder signal. Check the setting of Pn080 = n. □ □ X □ (Motor Phase Sequence Selection). Check the installation orientation for the linear encoder and Moving Coil. Check the setting of Pn282 (Linear Encoder Scale Pitch). Check the polarity sensor. Check the wiring of the polarity sensor.	The linear encoder signal level is too low. Check the voltage of the scale head. Or, replace the linear encoder. Check the setting of Pn080 = n.□□X□ (Motor Phase Sequence Selection). Check the installation orientation for the linear encoder and Moving Coil. Check the setting of Pn080 = n.□□X□. Change the setting of Pn080 = n.□□X□. Correctly reinstall the linear encoder or Moving Coil. Correctly reinstall the linear encoder or Moving Coil. Correct the FG wiring. Implement countermeasures against noise for the polarity sensor wiring. Check the setting of Pn282 (Linear Encoder Scale Pitch) is not correct. The polarity sensor is protruding from the Magnetic Way of the motor. Check the polarity sensor is not wired correctly. Check the wiring of the polarity sensor. Replace the mounting of the scale head. Or, replace the linear encoder. Change the setting of Pn080 = n.□□X□. Correctly reinstall the linear encoder or Moving Coil. Correct the FG wiring. Implement countermeasures against noise for the polarity sensor wiring. Check the setting of Pn080 = n.□□X□. Correct the FG wiring. Implement countermeasures against noise for the polarity sensor wiring. Check the setting of Pn080 = n.□□X□. Correct the FG wiring. Implement countermeasures against noise for the polarity sensor wiring. Check the setting of Pn080 = n.□□X□. Correct the FG wiring. Implement countermeasures against noise for the polarity sensor wiring. Check the polarity sensor of the linear encoder and set a correct value. Correctly reinstall the Moving Coil. Correctly reinstall the form of the polarity sensor. Check the wiring of the polarity sensor. Replace the polarity detection.

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Alarm Number: Alarm Name	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.	page 5-19, page 5-24
	There is noise on the scale signal.	Check to make sure that the frame grounds of the Serial Converter Unit and Servomotor are connected to the FG terminal on the SER-VOPACK and that the FG terminal on the SER-VOPACK is connected to the frame ground on the power supply. And, confirm that the shield is properly processed on the Linear Encoder Cable. Check to see if the detection reference is repeatedly output in one direction.	Implement appropriate countermeasures against noise for the Linear Encoder Cable.	-
A.C50: Polarity Detection Failure			The polarity cannot be properly detected if the detection reference is 0 and the speed feedback is not 0 because of an	
Duit	An external force was applied to the Moving Coil of the motor.	h = u = C	external force, such as cable tension, applied to the Moving Coil. Implement measures to reduce the external force so that	_
Driv	es ivic	otors C	the speed feedback goes to 0. If the external force cannot be reduced, increase the setting of Pn481 (Polarity Detection	5
			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.	_

12.2.2 Troubleshooting Alarms

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.C51: Overtravel Detected during Polarity Detection	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.	page 4-38
A.C52: Polarity Detection Not Completed	The servo was turned ON under the following circumstances. • Before polarity detection was completed • Before /P-DET was input	_	Input the /P-DET signal.	page 5-29
A.C53: Out of Range of Motion for Polar- ity Detection	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	An external force was applied to the Servomotor.	V / (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	A failure occurred in the encoder.	ors Co	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the Servomotor or linear encoder may be faulty. Replace the Servo- motor or linear encoder.	-
Error or Multiturn Limit Setting Error	A failure occurred in the SERVOPACK.	-	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	_

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Alarm Number:	er: Continued from previous				
Alarm Name	Possible Cause	Confirmation	Correction	Reference	
A.C90: Encoder Communications Error	There is a faulty contact in the connector or the connector is not wired correctly for the encoder.	Check the condition of the encoder connector.	Reconnect the encoder connector and check the encoder wiring.	page 4-25	
	There is a cable disconnection or short-circuit in the encoder. Or, the cable impedance is outside the specified values.	Check the condition of the Encoder Cable.	Use the Encoder Cable within the specifications.	-	
	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	Check the operating environment.	Improve the operating environmental, and replace the cable. If the alarm still occurs, replace the SERVOPACK.	page 3-2	
	A malfunction was caused by noise.	W	Correct the wiring around the encoder by separating the Encoder Cable from the Servomotor Main Circuit Cable or by grounding the encoder.	page 4-5	
	A failure occurred in the SERVOPACK.		Connect the Servomotor to another SERVOPACK, and turn ON the control power supply. If no alarm occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-	
Driv	Noise entered on the signal lines because the Encoder Cable is bent or the sheath is damaged.	Check the condition of the Encoder Cable and connectors.	Check the Encoder Cable to see if it is installed correctly.	page 4-8	
A.C91: Encoder Communications Position Data Acceleration Rate	The Encoder Cable is bundled with a high- current line or installed near a high- current line.	Check the installation condition of the Encoder Cable.	Confirm that there is no surge voltage on the Encoder Cable.	-	
Error	There is variation in the FG potential because of the influ- ence of machines on the Servomotor side, such as a welder.	Check the installation condition of the Encoder Cable.	Properly ground the machine to separate it from the FG of the encoder.	-	

Maintenance

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	Noise entered on the signal line from the encoder.	_	Implement countermeasures against noise for the encoder wiring.	page 4-5
	Excessive vibration or shock was applied to the encoder.	Check the operating conditions.	Reduce machine vibration. Correctly install the Servomotor or linear encoder.	_
A.C92: Encoder Commu- nications Timer Error	A failure occurred in the encoder.	_	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the Servomotor or linear encoder may be faulty. Replace the Servo- motor or linear encoder.	_
	A failure occurred in the SERVOPACK.		Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.CA0: Encoder Parame-	A failure occurred in the encoder.	Y // (Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the Servomotor or linear encoder may be faulty. Replace the Servo- motor or linear encoder.	-
ter Error	A failure occurred in the SERVOPACK.		Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The encoder is wired incorrectly or there is faulty contact.	Check the wiring of the encoder.	Make sure that the encoder is correctly wired.	page 4-25
	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.	-
A.Cb0: Encoder Echo- back Error	There is variation in the FG potential because of the influ- ence of machines on the Servomotor side, such as a welder.	Check the condition of the Encoder Cable and connectors.	Properly ground the machine to separate it from the FG of the encoder.	-
	Excessive vibration or shock was applied to the encoder.	Check the operating conditions.	Reduce machine vibration. Correctly install the Servomotor or linear encoder.	1 7
	A failure occurred in the encoder.		Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the Servomotor or linear encoder may be faulty. Replace the Servo- motor or linear encoder.	-
Driv	A failure occurred in the SERVOPACK.	tors C	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	0
A.CC0: Multiturn Limit Disagreement	When using a Direct Drive Servomotor, the setting of Pn205 (Mul- titurn Limit) does not agree with the encoder.	Check the setting of Pn205.	Correct the setting of Pn205 (0 to 65,535).	page 6-84
	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 in the SERVO-PACK.	Change the setting if the alarm occurs.	page 6-84
	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	n nevt nage

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
	The cable between the Serial Converter Unit and SERVOPACK is not wired correctly or there is a faulty contact.	Check the wiring of the external encoder.	Correctly wire the cable between the Serial Converter Unit and SERVO-PACK.	page 4-27
A.CF1: Reception Failed Error in Feed-	A specified cable is not being used between Serial Con- verter Unit and SER- VOPACK.	Check the wiring specifications of the external encoder.	Use a specified cable.	-
back Option Module Commu- nications	The cable between the Serial Converter Unit and SERVOPACK is too long.	Measure the length of the cable that connects the Serial Converter Unit.	The length of the cable between the Serial Converter Unit and SERVO-PACK must be 20 m or less.	-
	The sheath on cable between the Serial Converter Unit and SERVOPACK is broken.	Check the cable that connects the Serial Converter Unit.	Replace the cable between the Serial Converter Unit and SERVO-PACK.	-
A.CF2: Timer Stopped Error in Feed-	Noise entered the cable between the Serial Converter Unit and SERVOPACK.	Y /1 (Correct the wiring around the Serial Converter Unit, e.g., separate I/O signal lines from the Main Circuit Cables or ground.	-
back Option Module Commu- nications	A failure occurred in the Serial Converter Unit.	- /	Replace the Serial Converter Unit.	_
	A failure occurred in the SERVOPACK.	-	Replace the SERVO- PACK.	_
Drive	The Servomotor U, V, and W wiring is not correct.	Check the wiring of the Servomotor's Main Circuit Cables.	Make sure that there are no faulty contacts in the wiring for the Servomotor and encoder.	-
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.)	The frequency of the position reference pulse is too high.	Reduce the reference pulse frequency and try operating the SERVO- PACK.	Reduce the position reference pulse frequency or the reference acceleration rate, or reconsider the electronic gear ratio.	page 5-47
	The acceleration of the position reference is too high.	Reduce the reference acceleration and try operating the SERVO-PACK.	Apply smoothing, i.e., by using Pn216 (Position Reference Acceleration/ Deceleration Time Constant).	page 6-36
	The setting of Pn520 (Position Deviation Overflow Alarm Level) is too low for the operating conditions.	Check Pn520 (Position Deviation Overflow Alarm Level) to see if it is set to an appropriate value.	Optimize the setting of Pn520.	page 8-8
	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

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Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.d01: Position Deviation Overflow Alarm at Servo ON	The servo was turned ON after the position deviation exceeded the setting of Pn526 (Position Deviation Overflow Alarm Level at Servo ON) while the servo was OFF.	Check the position deviation while the servo is OFF.	Set the position deviation to be cleared while the servo is OFF. Optimize the setting of Pn526 (Position Deviation Overflow Alarm Level at Servo ON).	
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.		Set the position deviation to be cleared while the servo is OFF. Optimize the setting of Pn520 (Position Deviation Overflow Alarm Level). Or, adjust the setting of Pn529 or Pn584 (Speed Limit Level at Servo ON).	page 8-8
A.d10: Motor-Load Position Deviation	The motor direction and external encoder installation orientation are backward.	Check the motor direction and the external encoder installation orientation.	Install the external encoder in the opposite direction, or change the setting of Pn002 = n.XDDD (External Encoder Usage) to reverse the direction.	page 10-6
Overflow	There is an error in the connection between the load (e.g., stage) and external encoder coupling.	Check the coupling of the external encoder.	Check the mechanical coupling.	-
A.d30: Position Data Overflow	The position data exceeded ±1,879,048,192.	Check the input reference pulse counter.	Reconsider the operating specifications.	5
	There is a faulty connection between the SERVOPACK and the Safety Option Module.	Check the connection between the SERVO- PACK and the Safety Option Module.	Correctly connect the Safety Option Module.	-
A.E71: Safety Option Module Detec- tion Failure	The Safety Option Module was discon- nected.	_	Execute Fn014 (Reset Option Module Configuration Error) from the Digital Operator or SigmaWin+ and then turn the power supply to the SERVO-PACK OFF and ON again.	page 12-45
	A failure occurred in the Safety Option Module.	_	Replace the Safety Option Module.	_
	A failure occurred in the SERVOPACK.	_	Replace the SERVO-PACK.	_

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Alarm Name	Possible Cause	Confirmation	Correction	Reference
A.E72: Feedback Option Module Detec- tion Failure	There is a faulty con- nection between the SERVOPACK and the Feedback Option Module.	Check the connection between the SERVO- PACK and the Feed- back Option Module.	Correctly connect the Feedback Option Module.	_
	The Feedback Option Module was discon- nected.	_	Reset the Option Module configuration error and turn the power supply to the SERVOPACK OFF and ON again.	page 12-45
	A failure occurred in the Feedback Option Module.	_	Replace the Feedback Option Module.	-
	A failure occurred in the SERVOPACK.	_	Replace the SERVO- PACK.	-
A.E74: Unsupported	A failure occurred in the Safety Option Module.	-	Replace the Safety Option Module.	_
Safety Option Module	An unsupported Safety Option Module was connected.	Refer to the catalog of the connected Safety Option Module.	Connect a compatible Safety Option Module.	_
A.Eb1: Safety Function Signal Input Tim- ing Error	The delay between activation of the /HWBB1 and /HWBB2 input signals for the HWBB was ten second or longer.	Measure the time delay between the /HWBB1 and /HWBB2 signals.	The output signal circuits or devices for /HWBB1 and /HWBB2 or the SER-VOPACK input signal circuits may be faulty. Alternatively, the input signal cables may be disconnected. Check to see if any of these items are faulty or have been disconnected.	_
Drive	A failure occurred in the SERVOPACK.	oro O	Replace the SERVO- PACK.	-
A.EC8: Gate Drive Error 1 (An error occurred in the gate drive circuit.) A.EC9: Gate Drive Error 2 (An error occurred in the gate drive circuit.)	A failure occurred in the SERVOPACK.	.015 0	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	_

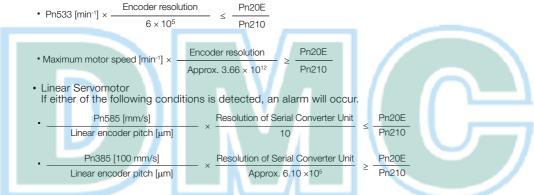
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A.F10: Power Supply Line Open Phase (The voltage was low for more than one second for phase R, S, or T when the main power supply was ON.) A.F10: A.F10: Power Supply Line Open Phase (The voltage was low for more than one second for phase R, S, or T when the main power supply was ON.) A failure occurred in the SERVOPACK. Check the power supply wiring. Check the power supply wiring. Make sure that the power supply wiring. Make sure that the power supply wiring. Make sure that the power supply wiring. Check the power supply by changing phases. Check the power supply by changing phases. Check the power supply and the parameter setting to the power supply and the parameter setting to the power supply to the SERVOPACK of F and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. A.F50: A failure occurred in the SERVOPACK may be
A.F10: Power Supply Line Open Phase (The voltage was low for more than one second for phase R, S, or T when the main power supply was ON.) A failure occurred in the SERVOPACK. Dower Supply Line Open Phase (The voltage was low for more than one second for phase R, S, or T when the main power supply was ON.) A failure occurred in the SERVOPACK. Dower supply wiring is not correct. Measure the voltage for each phase of the three-phase power supply by changing phases. Check the power supply and the parameter setting to the power supply. Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK. A failure occurred in the Kittle power supply is supply is correctly wired. Date of the three power supply by changing phases. Check the power supply by changing phases. Check the power supply by changing phases. The three-phase power supply by changing phases. Check the power supply by changing phases. The servopack is correctly wired. Date of the three the voltage for each phase of the three-phase power supply by changing phases. The servopack is correctly wired. Date of the three power supply by changing phases. The servopack is correctly wired. Date of the supply is supply is correctly wired. The three-phase power supply by changing phases. Deach phase Ac power supply by changing phases. The servopack is correctly wired. The servopach is correctly wired. The supply is correctly wired.
A.F10: Power Supply Line Open Phase (The voltage was low for more than one second for phase R, S, or T when the main power supply was ON.) A failure occurred in the SERVOPACK. The tiffee-phase power supply is unbalanced. A single-phase power supply. A single-phase power supply was input without specifying a single-phase AC power supply input (Pn00B = n.□1□□). Check the power supply and the parameter setting to the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK may be
(The voltage was low for more than one second for phase R, S, or T when the main power supply was ON.) A failure occurred in the SERVOPACK. A single-phase power supply was input without specifying a single-phase AC power supply input (Pn00B = n.□1□□). Check the power supply and the parameter setting to the power supply. Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. A failure occurred in the SERVOPACK may be
was ON.) A failure occurred in the SERVOPACK. Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK. The SERVOPACK may be
Servomotor Main Circuit Cable Dis-
connection (The Servomotor did not operate or power was not supplied to the Servomotor even though the /S-ON (Servo ON) signal was input when the Servomotor was ready to receive it.) The wiring is not correct or there is a faulty contact in the motor wiring. Check the wiring. Check the wiring. Make sure that the Servomotor is correctly wired.
FL-1*4: System Alarm FL-2*4:
System Alarm FL-3*4: System Alarm FL-4*4: System Alarm FL-5*4: System Alarm FL-5*4: System Alarm FL-6*4:
System Alarm There is a faulty see
There is a faulty contact between the Digital Operator Communications There is a faulty contact between the Digital Operator and the SERVOPACK. Check the connector contact. Check the connect tor and insert it again. Or, replace the cable.
Error 1 A malfunction was caused by noise Keep the Digital Operator or the cable away from sources of noise.

Alarm Number: Alarm Name	Possible Cause	Confirmation	Correction	Reference
CPF01: Digital Operator Communications Error 2	A failure occurred in the Digital Operator.	_	Disconnect the Digital Operator and then connect it again. If an alarm still occurs, the Digital Operator may be faulty. Replace the Digital Operator.	-
	A failure occurred in the SERVOPACK.	_	Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-

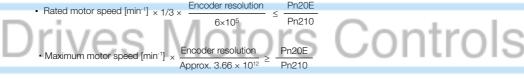
- *1. Detection Conditions
 - Rotary Servomotor

If either of the following conditions is detected, an alarm will occur.



- *2. Detection Conditions

Rotary Servomotor
 If either of the following conditions is detected, an alarm will occur.



Linear Servomotor

If either of the following conditions is detected, an alarm will occur.



- *3. Refer to the following manual for details.
 - Σ-7-Series Peripheral Device Selection Manual (Manual No.: SIEP S800001 32)
- *4. These alarms are not stored in the alarm history. They are only displayed on the panel display.

12.2.3 Resetting Alarms

12.2.3 Resetting Alarms

If there is an ALM (Servo Alarm) signal, use one of the following methods to reset the alarm after eliminating the cause of the alarm.

The /ALM-RST (Alarm Reset) signal will not always reset encoder-related alarms. If you cannot reset an alarm with the /ALM-RST signal, turn OFF the control power supply to reset it.



Be sure to eliminate the cause of an alarm before you reset the alarm. If you reset the alarm and continue operation without eliminating the cause of the alarm, it may result in damage to the equipment or fire.

Resetting Alarms with the /ALM-RST (Alarm Reset Input) Signal

Type	Signal	Connector Pin No.	Name
Input	/ALM-RST	CN1-44	Alarm Reset

Note: Use Pn50B = n.□□X□ (/ALM-RST (Alarm Reset) Signal Allocation) to allocate the /ALM-RST signal to other connector pins. Refer to the following section for details.

6.1.1 Input Signal Allocations on page 6-5

Resetting Alarms Using the Panel Operator

Simultaneously press the UP and the DOWN Keys on the Panel Operator.

Resetting Alarms Using the Digital Operator

Press the **ALARM RESET** Key on the Digital Operator. Refer to the following manual for details on resetting alarms.

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

Drives Motors Controls

12.2.4 Displaying the Alarm History

The alarm history displays up to the last ten alarms that have occurred in the SERVOPACK.

Preparations

No preparations are required.

Applicable Tools

The following table lists the tools that you can use to display the alarm history and the applicable tool functions.

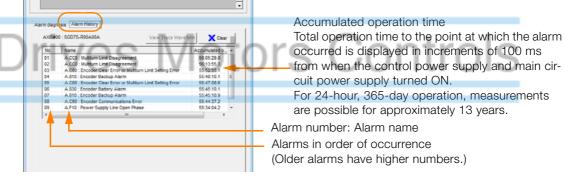
Tool	Function	Reference
Panel Operator	Fn000	13.4.1 Display Alarm History (Fn000) on page 13-12
Digital Operator	Fn000	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Alarm - Display Alarm	Operating Procedure on page 12-43

Operating Procedure

Use the following procedure to display the alarm history.

- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Display Alarm in the Menu Dialog Box. The Alarm Display Dialog Box will be displayed.
- 3. Click the Alarm History Tab.

The following display will appear and you can check the alarms that occurred in the past.



Information

- 1. If the same alarm occurs consecutively within one hour, it is not saved in the alarm history. If it occurs after an hour or more, it is saved.
- 2. You can clear the alarm history by clicking the **Clear** Button. The alarm history is not cleared when alarms are reset or when the SERVOPACK main circuit power is turned OFF.

This concludes the procedure to display the alarm history.

12.2.5 Clearing the Alarm History

You can clear the alarm history that is recorded in the SERVOPACK.

The alarm history is not cleared when alarms are reset or when the SERVOPACK main circuit power is turned OFF. You must perform the following procedure.

Preparations

Always check the following before you clear the alarm history.

• The parameters must not be write prohibited.

Applicable Tools

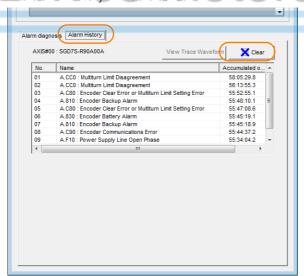
The following table lists the tools that you can use to clear the alarm history and the applicable tool functions.

Tool	Function	Reference
Panel Operator	Fn006	13.4.6 Clear Alarm History (Fn006) on page 13-16
Digital Operator	Fn006	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Alarm - Display Alarm	Operating Procedure on page 12-44

Operating Procedure

Use the following procedure to reset the alarm history.

- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Display Alarm in the Menu Dialog Box. The Alarm Display Dialog Box will be displayed.
- 3. Click the Alarm History Tab.
- 4. Click the Clear Button.
 The alarm history will be cleared.



This concludes the procedure to reset the alarm history.

Maintenance

12.2.6 Resetting Alarms Detected in Option Modules

If any Option Modules are attached to the SERVOPACK, the SERVOPACK detects the presence and models of the connected Option Modules. If it finds any errors, it outputs alarms. You can delete those alarms with this operation.



- This operation is the only way to reset alarms for Option Modules. The alarms are not reset when you reset other alarms or when you turn OFF the power supply to the SERVOPACK.
- Always remove the cause of an alarm before you reset the alarm.

Preparations

Always check the following before you clear an alarm detected in an Option Module.

• The parameters must not be write prohibited.

Applicable Tools

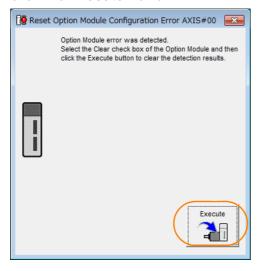
The following table lists the tools that you can use to reset Option Module configuration errors and the applicable tool functions.

Tool	Function	Reference
Panel Operator	Fn014	13.4.19 Reset Option Module Configuration Error (Fn014) on page 13-27
Digital Operator	Fn014	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Setup - Reset Option Module Configuration Error	Operating Procedure on page 12-45

Operating Procedure

Use the following procedure to reset alarms detected in Option Modules.

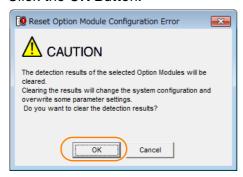
- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- 2. Select Reset Option Module Configuration Error in the Menu Dialog Box. The Reset Option Module Configuration Error Dialog Box will be displayed.
- 3. Select the Clear Check Box for the Option Modules from which to clear alarms and the click the Execute Button.



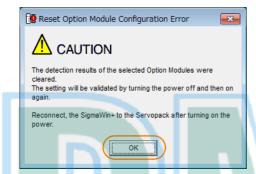
12

12.2.6 Resetting Alarms Detected in Option Modules

4. Click the OK Button.



5. Click the OK Button.



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

This concludes the procedure to reset alarms detected in Option Modules.

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Maintenance

12.2.7 Resetting Motor Type Alarms

The SERVOPACK automatically determines the type of Servomotor that is connected to it. If the type of Servomotor that is connected is changed, an A.070 alarm (Motor Type Change Detected) will occur the next time the SERVOPACK is started. If an A.070 alarm occurs, you must set the parameters to match the new type of Servomotor.

An A.070 alarm is reset by executing the Reset Motor Type Alarm utility function.



- This utility function is the only way to reset an A.070 alarm (Motor Type Change Detected).
 The errors are not reset when you reset alarms or turn OFF the power supply to the
 SERVOPACK.
- 2. If an A.070 alarm occurs, first set the parameters according to the newly connected Servomotor type and then execute the Reset Motor Type Alarm utility function.

Preparations

Always check the following before you reset a motor type alarm.

• The parameters must not be write prohibited.

Applicable Tools

The following table lists the tools that you can use to clear the motor type alarm and the applicable tool functions.

Tool	Function	Reference
Panel Operator	Fn021	13.4.24 Resetting Motor Type Alarms (Fn021) on page 13-29
Digital Operator	Fn021	Σ-7-Series Digital Operator Operating Manual (Manual No.: SIEP S800001 33)
SigmaWin+	Alarm - Reset Motor Type Alarm	Operating Procedure on page 12-47

Operating Procedure

Use the following procedure to reset Motor Type alarm.

- 1. Click the Servo Drive Button in the workspace of the Main Window of the SigmaWin+.
- **2.** Select Reset Motor Type Alarm in the Menu Dialog Box. The Reset Motor Type Alarm Dialog Box will be displayed.
- **3.** Click the Clear Button. The alarm will be cleared.

This concludes the procedure to reset Motor Type alarms.

12.3

Warning Displays

If a warning occurs in the SERVOPACK, a warning number will be displayed on the panel display. Warnings are displayed to warn you before an alarm occurs.

This section provides a list of warnings and the causes of and corrections for warnings.

12.3.1 List of Warnings

The list of warnings gives the warning name, warning meaning, and warning code output in order of the warning numbers.

Warning	Warning Name	Meaning	Warning Co- Output		
Number	o o	Ğ	ALO1	ALO2	ALO3
A.900	Position Deviation Overflow	The position deviation exceeded the percentage set with the following formula: (Pn520 × Pn51E/100)	Н	Н	Н
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: $(Pn526 \times Pn528/100)$	Н	Н	Н
A.910	Overload	This warning occurs before an overload alarm (A.710 or A.720) occurs. If the warning is ignored and operation is continued, an alarm may occur.	L	Н	Н
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 Selection).	L	Н	Н
A.912	Internal Temperature Warning 1 (Control Board Temperature Error)	The surrounding temperature of the control PCB is abnormal.	Н	L	Н
A.913	Internal Temperature Warning 2 (Power Board Temperature	The surrounding temperature of the power PCB is abnormal.	Ģ١	S	Н
	Error)				
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.	Н	L	Н
A.921	Dynamic Brake Over- load	This warning occurs before an A.731 alarm (Dynamic Brake Overload) occurs. If the warning is ignored and operation is continued, an alarm may occur.	Н	L	Н
A.923	SERVOPACK Built-in Fan Stopped	The fan inside the SERVOPACK stopped.	Н	L	Н
A.930	Absolute Encoder Battery Error	This warning occurs when the voltage of absolute encoder's battery is low.	L	L	Н
A.93B	Overheat Warning	The input voltage (temperature) for the overheat protection input (TH) signal exceeded the setting of Pn61C (Overheat Warning Level).	L	L	Н
A.941	Change of Parameters Requires Restart	Parameters have been changed that require the power supply to be turned OFF and ON again.	Н	Н	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 SER-VOPACK.	Н	Н	L

Warning Number	Warning Name	Meaning		Warning Code Output	
Number				ALO2	ALO3
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.	Η	L	L
A.9b0	Preventative Mainte- nance Warning	One of the consumable parts has reached the end of its service life.	Н	L	Н

- Note: 1. A warning code is not output unless you set Pn001 to n.1 \(\sigma\) (Output both alarm codes and warning codes).
 - 2. Use Pn008 = n.□X□□ (Warning Detection Selection) to control warning detection. However, the following warnings are not affected by the setting of Pn008 = n.□X□□ and other parameter settings are required in addition to Pn008 = n.□X□□.

Warning	Parameters That Must Be Set to Select Warning Detection	Reference
A.911	Pn310 = n.□□□X (Vibration Detection Selection)	page 6-98
A.923	_ (Not affected by the setting of Pn008 = n.□X□□.)	_
A.930	Pn008 = n.□□□X (Low Battery Voltage Alarm/Warning Selection)	page 12-3
A.942	Pn423 = n.□□X□ (Speed Ripple Compensation Information Disagreement Warning Detection Selection)	page 8-60
A.971	$Pn008 = n.\Box\Box X\Box$ (Function Selection for Undervoltage) (Not affected by the setting of $Pn008 = n.\Box X\Box\Box$.)	page 6-14
A.9A0	Pn00D = n.X□□□ (Overtravel Warning Detection Selection) (Not affected by the setting of Pn008 = n.□X□□.)	page 5-34
A.9b0	Pn00F = n.□□□X (Preventative Maintenance Warning Selection)	page 9-17

Drives Motors Controls

12.3.2 Troubleshooting Warnings

The causes of and corrections for the warnings are given in the following table. Contact your Yaskawa representative if you cannot solve a problem with the correction given in the table.

Warning Number: Warning Name	Possible Cause	Confirmation	Correction	Reference
	The Servomotor U, V, and W wiring is not correct.	Check the wiring of the Servomotor's Main Circuit Cables.	Make sure that there are no faulty connections in the wiring for the Servomotor and encoder.	-
	A SERVOPACK gain is too low.	Check the SERVO- PACK gains.	Increase the servo gain, e.g., by using autotuning without a host reference.	page 8-24
	The frequency of the position refer- ence pulse is too high.	Reduce the reference pulse frequency and try operating the SERVO- PACK.	Reduce the position reference pulse frequency or the reference acceleration rate, or reconsider the electronic gear ratio.	page 5-47
A.900: Position Deviation Overflow	The acceleration of the position reference is too high.	Reduce the reference acceleration and try operating the SERVO-PACK.	Apply smoothing, i.e., by using Pn216 (Position Reference Acceleration/ Deceleration Time Constant).	page 6-30
	The excessive position deviation alarm level (Pn520 × Pn51E/100) is too low for the operating conditions.	Check excessive position deviation alarm level (Pn520 × Pn51E/100) to see if it is set to an appropriate value.	Optimize the settings of Pn520 and Pn51E.	page 8-8
	A failure occurred in the SERVO-PACK.		Turn the power supply to the SERVOPACK OFF and ON again. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.901: Position Deviation Overflow Alarm at Servo ON	The position deviation when the servo was turned ON exceeded the percentage set with the following formula: (Pn526 × Pn528/100)	otors (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).	page 8-10

Continued from previous page.

Warning Number: Warning Name	Possible Cause	Confirmation	Correction	Reference
	The wiring is not correct or there is a faulty contact in the motor or encoder wiring.	Check the wiring.	Make sure that the Servo- motor and encoder are cor- rectly wired.	-
	Operation was performed that exceeded the overload protection characteristics.	Check the motor over- load characteristics and Run command.	Reconsider the load and operating conditions. Or, increase the motor capacity.	-
A.910: Overload (warning before an A.710 or A.720 alarm occurs)	An excessive load was applied during operation because the Servomotor was not driven because of mechanical problems.	Check the operation reference and motor speed.	Remove the mechanical problem.	-
	The overload warning level (Pn52B) is not suitable.	Check that the overload warning level (Pn52B) is suitable.	Set a suitable overload warning level (Pn52B).	page 5-44
	A failure occurred in the SERVO-PACK.	-V	The SERVOPACK may be faulty. Replace the SERVO-PACK.	_
	Abnormal vibration was detected during motor operation.	Check for abnormal motor noise, and check the speed and torque waveforms during operation.	Reduce the motor speed. Or, reduce the servo gain with custom tuning.	page 8-42
A.911: Vibration	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.	page 8-16
	The vibration detection level (Pn312 or Pn384) is not suitable.	Check that the vibration detection level (Pn312 or Pn384) is suitable.	Set a suitable vibration detection level (Pn312 or Pn384).	page 6-98

12.3.2 Troubleshooting Warnings

Continued from previous page.

			Continued from pre	vious page.
Warning Number: Warning Name	Possible Cause	Confirmation	Correction	Reference
	The surrounding temperature is too high.	Check the surrounding temperature using a thermostat. Or, check the operating status with the SERVOPACK installation environment monitor.	Decrease the surrounding temperature by improving the SERVOPACK installation conditions.	page 3-7
	An overload alarm was reset by turning OFF the power supply too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	-
A.912: Internal Tempera- ture Warning 1 (Control Board Tem- perature Error)	There was an excessive load or operation was performed that exceeded the regenerative processing capacity.	Use the accumulated load ratio to check the load during operation, and use the regenerative load ratio to check the regenerative processing capacity.	Reconsider the load and operating conditions.	-
	The SERVOPACK installation orientation is not correct or there is insufficient space around the SERVOPACK.	Check the SERVO- PACK installation con- ditions.	Install the SERVOPACK according to specifications.	page 3-3, page 3-6
	A failure occurred in the SERVO-PACK.		The SERVOPACK may be faulty. Replace the SERVO-PACK.	_
Drive	The surrounding temperature is too high.	Check the surrounding temperature using a thermostat. Or, check the operating status with the SERVOPACK installation environment monitor.	Decrease the surrounding temperature by improving the SERVOPACK installation conditions.	page 3-7
DITVO	An overload alarm was reset by turning OFF the power supply too many times.	Check the alarm display to see if there is an overload alarm.	Change the method for resetting the alarm.	-
A.913: Internal Tempera- ture Warning 2 (Power Board Tem- perature Error)	There was an excessive load or operation was performed that exceeded the regenerative processing capacity.	Use the accumulated load ratio to check the load during operation, and use the regenerative load ratio to check the regenerative processing capacity.	Reconsider the load and operating conditions.	-
	The SERVOPACK installation orientation is not correct or there is insufficient space around the SERVOPACK.	Check the SERVO- PACK installation con- ditions.	Install the SERVOPACK according to specifications.	page 3-3, page 3-6
	A failure occurred in the SERVO-PACK.	_	The SERVOPACK may be faulty. Replace the SERVO-PACK.	-

Continued from pre	vious page.
Correction	Reference

Warning Number: Warning Name	Possible Cause	Confirmation	Correction	Reference
	The power supply voltage exceeded the specified range.	Measure the power supply voltage.	Set the power supply voltage within the specified range.	-
A.920: Regenerative Overload (warning before an A.320 alarm occurs)	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 using the SigmaJunmaSize+ Capacity Selection Software or another means.	Change the regenerative resistance value, regenerative resistance capacity, or SERVOPACK capacity. Reconsider the operating conditions using the Sigma-JunmaSize+ Capacity Selection Software or other means.	-
	There was a continuous regeneration state because a negative load was continuously applied.	Check the load applied to the Servomotor during operation.	Reconsider the system including the servo, machine, and operating conditions.	-
	The Servomotor was rotated by an external force.	Check the operation status.	Implement measures to ensure that the motor will not be rotated by an external force.	_
A.921: Dynamic Brake Overload (warning before an A.731 alarm occurs)	When the Servo- motor was stopped with the dynamic brake, the rotational or linear kinetic energy exceeded the capacity of the dynamic brake resistor.	Check the power consumed by the DB resistor to see how frequently the DB is being used.	Reconsider the following: Reduce the Servomotor command speed. Decrease the moment of inertia or mass. Reduce the frequency of stopping with the dynamic brake.	-
Drive	A failure occurred in the SERVO-PACK.	tors C	The SERVOPACK may be faulty. Replace the SERVO-PACK.	-
A.923: SERVOPACK Built- in Fan Stopped	The fan inside the SERVOPACK stopped.	Check for foreign matter inside the SERVO-PACK.	Remove foreign matter from the SERVOPACK. If an alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.	-
A.930: Absolute Encoder Battery Error (The absolute encoder battery voltage was lower than the spec- ified level.) (Detected only when an abso-	The battery connection is faulty or a battery is not connected.	Check the battery connection.	Correct the battery connection.	page 4-26
	The battery voltage is lower than the specified value (2.7 V).	Measure the battery voltage.	Replace the battery.	page 12-3
lute encoder is connected.)	A failure occurred in the SERVO-PACK.	_	The SERVOPACK may be faulty. Replace the SERVO-PACK.	_

12.3.2 Troubleshooting Warnings

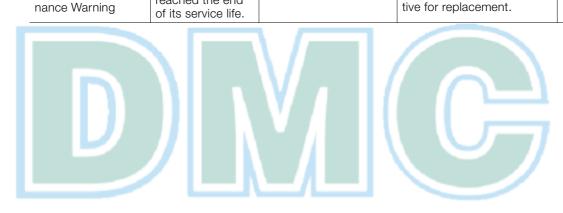
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Warning Number: Warning Name	Possible Cause	Confirmation	Correction	Reference
	The surrounding temperature is too high.	Check the surrounding temperature using a thermostat.	Lower the surrounding temperature by improving the installation conditions of the Linear Servomotor or the machine.	-
	Operation was performed under an excessive load.	Use the accumulated load ratio to check the load during operation.	Reconsider the load and operating conditions.	_
A.93B: Overheat Warning	A failure occurred in the SERVO-PACK.	_	The SERVOPACK may be faulty. Replace the SERVO-PACK.	_
	The temperature detection circuit in the Linear Servomotor is faulty or the sensor attached to the machine is faulty.	-	The temperature detection circuit in the Linear Servomotor may be faulty or the sensor attached to the machine may be faulty. Replace the Linear Servomotor or repair the sensor attached to the machine.	-
A.941: Change of Parame- ters Requires Restart	Parameters have been changed that require the power supply to be turned OFF and ON again.	Wall	Turn the power supply to the SERVOPACK OFF and ON again.	1
	The speed ripple compensation	-	Reset the speed ripple compensation value on the SigmaWin+.	page 8-60
A.942: Speed Ripple Compensation Information Disagreement	information stored in the encoder does not agree with the speed ripple compensa-	لكا/كا	Set Pn423 to n. \(\sigma\) (Do not detect A.942 alarms). However, changing the setting may increase the speed ripple.	page 8-60
Drive	tion information stored in the SERVOPACK.	otors (Set Pn423 to n. \(\sim \sim \sim \sim \sim \sim \sim \sim	page 8-60
	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.	-
	For a 100-V SERVOPACK, the AC power supply voltage dropped below 60 V.	Measure the power supply voltage.	Set the power supply voltage within the specified range.	-
A.971: Undervoltage	The power supply voltage dropped during operation.	Measure the power supply voltage.	Increase the power supply capacity.	-
	A momentary power interruption occurred.	Measure the power supply voltage.	If you have changed the setting of Pn509 (Momentary Power Interruption Hold Time), decrease the setting.	page 6-13
	The SERVOPACK fuse is blown out.	_	Replace the SERVOPACK and connect a reactor.	page 4-24
	A failure occurred in the SERVO-PACK.	_	The SERVOPACK may be faulty. Replace the SERVO-PACK.	-

Reference

Correction

Even if an overtravel signal is not shown by the input signal monitor, momentary overtravel may have been detected. Take the following precautions. • Do not specify movements that would cause overtravel from the host controller. • Check the wiring of the overtravel signals. • Implement countermeasures against noise.	page 5-34
Replace the part. Contact your Yaskawa representative for replacement.	page 9-17



Confirmation

Check the status of the

the input signal monitor.

overtravel signals on

Warning Number:

Warning Name

Overtravel (Over-

travel status was

Preventative Mainte-

A.9A0:

A.9b0:

detected.)

Possible Cause

Overtravel was

servo was ON.

One of the con-

reached the end

sumable parts has

detected while the

Drives Motors Controls

12.4

Troubleshooting Based on the Operation and Conditions of the Servomotor

This section provides troubleshooting based on the operation and conditions of the Servomotor, including causes and corrections.

Problem	Possible Cause	Confirmation	Correction	Reference
	The control power supply is not turned ON.	Measure the voltage between control power supply terminals.	Turn OFF the power supply to the servo system. Correct the wiring so that the control power supply is turned ON.	-
	The main circuit power supply is not turned ON.	Measure the voltage between the main circuit power input terminals.	Turn OFF the power supply to the servo system. Correct the wiring so that the main circuit power supply is turned ON.	-
Ι,	The I/O signal connector (CN1) pins are not wired correctly or are disconnected.	Turn OFF the power supply to the servo system. Check the wiring condition of the I/O signal connector (CN1) pins.	Correct the wiring of the I/O signal connector (CN1) pins.	page 4-34, page 9-7
	The wiring for the Servomotor Main Circuit Cables or Encoder Cable is disconnected.	Check the wiring conditions.	Turn OFF the power supply to the servo system. Wire the cable correctly.	1 7
Servomotor Does Not	There is an overload on the Servomotor.	Operate the Servomotor with no load and check the load status.	Turn OFF the power supply to the servo system. Reduce the load or replace the Servomotor with a Servomotor with a larger capacity.	-
Start	The type of encoder that is being used does not agree with the setting of Pn002 = n. \(\sigma \times \sigma	Check the type of the encoder that is being used and the setting of Pn002 = n.□X□□.	Set Pn002 = n. \(\Pi\)X\(\Pi\)D according to the type of the encoder that is being used.	page 6-73
	No speed or position reference is input.	Turn OFF the power supply 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.	page 4-34, page 9-7
	There is a mistake in the input signal allocations (Pn50A to Pn50D, Pn515, and Pn516).	Check the input signal allocations (Pn50A to Pn50D, Pn515, and Pn516).	Correctly allocate the input signals (Pn50A to Pn50D, Pn515, and Pn516).	page 6-5, page 9-7
	The /S-ON (Servo ON) signal is OFF.	Check the settings of Pn50A = n.□□□X (Input Signal Allocation Mode) and Pn50A = n.□□X□ (/S-ON (Servo ON) Signal Allocation).	Set Pn50A = n.□□XX correctly and turn ON the /S-ON signal.	page 5-17, page 9-7
	The function setting of the / P-CON (Proportional Control) signal is not correct.	Check the setting of $Pn000 = n.\square\square X\square$ (Control Method Selection).	Set the parameter to match the application.	page 5-13
	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.	page 6-73, page 9-7
	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. \(\begin{align*} \text{ So that is agrees with the reference pulse form.} \end{align*} Continued or	page 6-31

Problem	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.	page 9-7
	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.	page 9-7
	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.	page 6-31
	The /CLR (Position Deviation Clear) input signal has not been turned OFF.	Check the /CLR signal (CN1-14 and CN1-15).	Turn OFF the /CLR signal.	page 9-7
	The P-OT (Forward Drive Prohibit) or N-OT (Reverse Drive Prohibit) signal is still OFF.	Check the P-OT and N-OT signals.	Turn ON the P-OT and N-OT signals.	page 9-7
Servomotor Does Not Start	The safety input signals (/HWBB1 or /HWBB2) were not turned ON.	Check the /HWBB1 and /HWBB2 input signals.	Turn ON the /HWBB1 and /HWBB2 input signals. If you are not using the safety function, connect the Safety Jumper Connector (provided as an accessory) to CN8.	page 9-7
)ri\	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.	page 9-7
	A failure occurred in the SERVOPACK.	-	Turn OFF the power supply to the servo system. Replace the SERVO-PACK.	-
		Check the setting of Pn080 =n.□□□X (Polarity Sensor Selection).	Correct the parameter setting.	page 5-26
	The polarity detection was not executed.	Check the /S-ON (Servo ON) 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. 	page 5-27

Problem	Possible Cause	Confirmation	Correction	Reference
	There is a mistake in the Servomotor wiring.	Turn OFF the power supply to the servo system. Check the wiring.	Wire the Servomotor correctly.	_
	There is a mistake in the wiring of the encoder or Serial Converter Unit.	Turn OFF the power supply to the servo system. Check the wiring.	Wire the Serial Converter Unit correctly.	_
Servomotor	There is a mistake in the linear encoder wiring.	Turn OFF the power supply to the servo system. Check the wiring.	Wire the cable correctly.	_
Moves Instanta- neously,	The setting of Pn282 (Linear Encoder Scale Pitch) is not correct.	Check the setting of Pn282.	Correct the setting of Pn282.	page 5-19
and Then Stops	The count-up direction of the linear encoder does not match the forward direction of the Moving Coil in the motor.	Check the directions.	Change the setting of Pn080 = n.□□X□ (Motor Phase Sequence Selection). Place the linear encoder and motor in the same direction.	page 5-24
	Polarity detection was not performed correctly.	Check to see if electrical angle 2 (electrical angle from polarity origin) at any position is between ±10°.	Correct the settings for the polarity detection-related parameters.	-
Servomotor Speed Is Unstable	There is a faulty connection in the Servomotor wiring.	The connector connections for the power line (U, V, and W phases) and the encoder or Serial Converter Unit may be unstable. Turn OFF the power supply to the servo system. Check the wiring.	Tighten any loose terminals or connectors and correct the wiring.	7.
Dri	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.	page 9-7
	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.	page 9-7
Servomotor	The speed reference offset is not correct.	The SERVOPACK offset is adjusted incorrectly.	Adjust the SERVO- PACK offset.	page 6-19
Moves with- out a Refer- ence Input	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 supply to the servo system. Replace the SERVO-PACK.	-
	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. \$\square\$ (Motor Phase Sequence Selection). Match the linear encoder direction and Servomotor direction.	page 5-24

Problem	Possible Cause	Confirmation	Correction	Reference
Servomotor Moves with- out a Refer- ence Input	Polarity detection was not performed correctly.	Check to see if electrical angle 2 (electrical angle from polarity origin) at any position is between ±10°.	Correct the settings for the polarity detection-related parameters.	-
Dynamic Brake Does Not Operate	The setting of Pn001 = n.□□□X (Motor Stopping Method for Servo OFF and Group 1 Alarms) is not suitable.	Check the setting of Pn001 = n.□□□X.	Set Pn001 = n.□□□X correctly.	_
	The dynamic brake resistor is disconnected.	Check the moment of inertia, motor speed, and dynamic brake frequency of use. If the moment of inertia, motor speed, or dynamic brake frequency of use is excessive, the dynamic brake resistance may be disconnected.	Turn OFF the power supply to the servo system. Replace the SERVO-PACK. To prevent disconnection, reduce the load.	-
	There was a failure in the dynamic brake drive circuit.		There is a defective component in the dynamic brake circuit. Turn OFF the power supply to the servo system. Replace the SERVO-PACK.	-
Driv	The Servomotor vibrated considerably while performing the tuning-less function with the default settings.	Check the waveform of the motor speed.	Reduce the load so that the moment of inertia ratio or mass ratio is within the allowable value, or increase the load level or reduce the rigidity level in the tuning-less level settings. If the situation is not improved, disable the tuning-less function (i.e., set Pn170 to n.□□□0) and execute autotuning either with or without a host refer-	page 8-12
Abnormal Noise from Servomotor	The machine mounting is not secure.	Turn OFF the power supply to the servo system. Check to see if there are any loose mounting screws.	Tighten the mounting screws.	_
	The machine mounting is not secure.	Turn OFF the power supply to the servo system. Check to see if there is misalignment in the coupling.	Align the coupling.	_
		Turn OFF the power supply to the servo system. Check to see if the coupling is balanced.	Balance the coupling.	_
	The bearings are defective.	Turn OFF the power supply to the servo system. Check for noise and vibration around the bearings.	Replace the Servomotor. Continued on	-

Problem	Possible Cause	Confirmation	Correction	Reference
	There is a vibration source at the driven machine.	Turn OFF the power supply to the servo system. Check for any foreign matter, damage, or deformation in the machine's moving parts.	Consult with the machine manufacturer.	-
	Noise interference occurred because of incorrect I/O signal cable specifications.	Turn OFF the power supply to the servo system. Check the I/O signal cables to see if they satisfy specifications. Use shielded twisted-pair cables or screened twisted-pair cables with conductors of at least 0.12 mm ² (stranded wire).	Use cables that satisfy the specifications.	-
	Noise interference occurred because an I/O signal cable is too long.	Turn OFF the power supply to the servo system. Check the lengths of the I/O signal cables.	The I/O signal cables must be no longer than 3 m.	-
Abnormal Noise from	Noise interference occurred because of incorrect Encoder Cable specifications.	Turn OFF the power supply to the servo system. Check the Encoder Cable to see if it satisfies specifications. Use shielded twisted-pair cables or screened twisted-pair cables with conductors of at least 0.12 mm ² (stranded wire).	Use cables that satisfy the specifications.	1
Servomotor			Rotary Servomotors: The Encoder Cable length must be 50 m max.	
Dri	Noise interference occurred because the Encoder Cable is too long.	Turn OFF the power supply to the servo system. Check the length of the Encoder Cable.	Linear Servomotors: Make sure that the Serial Converter Unit cable is no longer than 20 m and that the Linear Encoder Cable and the Sensor Cable are no longer than 15 m each.	
	Noise interference occurred because the Encoder Cable is damaged.	Turn OFF the power supply to the servo system. Check the Encoder Cable to see if it is pinched or the sheath is damaged.	Replace the Encoder Cable and correct the cable installation envi- ronment.	-
	The Encoder Cable was subjected to excessive noise interference.	Turn OFF the power supply to the servo system. Check to see if the Encoder Cable is bundled with a high-current line or installed near a high-current line.	Correct the cable lay- out so that no surge is applied by high-current lines.	-
	There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder.	Turn OFF the power supply to the servo system. Check to see if the machines are correctly grounded.	Properly ground the machines to separate them from the FG of the encoder.	-

Problem	Possible Cause	Confirmation	Correction	Reference
Abnormal Noise from Servomotor	There is a SERVOPACK pulse counting error due to noise.	Check to see if there is noise interference on the signal line from the encoder.	Turn OFF the power supply to the servo system. Implement countermeasures against noise for the encoder wiring.	-
	The encoder was subjected to excessive vibration or shock.	Turn OFF the power supply to the servo system. Check to see if vibration from the machine occurred. Check the Servomotor installation (mounting surface precision, securing state, and alignment). Check the linear encoder installation (mounting surface precision and securing method).	Reduce machine vibration. Improve the mounting state of the Servomotor or linear encoder.	_
Servomotor Vibrates at Frequency of Approx. 200 to 400 Hz.	A failure occurred in the encoder.		Turn OFF the power supply to the servo system. Replace the Servomotor.	-
	A failure occurred in the Serial Converter Unit.		Turn OFF the power supply to the servo system. Replace the Serial Converter Unit.	-
	A failure occurred in the linear encoder.		Turn OFF the power supply to the servo system. Replace the linear encoder.	_
	The servo gains are not balanced.	Check to see if the servo gains have been correctly tuned.	Perform autotuning without a host reference.	page 8-24
	The setting of Pn100 (Speed Loop Gain) is too high.	Check the setting of Pn100. The default setting is Kv = 40.0 Hz.	Set Pn100 to an appropriate value.	_
	The setting of Pn102 (Position Loop Gain) is too high.	Check the setting of Pn102. The default setting is Kp = 40.0/s.	Set Pn102 to an appropriate value.	_
	The setting of Pn101 (Speed Loop Integral Time Constant) is not appropriate.	Check the setting of Pn101. The default setting is Ti = 20.0 ms.	Set Pn101 to an appropriate value.	-
	The setting of Pn103 (Moment of Inertia Ratio or Mass Ratio) is not appropri- ate.	Check the setting of Pn103.	Set Pn103 to an appropriate value.	-

	Continued from previous page.				
Problem	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.	page 8-24	
	The setting of Pn100 (Speed Loop Gain) is too high.	Check the setting of Pn100. The default setting is Kv = 40.0 Hz.	Set Pn100 to an appropriate value.	_	
Large Motor Speed	The setting of Pn102 (Position Loop Gain) is too high.	Check the setting of Pn102. The default setting is Kp = 40.0/s.	Set Pn102 to an appropriate value.	_	
Overshoot on Starting and Stop- ping	The setting of Pn101 (Speed Loop Integral Time Constant) is not appropriate.	Check the setting of Pn101. The default setting is Ti = 20.0 ms.	Set Pn101 to an appropriate value.	-	
	The setting of Pn103 (Moment of Inertia Ratio or Mass Ratio) is not appropri- ate.	Check the setting of Pn103.	Set Pn103 to an appropriate value.	-	
	The torque reference is saturated.	Check the waveform of the torque reference.	Use the mode switch.	_	
	The force limits (Pn483 and Pn484) are set to the default values.	The default values of the force limits are Pn483 = 30% and Pn484 = 30%.	Set Pn483 and Pn484 to appropriate values.	page 6-63	
Absolute Encoder	Noise interference occurred because of incorrect Encoder Cable specifications.	Turn OFF the power supply to the servo system. Check the Encoder Cable to see if it satisfies specifications. Use shielded twisted-pair cables or screened twisted-pair cables with conductors of at least 0.12 mm ² (stranded wire).	Use cables that satisfy the specifications.	7	
Position Deviation Error (The position	ves Mo	tors C	Rotary Servomotors: The Encoder Cable length must be 50 m max.	2	
that was saved in the host con- troller when the power was turned OFF is dif- ferent from the posi- tion when the power was next turned ON.)	Noise interference occurred because the Encoder Cable is too long.	Turn OFF the power supply to the servo system. Check the length of the Encoder Cable.	Linear Servomotors: Make sure that the Serial Converter Unit cable is no longer than 20 m and that the Linear Encoder Cable and the Sensor Cable are no longer than 15 m each.	-	
	Noise interference occurred because the Encoder Cable is damaged.	Turn OFF the power supply to the servo system. Check the Encoder Cable to see if it is pinched or the sheath is damaged.	Replace the Encoder Cable and correct the cable installation envi- ronment.	-	
	The Encoder Cable was subject to excessive noise interference.	Turn OFF the power supply to the servo system. Check to see if the Encoder Cable is bundled with a high-current line or installed near a high-current line.	Correct the cable lay- out so that no surge is applied by high-current lines.	-	

Problem	Possible Cause	Confirmation	Correction	Reference
	There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder.	Turn OFF the power supply to the servo system. Check to see if the machines are correctly grounded.	Properly ground the machines to separate them from the FG of the encoder.	-
	There is a SERVOPACK pulse counting error due to noise.	Turn OFF the power supply to the servo system. Check to see if there is noise interference on the I/O signal line from the encoder or Serial Converter Unit.	Implement counter- measures against noise for the encoder or Serial Converter Unit wiring.	_
Absolute Encoder Position Deviation Error (The position that was saved in the host con- troller when the power was turned OFF is dif- ferent from the posi- tion when the power was next turned ON.)	The encoder was subjected to excessive vibration or shock.	Turn OFF the power supply to the servo system. Check to see if vibration from the machine occurred. Check the Servomotor installation (mounting surface precision, securing state, and alignment). Check the linear encoder installation (mounting surface precision and securing method).	Reduce machine vibration. Improve the mounting state of the Servomotor or linear encoder.	_
	A failure occurred in the encoder.		Turn OFF the power supply to the servo system. Replace the Servomotor or linear encoder.	-
	A failure occurred in the SERVOPACK.	-	Turn OFF the power supply to the servo system. Replace the SERVO-PACK.	-
Driv	es Mot	Check the error detection section of the host controller.	Correct the error detection section of the host controller.	_
	Host Controller Multiturn Data or Absolute Encoder	Check to see if the host controller is executing data parity checks.	Perform parity checks for the multiturn data or absolute encoder posi- tion data.	_
	Position Data Reading Error	Check for noise interference in the cable between the SERVO-PACK and the host controller.	Implement counter- measures against noise and then perform parity checks again for the multiturn data or abso- lute encoder position data.	_

			Continued from pre	vious page.
Problem	Possible Cause	Confirmation	Correction	Reference
		Check the external power supply (+24 V) voltage for the input signals.	Correct the external power supply (+24 V) voltage for the input signals.	_
	The P-OT/N-OT (Forward Drive Prohibit or Reverse	Check the operating condition of the overtravel limit switches.	Make sure that the overtravel limit switches operate correctly.	_
	Drive Prohibit) signal was input.	Check the wiring of the overtravel limit switches.	Correct the wiring of the overtravel limit switches.	page 5-31
		Check the settings of the overtravel input signal allocations (Pn50A/Pn50B).	Set the parameters to correct values.	page 5-31
Overtravel Occurred		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.	_
	The P-OT/N-OT (Forward Drive Prohibit or Reverse Drive Prohibit) signal malfunctioned. There is a mistake in the allocation of the P-OT or N-OT (Forward Drive Prohibit or Reverse Drive Prohibit) signal in Pn50A = n.X□□□ or Pn50B = n.□□□X.	Check to see if the operation of the overtravel limit switches is unstable.	Stabilize the operating condition of the over-travel 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.	1
		Check to see if the P-OT signal is allocated in Pn50A = n.X□□□.	If another signal is allocated in Pn50A =n.X□□□, allocate the P-OT signal instead.	page 5-31
		Check to see if the N-OT signal is allocated in Pn50B = n.□□□X.	If another signal is allocated in Pn50B =n.□□□X, allocate the N-OT signal instead.	page o o i
Dri	The selection of the Servo-	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.	page 5-33
	motor stopping method is not correct.	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.	page 3-33
Improper Stop Posi-	The limit switch position and dog length are not appropriate.	_	Install the limit switch at the appropriate position.	_
tion for Overtravel (OT) Signal	The overtravel limit switch position is too close for the coasting distance.	_	Install the overtravel limit switch at the appropriate position.	_

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Problem	Possible Cause	Confirmation	Correction	Reference
FlobleIII	Fossible Cause	Check the Encoder Cable	Correction	neierence
	Noise interference occurred because of incorrect Encoder Cable specifications.	to see if it satisfies specifications. Use shielded twisted-pair cables or screened twisted-pair cables with conductors of at least 0.12 mm ² (stranded wire).	Use cables that satisfy the specifications.	-
Position Deviation (without Alarm)	Noise interference occurred because the Encoder Cable is too long.	Turn OFF the power supply to the servo system. Check the length of the Encoder Cable.	Rotary Servomotors: The Encoder Cable length must be 50 m max. Linear Servomotors: Make sure that the Serial Converter Unit cable is no longer than 20 m and that the Linear Encoder Cable and the Sensor Cable are no longer than 15 m each.	-
	Noise interference occurred because the Encoder Cable is damaged.	Turn OFF the power supply to the servo system. Check the Encoder Cable to see if it is pinched or the sheath is damaged.	Replace the Encoder Cable and correct the cable installation envi- ronment.	-
	The Encoder Cable was subjected to excessive noise interference.	Turn OFF the power supply to the servo system. Check to see if the Encoder Cable is bundled with a high-current line or installed near a high-current line.	Correct the cable lay- out so that no surge is applied by high-current lines.	-
	There is variation in the FG potential because of the influence of machines on the Servomotor side, such as a welder.	Turn OFF the power supply to the servo system. Check to see if the machines are correctly grounded.	Properly ground the machines to separate them from the FG of the encoder.	-
	There is a SERVOPACK pulse counting error due to noise.	Turn OFF the power supply to the servo system. Check to see if there is noise interference on the I/O signal line from the encoder or Serial Converter Unit.	Implement counter- measures against noise for the encoder wiring or Serial Converter Unit wiring.	-
	The encoder was subjected to excessive vibration or shock.	Turn OFF the power supply to the servo system. Check to see if vibration from the machine occurred. Check the Servomotor installation (mounting surface precision, securing state, and alignment). Check the linear encoder installation (mounting surface precision and securing method).	Reduce machine vibration. Improve the mounting state of the Servomotor or linear encoder.	-
	The coupling between the machine and Servomotor is not suitable.	Turn OFF the power supply to the servo system. Check to see if position offset occurs at the coupling between machine and Servomotor.	Correctly secure the coupling between the machine and Servomotor.	-

Problem	Possible Cause	Confirmation	Correction	Reference
Position Deviation	Noise interference occurred because of incorrect I/O signal cable specifications.	Turn OFF the power supply to the servo system. Check the I/O signal cables to see if they satisfy specifications. Use shielded twisted-pair cables or screened twisted-pair cables with conductors of at least 0.12 mm ² (stranded wire).	Use cables that satisfy the specifications.	-
	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 supply to the servo system. Check the I/O signal cables to see if they satisfy specifications. Use shielded twisted-pair cables or screened twisted-pair cables with conductors of at least 0.12 mm ² (stranded wire).	Use cables that satisfy the specifications.	-
(without Alarm)	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.	page 6-31
	Noise interference occurred because an I/O signal cable is too long.	Turn OFF the power supply to the servo system. Check the lengths of the I/O signal cables.	The I/O signal cables must be no longer than 3 m.	Ī
	An encoder fault occurred. (The pulse count does not change.)		Turn OFF the power supply to the servo system. Replace the Servomotor or linear encoder.	-
Dri	A failure occurred in the SERVOPACK.	tors C	Turn OFF the power supply to the servo system. Replace the SERVO-PACK.	
	The surrounding air temperature is too high.	Measure the surrounding air temperature around the Servomotor.	Reduce the surrounding air temperature to 40°C or less.	-
Servomotor Overheated	The surface of the Servomotor is dirty.	Turn OFF the power supply to the servo system. Visually check the surface for dirt.	Clean dirt, dust, and oil from the surface.	-
	There is an overload on the Servomotor.	Check the load status with a monitor.	If the Servomotor is overloaded, reduce the load or replace the Servo Drive with a SERVOPACK and Ser- vomotor with larger capacities.	-
	Polarity detection was not performed correctly.	Check to see if electrical angle 2 (electrical angle from polarity origin) at any position is between ±10°.	Correct the settings for the polarity detection-related parameters.	_

Panel Displays and Panel Operator Procedures

13

This chapter describes how to interpret panel displays and the operation of the Panel Operator.

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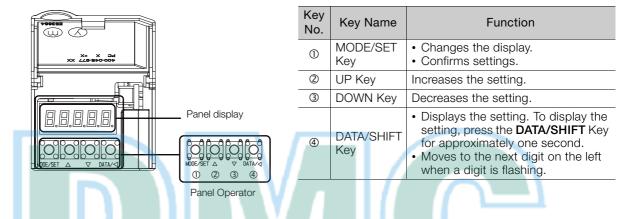
13.1 Panel Operator

13.1.1 **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.

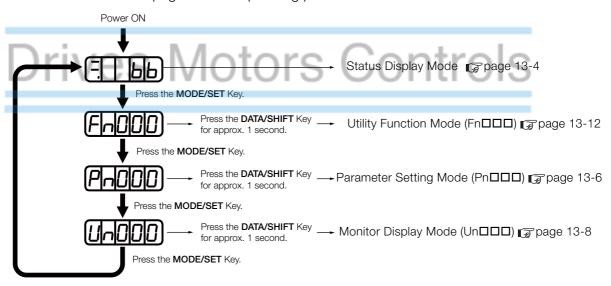
The Panel Operator key names and functions are given below.



13.1.2 **Changing Modes**

Press the MODE/SET Key to change between the modes as shown below.

Refer to the reference pages for the operating procedures in each function mode.



13.1.3 Status Displays

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 supply is turned ON. Set Pn52F to the Un number of the monitor display to display after the power supply is turned ON.

	Monitor Displa	y at Startup		Speed	Position Torque
Pn52F	Setting Range	Setting Unit	Default Setting	When Enabled	Classification
	0000 to 0FFF	ı	OFFF	Immediately	Setup

If OFFF is set (default setting), the SERVOPACK will enter the Status Display Mode after the power supply is turned ON.

13.1.3 Status Displays

The status is displayed as described below. Bit data Code 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 Detection) 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 4-5 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) 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 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.

Lit while the clear signal is being input. Not lit if the clear signal is not being input.

Lit if the current input torque reference is larger than the specified value (10% of the rated

Lit while the main circuit power supply is ON. Not lit if the main circuit power supply is OFF.

During Torque Control: Torque Reference Input Display

During Position Control: Clear Signal Input Display

Power Ready Display

torque) and not lit if the reference is smaller than the specified value.

Interpreting Codes

Display	Meaning	Display	Meaning
	Base Block Active Indicates that the servo is OFF.		Safety Function Indicates that the SERVOPACK is in
	Operation in Progress Indicates that the servo is ON.	<u> </u>	the hard wire base block state due to a safety function.
Pol	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
nob	Reverse Drive Prohibited Indicates that the N-OT (Reverse Drive Prohibit) signal is open.	(Displayed alternately.)	to the status of Servomotor and SERVOPACK. However, tSt will not be displayed during a test without a motor even if an alarm occurs.
FSE	Forced Stop Status Indicates that the FSTP (Force Stop Input) signal forced the Servomotor to stop.	<u> </u>	Alarm Status Flashes the alarm number.

Drives Motors Controls

13.2.1 Setting Parameters That Require Numeric Settings

13.2

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 5-4

5.1.2 Notation for Parameters on page 5-5

13.2.1 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 that requires a numeric setting.

Step	Panel Display after Operation	Keys	Operation
1	Pn 100	MODE/SET ▲ DATA/◀	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	00400	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The current setting of Pn100 will be displayed.
3	00400	MODE/SET ▲ DATA/◀	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	0 100.0	MODE/SET A DATA/	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. **Parameters with Settings of More Than Five Digits on page 13-7
5	(Flashing)	MODE/SET A DATA/	Press the MODE/SET Key. The display will flash. The setting has now been changed from 40.0 to 100.0.
6	Ph/100	MODE/SET DATA/	Press the DATA/SHIFT Key for approximately one second to return the display to Pn100 .

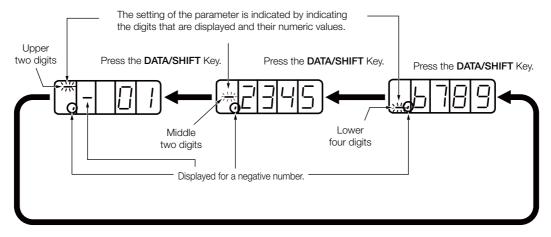
Information

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.

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.



13.2.2 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 $Pn000 = n.\square\square X\square$ (Control Method Selection) in Pn000 (Basic Function Selections 0) from speed control to position control.

Step	Panel Display after Operation	Keys	Operation
1	P-000	MODE/SET A DATA/	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	A0880	MODE/SEI DATA/◀	Press the DATA/SHIFT Key for approximately one second. The current setting of Pn000 will be displayed.
3	-0000	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key to move the digit that is flashing. (You can change the value of the digit that is flashing.)
4	-00 10	MODE/SET ▲ DATA/◀	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)	MÖDE/SET A DATA/	Press the MODE/SET Key. The display will flash. The control method has now been changed from speed control to position control.
6	P-000	MODE/SET ▲ V DATA/◀	Press the DATA/SHIFT Key for approximately one second. Pn000 is displayed again.
7	To enable the change t	o the setting, turn the	power supply to the SERVOPACK OFF and ON again.

13

13.3.1 Basic Monitor Display Operations

13.3

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 SERVO-PACK 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.

**Index: 15.2.2 Corresponding SERVOPACK Monitor Display Function Names on page 15-8

13.3.1 Basic Monitor Display Operations

The procedure for Un000 (Motor Speed) is described here as an example.

Step	Panel Display after Operation	Keys	Operation
1	U-000	MODE/SET A DATA/	Press the MODE/SET Key to enter Monitor Display Mode.
2	U-000	MODE/SET A DATA/	Press the UP Key or DOWN Key to select the Un number of the item that you want to monitor.
			Press the DATA/SHIFT Key for approximately one second. The contents of the monitor display for the
3		MODE/SET ▲ ▼ DATA/▼	specified Un number will appear. Refer to the following section for the operating procedure for displays with more than five digits.
	rivoc	Moto	
4		MODE/SET ■ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown for step 1 will appear again.

13.3.2 Input Signal Monitor (Un005)

You can use Un005 to display the status of allocated signals on the LED segments of the Panel Operator.

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.

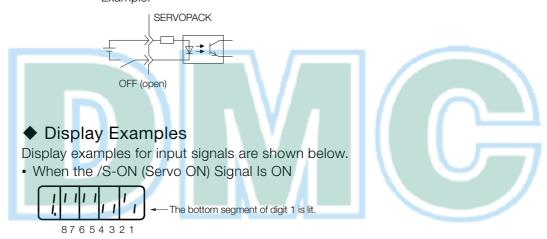
The allocations are given in the following table.

Display Digit 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:



When the /S-ON (Servo ON) Signal Is OFF



• When the P-OT (Forward Drive Prohibit) Signal Is Active



13.3.3 Output Signal Monitor (Un006)

You can use Un006 to display the status of allocated signals on the LED segments of the Panel Operator.

◆ 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.

13.3.4 Safety Input Signal Monitor (Un015)

• 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 Digit Number	Output Pin Numbers	Signal Name (Default Setting)
1	CN1-31and CN1-32	ALM+, CALM-
2	CN1-25 and CN1-26	/SO1+ (/COIN+ or /V-CMP+) and /SO1- (/COIN- or /V-CMP-)
3	CN1-27 and CN1-28	/SO2+ (/TGON+) /SO2- (/TGON-)
4	CN1-29 and CN1-30	/SO3+ (/S-RDY+) /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:

SERVOPACK

ON (transistor ON)

Display Examples

A display example for output signals is shown below.

· When the ALM (Servo Alarm) Signal Is OFF



13.3.4 Safety Input Signal Monitor (Un015)

◆ Interpreting the Display

You can display the status of allocated signals on the LED segments of the Panel Operator.

LED Segments



Top: ON Bottom: OFF

87654321

Display digit number

- If the signal that corresponds to the display digit number is ON, the top LED segment will be
- 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 Digit Number	Input Pin Numbers	Signal
1	CN8-3 and CN8-4	/HWBB1
2	CN8-5 and CN8-6	/HWBB2
3	-	Reserved.
4	-	Reserved.
5	-	Reserved.
6	-	Reserved.
7	-	Reserved.
8	_	Reserved.

13.3.5 Upper Limit Setting Monitor for Maximum Motor Speed/Upper Limit Setting for Encoder Output Resolution (Un010)

Information

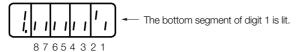
The configuration of the input circuits is shown below.

OFF: Open ON: Closed Example:

Display Example

A display example for safety input signals is shown below.

• When the /HWBB1 Signal Turns OFF to Activate a HWBB



13.3.5 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 the encoder output resolution setting (Pn281) for the current maximum motor speed setting (Pn385), or you can monitor the upper limit of the maximum motor speed setting for the current encoder output resolution setting.

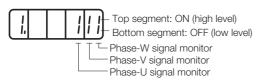
Select which signal to monitor with $Pn080 = n.X \square \square \square$ (Calculation Method for Maximum Speed or Encoder Output Pulses).

- If $Pn080 = n.0 \square \square \square$, the encoder output resolution (Pn281) that can be set is displayed.
- If Pn080 = n.1□□□, the maximum motor speed (Pn385) that can be set is displayed in mm/s.

13.3.6 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	Phase U	Phase V	Phase W		
0	L	L	L		
1	L	L	Н		
2	L	Н	L		
3	L	Н	Н		
4	Н	L	L		
5	Н	L	Н		
6	Н	Н	L		
7	Н	H	Н		

13

13.4.1 Display Alarm History (Fn000)

13.4

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.

15.2.1 Corresponding SERVOPACK Utility Function Names on page 15-7

13.4.1 Display Alarm History (Fn000)

Refer to the following section for information on this utility function other than the procedure.

12.2.4 Displaying the Alarm History on page 12-43

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET A V DATA/	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	0.810	MODE/SET A DATA/	Press the DATA/SHIFT Key for approximately one second. The most recent alarm will be displayed.
3	Alarm number	MODE/SET A DATA/	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. 12.2.1 List of Alarms on page 12-5
4	_3456	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key. The lower four digits of the time stamp will be displayed.
5	-7890	MODE/SET ▲ V DATA/◀	Press the DATA/SHIFT Key. The middle four digits of the time stamp will be displayed.
6		MODE/SET ▲ V DATA/◀	Press the DATA/SHIFT Key. The upper two digits of the time stamp will be displayed.
7		MODE/SET ▲ V DATA/◀	Press the DATA/SHIFT Key. The alarm number will flash on the display.
8	(Fn000	MODE/SET ■ DATA/◀	Press the DATA/SHIFT Key again for approximately one second to return the display to Fn000 .



Time Stamp

A time stamp gives the total operation time to the point at which the alarm occurred in increments of 100 ms from when the control power supply and main circuit power supply were turned ON. For 24-hour, 365-day operation, measurements are possible for approximately 13 years.

Example

Time Stamp Display Example

If 36000 is displayed, 3,600,000 ms = 3,600 s = 60 min = 1 h Therefore, the total operation time in hours is 1 hour.

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 7-7

Step	Panel Display after Operation	Keys	Operation		
1	F-000	MODE/SET ▲ ▼ DATA/▼	Press the MODE/SET Key to enter Utility Function Mode.		
2	F-1002	MODE/SET A DATA/	Press the UP Key or DOWN Key to display Fn002 .		
3		MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.		
4		MODE/SET ▲ ▼ DATA/◀	Press the MODE/SET Key to turn ON the servo.		
5		MODE/SET A DATA/	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	FU.O.G	MODE/SET ▲ DATA/◀	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	FA002	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second to return the display to Fn002 .		
8	Turn the power supply to the SERVOPACK OFF and ON again after you finish jogging.				

Drives Motors Controls

13.4.3 Origin Search (Fn003)

Refer to the following section for information on this utility function other than the procedure. \bigcirc 7.6.2 Origin Search on page 7-25

Step	Panel Display after Operation	Keys			Operation	
1	F-000	MODE/SET ▲ ▼ DATA/◀	Press the Mode.	Press the MODE/SET Key to enter Utility Function Mode.		Jtility Function
2	F-003	MODE/SET A DATA/	Press the	UP Key or D	OOWN Key to	display Fn003 .
3		MODE/SET ▲ DATA/◀			F Key for approin	oximately one sec- vill appear.
4		MODE/SET ▲ ▼ DATA/▼			Key to turn O left will appear	N the servo. The
			ward direct Press the I reverse direct The rotation according shown in t	etion. DOWN Key rection. on direction (to operate the of the Servomory of Pn000 =	
			Pa	rameter	UP Key	DOWN Key
			Pn000	n. 🗆 🗆 🗆 0	CCW	CW
5		MODE/SET A DATA/	load	n. \(\sigma \) In. \(\sigma \) In the direction of the Servomotors	On when viewed Servomotor.	from the
			Para	ameter	UP Key	DOWN Key
	rives	Moto	Pn000	n.□□□0 ^l	inearencoder counts up.	Linear encoder counts down.
					inear encoder counts down.	Linear encoder counts up.
			the for	forward direc details.		encoder counts up is e following section y on page 5-18
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 rotation of the encoder.		ime, the Servomo-	
7	Fn003	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second to return the display to Fn003 .			
8	Turn the power supply to the SERVOPACK OFF and ON again after you finish the origin search.					

13.4.4 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 7-20

Step	Panel Display after Operation	Keys	Operation	
1	F-000	MODE/SET A DATA/	Press the MODE/SET Key to enter Utility Function Mode.	
2	F-004	MODE/SET A DATA/	Press the UP Key or DOWN Key to display Fn004 .	
3	- <u>.</u> P.J.0.5	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown on the left will appear.	
4	T.P.J.0.5	MODE/SET ▲ V DATA/◀	Press the MODE/SET Key to turn ON the servo. The display shown on the left will appear.	
5	.P.JOG	Mode/SET ▲ DATA/	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. The display shown for step 2 will appear again.	
			When program jogging has been completed, End will flash on the display, and then the display shown on the left will appear again.	
6		-	 Additional Information Press the MODE/SET Key during operation to turn OFF the servo and return to the display shown for step 3. 	
Dı	Turn the power cumply	to the SEDVODACK O	Press the DATA/SHIFT Key for approximately one second during operation to return to the display shown for step 2.	
7 Turn the power supply to the SERVOPACK OFF and ON again after you finish program operation.				

13.4.5 Initialize Parameters (Fn005)

Refer to the following section for information on this utility function other than the procedure. *5.1.5 Initializing Parameter Settings* on page 5-11

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET ▲ ▼ DATA/◀	Press the MODE/SET Key to enter Utility Function Mode.
2	F-005	MODE/SET ▲ V DATA/◀	Press the UP Key or DOWN Key to display Fn005 .
3	P. In IL	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.
4	P. In IL	MODE/SET ▲ ▼ DATA/◀	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			power supply to the SERVOPACK OFF and ON again s been completed.

13.4.6 Clear Alarm History (Fn006)

Refer to the following section for information on this utility function other than the procedure.

12.2.5 Clearing the Alarm History on page 12-44

Step	Panel Display after Operation	Keys	Operation
1	FACCO	MODE/SET A DATA	Press the MODE/SET Key to enter Utility Function Mode.
2	F-005	NODE/SET A DATA	Press the UP Key or DOWN Key to display Fn006 .
3	EFELF	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.
4	ELCL	MODE/SET A DATA/	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	Fn006	MODE/SET A DATA	Press the DATA/SHIFT Key for approximately one second to return the display to Fn006 .

13.4.7 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 5-51

Step	Panel Display after Operation	Keys	Operation	
1		MODE/SET A DATA/	Press the MODE/SET Key to enter Utility Function Mode.	
2	Fn008	MODE/SET ▲ ▼ DATA/◀	Press the UP Key or DOWN Key to display Fn008 .	
3	PGELI	MODE / SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second. PGCL1 will be displayed.	
4	PGELS	MODE/SET A DATA/	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	donE	MODE/SET A DATA/	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	PGCLS	1	After displaying donE , the display will return to the PGCL5 display.	
7	F-008	MODE / SET ▼ DATA/◀	Press the DATA/SHIFT Key for approximately one second to return the display to Fn008 .	
8	To enable the change to the settings, turn the power supply to the SERVOPACK OFF and ON again.			

Drives Motors Controls

13.4.8 Autotune Analog (Speed/Torque) Reference Offset (Fn009)

Refer to the following section for information on this utility function other than the procedure.

- ♠ Automatically Adjusting the Speed Reference Offset on page 6-20
- Automatically Adjusting the Torque Reference Offset on page 6-41

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	F-000	MODE/SET DATA	Press the MODE/SET Key to enter Utility Function Mode.
3	F-009	MODE/SET ▲ ▼ DATA/◀	Press the UP Key or DOWN Key to display Fn009 .
4	CEF_O	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second. rEF_o will be displayed.
5	FEF_0	MODE/SET A DATA/	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	F-009	MODE/SET ▲ ▼ DATA/◀	Press the DATA/SHIFT Key for approximately one second to return the display to Fn009 .

13.4.9 Manually Adjust Speed Reference Offset (Fn00A)

Refer to the following section for information on this utility function other than the procedure.

**Manually Adjusting the Speed Reference Offset on page 6-22*

Step	Panel Display after Operation	Keys	Operation
1	(F-1000)	MODE/SET A DATA/	Press the MODE/SET Key to enter Utility Function Mode.
2	FNOOR	MODE/SET ▲ V DATA/◀	Press the UP Key or DOWN Key to display Fn00A .
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
3		MODE/SET ▲ DATA/	the display for approximately one second. Change the setting of Fn010 to enable writing.
4	<u> </u>	-	Turn ON the servo from an external device. The display shown on the left will appear.
5	00000	MODE/SET ▲ ▼ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The current amount of offset will be displayed.
6	Example:	MODE/SET A DATA/	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	TSPa	MODE/SET A DATA/	Press the MODE/SET Key. donE will flash on the display, and then the display shown on the left will appear.

13.4.10 Manually Adjust Torque Reference Offset (Fn00B)

Operation		
HIFT Key for approximately one ne display to Fn00A.		
fset (Fn00B)		

Press the **DATA/SHIFT** Key for approximately on second to return the display to **Fn00A**.

13.4.10 Manually Adjust Torque Reference Offset (Fn00B)

Keys

Panel Display after

Operation

Step

Refer to the following section for information on this utility function other than the procedure.

Manually Adjusting the Torque Reference Offset on page 6-43

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET A DATA/	Press the MODE/SET Key to enter Utility Function Mode.
2	Fn00b	MODE/SET A DATA/	Press the UP Key or DOWN Key to display Fn00b .
3	= 12-9	MODE/SET ▲ 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. The display shown on the left will appear.
5		MODE/SET ▲ ▼ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The current amount of offset will be displayed.
6	Example:	MODE/SET ▲ DATA/	Press the UP Key or DOWN Key to adjust the amount of offset.
7		MODE/SET DATA	Press the MODE/SET Key. donE will flash on the display, and then the display shown on the left will appear.
8	F-00b	MODE/SET ▲ ▼ DĀTA/◀	Press the DATA/SHIFT Key for approximately one second to return the display to Fn00b .

13.4.11 Adjust Analog Monitor Output Offset (Fn00C)

Refer to the following section for information on this utility function other than the procedure.

Adjusting the Analog Monitor Output on page 9-12

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET A DATA/	Press the MODE/SET Key to enter Utility Function Mode.
2	FACCE	MODE/SET A DATA/	Press the UP Key or DOWN Key to display Fn00C .
3		MODE/SET A DATA/	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.
4		MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key. The offset will be displayed as shown on the left.
5	-0001	MODE/SET A DATA/	Press the UP Key or DOWN Key to adjust the offset.
6		MODE/SET A DATA/	Press the DATA/SHIFT Key. The display shown on the left will appear again.
7		MODE/SET A DATA/	Press the MODE/SET Key. The display will change to the monitor output for channel 2 (analog monitor 2 output).
8		MODE/SET A DATA/	Press the DATA/SHIFT Key. The offset will be displayed as shown on the left.
9	(-000 i	MODE/SET ▲ V DATA/◀	Press the UP Key or DOWN Key to adjust the offset.
10	F-005	MODE/SET A DATA/	Press the DATA/SHIFT Key for approximately one second. Ch2-o will be displayed, and then Fn00C will be displayed again.

13.4.12 Adjust Analog Monitor Output Gain (Fn00D)

Refer to the following section for information on this utility function other than the procedure. \bigcirc Adjusting the Analog Monitor Output on page 9-12

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET A DATA/	Press the MODE/SET Key to enter Utility Function Mode.
2	FnOOd	MODE/SET ▲ V DATA/◀	Press the UP Key or DOWN Key to display Fn00D .
3		MODE/SET ▲ V DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.
4		MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key. The gain adjustment will be displayed as shown on the left.

Step	Panel Display after Operation	Keys	Operation
5	-0001	MODE/SET A DATA/	Press the UP Key or DOWN Key to adjust the gain.
6		MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key. The display shown on the left will appear again.
7	[275]	MODE/SET A DATA/	Press the MODE/SET Key. The display will change from the monitor output for channel 1 to the monitor output for channel 2.
8		MODE/SET ▲ V DATA/◀	Press the DATA/SHIFT Key. The gain adjustment will be displayed as shown on the left.
9	-0001	MODE/SET A DATA/	Press the UP Key or DOWN Key to adjust the gain.

Autotune Motor Current Detection Signal Offset (Fn00E) 13.4.13

Refer to the following section for information on this utility function other than the procedure. 6.16.1 Automatic Adjustment on page 6-102

displayed again.

Ste	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET A DATA/	Press the MODE/SET Key to enter Utility Function Mode.
2	FADDE	MODE/SEP A DAIA	Press the UP Key or DOWN Key to display Fn00E .
3		MODE/SET A DATA/	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.
4		MODE/SET ▲ ▼ DATA/◀	Press the MODE/SET Key to perform automatic off- set-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	FADDE	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second to return the display to Fn00E .

13.4.14 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 6-104

Step	Panel Display after Operation	Keys	Operation
1	FACCO	MODE/SET ▲ DATA/◀	Press the MODE/SET Key to enter Utility Function Mode.
2		MODE/SET A DATA/	Press the UP Key or DOWN Key to display Fn00F .
3		MODE/SET A DATA/	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		MODE/SET ■ DATA/◀	Press the DATA/SHIFT Key. The amount of offset for phase U will be displayed.
5	-0010	MODE/SET ▲ V DATA/	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		MODE/SET A DATA/	Press the DATA/SHIFT Key. The display shown on the left will appear again.
7	[[]]	MODE/SET ▲ ▼ DATA/▼	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		MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key. The amount of offset for phase V will be displayed.
9	-00 10	MODE/SET A DATA/ DATA/ DATA/ DATA/ DATA/ DATA/ DATA/ DATA/ DATA/ DATA/ DATA/ DATA/ DATA/ DATA/ DATA/	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	FADDE	MODE/SET ▲ DATA/◀	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 the amounts of offset.	which you change the	offsets each time and repeat steps 3 to 10* to fine-tune

^{*} Examples of the Amount of Change to Adjust Offsets

The above values are guidelines. Vary the amount of change and the number of repetitions according to your system.

[•] First time: 10 units at a time

[•] Second time: 5 units at a time

Third time: 1 unit at a time

13.4.15 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 for Parameters on page 5-8

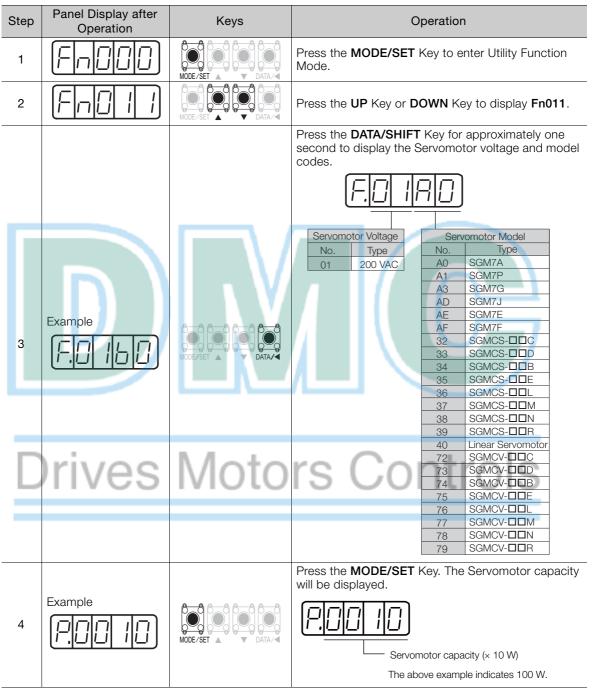
Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET ▲ ▼ DATA/◀	Press the MODE/SET Key to enter Utility Function Mode.
2	F-0 10	MODE/SET ▲ ▼ DATA/◀	Press the UP Key or DOWN Key to display Fn010 .
3	P.0000	MODE/SET ▲ V DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.
4	P.000 i	MODE/SET ▲ ▼ DATA/◀	Press the UP Key or DOWN Key and set one of the following. P.0000: Write permitted (default setting) P.0001: Write prohibited
5	P.0001	MODE/SET A DATA/	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.
6	To enable the change to the setting, turn the power supply to the SERVOPACK OFF and ON again after write protection has been set or cleared.		

Drives Motors Controls

13.4.16 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 9-2



13.4.17 Display Software Version (Fn012)

	5 15 1 6		Continued from previous page.
Step	Panel Display after Operation	Keys	Operation
5	Example E.DDZD	MODE/SET ▲ V DATA/	Rotary Servomotors Press the MODE/SET Key. The encoder type and resolution codes will be displayed. Encoder Type No.
	UDDDD ives I	MODE/SET A DATA	Encoder Type No. Type Old Incremental Old Absolute Press the MODE/SET Key. The code for custom SERVOPACK specifications will be displayed. y.0000 indicates a standard model. If anything other than y.0000 is displayed, a customized SERVOPACK is being used. Specifications code
7	FnOII	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second to return the display to Fn011 .

13.4.17 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 9-2

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET ▲ ▼ DATA/◀	Press the MODE/SET Key to enter Utility Function Mode.
2	Fn0 12	MODE/SET ▲ V DATA/◀	Press the UP Key or DOWN Key to display Fn012 .
3	000 i	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The software version of the SERVOPACK will be displayed.

13.4.18 Multiturn Limit Setting after Multiturn Limit Disagreement Alarm (Fn013)

Step	Panel Display after Operation	Keys	Operation
4	E.000 I	MODE/SET ▲ DATA/	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	Fn0 12	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second to return the display to Fn012 .

13.4.18 Multiturn Limit Setting after Multiturn Limit Disagreement Alarm (Fn013)

Refer to the following section for information on this utility function other than the procedure. © 6.12.9 Multiturn Limit Disagreement Alarm (A.CCO) on page 6-84

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET A DATA/	Press the MODE/SET Key to enter Utility Function Mode.
2	Fn0 13	MODE/SET A V DATA/	Press the UP Key or DOWN Key to display Fn013 .
3	POSEE	MODE/SET A DATA/	Press the DATA/SHIFT Key for approximately one second. PGSEt will be displayed.
4	- donE	MODE/SET A DATA/	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	PBSEL	-	After displaying donE , the display will return to the PGSEt display.
6	Fn0 13	MODE/SET ▲ ▼ DATA/◀	Press the DATA/SHIFT Key for approximately one second to return the display to Fn013 .
7	To enable the change to	o the settings, turn the	power supply to the SERVOPACK OFF and ON again.

13

13.4.19 Reset Option Module Configuration Error (Fn014)

Refer to the following section for information on this utility function other than the procedure. 12.2.6 Resetting Alarms Detected in Option Modules on page 12-45

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET ▲ V DATA/◀	Press the MODE/SET Key to enter Utility Function Mode.
2	Fn0 14	MODE/SET A 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	a,FEEd	MODE/SET A DATA/	Press the UP Key or DOWN Key to select the Option Module to be cleared.
5	0.1111	MODE/SET DATA/	Press the MODE/SET Key for approximately one second. The display shown at the left will appear.
6	a.FEEd	MODE/SET ▲ V 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	Fn0 14	MODE/SET ▲ V 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 supply to the SERVOPACK OFF and ON again after clearing detected Option Module alarms has been completed.		

Initialize Vibration Detection Level (Fn01B) 13.4.20

Refer to the following section for information on this utility function other than the procedure. 6.15 Initializing the Vibration Detection Level on page 6-98

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET A DATA/	Press the MODE/SET Key to enter Utility Function Mode.
2	Fn0 16	MODE/SET ▲ DATA/◀	Press the UP Key or DOWN Key to display Fn01b .
3		MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.
4	(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.

13.4.21 Display SERVOPACK and Servomotor IDs (Fn01E)

Continued from previous page.

St	tep	Panel Display after Operation	Keys	Operation
	5	donE	MODE/SET A 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	Fn0 16	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second to return the display to Fn01b .

13.4.21 Display SERVOPACK and Servomotor IDs (Fn01E)

This function cannot be executed from the Panel Operator on the SERVOPACK.

13.4.22 Display Servomotor ID from Feedback Option Module (Fn01F)

This function cannot be executed from the Panel Operator on the SERVOPACK.

13.4.23 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 5-54

Step	Panel Display after Operation	Keys	Operation
	Fh080	MODE/SET DATA	Press the MODE/SET Key to enter Utility Function Mode.
2	F-020	MODE/SET A DATA/	Press the UP Key or DOWN Key to display Fn020 .
3	OSEL I	MODE/SET DATA/	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.
4	05885	MODE/SET A DATA	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	05885	MODE/SET A DATA/	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	F-020	MODE/SET DATA/	Press the DATA/SHIFT Key for approximately one second to return the display to Fn020 .
7	To enable the change to the settings, turn the power supply to the SERVOPACK OFF and ON again.		

13.4.24 Resetting Motor Type Alarms (Fn021)

Refer to the following section for information on this utility function other than the procedure. 12.2.7 Resetting Motor Type Alarms on page 12-47

Step	Panel Display after Operation	Keys	Operation		
1	F-000	MODE/SET A DATA/-	Press the MODE/SET Key to enter Utility Function Mode.		
2	F-021	MODE SET A DATA -	Press the UP Key or DOWN Key to display Fn021 .		
3	[. n E	MODE SET A DATA/	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.		
4	[. n E	MODE SET A DATA -	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	Fn021	MODE SET A DATA -	Press the DATA/SHIFT Key for approximately one second to return the display to Fn021 .		
6	To enable the change to the settings, turn the power supply to the SERVOPACK OFF and ON again.				

13.4.25 Software Reset (Fn030)

Refer to the following section for information on this utility function other than the procedure.

6.14 Software Reset on page 6-96

Step	Panel Display after Operation	Keys	Operation
	F-000	MODE/SET A DATA/	Press the MODE/SET Key to enter Utility Function Mode.
2	Fn030	MODE/SET A DATA/	Press the UP Key or DOWN Key to display Fn030 .
3	S-SEI	MODE/SET ▲ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.
4	5-5-5	MODE/SET A DATA/	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		MODE/SET ▲ V DATA/◀	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 supply is turned ON.

13.4.26 Polarity Detection (Fn080)

Refer to the following section for information on this utility function other than the procedure. *5.11 Polarity Detection* on page 5-27

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET DATA	Press the MODE/SET Key to enter Utility Function Mode.

13.4.27 Tuning-less Level Setting (Fn200)

Continued from previous page.

Step	Panel Display after Operation	Keys	Operation
2	F-080	MODE/SET A DATA	Press the UP Key or DOWN Key to display Fn080 .
3	<u> </u>	MODE/SET A DATA/	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.
4	P-dE	MODE/SET DATA	Press the MODE/SET Key to start polarity detection.
5	<u> </u>	_	After polarity detection has been completed, the display shown on the left will appear. The Servomotor will enter the servo OFF state.
6	F-080	MODE/SET ▲ V DATA/◀	Press the DATA/SHIFT Key for approximately one second to return the display to Fn080.

13.4.27 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 8-12

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET ▲ DATA/◀	Press the MODE/SET Key to enter Utility Function Mode.
2	Fn200	MODE/SET ▲ ▼ DATA/◀	Press the UP Key or DOWN Key to display Fn200 .
3	Load level	MODE/SET ▲ DATA/◀	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		MODE/SET ▲ ▼ DATA/◀	Press the MODE/SET Key to display. The tuningless level setting display for the tuning-less levels will appear.
5	Rigidity level	MODE/SET ▲ V DATA/◀	Press the UP Key or DOWN Key to set the rigidity level. Set the rigidity 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 rigidity level is too high. Lower the rigidity 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		MODE/SET A DATA/	Press the MODE/SET Key. "donE" will flash for approximately one second and then L0004 will be displayed. The settings will be saved in the SERVOPACK.
7	Fn200	MODE/SET ▲ ▼ DATA/◀	Press the DATA/SHIFT Key for approximately one second to return the display to Fn200 .

13.4.28 Advanced Autotuning without Reference (Fn201)

This function cannot be executed from the Panel Operator on the SERVOPACK.

13.4.29 Advanced Autotuning with Reference (Fn202)

This function cannot be executed from the Panel Operator on the SERVOPACK.

13.4.30 One-Parameter Tuning (Fn203)

Refer to the following section for information on this utility function other than the procedure. 8.8 Custom Tuning on page 8-42

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET A DATA	Press the MODE/SET Key to enter Utility Function Mode.
2	Fn203	MODE/SET A V DATA/	Press the UP Key or DOWN Key to display Fn203 .
3		MODE/SET A DATA/	Press the DATA/SHIFT Key for approximately one second. The display shown at the left will appear.
4		MODE/SET A V DATA/≪	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.
5		lotor	Note: The rigidity type is always 2. 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	L0040	MODE/SET ▲ ▼ DATA/◀	Press the DATA/SHIFT Key for less than one second. The one-parameter gain will be displayed as shown on the left.
7		MODE/SET ▲ DATA/	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		MODE/SET A DATA/	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	F-203	MODE/SET A PATA/	Press the DATA/SHIF T Key for approximately one second to return the display to Fn203 .

13.4.31 Adjust Anti-resonance Control (Fn204)

13.4.31 Adjust Anti-resonance Control (Fn204)

This function cannot be executed from the Panel Operator on the SERVOPACK.

13.4.32 Vibration Suppression (Fn205)

This function cannot be executed from the Panel Operator on the SERVOPACK.

13.4.33 Easy FFT (Fn206)

Refer to the following section for information on this utility function other than the procedure. 8.14.2 Easy FFT on page 8-94

Step	Panel Display after Operation	Keys	Operation
1	F-000	MODE/SET A DATA/	Press the MODE/SET Key to enter Utility Function Mode.
2	F-205	MODE/SET A DATA/	Press the UP Key or DOWN Key to display Fn206 .
3	(Reference amplitude setting)	MODE/SET A 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	In 15 rives	DATA/≪	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	(Ready to operate status)	MODE/SET A DATA/	Press the DATA/SHIFT Key for approximately one second. The ready to operate status will be entered.
6		MODE/SET ▲ ▼ DATA/▼	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	(Flashing) (Flashing) Slight movement in Servomotor	MODE/SET ▲ DATA/	While the servo is ON, press the UP Key (forward) or the DOWN Key (reverse). 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 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 check 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	n	MODE/SET A DATA/	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. If the 1st notch filter frequency is already set (Pn408 = n.□□□1), the 2nd notch filter frequency will be automatically set (Pn40C). Press the MODE/SET Key to return to step 5. Note: 1. If both the 1st and 2nd notch filter frequencies are already set (Pn408 = n.□1□1), no more notch filter frequencies can be set. 2. If the frequency detected by this function is not to be used, set Pn408 to n.□□□0 (Disable notch filter).
10	Fn205	MODE/SET A DATA/	Press the DATA/SHIFT Key for approximately one second to return the display to Fn206 .
11	Turn the power supply	to the SERVOPACK O	FF and ON again after you finish executing Easy FFT.

Orives Motors Controls

Parameter Lists

14

This chapter provides information on the parameters.

14.1	List of Parameters
	14.1.1Interpreting the Parameter Lists
14.2	Parameter Recording Table 14-34

Drives Motors Controls

14.1.1 Interpreting the Parameter Lists

The types of Servomotors to which the parameter applies.

- All: The parameter is used for both Rotary Servomotors and Linear Servomotors.
- Rotary: The parameter is used for only Rotary Servomotors.
- · Linear: The parameter is used for only Linear Servomotors.

Rotary Servomotor terms are used for parameters that are applicable to all Servomotors. If you are using a Linear Servomotor, you need to interpret the terms accordingly. Refer to the following section for details.

THE STATE OF

◆ Differences in Terms for Rotary Servomotors and Linear Servomotors on page xi

Indicates when a change to the parameter will be effective.

									1/			
Parameter No.	Size		Name		Setting Range	Setting Unit	Default Setting	Applica- ble Motors	When Enabled	Classi- fication	Refe	
	2	Basic Fun	ction Selecti	ions 0	0000h to 10B1h	-	0000h	All	After restart	Setup	-	
		Servo provid • To	omotor and L ded for both. op row: For F	inear S Rotary S	the parameters ervomotor, info servomotors ar Servomotors	rmation is	• Set	up ning to the followir	ving two classing section for ceter Classificat	details.	ge 5-4	
			Rotation D	Direction	on Sel ction					Deferen		
			Movemen	t Direc	tion Selectio	n				Reference	ce	
	n.	пппх	0 1	Use Co Use th ward c	page 5-1	10						
			Use CW as the forward direction. (Reverse Rotation Mode)								10	
			Control M	ethod	Selection					Reference		
Dr	۲į۱	ve	1 1	Positio Torque	control with a n control with control with a l set speed c	pulse train analog refe	reference rences	\cup 11	tro	S		
_					<u> </u>				ntact refer-			
Pn000				Switching between internal set speed control with contact references and speed control with analog references								
				Switching between internal set speed control with contact references and position control with pulse train references								
	n.	ппхп			ing between i and torque co				ntact refer-	page 5-1	13	
					ing between p control with a			ulse train refe	erences and			
			8	Switch torque	ing between p	oosition co analog refe	ntrol with pr	ulse train refe	erences and			
					ing between t control with a			alog referen	ces and			
					ing between s control with z			alog referend	ces and			
			В	Switch positio	ing between p n control with	oosition co reference	ntrol with populse inhib	ulse train refe ition	erences and			
	n.	ПΩХПП	Reserved	param	eter (Do not	change.)						
			Rotary/Line	ear Se	vomotor Star	tup Selecti	on When Er	ncoder Is No	t Connected	Reference	ce	
	n.	XDDD			an encoder is Servomotor.	not conne	cted, start	as SERVOP	ACK for	page 5 1	16	
					an encoder is rvomotor.	not conne	cted, start	as SERVOP	ACK for Lin-	page 5-16		

Parameter Lists

List of Parameters 14.1.2

The following table lists the parameters.

- Note: Do not change the following parameters from their default settings.

 Reserved parameters

 Parameters not given in this manual

 Parameters that are not valid for the Servomotor that you are using, as given in the parameter table

Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence				
	2	Basic Fund tions 0	tion Selec-	0000h to 10B1h	_	0000h	All	After restart	Setup	-				
			Rotation Dir	ection Selectio	n				Refere	ance				
			Movement [Direction Select	tion				riciere	SIICE				
				se CCW as the t										
		n.□□□X	Wa	se the direction ard direction.					page :	5-18				
			Use CW as the forward direction. (Reverse Rotation Mode) Use the direction in which the linear encoder counts down as the											
			0.0	se the direction ward direction.				down as the						
			Control Met	hod Selection					Refere	ence				
			0 Sp	eed control wit	h analog r	eferences								
			1 Po	sition control w	ith pulse t	rain referer	nces							
			2 To	rque control wit	h analog r	eferences								
			3 Int											
				vitching betwee ces and speed				ontact refer-						
Pn000			5 Sv en	vitching betwee ces and positio	n internal on control v	set speed vith pulse	control with c train reference	ontact referes						
		n.□□X□	6 Switching between internal set speed control with contact references and torque control with analog references							5-13				
				vitching betwee eed control with			h pulse train re	eferences and	k					
Dri	V	'es	8 Sv to	vitching betwee rque control wit	n position h analog r	control wit	h pulse train re	eferences and	s and					
				vitching betwee eed control with			analog refere	ences and						
				vitching betwee eed control with			analog refere	nces and						
			B Sv pc	vitching betwee sition control w	n position ith referen	control wit ce pulse ir	h pulse train re hibition	eferences and	k					
		n.□X□□	Reserved pa	arameter (Do no	ot change	.)			·					
			Rotary/Linea	ar Servomotor	Startup Se	election W	hen Encoder	Is Not Con-	Refere	ence				
		n.X□□□		hen an encoder otary Servomoto		nected, st	art as SERVC	PACK for	2000	F 16				
				When an encoder is not connected, start as SERVOPACK for Linear Servomotor.					page 5-16					
			<u> </u>						-					

Continued from previous page.

Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence	
	2	Application Selections	Function 1	0000h to 1142h	-	0000h	All	After restart	Setup	-	
			Motor Stop	ping Method fo	r Servo Ol	F and Gro	oup 1 Alarms		Refere	ence	
				top the motor by	,						
		n.□□□X		top the motor by ne dynamic brake		ing dynam	ic brake and	then release	page 5-41		
			2 C	oast the motor t	o a stop w	ithout the	dynamic brak	e.			
			Overtravel	Stopping Metho	od				Refere	ence	
				pply the dynamic topping method				p (use the			
				ecelerate the mone maximum tord							
		n.□□X□		ecelerate the money maximum torc				in Pn406 as	page 5	5-33	
Pn001				ecelerate the monday			ne deceleratio	n time set in			
				ecelerate the monagement of th			ne deceleratio	n time set in			
			Main Circuit Power Supply AC/DC Input Selection							ence	
		- EVEE		nput AC power as nd L3 terminals (ng the L1, L2	,		
	ŀ	n.□X□□	1 a	nput DC power a nd ⊝ 2 terminals onverter or the s	s or the B	1 and Θ 2		0		5-14	
			Warning Co	ode Output Sele	ction				Refere	ence	
			1 () 1	utput only alarmals.	codes on	the ALO1,	ALO2, and A	LO3 termi-			
		n.X□□□	1 a	utput both warn nd ALO3 termina utput, the ALM (nal state).	als. Howev	er, while a	n warning cod	de is being	6-11		
L)r	mai state).							IS			

UUI	ııııueu	ПОП	pre	viou	s pa	age.	
			- :			-	i

Application Selections	Speed/Position Control Option (T-REF Input Option option) O Do not use T-REF. 1 Use T-REF as an external torque option option (V-REF Input Alloce option) Torque Control Option (V-REF Input Alloce option) O Do not use V-REF. 1 Use V-REF as an external speed options. I Use the encoder according to entions. 1 Use the encoder as an increment option option. External Encoder Usage O Do not use an external encoder.	0000h	-	After restart	Setup	_			
	0					Testart	•		
	Speed/Po	sition Control Op	tion (T-RE	F Input All	ocation)	Applicable Motors	Refere	ence	
	0 [On not use T-REE				MOTOLS	_		
n.□□□X				raue limit i	nput.		page (3-68	
				•	•	All	page 8		
	2 1	Jse T-REF as an e	external to						
Torque Control Option (V-REF Input Allocation) n.□□X□ 0							Applicable Reference		
n.□□X□	0	Do not use V-REF.		ΔII	2000 (2 15			
	1 (Jse V-REF as an e	nput.	All	page)-40			
	Encoder L	Jsage				Applicable Motors	Refere	ence	
n.□X□□		tions.							
	1 l						page 6	3-73	
	2	Jse the encoder a encoder.	Rotary						
	External E	ncoder Usage		ш		Applicable Motors	Refere	ence	
	0 0	Do not use an ext	ernal enco	der.			/		
n.X000					ward direc-				
	2 F	Reserved setting (Do not us	e.)		Rotary	page	10-6	
					erse direc-				
	4	Reserved setting (Do not us	e.)					
	n. 🗆 X 🗆 🗆	n.□□X□	Torque Control Option (V-R 0 Do not use V-REF 1 Use V-REF as an of Encoder Usage 0 Use the encoder attions. 1 Use the encoder attions. 1 Use the encoder attions. External Encoder Usage 0 Do not use an ext 1 The external encotion for CCW motor of the encoder of the encoder of the encoder of the encoder.	n.□□X□ Torque Control Option (V-REF Input / 0 Do not use V-REF. 1 Use V-REF as an external specific process. Encoder Usage Use the encoder according tions. 1 Use the encoder as an incree 2 Use the encoder as a single encoder. External Encoder Usage 0 Do not use an external encoder moves tion for CCW motor rotation 2 Reserved setting (Do not use 3 The external encoder moves tion for CCW motor rotation)	n.□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□	Torque Control Option (V-REF Input Allocation) 0 Do not use V-REF. 1 Use V-REF as an external speed limit input. Encoder Usage 0 Use the encoder according to encoder specifications. 1 Use the encoder as an incremental encoder. 2 Use the encoder as a single-turn absolute encoder. External Encoder Usage 0 Do not use an external encoder. 1 The external encoder moves in the forward direction for CCW motor rotation. 2 Reserved setting (Do not use.) 3 The external encoder moves in the reverse direction for CCW motor rotation.	Torque Control Option (V-REF Input Allocation) Do not use V-REF. 1 Use V-REF as an external speed limit input. Encoder Usage O Use the encoder according to encoder specifications. 1 Use the encoder as an incremental encoder. 2 Use the encoder as a single-turn absolute encoder. External Encoder Usage O Do not use an external encoder. 1 The external encoder moves in the forward direction for CCW motor rotation. 2 Reserved setting (Do not use.) The external encoder moves in the reverse direction for CCW motor rotation. 4 Reserved setting (Do not use.)	Torque Control Option (V-REF Input Allocation) Do not use V-REF. 1 Use V-REF as an external speed limit input. Encoder Usage Use the encoder according to encoder specifications. Use the encoder as an incremental encoder. Use the encoder as a single-turn absolute encoder. External Encoder Usage External Encoder Usage Do not use an external encoder. The external encoder moves in the forward direction for CCW motor rotation. Reference Applicable Motors Reference Reference Reference Reference Applicable Motors Reference Reference Reference Applicable Motors Reference Re	

Continued from previous page.

Setting Setting Default Applicable When Classi- Refer-

Parameter	Size	N	ame	Setting	Setting	Default	Applicable	When	Classi-	Refer-		
No.	တ	Application	Function	Range	Unit	Setting	Motors	Enabled	fication	ence		
	2	Application Selections	6	0000h to 105Fh	-	0002h	All	Immedi- ately	Setup	9-10		
		"				1.	II.		Ш			
			Analog Mo	nitor 1 Signal Se	election							
			00	Motor speed (1	V/1,000 m	nin ⁻¹)						
				Motor speed (1	V/1,000 m	nm/s)						
			01	Speed reference		•						
				Speed reference								
			02	Torque reference								
				Force reference								
			03	Position deviation (0.05 V/reference unit) Position amplifier deviation (after electronic gear) (0.05 V/encoder pulse unit)								
			04	Position amplifier deviation (after electronic gear) (0.05 V/encoder pulse Position amplifier deviation (after electronic gear) (0.05 V/linear encoder								
			04	r encoder								
	Position reference speed (1 V/1,000 min ⁻¹)											
				Position reference speed (1 V/1,000 mm/s)								
		- □□VV	06	Reserved setting								
Pn006		n.□□XX	07	Load-motor position deviation (0.01 V/reference unit)								
			08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)								
			09	Speed feedforw	ard (1 V/1	,000 min ⁻¹						
				Speed feedforw			<i>'</i>					
			OA	Torque feedforw			1 /					
			/	Force feedforwa								
			0B	Active gain (1st				1				
			0C	Completion of p pleted: 0 V)	osition ref	erence dis	tribution (com	pleted: 5 V,	not com-			
			0D	External encode	er speed (1	V/1,000 r	min ⁻¹ : value at	the motor s	shaft)			
			0E	Reserved setting	-							
	١.		0F	Reserved setting		use.)		L	_			
- 1) r		Ve:	10	Main circuit DC			$-$ 0 $^{\circ}$ 1	ILO	18			
		400	11 to 5F	Reserved setting	gs (Do not	use.)	<u> </u>	-11	-			
		n.□X□□	Reserved	parameter (Do no	ot change.	.)						
		n.X□□□	Reserved	Reserved parameter (Do not change.)								

14

Parameter	Φ			Setting	Setting	Default	Applicable	tinued fron	Classi-	Refe	
No.	Size	N	ame	Range	Unit	Setting	Motors	Enabled	fication	enc	
	2	Application Selections	Function 7	0000h to 105Fh	_	0000h	All	Immedi- ately	Setup	ра(9-1	
			Analog Mo	onitor 2 Signal Se	election						
				Motor speed (1		nin ⁻¹)					
			00	Motor speed (1							
			01	Speed reference	e (1 V/1,00	00 min ⁻¹)					
			01	Speed reference	e (1 V/1,00	00 mm/s)					
			02	Torque referenc	•						
				Force reference							
			03	Position deviation				0 05 Wanas	dor pulos	.unit\	
			04	Position amplifie		,	0 / (·			
			05	pulse unit) Position reference speed (1 V/1,000 min ⁻¹)							
			05	Position reference speed (1 V/1,000 mm/s)							
			06	Reserved settin	<u> </u>						
Pn007	ľ	n.□□XX	07	Load-motor pos							
			08	Positioning completion (positioning completed: 5 V, positioning r pleted: 0 V)							
	-1		09	Speed feedforward (1 V/1,000 min ⁻¹) Speed feedforward (1 V/1,000 mm/s)							
	J								7		
	4		0A	Torque feedforvers					/		
			0B	Active gain (1st			· ·				
			0C	Completion of position reference distribution (completed: 5 V, no pleted: 0 V)							
			0D								
			0E	Reserved setting (Do not use.)							
\:	ш		0F	, , , , , , , , , , , , , , , , , , ,							
Jri	V	es	10 Main circuit DC voltage 11 to 5F Reserved settings (Do not use.)						S		
	r	n. 🗆 X 🗆 🗆									
	r	n.X000	Reserved	oarameter (Do n	ot change.	.)					
		Application	Function	0000h to			5.	After		1	
	2	Selections		7121h	_	0000h	Rotary	restart	Setup	-	
			Low Batte	ry Voltage Alarm	/Warning :	Selection			Refere	ence	
	r	n.□□□X	0 (Output alarm (A.8	30) for low	battery v	oltage.		page	12-2	
			1 (Output warning (A	4.930) for I	ow battery	voltage.		page	12-2	
				selection for Und					Refere	ence	
Pn008				Oo not detect und							
11000	'	n.□□X□		Detect undervolta			•		page 6-14		
		Detect undervoltage warning and limit torque with Pn424 and Pn425 (i.e., only in SERVOPACK).									
		Warning Detection Selection						Refere	ence		
	r	n.□X□□	0 [Detect warnings.					page		
			1 Г	1 Do not detect warnings except for A.971.							

Continued from previous page.

5				0	0	D (!!		lunuea iron					
Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence			
	2	Application Selections		0000h to 0121h	_	0010h	All	After restart	Tuning	-			
		n.□□□X	Reserved p	parameter (Do no	ot change.)							
			Current Co	ntrol Mode Sele	ction				Refere	ence			
				se current contro			D004 4D0	A 000A					
Pn009		n.□□X□	1 .	SERVOPACK Mo 3R8A, -5R5A, ar SERVOPACK Mo 470A, -550A, -5	nd -7R6A: odels SGD	Use currents 7S-120A,	nt control mod -180A, -200A	de 1. ., -330A, -	page 8	3-73			
			2 U	se current contro	ol mode 2.								
			Speed Dete	ection Method S	election				Refere	ence			
		n.□X□□		se speed detecti					page 8	3-74			
		1 Use speed detection 2.											
	n.X□□□ Reserved parameter (Do not change.)												
		Application	Eunotion	0000h to				After	-				
	2	Selections		1044h	-	0001h	All	restart	Setup	_			
			Motor Sto	Motor Stopping Method for Group 2 Alarms									
	L			Apply the dynamic brake or coast the motor to a stop (use the stopping method set in $Pn001 = n.\square\square\squareX$).									
			1 t	Decelerate the me the maximum tore status after stopp	otor to a s	top using	the torque set						
		n.□□□X		Decelerate the make the maximum tord				t in Pn406 as	s page 5-42				
			3 F	Decelerate the management of the second seco									
Dr	'n	ves		Decelerate the monastrate of t			the decelerati	on time set ir	ls				
Pn00A			Stopping I	Method for Force	ed Stops				Refer	ence			
				Apply the dynami stopping method				op (use the					
			1 t	Decelerate the maximum torestatus after stopp	que. Use tl								
		n.□□X□	2 [t	Decelerate the make the maximum toron	otor to a s que and th	top using en let the	the torque set motor coast.	t in Pn406 as	page 6	6-106			
			3 F	Decelerate the manager Pn30A. Use the satopping.	otor to a s etting of F	top using [.] 2n001 = n.	the decelerati □□□X for th	on time set ir e status after	<u>.</u>				
				Decelerate the me Pn30A and then I			the decelerati	on time set ir	ו				
		n.□X□□	Reserved	parameter (Do n	ot change	e.)							
		n.X□□□	Reserved	parameter (Do n	ot change	r.)							

						14.1.2 L	ist of Par	rameters	
					Con	tinued fron	n previou:	s page.	
Name		Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence	
n Functio s B	n	0000h to 1121h	1	0000h	All	After restart	Setup	_	
0		ameter Display	0.1				D.C.		
			Reference						
0	- '	lay only setup		page 5	5-4				
1	Disp	lay all paramet							
Motor S	toppir	ng Method for	Group 2	Alarms			Refere	nce	
0	Sto	o the motor by	setting th	e speed re	ference to 0.				
1	App	ly the dynamic oping method s	brake or set in Pn00	coast the r	motor to a sto I□X).	p (use the	page 5	-42	
2	Set	the stopping m	nethod wit	:h Pn00A =	n.□□□X.				
D		National Control		· OEDVOI	24.014		D . (
-	· ·	Selection for Th	•		PACK		Refere	nce	
0		a three-phase	·				page 5-15		
1		a three-phase oly input.	power su	ppiy input	as a single-pr	lase power	page 5-15		
Reserve	ed para	ameter (Do not	change.)						
		M/M							
n Functio s C	n	0000h to 0131h	—	0000h	-	After restart	Setup	page 7-27	
Functio	n Sele	ection for Test	without a	Motor			Applical Motor		
0	Disa	A II							
1	Ena	All							
Encode	Encoder Resolution for Tests without a Motor Applicable Motors								
0	Use	13 bits.							
_1	Use	20 bits.					Dotor	.,	
2		22 bits.	0		nnti	rola	Rotan	у	
2	Lloc	0.4 bita	400						

2 Use 22 bits. Use 24 bits 3 Applicable **Encoder Type Selection for Tests without a Motor** Motors $n.\Box X\Box\Box$ 0 Use an incremental encoder. ΑII 1 Use an absolute encoder.

 $n.X\square\square\square$ Reserved parameter (Do not change.)

Parameter

No.

Pn00B

Pn00C

Pn00D

Size

2

 $n.\Box\Box\Box X$

n.□□X□

n.□X□□

n.X□□□

n.□□□X

n. \square \square X \square

2

Name

Application Function Selections C

Application Function Selections B

2	Application Function Selections D	0000h to	_	0000h	All	After restart	Setup	page 5-34

n.□□□X	Reserve	Reserved parameter (Do not change.)							
n.□□X□	Reserved parameter (Do not change.)								
$n.\Box X\Box\Box$	Reserved parameter (Do not change.)								
	_								
	Overtrav	el Warning Detection Selection							
n.X□□□	0	Do not detect overtravel warnings.							
	1	Detect overtravel warnings.							
-									

Continued from previous page.

Б .				0	0	5 (11		lunuea iron			
Parameter No.	Size	١	lame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence	
	2	Applicatio Selections	n Function s F	0000h to 2011h	-	0000h	All	After restart	Setup	-	
			Preventative	Maintenance \	Warning S	election			Reference	се	
		n.□□□X		ot detect preve					page 9-	17	
Pn00F			1 Dete	ct preventative	maintena	nce warnir	ngs.		1		
		n.□□X□		rameter (Do no		,					
		n.□X□□	Reserved pa	rameter (Do no	ot change.	.)					
	n.X□□□ Reserved parameter (Do not change.)										
Pn010	2		ess Selection USB Commu-	0000h to 007Fh	-	0001h	All	After restart	Setup	_	
Pn021	2	not chang	·	_	_	0000h	All	-	-	-	
Pn022	2	not chang		1	-	0000h	All	-	-	-	
	2	Σ-V Comp tion Switc	atible Func- h	0000h to 2111h	_	0000h	-	After restart	Setup	_	
	n.□□□X Reserved parameter (Do not change.)										
	Encoder Resolution Compatibility Selection									ıble	
Pn040	n.□□X□ 0 Use the encoder resolution of the Servemotor.								Motor	rs	
	1 Use a resolution of 20 bits when connected to an SGM7J, SGM7A, SGM7P, SGM7G, SGM7E, or SGM7F Servomotor.									У	
	n.	n.□X□□ Reserved parameter (Do not change.)									
	n.	XDDD	Reserved para	meter (Do not	change.)				_		
-Dr	ivoc Motoro Control										
DI	2	Applications Selections	n Function 80	0000h to 1111h	11-0	0000h	Linear	After restart	Setup	-	
			Polarity Sens	or Salaction					Refere	nce	
	r	n.□□□X	-	polarity senso	r.						
			1 Do	not use polarity	sensor.				page 5	5-26	
				Sequence Sel					Refere	ence	
Pn080	r	□□X□		a phase-A lead					page 5	5-24	
				a phase-B lead			ce or U, v, an	a vv.			
	r	n.0X00	Reserved par	rameter (Do no	t change.)						
				lethod for Max	•				Refere	ence	
	r	n.X000	0 Cal	culate the enco ed.	aer outpu	τ puise set	ting for a fixed	a maximum	2000	15 0	
			Calculate the maximum speed for a fixed encoder output pulse setting.			utput pulse	—— page 15-8				

14

Continued from previous page.

Parameter No.	Name Name		Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence				
	2	Application Selections	Function 81	0000h to 1111h	-	0000h	All	After restart	Setup	page 6-49			
		Phase-C Pulse Output Selection											
				•			1 12 12						
		n.□□□X		Output phase-C p									
Pn081			1 (Output phase-C pulses in both the forward and reverse directions.									
	n.□□X□		Reserved	Reserved parameter (Do not change.)									
	Ī	n.□X□□	Reserved	parameter (Do not change.)									
	n.XDDD Reserved parameter (Do not change.)												
	-			()		,							
Pn100	2	Speed Loc	p Gain	10 to 20,000	0.1 Hz	400	All	Immedi- ately	Tuning	page 8-76			
Pn101	2	Speed Loop Integral Time Constant		15 to 51,200	0.01 ms	2000	All	Immedi- ately	Tuning	page 8-76			
Pn102	2	Position Lo	oop Gain	10 to 20,000	0.1/s	400	All	Immedi- ately	Tuning	page 8-76			
Pn103	2	Moment of	f Inertia Ratio	0 to 20,000	1%	100	All	Immedi- ately	Tuning	page 8-76			
Pn104	2	Second Sp Gain	beed Loop	10 to 20,000	0.1 Hz	400	All	Immedi- ately	Tuning	page 8-66			
Pn105	2	Second Sp Integral Tir	oeed Loop me Constant	15 to 51,200	0.01 ms	2000	All	Immedi- ately	Tuning	page 8-66			
Pn106	2	Second Po Gain	osition Loop	10 to 20,000	0.1/s	400	All	Immedi- ately	Tuning	page 8-66			
Pn109	2	Feedforwa	rd	0 to 100	1%	0	All	Immedi- ately	Tuning	page 8-86			
Pn10A	2	Feedforwa Constant	rd Filter Time	0 to 6,400	0.01 ms	0	All	Immedi- ately	Tuning	page 8-86			
	2	Gain Appli tions	cation Selec	- 0000h to 5334h	_	0000h	All	-	Setup	-			
D.::			N 4					Whon					

Dri	M	es	Mode Sv	vitch	ing Selection	S	\mathbb{C}	nti	When Enabled	Refere	ence
	Ť		0		e the internal to el setting: Pn10		ence as th	e condition			
			1		the speed reference to the the speed reference to the speed referenc	erence as	the condit	ion (level set-			
		n.□□□X	'		the speed reference that the speed reference that the speed reference the speed reference the speed reference the speed reference that the speed reference the speed reference the speed reference the speed reference that the speed reference the speed reference the speed reference the speed reference that the speed reference t	erence as	the condit	ion (level set-			
			2		the accelerati ing: Pn10E).	on referen	ce as the	condition (leve	Immedi- ately	page	8-89
Pn10B			2		the accelerati ing: Pn182).	el					
			3		the position of: Pn10F).	eviation a	-				
			4	Do	not use mode	switching.					
			Speed Le	оор	Control Metho	d			When Enabled	Refere	ence
		n.□□X□	0	PLo	control						
			1	I-P	control				After restart	page	8-82
			2 and 3	Res	served settings	(Do not u	se.)		rootart		
		n. 🗆 X 🗆 🗆	Poportion	d no.	ramatar (Da na	t change	1				
		11. LALL	Reserved parameter (Do not change.)								
		n.X000	Reserved	d pai	rameter (Do no	t change.	.)				
Pn10C	2	Mode Swite for Torque			0 to 800	1%	200	All	Immedi- ately	Tuning	page 8-89

Continued from previous page.

		1				1		itinued from	· .	
Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
Pn10D	2	Mode Swite for Speed I	ching Level Reference	0 to 10,000	1 min ⁻¹	0	Rotary	Immedi- ately	Tuning	page 8-89
Pn10E	2	Mode Swite for Acceler	ching Level ation	0 to 30,000	1 min ⁻¹ /s	0	Rotary	Immedi- ately	Tuning	page 8-89
Pn10F	2	Mode Switt for Position	ching Level Deviation	0 to 10,000	1 refer- ence unit	0	All	Immedi- ately	Tuning	page 8-89
Pn11F	2	Position Int Constant	tegral Time	0 to 50,000	0.1 ms	0	All	Immedi- ately	Tuning	page 8-91
Pn121	2	Friction Co Gain	mpensation	10 to 1,000	1%	100	All	Immedi- ately	Tuning	page 8-66, page 8-70
Pn122	2	Second Fri pensation (ction Com- Gain	10 to 1,000	1%	100	All	Immedi- ately	Tuning	page 8-66, page 8-70
Pn123	2	Friction Co Coefficient	mpensation	0 to 100	1%	0	All	Immedi- ately	Tuning	page 8-70
Pn124	2	Friction Co Frequency	mpensation Correction	-10,000 to 10,000	0.1 Hz	0	All	Immedi- ately	Tuning	page 8-70
Pn125	2	Friction Co Gain Corre	mpensation ction	1 to 1,000	1%	100	All	Immedi- ately	Tuning	page 8-70
Pn131	2	Gain Switc	hing Time 1	0 to 65,535	1 ms	0	All	Immedi- ately	Tuning	page 8-66
Pn132	2	Gain Switc	hing Time 2	0 to 65,535	1 ms	0	All	Immedi- ately	Tuning	page 8-66
Pn135	2	Gain Switc Time 1	hing Waiting	0 to 65,535	1 ms	0	All	Immedi- ately	Tuning	page 8-66
Pn136	2	Gain Switc Time 2	hing Waiting	0 to 65,535	1 ms	0	All	Immedi- ately	Tuning	page 8-66
	2	Automatic ing Selection	Gain Switch- ons 1	0000h to 0052h	<i>/</i>	0000h	All	Immedi- ately	Tuning	page 8-66
Dr Pn139	·i	n.000X	0 Us 1 Re 2 See Gain Switch 0 /C 1 /C 2 /N	se manual gain se gain is switch eserved setting les gain is switch eserved setting les gain is switch eserved gain is switch witching condition accord gain to the coll (Positioning COIN (Posi	ed manua Do not us in switchir ed automa in A is sati e first gain A g Complet g Complet out) signal	e.) ag pattern atically fron sfied. The when swi	1. n the first gair gain is switch tching conditi) signal turns) signal turns	n to the seco led automation A is not s	nd gain w	
		n.0X00								
								Immedi-		page
Pn13D	2	Current Ga	ıın Level	100 to 2,000	1%	2000	All	ately	Tuning	page 8-73

Continued from previous page.

Parameter No.	Size	Na	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
	2	Model Follo trol-Related	wing Con- I Selections	0000h to 1121h	_	0100h	All	Immedi- ately	Tuning	-
			Model Foll	owing Control So	election				Referer	ice
		n.□□□X		not use model for		ontrol.			11010101	
				e model following					page 8-83	
			Vibration S	uppression Sele	ection				Reference	
		n.□□X□ -		not perform vibr	- ' '				page 8-83	
		-		rform vibration su						
			2 Pe	and the second s						
Pn140				uppression Adju					Referen	ice
	n.□X□□			o not adjust vibr on of autotuning ost reference, ar	without a	host refere			- page 8-	.33
			1 a	djust vibration su utotuning withou rence, and custo	t a host re				pago o	
			Speed Fee	dforward (VFF)/7	Torque Fe	edforward	(TFF) Selecti	on	Referen	ice
		Do not use model following control and speed/torque feedfor-								
	n.XDDD ward together. 1 Use model following control and speed/torque feedforward together.						page 8-33, page 8-59			
							page o-	.09		
	togotion.							1		
Pn141	2	Model Follo trol Gain	wing Con-	10 to 20,000	0.1/s	500	All	Immedi- ately	Tuning	page 8-83
Pn142	2	Model Follo trol Gain Co		500 to 2,000	0.1%	1000	All	Immedi- ately	Tuning	page 8-66
Pn143	2	Model Follo trol Bias in Direction	wing Con- the Forward	0 to 10,000	0.1%	1000	All	Immedi- ately	Tuning	page 8-83
Pn144	2	Model Follo trol Bias in Direction		0 to 10,000	0.1%	1000	All	Immedi- ately	Tuning	page 8-83
Pn145	2	Vibration Su Frequency	uppression A	1 10 to 2,500	0.1 Hz	500	All	Immedi- ately	Tuning	page 8-59
Pn146	2	Vibration Su Frequency		1 10 to 2,500	0.1 Hz	700	All	Immedi- ately	Tuning	page 8-59
Pn147	2	Model Follo trol Speed I Compensat	Feedforward	0 to 10,000	0.1%	1000	All	Immedi- ately	Tuning	page 8-83
Pn148	2	Second Mo ing Control		10 to 20,000	0.1/s	500	All	Immedi- ately	Tuning	page 8-66
Pn149	2	Second Mo ing Control tion		500 to 2,000	0.1%	1000	All	Immedi- ately	Tuning	page 8-66
Pn14A	2	Vibration Su Frequency	uppression :	2 10 to 2,000	0.1 Hz	800	All	Immedi- ately	Tuning	page 8-59
Pn14B	2	Vibration Su Correction	uppression :	2 10 to 1,000	1%	100	All	Immedi- ately	Tuning	page 8-59

Continued from previous page.

Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence	
	2	Control-Re	lated Selec-	0000h to 0021h	_	0021h	All	After restart	Tuning	_	
					•						
			Model Follov	ving Control Ty	pe Select	ion			Refere	ence	
		n.□□□X	-	e model followi					page 8	3-86	
			1 Use	e model followi	ng control	type 2.					
Pn14F			Tuning-less 7	Type Selection					Refere	ence	
		n.□□X□		e tuning-less ty	<u>'</u>					2.40	
				e tuning-less ty e tuning-less ty	<u>'</u>				page 8	3-13	
	_	n.□X□□	Reserved pa	rameter (Do no	ot change.	.)					
		n.X□□□	Reserved pa	rameter (Do no	ot change.	.)					
	2	Anti-Reson	nance Con- d Selections	0000h to 0011h		0010h	All	Immedi- ately	Tuning	_	
		troi riolatot	00100110110	001111				atory			
			Anti-Resonal	nce Control Se	election				Refere	ence	
	П	n.□□□X		not use anti-re		control.					
			1 Use	e anti-resonanc	ce control.				— page 8	3-51	
			Anti-Resonal	nce Control Ac	djustment	Selection			Refere	ence	
Pn160				not adjust anti							
		n.□□X□		n of autotuning erence, and cus			nce, autotuni	ng with a hos	page 8		
				Adjust anti-resonance control automatically during execution of							
				ce, and custom		rerence, a	utotuning witr	n a nost refer	-		
		n. 🗆 X 🗆 🗆	Reserved pa	rameter (Do no	ot change.)					
				`							
1) r	П,	n.X□□□	Reserved pa	rameter (Do no	ot change.	.)	on	tro	18		
		Anti-Reson	opoo Ero				OII	Immodi	10	paga	
Pn161	2	quency	iance Fre-	10 to 20,000	0.1 Hz	1000	All	Immedi- ately	Tuning	page 8-51	
Pn162	2	Anti-Reson Correction		1 to 1,000	1%	100	All	Immedi- ately	Tuning	page 8-51	
Pn163	2	Anti-Resonance Damping Gain		0 to 300	1%	0	All	Immedi- ately	Tuning	page 8-51	
Pn164	Anti-Resonance Filter Time Constant 1 Correction		-1,000 to 1,000	0.01 ms	0	All	Immedi- ately	Tuning	page 8-51		
Pn165	Anti-Resonance Filter Time Constant 2 Correction			-1,000 to 1,000	0.01 ms	0	All	Immedi- ately	Tuning	page 8-51	
Pn166	2 Anti-Resonance Damping Gain 2			0 to 1,000	1%	0	All	Immedi- ately	Tuning	page 8-54	

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Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer ence	
	2	Tuning-less Related Se		0000h to 2711h	-	1401h	All	-	Setup	page 8-12	
	-										
			Tuning-le	ss Selection					Whe Enab		
		n.□□□X	0	Disable tuning-les					After restart		
			1	Enable tuning-les	s function.				resta	غارا 	
			Speed Co	ontrol Method					Whe Enab		
Pn170		n.□□X□	0	Use for speed co	ntrol.				Afte	er	
11170			1	Use for speed co	ol. resta	art					
			Rigidity L	evel					Whe Enab		
		n.□X□□	0 to 7	Set the rigidity lev	rel.				Imme		
			Tuning-le	ss Load Level		1			When Enabled		
		n.X□□□	0 to 2	to 2 Set the load level for the tuning-less function.						edi- ly	
	-										
Pn181	2	Mode Swit	ching Leve Reference	ning Level 0 to 10,000 1 mm/s 0 Linear Immediately						page 8-89	
Pn182	2	Mode Swit	ching Leve	0 to 30,000	1 mm/s ²	0	Linear	Immedi- ately	Tuning	page 8-89	
	2	Position Co	ontrol Reference		_	0000h	All	After restart	Setup	_	
										<u> </u>	
			Reference	e Pulse Form					Refere	ence	
			0	Sign and pulse tra							
			1	CW and CCW pu Two-phase pulse				abasa A and			
)ri	V	20	2	phase B) ×1, pos	tive logic		nti	$r \cap I$			
711	V	n.□□□X	3	Two-phase pulse phase B) ×2, pos		90° phase	e differential (p	ohase A and	page 6	3-31	
			4	Two-phase pulse	trains with	90° phase	e differential (p	ohase A and			
				phase B) ×4, posi		a logio					
			5 6	CW and CCW pu	, ,		ogic				
	Ī		Clear Sig	nal Form					Refere	ence	
Pn200			0	Clear position dev	viation whe	en the sign	al is at high le	vel.			
111200		n.□□X□	1	Clear position dev	/iation on t	he rising e	edge of the sig	gnal.	page 6	6-33	
			2	Clear position dev					- Pago (, 00	
			3	Clear position dev	/iation on t	the falling (edge of the si	gnal.			
			Clear Ope						Refere	ence	
		» חערת	0	Clear position devalarm occurs).	/ıation at a	base bloc	k (at servo Ol	-F or when			
	n.□X□□ —		Do not clear position error (cleared only with CLR (Clear Positio Deviation) signal).						page 6	3-33	
			2	Clear position dev	viation whe	en an alarn	n occurs.				
	_	Filter Selection									

Use the reference input filter for a line-driver signal. (1 Mpps max.)

Use the reference input filter for an open-collector signal. (200 kpps max.)

Use reference input filter 2 for a line-driver signal. (1 to 4 Mpps)

0

1

2

n.X□□□

Continued on next page.

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Continued from previous page.

								tinued from		
Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
Pn205	2	Multiturn L	imit	0 to 65,535	1 rev	65535	Rotary	After restart	Setup	page 6-82
	2	Position Co tion Select	ontrol Func- ions	0000h to 2210h	-	0000h	All	After restart	Setup	_
		n.□□□X	Reserved pa	rameter (Do no	ot change.)				
	Ī		Position Cor	ntrol Option					Refere	ence
		n.□□X□		not use V-REF e V-REF as a si	='	nack input			page 8	3-88
		n.□X□□		rameter (Do no		· ·	•			
Pn207		11.0700	neserveu pa	irameter (DO no	or change.	·)			Dofe	
111207			/COIN (Posit	ioning Comple	tion Outp	ut) Signal	Output Timin	g	Refer- ence	
			0 sar	tput when the ame or less than dth).	absolute v the setting	alue of the g of Pn522	position devi (Positioning	ation is the Completed		
		n.X□□□	1 or	tput when the a less than the se d the reference	etting of Pr	n522 (Posi	tioning Comp	leted Width)	page 6	3-37
	Ī		2 or	tput when the a less than the se d the reference	etting of Pi	n522 (Posi			?	
Pn20A	4	Number of Encoder Se	External cale Pitches	4 to 1,048,576	1 scale pitch/ revolu- tion	32768	Rotary	After restart	Setup	page 10-7
Pn20E	4	Electronic (Numerator		1 to 1,073,741,824	1	64	All	After restart	Setup	page 5-47
Pn210	4	Electronic (Denomina		1 to 1,073,741,824	1	1	All	After restart	Setup	page 5-47
Pn212	4	Number of Output Pul		16 to 1,073,741,824	1 P/Rev	2048	Rotary	After restart	Setup	page 6-52
Pn216	2	Position Re Acceleration tion Time C	n/Decelera-	0 to 65,535	0.1 ms	0	All	Immedi- ately after the motor stops	Setup	page 6-36
Pn217	2	Average Po	osition Refer- ment Time	0 to 10,000	0.1 ms	0	All	Immediately after the motor stops	Setup	page 6-36
Pn218	2	Reference Multiplier	Pulse Input	1 to 100	× 1	1	All	Immedi- ately	Setup	page 6-34
	2	Fully-close Selections	d Control	0000h to 1003h	-	0000h	Rotary	After restart	Setup	page 10-10
		n.□□□X	Reserved pa	rameter (Do no	ot change.)				
		n.□□X□	Reserved pa	rameter (Do no	ot change.)				
Pn22A		n.□X□□	Reserved pa	ırameter (Do no	ot change.	.)				
		n.X000		Control Speed		k Selectio	n			
			1 Use external encoder speed.							
Pn281	2		utput Resolu-	1 to 4,096	1 edge/	20	All	After	Setup	page
		tion Linear Enc	oder Scale	0 to	pitch 0.01			restart After	·	6-53 page
Pn282	4	Pitch	-	6,553,600	μm	0	Linear	restart	Setup ed on nex	page 5-19 d page.

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Continued from previous page.

Parameter	Φ		Setting	Setting	Default	Applicable	When	Classi-	Refer-
No.	Size	Name	Range	Unit	Setting	Motors	Enabled	fication	ence
Pn300	2	Speed Reference Input Gain	150 to 3,000	0.01 V/ Rated motor speed	600	All	Immedi- ately	Setup	page 6-19, page 6-46, page 8-88
Pn301	2	Internal Set Speed 1	0 to 10,000	Rotary: 1 min ⁻¹ Direct Drive: 0.1 min ⁻¹	100	Rotary	Immedi- ately	Setup	page 6-54
Pn302	2	Internal Set Speed 2	0 to 10,000	Rotary: 1 min ⁻¹ Direct Drive: 0.1 min ⁻¹	200	Rotary	Immedi- ately	Setup	page 6-54
Pn303	2	Internal Set Speed 3	0 to 10,000	Rotary: 1 min ⁻¹ Direct Drive: 0.1 min ⁻¹	300	Rotary	Immedi- ately	Setup	page 6-54
Pn304	2	Jogging Speed	0 to 10,000	Rotary: 1 min ⁻¹ Direct Drive: 0.1 min ⁻¹	500	Rotary	Immedi- ately	Setup	page 7-7
Pn305	2	Soft Start Acceleration Time	0 to 10,000	1 ms	0	All	Immedi- ately	Setup	page 6-24
Pn306	2	Soft Start Deceleration Time	0 to 10,000	1 ms	0	All	Immedi- ately	Setup	page 6-24
Pn307	2	Speed Reference Filter Time Constant	0 to 65,535	0.01 ms	40	All	Immedi- ately	Setup	page 6-24
Pn308	2	Speed Feedback Filter Time Constant	0 to 65,535	0.01 ms	0	All	Immedi- ately	Setup	page 8-82
Pn30A	2	Deceleration Time for Servo OFF and Forced Stops	0 to 10,000	1 ms	0	All	Immedi- ately	Setup	page 5-33
Pn30C	2	Speed Feedforward Average Movement Time	0 to 5,100	0.1 ms	0	All	Immedi- ately	Setup	page 8-88
	2	Vibration Detection Selections	0000h to 0002h	_	0000h	All	Immedi- ately	Setup	page 6-98

Pn310

	Vibration Detection Selection								
п.ПППХ	0	Do not detect vibration.							
11.000	1	Output a warning (A.911) if vibration is detected.							
	2	Output an alarm (A.520) if vibration is detected.							

n.□□X□ Reserved parameter (Do not change.)

n.□X□□ Reserved parameter (Do not change.)

n.X□□□ Reserved parameter (Do not change.)

Pn	311	2	Vibration Detection Sensitivity	50 to 500	1%	100	All	Immedi- ately	Tuning	page 6-98
Pn	312	2	Vibration Detection Level	0 to 5,000	1 min ⁻¹	50	Rotary	Immedi- ately	Tuning	page 6-98
Pn	316	2	Maximum Motor Speed	0 to 65,535	1 min ⁻¹	10000	Rotary	After restart	Setup	page 6-16
Pn	324	2	Moment of Inertia Cal- culation Starting Level	0 to 20,000	1%	300	All	Immedi- ately	Setup	page 8-31
Pn	380	2	Internal Set Speed 1	0 to 10,000	1 mm/s	10	Linear	Immedi- ately	Setup	page 6-54

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Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
Pn381	2	Internal Se	t Speed 2	0 to 10,000	1 mm/s	20	Linear	Immedi- ately	Setup	page 6-54
Pn382	2	Internal Se	t Speed 3	0 to 10,000	1 mm/s	30	Linear	Immedi- ately	Setup	page 6-54
Pn383	2	Jogging Sp	peed	0 to 10,000	1 mm/s	50	Linear	Immedi- ately	Setup	page 7-7
Pn384	2	Vibration D Level	etection	0 to 5,000	1 mm/s	10	Linear	Immedi- ately	Tuning	page 6-98
Pn385	2	Maximum I	Motor Speed	1 to 100	100 mm/s	50	Linear	After restart	Setup	page 6-16
Pn400	2	Torque Ref Gain	erence Input	10 to 100	0.1 V/ rated torque	30	All	Immedi- ately	Setup	page 6-40, page 8-88
Pn401	2	First Stage Reference Constant	First Torque Filter Time	0 to 65,535	0.01 ms	100	All	Immedi- ately	Tuning	page 8-79
Pn402	2	Forward To	orque Limit	0 to 800	1% ^{*1}	800	Rotary	Immedi- ately	Setup	page 6-63
Pn403	2	Reverse To	orque Limit	0 to 800	1%*1	800	Rotary	Immedi- ately	Setup	page 6-63
Pn404	2	Forward Ex Limit	cternal Torque	0 to 800	1%* ¹	100	All	Immedi- ately	Setup	page 6-64, page 6-69
Pn405	2	Reverse Ex Limit	ternal Torque	0 to 800	1% ^{*1}	100	All	Immedi- ately	Setup	page 6-64, page 6-69
Pn406	2	Emergency	Stop Torque	0 to 800	1%*1	800	All	Immedi- ately	Setup	page 5-33
Pn407	2	Speed Lim Torque Cor		0 to 10,000	1 min ⁻¹	10000	Rotary	Immedi- ately	Setup	page 6-45
	2	Torque-Rel tion Selecti	ated Func- ions	0000h to 1111h	-	0000h	All	-	Setup	_
Dr	i	n.□□□X		Selection 1 able first stage			on	When Enabled Immediately		
			Speed Limit	Selection				When Enabled	Refere	ence
Pn408		n.□□X□	0 seti	e the smaller of ting of Pn407 a the smaller of ting of Pn480 a the smaller of	as the spe the maxin as the spe	ed limit. num motor ed limit.	speed and th		page 6	6-46
			1 Spe	ed and the set the smaller of ed and the set	ting of Pn the overs	407 as the peed alarn	speed limit.			
			Notch Filter S	Selection 2				When Enabled	Refere	ence
		n.□X□□		able second stable second sta				Immedi- ately	page 8	3-79
								When		
		n.X□□□		pensation Fun able friction co				Enabled		ence
	_			able friction cor				Immedi- ately	page 8	3-70
		First Stage	Notch Filter			_		Immedi-		nage
Pn409	2	Frequency	. TO COLL I IIIOI	50 to 5,000	1 Hz	5000	All	ately	Tuning	page 8-79

Tuning 8-79

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Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
Pn40A	2	First Stage Notch Filter Q Value	50 to 1,000	0.01	70	All	Immedi- ately	Tuning	page 8-79
Pn40B	2	First Stage Notch Filter Depth	0 to 1,000	0.001	0	All	Immedi- ately	Tuning	page 8-79
Pn40C	2	Second Stage Notch Filter Frequency	50 to 5,000	1 Hz	5000	All	Immedi- ately	Tuning	page 8-79
Pn40D	2	Second Stage Notch Filter Q Value	50 to 1,000	0.01	70	All	Immedi- ately	Tuning	page 8-79
Pn40E	2	Second Stage Notch Filter Depth	0 to 1,000	0.001	0	All	Immedi- ately	Tuning	page 8-79
Pn40F	2	Second Stage Second Torque Reference Filter Frequency	100 to 5,000	1 Hz	5000	All	Immedi- ately	Tuning	page 8-79
Pn410	2	Second Stage Second Torque Reference Filter Q Value	50 to 100	0.01	50	All	Immedi- ately	Tuning	page 8-79
Pn412	2	First Stage Second Torque Reference Filter Time Constant	0 to 65,535	0.01 ms	100	All	Immedi- ately	Tuning	page 8-66
Pn415	2	T-REF Filter Time Constant	0 to 65,535	0.01 ms	0	All	Immedi- ately	Setup	page 6-45
_	2	Torque-Related Function Selections 2	0000h to 1111h	-	0000h	All	Immedi- ately	Setup	page 8-81
Pn416		Notch Filter 0 Dis 1 En	sable fourth stag able fourth stag	ge notch fil notch filte	ter.	onti	rok	5	
Pn417	2	Third Stage Notch Filter Frequency	50 to 5,000	1 Hz	5000	All	Immedi- ately	Tuning	page 8-81
Pn418	2	Third Stage Notch Filter Q Value	50 to 1,000	0.01	70	All	Immedi- ately	Tuning	page 8-81
Pn419	2	Third Stage Notch Filter Depth	0 to 1,000	0.001	0	All	Immedi- ately	Tuning	page 8-81
Pn41A	2	Fourth Stage Notch Filter Frequency	50 to 5,000	1 Hz	5000	All	Immedi- ately	Tuning	page 8-81
Pn41B	2	Fourth Stage Notch Filter Q Value	50 to 1,000	0.01	70	All	Immedi- ately	Tuning	page 8-81
Pn41C	2	Fourth Stage Notch Filter Depth	0 to 1,000	0.001	0	All	Immedi- ately	Tuning	page 8-81
Pn41D	2	Fifth Stage Notch Filter Frequency	50 to 5,000	1 Hz	5000	All	Immedi- ately	Tuning	page 8-81
Pn41E	2	Fifth Stage Notch Filter Q Value	50 to 1,000	0.01	70	All	Immedi- ately	Tuning	page 8-81
Pn41F	2	Fifth Stage Notch Filter Depth	0 to 1,000	0.001	0	All	Immedi- ately	Tuning	page 8-80

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Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence	
	2	Speed Ripp sation Sele	ole Compen- ections	0000h to 1111h	-	0000h	Rotary	-	Setup	page 8-64	
					'						
			Speed Ripple	e Compensatio	on Functio	n Selectio	n		Whe Enab		
		n.□□□X	0 Dis	able speed ripp	ole compe	nsation.			Imme	edi-	
			1 Ena	able speed ripp	le comper	nsation.			ate		
			Speed Ripple	e Compensation	on Informa	ition Disaç	greement War	rning Detec-	Whe Enab		
Pn423		n.□□X□	0 Det	ect A.942 aları	ms.				Afte	er	
			1 Do	not detect A.9	42 alarms				resta		
			Speed Ripple	e Compensatio	on Enable	Condition	Selection		Whe Enab		
		n.□X□□	0 Spe	eed reference					After		
			1 Mo	tor speed					resta		
		n.XDDD	Reserved par	rameter (Do no	ot change.)					
					J						
Pn424	2	Torque Lim	nit at Main Cir- e Drop	0 to 100	1%*1	50	All	Immedi- ately	Setup	page 6-15	
Pn425	2	Release Tir Limit at Ma Voltage Dro		0 to 1,000	1 ms	100	All	Immedi- ately	Setup	page 6-15	
Pn426	2	Torque Fee Average M Time		0 to 5,100	0.1 ms	0	All	Immedi- ately	Setup	page 8-88	
Pn427	2	Speed Ripp sation Enal	ole Compen- ble Speed	0 to 10,000	1 min ⁻¹	0	Rotary	Immedi- ately	Tuning	page 8-64	
Pn456	2	Sweep Tor- ence Ampl		1 to 800	1%	15	All	Immedi- ately	Tuning	page 8-97	
Dr	2	Notch Filte Selections	r Adjustment 1	0000h to 0101h	re	0101h	All	Immedi- ately	Tuning	page 8-15, page 8-32	
	1	V 0	2 1 1 1				OH	u U			
				Adjustment Se		and all en		1 1			
		n.□□□X	0 tun	not adjust the ing without a hing.							
				ust the first stanout a host refe							
Pn460		n.□□X□ Reserved parameter (Do not change.)									
		Notch Filter Adjustment Selection 2									
				not adjust the							
		n.□X□□		otuning withou stom tuning.	t a host re	terence, a	utotuning with	n a host refer	ence, and	i	
			Adj 1 ing	ust the second without a host ing.							
		n.X□□□	Reserved par	rameter (Do no	ot change.)					
				and the							

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Continued	from	previous	page.

Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
	2	Gravity Compensation- Related Selections	0000h to 0001h	-	0000h	All	After restart	Setup	page 8-71
	1		pensation Selec						
			able gravity co	· ·					
Pn475	_		rameter (Do not						
	_	•	ameter (Do not	<u> </u>					
	_	•	ameter (Do not	0 ,					
		Ticoci voa par	arrotor (Bo riot	orialigo.)					
Pn476	2	Gravity Compensation Torque	-1,000 to 1,000	0.1%	0	All	Immedi- ately	Tuning	page 8-71
Pn480	2	Speed Limit during Force Control	0 to 10,000	1 mm/s	10000	Linear	Immedi- ately	Setup	page 6-45
Pn481	2	Polarity Detection Speed Loop Gain	10 to 20,000	0.1 Hz	400	Linear	Immedi- ately	Tuning	-
Pn482	2	Polarity Detection Speed Loop Integral Time Constant	15 to 51,200	0.01 ms	3000	Linear	Immedi- ately	Tuning	 _ L
Pn483	2	Forward Force Limit	0 to 800	1%*1	30	Linear	Immedi- ately	Setup	page 6-63
Pn484	2	Reverse Force Limit	0 to 800	1%*1	30	Linear	Immedi- ately	Setup	page 6-63
Pn485	2	Polarity Detection Reference Speed	0 to 100	1 mm/s	20	Linear	Immedi- ately	Tuning	_
Pn486	2	Polarity Detection Reference Acceleration/ Deceleration Time	0 to 100	1 ms	25	Linear	Immedi- ately	Tuning	_ _
Pn487	2	Polarity Detection Constant Speed Time	0 to 300	1 ms	0	Linear	Immedi- ately	Tuning	ı
Pn488	2	Polarity Detection Reference Waiting Time	50 to 500	1 ms	100	Linear	Immedi- ately	Tuning	_
Pn48E	2	Polarity Detection Range	1 to 65,535	1 mm	10	Linear	Immedi- ately	Tuning	-
Pn490	2	Polarity Detection Load Level	0 to 20,000	1%	100	Linear	Immedi- ately	Tuning	-
Pn495	2	Polarity Detection Confirmation Force Reference	0 to 200	1%	100	Linear	Immedi- ately	Tuning	- I
Pn498	2	Polarity Detection Allowable Error Range	0 to 30	1 deg	10	Linear	Immedi- ately	Tuning	_
Pn49F	2	Speed Ripple Compensation Enable Speed	0 to 10,000	1 mm/s	0	Linear	Immedi- ately	Tuning	page 8-64
Pn501	2	Zero Clamping Level	0 to 10,000	1 min ⁻¹	10	Rotary	Immedi- ately	Setup	page 6-25
Pn502	2	Rotation Detection Level	1 to 10,000	1 min ⁻¹	20	Rotary	Immedi- ately	Setup	page 6-11
Pn503	2	Speed Coincidence Detection Signal Output Width	0 to 100	1 min ⁻¹	10	Rotary	Immedi- ately	Setup	page 6-27
Pn506	2	Brake Reference-Servo OFF Delay Time	0 to 50	10 ms	0	All	Immedi- ately	Setup	page 5-36
Pn507	2	Brake Reference Output Speed Level	0 to 10,000	1 min ⁻¹	100	Rotary	Immedi- ately	Setup	page 5-36
Pn508	2	Servo OFF-Brake Com- mand Waiting Time	10 to 100	10 ms	50	All	Immedi- ately	Setup	page 5-36
Pn509	2	Momentary Power Inter- ruption Hold Time	20 to 50,000	1 ms	20	All	Immedi- ately	Setup	page 6-13

Continued from previous page.

Parameter No.	Size	Na	ame		Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
	2	Input Signa	al Selectio	ns	0000h to FFF2h	_	2100h	All	After restart	Setup	_
			Input Sig	ınal A	Allocation Mod	de				Refere	ence
		n.□□□X	0	Use tion	the sequences.	input sigr	nal termina	ls with the de	fault alloca-		
			1 2		erved setting	•		cations.		page	6-5
			/S-ON (S	Servo	ON) Signal A	llocation				Refere	ence
			0		ve when CN1-		ignal is ON	V (closed).		1101010	J1100
			1		ve when CN1-	•		,			
			2	Acti	ve when CN1-	-42 input s	ignal is ON	(closed).			
			3	Acti	ve when CN1-	-43 input s	ignal is ON	l (closed).			
			4	Acti	ve when CN1-	-44 input s	ignal is ON	l (closed).			
			5	Acti	ve when CN1-	-45 input s	ignal is ON	V (closed).			
			6	Acti	ve when CN1-	-46 input s	ignal is ON	V (closed).			
		n.□□X□	7	The	signal is alwa	ys active.				page 5	5_17
			8	The	signal is alwa	ys inactive				page	<i>J</i> 11
			9	Acti	ve when CN1-	-40 input s	ignal is OF	F (open).			
			А	Acti	ve when CN1-	-41 input s	ignal is OF	F (open).			
			В	Acti	ve when CN1-	-42 input s	ignal is OF	F (open).			
			С		ve when CN1-		•				
			D		ve when CN1-			_			
Pn50A			E		ve when CN1-						
			F	Acti	ve when CN1-	-46 input s	ignal is OF	F (open).			
			/P-CON	(Prop	ortional Cont	rol) Signa	Allocation	า		Refere	ence
		n.□X□□	0 to F		allocations ar ons.	e the same	e as the /S	-ON (Servo C	N) signal allo	page 8	8-74
D.			P-OT (Fo	rwar	d Drive Prohil	oit) Signal	Allocation		Luc	Refere	ence
- 1) r		V = 9	0	Ena	ble forward dr	ive when (N1-40 inp	out signal is C	N (closed).	15	
		V	11	Ena	ble forward dr	ive when (ON1-41 inp	out signal is C	N (closed).		
			2	Ena	ble forward dr	ive when (ON1-42 inp	out signal is C	N (closed).		
			3	Ena	ble forward dr	ive when (CN1-43 inp	out signal is C	N (closed).		
			4	Ena	ble forward dr	ive when (N1-44 inp	out signal is C	N (closed).		
			5	Ena	ble forward dr	ive when (CN1-45 inp	out signal is C	N (closed).		
			6	Ena	ble forward dr	ive when (CN1-46 inp	out signal is C	N (closed).		
		n.X□□□	7	Set	the signal to a	always pro	nibit forwa	rd drive.		page 5	5-32
			8	Set	the signal to a	ılways ena	ble forward	d drive.		page	02
			9	Ena	ble forward dr	ive when (CN1-40 inp	out signal is C	FF (open).		
			Α	Ena	ble forward dr	ive when (CN1-41 inp	out signal is C	FF (open).		
			В	Ena	ble forward dr	ive when (CN1-42 inp	out signal is C	FF (open).		
			С		ble forward dr			ŭ			
			D		ble forward dr		-				
			Е		ble forward dr		•				
			F	Ena	ble forward dr	ive when (CN1-46 inp	out signal is C	FF (open).		

Continued	from	previous	page.

							COH	unueu mom	previou	s paye.
Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
	2	Input Signa 2	al Selections	0000h to FFFFh	-	6543h	All	After restart	Setup	_
		"			I	1.				
			N-OT (Rev	erse Drive Prohib	oit) Signal	Allocation			Refere	ence
			0 E	Enable reverse dri	ve when C	N1-40 inp	ut signal is O	N (closed).		
			1 E	Enable reverse dri	ve when C	N1-41 inp	ut signal is O	N (closed).		
			2 E	Enable reverse dri	ve when C	N1-42 inp	ut signal is O	N (closed).		
				Enable reverse dri						
				Enable reverse dri						
				nable reverse dri						
		n.□□□X		Enable reverse dri Set the signal to a				in (ciosea).		
		п.ппл		Set the signal to a					page 5	5-32
				Enable reverse dri				FF (open).		
				Enable reverse dri				,		
			ВЕ	Enable reverse dri	ve when C	N1-42 inp	ut signal is O	FF (open).		
			C E	Enable reverse dri	ve when C	N1-43 inp	ut signal is O	FF (open).		
			D E	Enable reverse dri	ve when C	N1-44 inp	ut signal is O	FF (open).		
				Enable reverse dri						
			FE	Enable reverse dri	ve when C	N1-46 inp	ut signal is O	FF (open).		
			/ALM-RST	(Alarm Reset) Si	gnal Alloc	ation			Refere	ence
			0 4	Active on signal ed DFF (open) to ON	dge when (closed).	CN1-40 in	put signal cha	anges from		
				Active on signal ed DFF (open) to ON		CN1-41 in	put signal cha	anges from	7	
D : 50D				Active on signal ed DFF (open) to ON		CN1-42 in	put signal cha	anges from		
Pn50B			3 4	Active on signal ed DFF (open) to ON	dge when (closed).	CN1-43 in	put signal cha	anges from		
Dui			4	Active on signal ed DFF (open) to ON	dge when (closed).	CN1-44 in	put signal cha	anges from		
	V	es	5	Active on signal ed OFF (open) to ON	dge when (closed).	CN1-45 in	put signal cha	anges from	5	
				Active on signal ed DFF (open) to ON		CN1-46 in	put signal cha	anges from		
		n.□□X□		Reserved setting (,			page	
				The signal is alway	<u>'</u>				42	-
			9 (Active on signal ed closed) to OFF (o	pen).					
			Α (Active on signal ed closed) to OFF (o	pen).					
			В (Active on signal ed closed) to OFF (o	pen).					
			(Active on signal ed closed) to OFF (o	pen).					
			D (Active on signal ed closed) to OFF (o	pen).					
			E (Active on signal ed closed) to OFF (o	pen).					
				Active on signal ed closed) to OFF (o		JN1-46 in¢	out signal cha	nges trom ON	1	
	, DYDD /F			ward External To	rque Limi	t Input) Sig	nal Allocatio	n	Refere	ence
		n.□X□□	0 to F T	The allocations are the same as the /S-ON (Servo ON) signal allocation						6-64
			/N-CL (Rev	verse External To	rque Limi	t Input) Sid	nal Allocatio	n	Refere	ence
		n.X□□□		The allocations are t	•	, , ,				
			+							

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_				_	_					
Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
	2	Input Signa	al Selection	ns 0000h to FFFFh	-	8888h	All	After restart	Setup	_
						I				
	Ī		/SPD-D (Motor Direction)	Signal Allo	cation			Refere	ence
			0	Active when CN	-40 input s	signal is ON	V (closed).			
			1	Active when CN	-41 input s	signal is ON	V (closed).			
			2	Active when CN	-42 input s	signal is ON	V (closed).			
			3	Active when CN	-43 input s	signal is ON	V (closed).			
			4	Active when CN	-44 input s	signal is ON	V (closed).			
			5	Active when CN	-45 input s	signal is ON	V (closed).			
			6	Active when CN	-46 input s	signal is ON	V (closed).			
		n.□□□X	7	The signal is always	ays active.				page (8-54
			8	The signal is always	ays inactive).			page	0-04
			9	Active when CN1	-40 input s	signal is OF	F (open).			
			А	Active when CN1	-41 input s	signal is OF	F (open).			
Pn50C			В	Active when CN1	-42 input s	signal is OF	F (open).			
			С	Active when CN1	-43 input s	signal is OF	F (open).			
			D	Active when CN1	-44 input s	signal is OF	F (open).			
			Е	Active when CN1	-45 input s	signal is OF	F (open).			
			F	Active when CN1	-46 input s	signal is OF	F (open).			
	j		/SPD-A (Internal Set Spee	d Se <mark>lec</mark> tion	n Input) Si	gnal Allocatio	on	Refere	ence
	Ь	n.□□X□	0 to F	The allocations a nal allocations.	re the same	e as the /S	PD-D (Motor	Direction) sig	page 6	6-54
	Ī		/SPD-B (Internal Set Spee	d Selection	n Input) Si	gnal Allocation	on	Refere	ence
_		n.□X□□	0 to F	The allocations a nal allocations.	re the same	e as the /S	PD-D (Motor	Direction) sig	page 6	6-54
	Ī		/C-SEL (Control Selection	Input) Sigi	nal Allocat	ion		Refere	ence
		n.XDDD	0 to F	The allocations a nal allocations.	re the same	e as the /S	PD-D (Motor	Direction) sig	page (6-60
1)r	1	VA	$\leq 1/$	/Into	re		On	tro	2	
		$V \cup V$	J 11		$/$ 1 \cup		\cup 111	Continue	d on nex	kt page.

Continued from previous page.

Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
	2	Input Signa 4	al Selections	0000h to FFFFh	-	8888h	_	After restart	Setup	_
			/ZCLAMP (Z	Zero Clamping I	nput) Sigr	nal Allocat	ion	Applicable Motors	Refere	ence
			0 Ac	tive when CN1-	40 input s	ignal is ON	V (closed).			
			1 Ac	ctive when CN1-	41 input s	signal is ON	l (closed).			
			2 Ac	ctive when CN1-	42 input s	signal is ON	l (closed).			
			3 Ac	tive when CN1-	43 input s	signal is ON	V (closed).			
			4 Ac	tive when CN1-	44 input s	signal is ON	V (closed).			
			_	tive when CN1-						
		n.□□□X	6 Ad	tive when CN1-	46 input s	signal is ON	l (closed).			
	'	1.000	7 Th	e signal is alwa	ys active.			All	page	6-26
				e signal is alwa			pago	0 20		
			_	tive when CN1-						
				tive when CN1-			· ' '			
Pn50D				tive when CN1-						
1 1130D				ctive when CN1-		0	(1 /			
				ctive when CN1-		<u> </u>	· · · /		1	
				ctive when CN1-						
			F Ad	tive when CN1-	46 input s	signal is OF	F (open).			
	J	n.□□X□	/INHIBIT (Re	eference Pulse	Inhibit Inp	ut) Signal	Allocation	Applicable Motors	Refere	ence
	1	11.111.11		ie allocations ar ero Clamping In				All	page	6-39
		n.□X□□	/G-SEL (Ga	n Selection Inp	ut) Signal	Allocation		Applicable Motors	Refere	ence
		n.UXUU		e allocations are ero Clamping In				All	page	8-67
Dri	./	n.X□□□	/P-DET (Pol	arity Detection	tion	Applicable Motors	Refere	ence		
	Y			e allocations are ero Clamping In				Linear	page	5-29

Continued from previous page.

D	-			0 - 11'	0.11	D. (- 11		unued from			
Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence	
NO.	2	Output Sig	ınal Selec-	0000h to	- Offit	3211h	All	After	Setup	ence _	
		tions 1		6666h		021111	/\li	restart	Остар		
			/COIN (Po	sitioning Comple	etion Outp	ut) Signal	Allocation		Refere	ence	
			0 1	Disabled (the abo	ve signal c	output is no	ot used).				
			1 (Output the signal	from the C	N1-25 or	CN1-26 outpu	ut terminal.			
		n.□□□X	2 (Output the signal	from the C	N1-27 or	CN1-28 outpu	ut terminal.			
				Output the signal			· · · · · · · · · · · · · · · · · · ·	ut terminal.	page 6	5-37	
				Output the signal			•				
				Output the signal			•				
Pn50E			6	Output the signal	from the C	CN1-39 ou	tput terminal.				
			/V-CMP (S	Speed Coinciden	ce Detecti	on Output) Signal Alloc	ation	Reference		
		n.□□X□		The allocations ar ion) signal alloca		e as the /C	OIN (Position	ing Comple-	page 6	6-27	
			/TGON (R	otation Detection	Output) S	Signal Allo	cation		Reference		
		n.□X□□		The allocations ar				ing Comple-			
			0 to 6	tion) signal alloca	tions.				page 6-11		
				Reference							
		n.XDDD	page 6-12								
		n.XDDD 0 to 6 The allocations are the same as the /COIN (Positioning Completion) signal allocations.									
		0	101	00001							
	2	Output Sig tions 2	inal Selec-	0000h to 6666h		0000h	All	After restart	Setup	_	
			/ 11						7/		
			/CLT (Toro	ue Limit Detection	on Output)	Signal All	ocation		Refere	ence	
				Disabled (the abo					1101010		
				Output the signal				ut terminal.			
				Output the signal			· · · · · · · · · · · · · · · · · · ·				
		n.□□□X	3 0	Output the signal	from the C	N1-29 or	CN1-30 outpu	ut terminal.	page 6	5-72	
D V	٠į٠	VO		Output the signal	from the C	N1-37 ou	tput terminal.	tro			
	н	V C	5	Output the signal	from the C	N1-38 ou	tput terminal.	\cup	10		
Pn50F		5 Output the signal from the CN1-38 output terminal. 6 Output the signal from the CN1-39 output terminal.									
FIISUF			/VLT (Speed Limit Detection) Signal Allocation								
		n.□□X□									
			'	output) signal allo	ocations.						
			- ` -	e Output) Signal					Refere	ence	
		n.□X□□		The allocations ar Output) signal allo		e as the /C	LT (Torque Lir	mit Detectior	page 5	5-37	
			/WARN (W	/arning Output) S	Signal Allo	cation			Refere	ence	
	n.XDDD								page 6	—— 6-11	

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							COI	itiiliueu iioii	i bienon	s page.
Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
	2	Output Sig	nal Selec-	0000h to 0666h	_	0000h	All	After restart	Setup	_
			/NEAR (Near	Output) Signa	ıl Allocatic	on			Refere	ence
			0 Disabled (the above signal output is not used).							
			1 Out	tput the signal	from the C	N1-25 or	CN1-26 outp	ut terminal.		
		n.□□□X	2 Out	tput the signal	from the C	N1-27 or	CN1-28 outp	ut terminal.		
				tput the signal				ut terminal.	page 6	6-38
Pn510				 Output the signal from the CN1-37 output terminal. Output the signal from the CN1-38 output terminal. 						
FIISTO				tput the signal						
							tpat torriiriai.			
		n.□□X□	Reserved pa	rameter (Do no	ot change.	.)				
				erence Pulse II	nput Multi	plication S	Switching Ou	tput) Signal	Refere	ence
		n.□X□□	Allocation	e allocations are	a the same	as the /N	IFAR (Near) s	ignal alloca-		
			0 to 6 tion		o tho barri	0 00 110 71	LD (IT (ITOCIT) O	igriai alloca	page 6	S-34
		n.XDDD	Reserved par	rameter (Do no	ot change.	.)				
						1//				
	2		nal Inverse	0000h to	_	0000h	All	After	Setup	page
	H	Settings		1111h		1		restart		6-8
	J		Output Signs	al Inversion for	CNI1 25 c	and CN1 3	26 Torminals			
		n.□□□X		e signal is not in		and Civi-2	to reminais			
				e signal is inver						
			Output Signs	al Inversion for	CN1-27	and CN1-2	98 Terminals			
		n.□□X□	Output Signal Inversion for CN1-27 and CN1-28 Terminals 0 The signal is not inverted.							
Pn512			1 The signal is inverted.							
Dri		100	Output Signal Inversion for CN1-29 and CN1-30 Terminals							
	V	n.□X□□	0 The signal is not inverted.							
			1 The	e signal is inver	ted.					
			Output Signa	al Inversion for	CN1-37	Terminal				
		n.X□□□		e signal is not in						
			1 The	e signal is inver	ted.					
				1	1	T	T	T	T	
	2	Output Sig Settings 2	nal Inverse	0000h to 0011h	-	0000h	All	After restart	Setup	page 6-8
		1.3-1.3-1		1	1	I	1		<u> </u>	
			Output Signa	al Inversion for	CN1-38	Terminal				
		n.□□□X		e signal is not in						
			1 The	e signal is inver	ted.					
Pn513			Output Signa	al Inversion for	CN1-39	Terminal				
		n.□□X□		e signal is not in						
			1 The	e signal is inver	ted.					
		n.□X□□	Reserved pa	rameter (Do no	ot change.	.)				
		р УППП								
		n.X□□□	neserveu pa	rameter (Do no	or change.	.)				

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Parameter No.	Size	N	Name		Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence	
	2	Output Sig tions 4	nal Selec-	0000h to 0666h	_	0000h	All	After restart	Setup	_	
		n.□□□X	Reserved pa	rameter (Do no	ot change.	.)					
		n.□□X□	Reserved pa	rameter (Do no	ot change.	.)					
	Ī		/PM (Preven	tative Maintena	ance Outp	ut) Signal	Allocation		Refere	ence	
Pn514	0 Dis	abled (the abov	ve signal c	output is no	ot used).						
	1 Ou	tput the signal	from the C	N1-25 or	CN1-26 outp	ut terminal.					
	л ПУПП	n.□X□□	2 Ou	Output the signal from the CN1-27 or CN1-28 output terminal.							
			3 Ou	Output the signal from the CN1-29 or CN1-30 output terminal. page 9-17							
				tput the signal			<u> </u>				
				tput the signal							
			6 Ou	Output the signal from the CN1-39 output terminal.							
		n.X□□□	Reserved pa	rameter (Do no	ot change.	.)					
Continued on next page.											

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Parameter No.	Size	I	Name		Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer
	2	Input Sigi 6	nal Selecti	ons	0000h to FFFFh	-	8888h	All	After restart	Setup	_
			SEN (Ab	solute	Data Reques	t Input) Si	gnal Alloc	ation		Refere	nce
			0	Activ	e when CN1-4	0 input siç	gnal is ON	(closed).			
			1 Active when CN1-41 input signal is ON (closed).								
			2	Activ	e when CN1-4	2 input siç	gnal is ON	(closed).			
			3	Activ	e when CN1-4	3 input siç	gnal is ON	(closed).			
			4	Activ	e when CN1-4	4 input siç	gnal is ON	(closed).			
			5	Activ	e when CN1-4	5 input siç	gnal is ON	(closed).			
			6	Activ	e when CN1-4	6 input siç	gnal is ON	(closed).			
	n.	.00X	7	The	signal is always	s active.				page 6	-76,
			8	Enab	le when 5 V is	input to C	N1-4.			page 6	-89
			9	Activ	e when CN1-4	0 input siç	gnal is OFF	(open).			
			А	Activ	e when CN1-4	1 input siç	gnal is OFF	(open).			
			В	Activ	e when CN1-4	2 input siç	gnal is OFF	(open).			
			С	Activ	e when CN1-4	3 input sig	gnal is OFF	(open).			
			D		e when CN1-4	'		(1 /			
			E	Activ	e when CN1-4	5 input sig	gnal is OFF	(open).			
			F	Activ	e when CN1-4	6 input sig	gnal is OFF	(open).			
Pn515	j		/PSEL (F	Refere	nce Pulse Inpu	ut Multiplio	cation Swi	tching Input)	Signal Allo-	Refere	nce
			0	Activ	e when CN1-4	0 input sig	gnal is ON	(closed).		/	
			1	Activ	e when CN1-4	1 input sig	gnal is ON	(closed).			
			2	Activ	e when CN1-4	2 input sig	gnal is ON	(closed).			
			3	Activ	e when CN1-4	3 input siç	gnal is ON	(closed).			
			4	Activ	e when CN1-4	4 input siç	gnal is ON	(closed).			
			5	Activ	e when CN1-4	5 input siç	gnal is ON	(closed).			
			6	Activ	e when CN1-4	6 input siç	gnal is ON	(closed).			
Dri	n.	.00X0	7	The	signal is always	enabled.		\nt	201	page 6	-34
ノロ	VII	C 5	8	The	signal is always	s inactive.	$\bigcup ($	ЛП	LOI:	page c	1-04
			9	Activ	e when CN1-4	0 input siç	gnal is OFF	(open).			
			А	Activ	e when CN1-4	1 input siç	gnal is OFF	(open).			
			В	Activ	e when CN1-4	2 input siç	gnal is OFF	(open).			
			С	Activ	e when CN1-4	3 input siç	gnal is OFF	(open).			
			D	Activ	e when CN1-4	4 input siç	gnal is OFF	(open).			
			E	Activ	e when CN1-4	5 input siç	gnal is OFF	(open).			
			F	Activ	e when CN1-4	6 input siç	gnal is OFF	(open).			
	n.	.0X00	Reserved	d para	meter (Do not	change.)					
	_	.X000	Posoryo	d nara	meter (Do not	change.)					
	n.		LI LESEI VEI								

Continued from previous page.

							001	itinuea fron	i previou	s page.
Parameter No.	Size	N	ame	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
	2	Input Signa	al Selections	0000h to FFFFh	-	8888h	All	After restart	Setup	-
Pn516		7	FSTP (Forced	Stop Input) Si able drive wher able drive where	n CN1-40 n CN1-41 n CN1-42 n CN1-43 n CN1-44 n CN1-45 n CN1-46 always pro always ena n CN1-40 n CN1-40 n CN1-41 n CN1-42 n CN1-43 n CN1-44 n CN1-44	eation input signal	al is ON (close al is OFF (ope	restart ed). ed). ed). ed). ed). ed). ed). ed)	Refere	
	1	n.□□X□ Reserved parameter (Do not change.)								
	1	n.0X00	Reserved par	am <mark>eter (</mark> Do not	change.)					
	ı	n.XDDD	Reserved par	ameter (Do not	change.)					
	2	Output Sig	nal Selec-	0000h to 0666h	_	0654h	All	After restart	Setup	page 6-8
Dr	'n	Ves	0 Dis	Code Output) abled (the above	ve signal c	utput is no		tro	S	
Pn517		n.□□□X	2 Ou 3 Ou 4 Ou 5 Ou	tput the signal	from the C from the C from the C from the C	CN1-27 or CN1-29 or CN1-37 out	CN1-28 outp CN1-30 outp put terminal. put terminal.	ut terminal.		
			6 Ou	tput the signal	from the C	JN1-39 out	put terminal.			
		n.□□X□		Code Output) e allocations are	-		.O1 (Alarm C	ode Output)	signal allo	ca-
		n.□X□□	-	Code Output) e allocations are			-O1 (Alarm C	ode Output)	signal allo	ca-
	n.X□□□ Reserved parameter (Do not change.)									
Pn518*2	_	Safety Mod Parameter	dule-Related s	-	-	-	All	-	_	_
Pn51B	4	Motor-Loa Deviation (Detection	Overflow	0 to 1,073,741,824	1 refer- ence unit	1000	Rotary	Immedi- ately	Setup	page 10-8

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Continuod	from	mravia	0000
Continued	11()111	Drevious	Dage

Size	Name	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
2	Position Deviation Over- flow Warning Level	10 to 100	1%	100	All	Immedi- ately	Setup	page 8-9
4	Position Deviation Over- flow Alarm Level	1 to 1,073,741,823	1 refer- ence unit	524288 0	All	Immedi- ately	Setup	page 8-8, page 8-85
4	Positioning Completed Width	0 to 1,073,741,824	1 refer- ence unit	7	All	Immedi- ately	Setup	page 6-37
4	Near Signal Width	1 to 1,073,741,824	1 refer- ence unit	107374 1824	All	Immedi- ately	Setup	page 6-38
4	Position Deviation Over- flow Alarm Level at Servo ON	1 to 1,073,741,823	1 refer- ence unit	524288 0	All	Immedi- ately	Setup	page 8-10
2	Position Deviation Over- flow Warning Level at Servo ON	10 to 100	1%	100	All	Immedi- ately	Setup	page 8-10
2	Speed Limit Level at Servo ON	0 to 10,000	1 min ⁻¹	10000	Rotary	Immedi- ately	Setup	page 8-10
2	Multiplier per Fully- closed Rotation	0 to 100	1%	20	Rotary	Immedi- ately	Tuning	page 10-8
2	Overload Warning Level	1 to 100	1%	20	All	Immedi- ately	Setup	page 5-44
2	Base Current Derating at Motor Overload Detection	10 to 100	1%	100	All	After restart	Setup	page 5-45
2	Monitor Display at Startup	0000h to 0FFFh	_	OFFFh	All	Immedi- ately	Setup	page 13-4
2	Program Jogging- Related Selections	0000h to 0005h	_	0000h	All	Immedi- ately	Setup	page 7-20
	2 4 4 4 4 2 2 2 2 2 2 2	2 Position Deviation Over- flow Warning Level 4 Position Deviation Over- flow Alarm Level 4 Positioning Completed Width 4 Near Signal Width 4 Position Deviation Over- flow Alarm Level at Servo ON 2 Position Deviation Over- flow Warning Level at Servo ON 2 Speed Limit Level at Servo ON 2 Multiplier per Fully- closed Rotation 2 Overload Warning Level 2 Base Current Derating at Motor Overload Detection 2 Monitor Display at Startup 2 Program Jogging-	Position Deviation Over- flow Warning Level Position Deviation Over- flow Alarm Level Positioning Completed Width Near Signal Width Position Deviation Over- flow Alarm Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Speed Limit Level at Servo ON Multiplier per Fully- closed Rotation Near Signal Width 1 to 1,073,741,824 1 to 1,073,741,824 1 to 1,073,741,823 1 to 1,073,741,824 1 to 1,073,741,823 1 to 1,073,741,824 1 to 1,073,741,824	Position Deviation Over- flow Warning Level Position Deviation Over- flow Alarm Level Positioning Completed Width Near Signal Width Position Deviation Over- flow Alarm Level Position Deviation Over- flow Alarm Level Position Deviation Over- flow Alarm Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Do to 100 Multiplier per Fully- closed Rotation O to 100 Multiplier per Fully- closed Rotation Do to 100 Multiplier per Fully- closed Rotation Multiplier per Fully- closed Rotation Multiplier per Fully- closed Rotation O to 100 Multiplier per Fully- closed Rotation O to 100 Multiplier per Fully- closed Rotation O to 100 Monitor Display at Startup Program Jogging- O000h to OFFFh O0000h to OFFFh O0000h to OFFFh O0000h to	Position Deviation Over-flow Warning Level Position Deviation Over-flow Alarm Level Positioning Completed Width Near Signal Width Position Deviation Over-flow Alarm Level at Servo ON Position Deviation Over-flow Warning Level at Servo ON Speed Limit Level at Servo ON Multiplier per Fully-closed Rotation Multiplier per Fully-closed Rotation Monitor Display at Startup Program Jogging- Position Deviation Over-flow Marning Level Alarm Level at Servo ON Monitor Display at Startup Program Jogging- 10 to 100 11 reference ence unit 1 reference unit 1 refe	2 Position Deviation Over- flow Warning Level 4 Position Deviation Over- flow Alarm Level 4 Positioning Completed Width 4 Positioning Completed Width 524288 0 All 6 Positioning Completed Width 7 All 7 All 8 Near Signal Width 1 to 1,073,741,824 1 reference ence unit 1 to 1,073,741,824 1 reference ence unit 1 to 1,073,741,824 All 9 Position Deviation Over- flow Alarm Level at Servo ON 1 to 1,073,741,823 1 reference ence unit 1 to 1,073,741,824 All 1 Servo ON 2 Position Deviation Over- flow Warning Level at Servo ON 2 Speed Limit Level at Servo ON 2 Speed Limit Level at Servo ON 2 Multiplier per Fully- closed Rotation 2 Overload Warning Level 1 to 100 1 to 100 1 min ⁻¹ 1000 Rotary 2 Overload Warning Level 1 to 100 1 to 100 1 min ⁻¹ 1 1000 All 2 Base Current Derating at Motor Overload Detection 2 Monitor Display at Startup 1 to 100 1 to 100 1 min ⁻¹ 1 to 100 All 2 Program Jogging- 0000h to 0000h 1 to 100 2 Program Jogging- 0000h to 0000h 1 to 100 2 Program Jogging- 0000h to 0000h to 0000h 1 to 100 2 Program Jogging- 0000h to 0000h to 0000h 1 to 100 1	Position Deviation Over-flow Warning Level Position Deviation Over-flow Warning Level Position Deviation Over-flow Warning Level Position Deviation Over-flow All Immediately Position Deviation Over-flow All Immediately Positioning Completed Width Positioning Completed Width Positioning Completed Unit Near Signal Width Position Deviation Over-flow All Immediately Position Deviation Over-flow Over-flow All Immediately Position Deviation Over-flow Over-flow All Immediately All Immediately Position Deviation Over-flow All Immediately Program Jogging- Over-flow Over-flow Over-flow All Immediately Program Jogging- Over-flow Over-flow Over-flow Over-flow All Immediately Program Jogging- Over-flow Over-	Position Deviation Over- flow Alarm Level Position Deviation Over- flow Alarm Level Positioning Completed Width Near Signal Width Position Deviation Over- flow Alarm Level Position Deviation Over- flow Alarm Level Positioning Completed Width To to 1,073,741,824 ence unit Position Deviation Over- flow Alarm Level Position Deviation Over- flow Alarm Level Position Deviation Over- flow Alarm Level at Servo ON Position Deviation Over- flow Alarm Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Servo ON Position Deviation Over- flow Warning Level at Oto 10,000 Position Deviation Over- flow Warning Level at Oto 10,000 Position Deviation Over- flow Warning Level at Oto 10,000 Position Deviation Over- flow Warning Level at Oto 10,000 Position Deviation Over- flow Warning Level at Oto 10,000 Position Deviation Over- flow Warning Level at Oto 10,000 Position Deviation Over- flow Warning Level at Oto 10,000 Position Deviation Over- flow Warning Level at Oto 10,000 Position Deviation Over- flow Alarm Level at Oto 10,000 Position Deviation Over- flow Alarm Level at Oto 10,000 Position Deviation Over- flow Alarm Level at Oto 10,000 All Immediately Position Deviation Over- flow Alarm Level at Immed

Program Jogging Operation Pattern (Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements 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 (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 (Waiting time in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536 (Waiting time in Pn535 → Forward by travel distance in Pn531 → Waiting time in Pn536 → Reverse by travel distance in Pn531 → Waiting time in Pn536 → Forward by travel distance in Pn531 → Waiting time in Pn536 → Reverse by travel distance in Pn531 → Waiting time in Pn536 → Forward by travel d											
Pn531 Waiting time in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536				Program Jo	gging Operation	Pattern					
Pn530 Maiting time in Pn536											
Pn530 P	D.::					e in Pn531) ×	Number	of			
Pn530 A	Dri	V	es	2 m	ovements in Pna aiting time in Pr	536 1535 → Re	\bigcirc	ノレエロ		J	
4 in Pn535 → Reverse by travel distance in Pn531) × Number of movements in Pn536 (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.□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□	Pn530		п.⊔⊔⊔х	3 m (M	ovements in Pna aiting time in Pr	536 1535 → Fo	,		,		
5 in Pn535 → Forward by travel distance in Pn531) × Number of movements in Pn536 n.□□X□ Reserved parameter (Do not change.) n.□X□□ Reserved parameter (Do not change.) n.X□□□ Reserved parameter (Do not change.) Pn531 4 Program Jogging Travel 1 to 1 reference 32768 All Immediately Setup Page 1 (73,741,824) Program Jogging Travel 1				4 in	in Pn535 → Reverse by travel distance in Pn531) × Number of movements in						
n.□X□□ Reserved parameter (Do not change.) n.X□□□ Reserved parameter (Do not change.) Pn531 4 Program Jogging Travel 1 to 1 reference 32768 All Immediately Setup 7.5				5 in	Pn535 → Forwa						
n.X□□□ Reserved parameter (Do not change.) Pn531 4 Program Jogging Travel 1 to 1 reference 32768 All Immediately Setup parameter (Do not change.)			n.□□X□	Reserved p	arameter (Do no	t change.)				
Pn531 4 Program Jogging Travel 1 to 1 reference 32768 All Immediately Setup pages 1 to 27.7			n.□X□□	Reserved p	Reserved parameter (Do not change.)						
Pn531 4 Program Jogging Iravel 1 to ence 32768 All Immediately Setup page 1 1 773 741 824 ence 32768			n.X□□□	Reserved p	Reserved parameter (Do not change.)						
Pn531 4 Program Jogging Iravel 1 to ence 32768 All Immediately Setup page 1 1 773 741 824 ence 32768											
	Pn531	4		ogging Travel		ence	32768	All		Setup	page 7-20

Rotary: 1 min⁻¹ Direct Drive:

0.1 min⁻¹

1 to 10,000

500

Rotary

Program Jogging Movement Speed

2

Pn533

Continued on next page.

Setup

Immediately page 7-20

Continued from previous page.

		Continued from previous page.							
Parameter No.	Size	Name	Setting Range	Setting Unit	Default Setting	Applicable Motors	When Enabled	Classi- fication	Refer- ence
Pn534	2	Program Jogging Acceleration/Deceleration Time	2 to 10,000	1 ms	100	All	Immedi- ately	Setup	page 7-20
Pn535	2	Program Jogging Wait- ing Time	0 to 10,000	1 ms	100	All	Immedi- ately	Setup	page 7-20
Pn536	2	Program Jogging Number of Movements	0 to 1,000	1 time	1	All	Immedi- ately	Setup	page 7-20
Pn550	2	Analog Monitor 1 Offset Voltage	-10,000 to 10,000	0.1 V	0	All	Immedi- ately	Setup	page 9-12
Pn551	2	Analog Monitor 2 Offset Voltage	-10,000 to 10,000	0.1 V	0	All	Immedi- ately	Setup	page 9-12
Pn552	2	Analog Monitor 1 Mag- nification	-10,000 to 10,000	× 0.01	100	All	Immedi- ately	Setup	page 9-12
Pn553	2	Analog Monitor 2 Mag- nification	-10,000 to 10,000	× 0.01	100	All	Immedi- ately	Setup	page 9-12
Pn55A	2	Power Consumption Monitor Unit Time	1 to 1,440	1 min	1	All	Immedi- ately	Setup	ı
Pn560	2	Residual Vibration Detection Width	1 to 3,000	0.1%	400	All	Immedi- ately	Setup	page 8-56
Pn561	2	Overshoot Detection Level	0 to 100	1%	100	All	Immedi- ately	Setup	page 8-32, page 8-40
Pn580	2	Zero Clamping Level	0 to 10,000	1 mm/s	10	Linear	Immedi- ately	Setup	page 6-25
Pn581	2	Zero Speed Level	1 to 10,000	1 mm/s	20	Linear	Immedi- ately	Setup	page 6-11
Pn582	2	Speed Coincidence Detection Signal Output Width	0 to 100	1 mm/s	10	Linear	Immedi- ately	Setup	page 6-27
Pn583	2	Brake Reference Output Speed Level	0 to 10,000	1 mm/s	10	Linear	Immedi- ately	Setup	page 5-36
Pn584	2	Speed Limit Level at Servo ON	0 to 10,000	1 mm/s	10000	Linear	Immedi- ately	Setup	page 8-10
Pn585	2	Program Jogging Move- ment Speed	1 to 10,000	1 mm/s	50	Linear	Immedi- ately	Setup	page 7-20
Pn586	2	Motor Running Cooling Ratio	0 to 100	1%/ Max. speed	0	Linear	Immedi- ately	Setup	-
Pn600	2	Regenerative Resistor Capacity*3	Depends on model.*4	10 W	0	All	Immedi- ately	Setup	page 5-57
Pn601	2	Dynamic Brake Resistor Allowable Energy Consumption	0 to 65,535	10 J	0	All	After restart	Setup	*5
Pn603	2	Regenerative Resistance	0 to 65,535	10 mΩ	0	All	Immedi- ately	Setup	page 5-57
Pn604	2	Dynamic Brake Resistance	0 to 65,535	10 mΩ	0	All	After restart	Setup	*5
	2	Overheat Protection Selections	0000h to 0003h	-	0000h	Linear	After restart	Setup	page 6-109

P	n6	1	Α

n.□□□X	Overheat	: Protection Selection
	0	Disable overheat protection.
	1	Use overheat protection in the Yaskawa Linear Servomotor.*6
	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 parameter (Do not change.)
n.□X□□	Reserved parameter (Do not change.)
n.X□□□	Reserved parameter (Do not change.)

Continued from previous page.

Parameter	Size	Name	Setting	Setting	Default	Applicable	When	Classi-	Refer-
No. σ			Range	Unit	Setting	Motors	Enabled	fication	ence
Pn61B *7	2	Overheat Alarm Level	0 to 500	0.01 V	250	All	Immedi- ately	Setup	page 6-110
Pn61C *7	2	Overheat Warning Level	0 to 100	1%	100	All	Immedi- ately	Setup	page 6-110
Pn61D *7	2	Overheat Alarm Filter Time	0 to 65,535	1 s	0	All	Immedi- ately	Setup	page 6-110
Pn621 to Pn628*2	-	Safety Module-Related Parameters	-	-	-	All	-	-	-

- *1. Set a percentage of the motor rated torque.
- *2. These parameters are for SERVOPACKs with a Safety Module. Refer to the following manual for details.

 Σ-V-Series/Σ-V-Series for Large-Capacity Models/Σ-7-Series User's Manual Safety Module (Manual No.: SIEP C720829 06)
- *3. Normally set this parameter to 0. If you use an External Regenerative Resistor, set the capacity (W) of the External Regenerative Resistor.
- *4. The upper limit is the maximum output capacity (W) of the SERVOPACK.
- *5. These parameters are for SERVOPACKs with the dynamic brake option. Refer to the following manual for details.

 Σ-7-Series AC Servo Drive Σ-7S/Σ-7W SERVOPACK with Dynamic Brake Hardware Option Specifications Product Manual (Manual No.: SIEP S800001 73)
- *6. The SGLFW2 is the only Yaskawa Linear Servomotor that supports this function.
- *7. Enabled only when Pn61A is set to n.□□□2 or n.□□□3.



Drives Motors Controls

14.2 Parameter Recording Table

Use the following table to record the settings of the parameters.

Pn000 0000h Basic Function Selections 0 After restart After restart Application Function Selections 1 After restart After restart After restart After restart Lons 8 After restart After restart After restart After restart Lons 6 After restart After restart Lons 6 After restart Lons 8 After r	Parameter No.	Default Setting					Name	When Enabled
Pn002 0000h	Pn000	0000h					Basic Function Selections 0	After restart
Pn006 0002h tions 2 Application Function Selections 6 Immediately tions 6 Pn007 0000h Application Function Selections 7 Immediately tions 7 Application Function Selections 9 After restart after restart tons 8 Pn008 0000h Application Function Selections 9 After restart after restart tons 9 After restart after restart tons 8 Pn00B 0000h Application Function Selections After restart tons B After restart tons B Pn00C 0000h Application Function Selections B After restart tons B Pn00D 0000h Application Function Selections B After restart tons B Pn00F 0000h Application Function Selections F After restart tons B Pn00F 0000h Application Function Selection for UART/USB Communications F After restart tons F Pn010 0000h Reserved parameter — Pn021 0000h Reserved parameter — Pn022 0000h Reserved parameter — Pn030 0000h Application Function Selection Selections Selec	Pn001	0000h						After restart
Pn007 0000h Application Function Selections 9 Pn008 0000h Application Function Selections 9 Pn009 0010h Application Function Selections 9 Pn000 0010h Application Function Selections 9 Pn000 0010h Application Function Selections 9 Pn000 0000h Application Function Selections After restart tons 9 Pn000 0000h Application Function Selections After restart tons B Pn000 0000h Application Function Selections BAPplication Function Selections BAPplication Function Selections BAPplication Function Selections BAPplication Function Selections DAPplication Function Selections DAPplication Function Selections BAPplication Function Function Function Function Function Function Function Function Functi	Pn002	0000h						After restart
Pn008 0000h	Pn006	0002h						Immediately
Pn009 0010h	Pn007	0000h						Immediately
Pn00A 0001h	Pn008	0000h						After restart
Pn00B 0000h Application Function Selections B Pn00C 0000h Application Function Selections B After restart tions C Application Function Selections C After restart tions D Application Function Selections C After restart tions D Application Function Selections C After restart tions D Application Function Selections F Asia Address Selection for UART/USB Communications Pn010 0001h Reserved parameter — Pn021 0000h Reserved parameter — Pn022 0000h Reserved parameter — Pn040 0000h Application Function Selections S After restart tions Pn081 0000h Application Function Selections 80 Application Function Selections 81 Pn100 400 Application Function Selections 81 Pn101 2000 Speed Loop Gain Immediately Pn102 400 Position Loop Gain Immediately Pn103 100 Moment of Inertia Ratio Immediately Pn104 400 Second Speed Loop Integral Time Constant Pn105 2000 Second Speed Loop Integral Time Constant Pn106 400 Second Speed Loop Integral Time Constant Immediately Pn105 2000 Second Speed Loop Integral Time Constant Immediately Pn106 400 Second Speed Loop Integral Time Constant Immediately Pn106 400 Second Speed Loop Integral Time Constant Immediately Pn106 400 Second Speed Loop Integral Time Constant Immediately Pn106 400 Second Speed Loop Integral Time Constant Immediately Pn106 400 Second Speed Loop Integral Time Constant Immediately Pn106 400 Second Speed Loop Integral Time Constant Immediately Pn107 Reserved Filter Time Constant Immediately Pn108 0000h Gain Application Selections * Pn109 Doministry Immediately Pn109 Doministry Immediately Pn109 Doministry Immediately Pn109 Doministry Immediately Pn100 Immediate	Pn009	0010h						After restart
Pn00C 0000h	Pn00A	0001h					tions A	After restart
Pn00D 0000h Application Function Selections D After restart from Fn00F 0000h Application Function Selections D Application Function Selections F After restart Axis Address Selection for UART/USB Communications Fn021 0000h Reserved parameter — Reserved parameter — Pn022 0000h Reserved parameter — Pn040 0000h Application Function Switch After restart from Switch Application Function Selections 80 After restart from 80 After restart from 80 After restart from 80 Application Function Selections 81 After restart from 82 Application Function Selections 83 After restart from 84 Application Function Selections 85 After restart from 86 Application Function Selections 86 After restart from 87 After restart from 88 Application Function Selections 81 After restart from 88 Application Function Selections 81 After restart from 88 Application Function Selections 81 Immediately Pn100 A00 Speed Loop Gain Immediately Pn101 A00 A00 A00 A00 A00 A00 A00 A00 A00	Pn00B	0000h			III			After restart
Pn00F 0000h Application Function Selections F After restart After restart for UART/USB Communications Pn021 0000h Reserved parameter — Pn022 0000h Reserved parameter — Pn040 0000h After restart for Switch After restart Pn080 0000h Application Function Selections 80 After restart for Switch After restart for Selections 81 After restart for Selections 81 Immediately Pn101 2000 Speed Loop Gain 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 Gain Immediately Pn106 400 Second Speed Loop Gain Immediately Pn107 Second Speed Loop Gain Immediately Pn108 0 Second Speed Loop Gain Immediately Pn109 0 Second Speed Loop Gain Immediately Second Speed Loop Gain Immediately Pn106 400 Second Speed Loop Gain Immediately Pn107 Second Speed Loop Gain Immediately Pn108 0 Second Speed Loop Gain Immediately Second Speed Loop Gain Immediately Second Speed Loop Gain Immediately Pn108 0 Second Position Loop Gain Immediately Feedforward Filter Time Constant Immediately Feedforward Filter Filte	Pn00C	0000h						After restart
Pn010 0001h	Pn00D	0000h						After restart
Pn010 0001h UART/USB Communications After restart and tions Pn021 0000h Reserved parameter — Pn022 0000h E-V Compatible Function Switch After restart Pn040 0000h Application Function Selections 80 After restart Pn081 0000h Application Function Selections 81 After restart Pn100 400 Speed Loop Gain Immediately Pn101 2000 Speed Loop Gain 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 Speed Loop Gain Immediately Pn109 0 Feedforward Immediately Pn100 0 Feedforward Filter Time Constant Immediately Pn10B 0000h Gain Application Selections * Pn10C 200 Mode Switching Level for Torque Reference Immediately	Pn00F	0000h			$-\Lambda$			After restart
Pn022 0000h Reserved parameter - Pn040 0000h \$\subsetext{SVCompatible Function Switch}}\$ After restart Pn080 0000h Application Function Selections 80 After restart Pn081 0000h Application Function Selections 81 After restart Pn100 400 Speed Loop Gain Immediately Pn101 2000 Speed Loop Integral Time Constant Immediately Pn102 400 Position Loop Gain Immediately Pn103 100 Moment of Inertia Ratio Immediately Pn104 400 Second Speed Loop Gain Immediately Pn105 2000 Second Speed Loop Integral Time Constant Immediately Pn106 400 Second Position Loop Gain Immediately Pn109 0 Feedforward Immediately Pn10A 0 Feedforward Filter Time Constant Immediately Pn10B 0000h Gain Application Selections * Pn10C 200 Mode Switching Level for Torque Reference Immediately Pn10D Mode Switching Level for Immediately	Pn010	0001h					UART/USB Communica-	After restart
Pn040 0000h \$\sigma\$-V Compatible Function Switch After restart Pn080 0000h Application Function Selections 80 After restart Pn081 0000h Application Function Selections 81 After restart Pn100 400 Speed Loop Gain Immediately Pn101 2000 Speed Loop Integral Time Constant Immediately Pn102 400 Position Loop Gain Immediately Pn103 100 Moment of Inertia Ratio Immediately Pn104 400 Second Speed Loop Gain Immediately Pn105 2000 Second Speed Loop Integral Time Constant Immediately Pn106 400 Second Speed Loop Gain Immediately Pn109 0 Feedforward Immediately Pn109 0 Feedforward Filter Time Constant Immediately Pn10A 0 Feedforward Filter Time Constant Immediately Pn10B 0000h Gain Application Selections * Pn10C 200 Mode Switching Level for Torque Reference Immediately	Pn021	0000h					Reserved parameter	_
Pn080 0000h Application Function Selections 80 Pn081 0000h Application Function Selections 80 Application Function Selections 81 After restart Pn100 400 Speed Loop Gain Immediately Pn101 2000 Constant Position Loop Gain Immediately Pn102 400 Position Loop Gain Immediately Pn103 100 Moment of Inertia Ratio Immediately Pn104 400 Second Speed Loop Integral Time Constant Immediately Pn105 2000 Second Position Loop Gain Immediately Pn106 400 Second Position Loop Gain Immediately Pn109 0 Feedforward Immediately Pn109 0 Feedforward Immediately Pn10A 0 Gain Application Selections * Pn10B 0000h Gain Application Selections Immediately Pn10B 0000h Gain Application Selections Immediately Pn10C 200 Mode Switching Level for Immediately Pn10C Immediately	Pn022	0000h	$N \Lambda \nu$	\sim t.	00	~ 1		O =
Pn081 0000h tions 80 Application Function Selections 81 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 Gain Immediately Pn106 400 Second Speed Loop Integral Time Constant Immediately Pn109 0 Feedforward Immediately Pn109 0 Feedforward Immediately Pn10A 0 Gain Application Selections * Pn10B 0000h Gain Application Selections Immediately Pn10C 200 Mode Switching Level for Torque Reference Immediately Pn10D Immediately Pn10D Mode Switching Level for Immediately Pn10D Immediately	Pn040	0000h	IVI	JU	OI:	2 /	Switch	After restart
Pn100 400 Speed Loop Gain Immediately Pn101 2000 Position Loop Gain 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 Gain Immediately Pn106 400 Second Speed Loop Integral Time Constant Pn109 0 Second Speed Loop Gain Immediately Pn109 0 Feedforward Immediately Pn109 0 Feedforward Filter Time Constant Pn10B 0000h Gain Application Selections Pn10C 200 Mode Switching Level for Torque Reference Mode Switching Level for Immediately Pn10D Mode Switching Level for Immediately Pn10D Mode Switching Level for Immediately	Pn080	0000h					tions 80	After restart
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 Pn109 0 Feedforward Filter Time Constant Immediately Pn10A 0 Gain Application Selections * Pn10B 0000h Gain Application Selections * Pn10C 200 Mode Switching Level for Immediately Pn10D Mode Switching Level for Immediately Pn10D Mode Switching Level for Immediately							tions 81	
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 Gain Application Selections Pn10B 0000h Gain Application Selections Pn10C 200 Mode Switching Level for Torque Reference Mode Switching Level for Immediately	Pn100	400						Immediately
Pn103 100							Constant	
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 Mode Switching Level for Torque Reference 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 Mode Switching Level for Immediately								
Pn106 400 Second Position Loop Gain Immediately Pn109 0 Feedforward Immediately Pn10A 0 Feedforward Filter Time Constant Pn10B 0000h Gain Application Selections * Pn10C 200 Mode Switching Level for Torque Reference Mode Switching Level for Immediately Mode Switching Level for Immediately	PN104	400						irimediately
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 Torque Reference Immediately							gral Time Constant	
Pn10A 0 Feedforward Filter Time Constant Immediately Pn10B 0000h Gain Application Selections * Pn10C 200 Mode Switching Level for Torque Reference Immediately Mode Switching Level for Immediately							'	
Pn10B 0000h Gain Application Selections * Pn10C 200 Mode Switching Level for Torque Reference Immediately Mode Switching Level for Immediately							Feedforward Filter Time	
Pn10C 200 Mode Switching Level for Torque Reference Mode Switching Level for Mode Switching Level for Immediately	Pn10B	0000h						*
Mode Switching Level for Immediately							Mode Switching Level for	Immediately
	Pn10D	0					Mode Switching Level for	Immediately

Continued from previous page.

Parameter					Continued from p	When
No.	Default Setting				Name	Enabled
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		AY.		Gain Switching Waiting Time 2	Immediately
Pn139	0000h		W		Automatic Gain Switching Selections 1	Immediately
Pn13D	2000			7 1	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
Pn143	1000	Иc	to	rs	Model Following Control Bias in the Forward Direc- tion	Immediately
Pn144	1000				Model Following Control Bias in the Reverse Direc- tion	Immediately
Pn145	500				Vibration Suppression 1 Frequency A	Immediately
Pn146	700				Vibration Suppression 1 Frequency B	Immediately
Pn147	1000				Model Following Control Speed Feedforward Com- pensation	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	0021h				Control-Related Selections	After restart
Pn160	0010h				Anti-Resonance Control- Related Selections	Immediately
Pn161	1000				Anti-Resonance Frequency	Immediately

						Continued from p	
Parameter No.	Default Setting					Name	When Enabled
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	*
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	64					Electronic Gear Ratio (Numerator)	After restart
Pn210	1		7			Electronic Gear Ratio (Denominator)	After restart
Pn212	2048					Number of Encoder Output Pulses	After restart
Pn216	0	ΝЛ	O.t.	or		Position Reference Acceleration/Deceleration Time Constant	Immediately after the motor stops
Pn217		IVI	Οt	OI ·	0	Average Position Reference Movement Time	Immediately after the motor stops
Pn218	1					Reference Pulse Input Multiplier	Immediately
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
						Continued	on next page.

Continued from previous page.

Parameter	5 (" 2 " "				Continued from p	When
No.	Default Setting				Name	Enabled
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		N		Torque Reference Input Gain	Immediately
Pn401	100		V		First Stage First Torque Reference Filter Time Con- stant	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	// _	4 -		Emergency Stop Torque	Immediately
Pn407	10000	VIC.	OJ(rs	Speed Limit during Torque Control	Immediately
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 Con- stant	Immediately

						Continued from p	, ,
Parameter No.	Default Setting					Name	When Enabled
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	0000h					Speed Ripple Compensation Selections	*
Pn424	50					Torque Limit at Main Circuit Voltage Drop	Immediately
Pn425	100		7	=/		Release Time for Torque Limit at Main Circuit Voltage Drop	Immediately
Pn426	0					Torque Feedforward Average Movement Time	Immediately
Pn427	0	ΝЛ	Ot.	Or	0	Speed Ripple Compensation Enable Speed	Immediately
Pn456	15	IVI	Οt	UI ·	0	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 Con- stant	Immediately
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

Continued from previous page.

D						Continued from p	
Parameter No.	Default Setting					Name	When Enabled
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	Immediately
Pn501	10					Zero Clamping Level	Immediately
Pn502	20					Rotation Detection Level	Immediately
Pn503	10					Speed Coincidence Detection Signal Output Width	Immediately
Pn506	0		7		_	Brake Reference-Servo OFF Delay Time	Immediately
Pn507	100					Brake Reference Output Speed Level	Immediately
Pn508	50		N			Servo OFF-Brake Com- mand Waiting Time	Immediately
Pn509	20		V	7,1		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	// _	1			Output Signal Selections 3	After restart
Pn512	0000h	VIC.	OJ(rs		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
Pn51B	1000					Motor-Load Position Deviation Overflow Detection Level	Immediately
Pn51E	100					Position Deviation Over- flow Warning Level	Immediately
Pn520	5242880					Position Deviation Over- flow Alarm Level	Immediately
Pn522	7					Positioning Completed Width	Immediately
Pn524	1073741824					Near Signal Width	Immediately
Pn526	5242880					Position Deviation Over- flow Alarm Level at Servo ON	Immediately
Pn528	100					Position Deviation Over- flow Warning Level at Servo ON	Immediately

						Continued from p	revious page.
Parameter No.	Default Setting					Name	When Enabled
Pn529	10000					Speed Limit Level at Servo ON	Immediately
Pn52A	20					Multiplier per Fully-closed Rotation	Immediately
Pn52B	20					Overload Warning Level	Immediately
Pn52C	100					Base Current Derating at Motor Overload Detection	After restart
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
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	N/I	\circ t	or	9	Residual Vibration Detection Width	Immediately
Pn561	100	IVI		\cup I	0	Overshoot Detection Level	Immediately
Pn580	10					Zero Clamping Level	Immediately
Pn581	20					Zero Speed Level Speed Coincidence Detec-	Immediately
Pn582	10					tion 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
Pn600	0					Regenerative Resistor Capacity	Immediately
Pn601	0					Dynamic Brake Resistor Allowable Energy Con- sumption	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

Parameter No.	Default Setting			Name	When Enabled
Pn61C	100			Overheat Warning Level	Immediately
Pn61D	0			Overheat Alarm Filter Time	Immediately

^{*} The enable timing depends on the digit that is changed. Refer to the following section for details.

** 14.1 List of Parameters on page 14-2**



Appendices

15

The appendix provides host controller connection examples, and tables of corresponding SERVOPACK and SigmaWin+ function names.

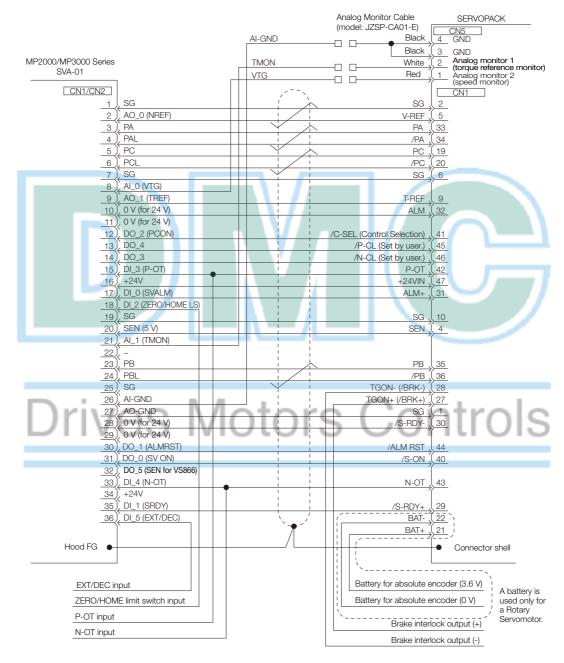
15.1	Examp	oles of Connections to Host Controllers 15-2
	15.1.1 15.1.2	Example of Connections to MP2000/MP3000- Series SVA-01 Motion Module
	15.1.3	for Position Control
	15.1.4 15.1.5	for Position Control
	10.1.0	Positioning Module for Position Control 15-6
15.2	Corresp	onding SERVOPACK and SigmaWin+ Function Names15-7
	15.2.1	Corresponding SERVOPACK Utility Function

15.2.2 Corresponding SERVOPACK Monitor Display

15.1 Examples of Connections to Host Controllers

This section provides examples of connections to host controllers.

15.1.1 Example of Connections to MP2000/MP3000-Series SVA-01 Motion Module



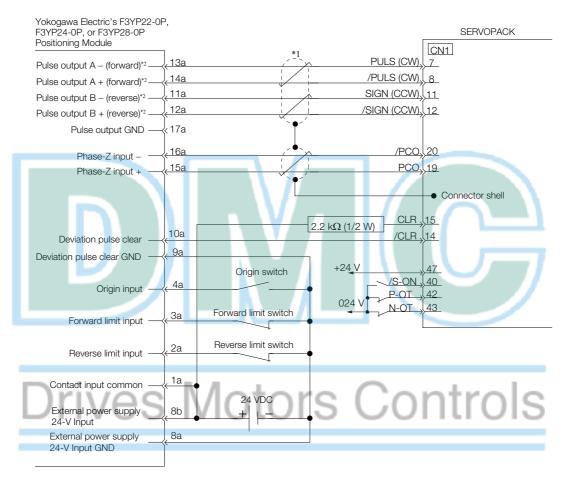
Note: 1. Cables to connect the SERVOPACK to the MP2000/MP3000 are available from Yaskawa. For details, refer to the manual for the Machine Controller.

- Only signals that are applicable to the MP2000/MP3000-Series SVA-01 Motion Module and the SERVO-PACK 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).
- 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.

15.1.2 Example of Connections to Yokogawa Electric's F3YP2□-0P Positioning Module for Position Control

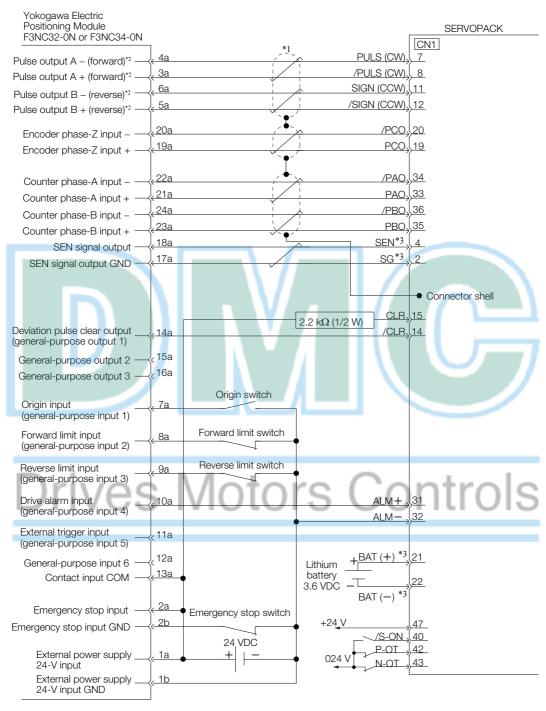
- 9. The SERVOPACK provides safety functions to protect people from the hazardous operation of the moving parts of the machine. In order to use the safety functions, the required circuits must be configured for CN8. If the safety functions will not be used, leave the enclosed Safety Jumper Connector connected to the SERVOPACK (CN8). Refer to the following chapter for details.
 - Chapter 11 Safety Functions

15.1.2 Example of Connections to Yokogawa Electric's F3YP2□-0P Positioning Module for Position Control



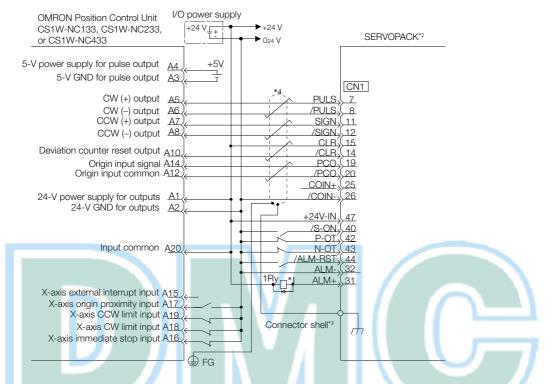
- *1. Indicates shielded twisted-pair cable.
- *2. The pulse output from Yokogawa Electric's F3YP2□-0P Positioning Module uses negative logic, so the positive and negative connections are reversed.
- Note: 1. Only signals that are applicable to the SERVOPACK and Yokogawa Electric's F3YP2□-0P Positioning 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.

15.1.3 Example of Connections to Yokogawa Electric's F3NC3□-0N Positioning Module for Position Control



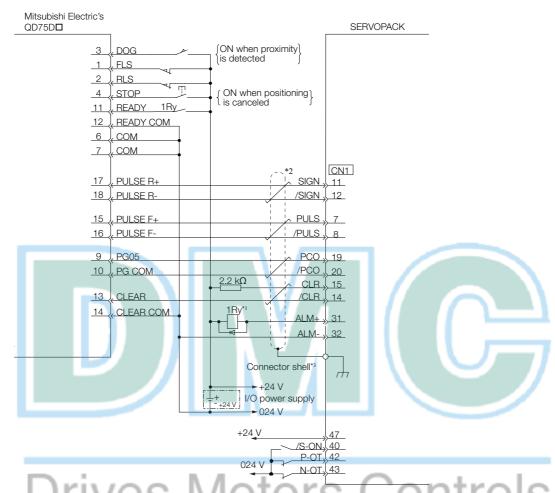
- *1. Indicates shielded twisted-pair cable.
- *2. The pulse output from Yokogawa Electric's F3NC3□-0N Positioning Module uses negative logic, so the positive and negative connections are reversed.
- *3. Connect these when using an absolute encoder.
- Note: 1. Only signals that are applicable to the 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.

15.1.4 Example of Connections to an OMRON Position Control Unit



- *1. The ALM (Servo Alarm) signal is output for approximately five 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).
 - 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) 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.
 - Chapter 11 Safety Functions

15.1.5 Example of Connection to Mitsubishi's QD75D□ Positioning Module for Position Control



- *1. The ALM (Servo Alarm) signal is output for up to five 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) 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.
 - Chapter 11 Safety Functions

15.2

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+.

15.2.1 Corresponding SERVOPACK Utility Function Names

	SigmaWin+		SERVOPACK
Button in Menu Dialog Box	Function Name	Fn No.	Function Name
	Origin Search	Fn003	Origin Search
	Absolute Encoder Reset	Fn008	Reset Absolute Encoder
	Adjust the Speed and Torque Ref-	Fn009	Autotune Analog (Speed/Torque) Reference Off set
	erence Offset	Fn00A	Manually Adjust Speed Reference Offset
		Fn00B	Manually Adjust Torque Reference Offset
	Adjust the Apples Maniter Output	Fn00C	Adjust Analog Monitor Output Offset
	Adjust the Analog Monitor Output	Fn00D	Adjust Analog Monitor Output Gain
	A II - I II - AI - I - I - I - I - I - I	Fn00E	Autotune Motor Current Detection Signal Offse
Catura	Adjust the Motor Current Detection Signal Offsets	Fn00F	Manually Adjust Motor Current Detection Signa Offset
Setup	Multiturn Limit Setting	Fn013	Multiturn Limit Setting after Multiturn Limit Disagreement Alarm
	Reset Option Module Configuration Error	Fn014	Reset Option Module Configuration Error
	Initialize Vibration Detection Level	Fn01B	Initialize Vibration Detection Level
	Set Origin	Fn020	Set Absolute Linear Encoder Origin
	Reset Motor Type Alarm	Fn021	Reset Motor Type Alarm
Dri۱	Software Reset Polarity Detection	Fn030 Fn080	Software Reset Polarity Detection
	Tuning-less Level Setting	Fn200	Tuning-less Level Setting
	Easy FFT	Fn206	Easy FFT
	Initialize	Fn005	Initializing Parameters
Parameters	Write Prohibition Setting	Fn010	Write Prohibition Setting
	Setup Wizard	_	_
	Autotuning without Host Reference	Fn201	Advanced Autotuning without Reference
	Autotuning with Host Reference	Fn202	Advanced Autotuning with Reference
Tuning	Custom Tuning	Fn203	One-Parameter Tuning
· ·	Adjust Anti-resonance Control	Fn204	Adjust Anti-resonance Control
	Vibration Suppression	Fn205	Vibration Suppression
	Moment of Inertia Estimation	_	_
		Fn011	Display Servomotor Model
Monitoring		Fn012	Display Software Version
	Product Information	Fn01E	Display SERVOPACK and Servomotor IDs
		Fn01F	Display Servomotor ID from Feedback Option Module
Test Opera-	Jog	Fn002	Jog
tion	Jog Program	Fn004	Jog Program
Alexans	Alexander Diegology	Fn000	Display Alarm History
Alarms	Alarm Display	Fn006	Clear Alarm History
Solutions	Mechanical Analysis	_	_

Corresponding SERVOPACK Monitor Display Function Names 15.2.2

	SigmaWin+	SERVOPACK				
Button in Menu Dialog Box	Name [Unit]	Un No.	Name [Unit]			
	Motor Speed [min ⁻¹]	Un000	Motor Speed [min ⁻¹]			
	Speed Reference [min ⁻¹]	Un001	Speed Reference [min ⁻¹]			
	Torque Reference [%]	Un002	Torque Reference [%] (percentage of rated torque)			
	 Rotary Servomotors: Rotational Angle 1 [encoder pulses] (number of encoder pulses from origin within one encoder rotation) Linear Servomotors: Electrical Angle 1 [linear encoder pulses] (linear encoder pulses from the polarity origin) 	Un003	Rotary Servomotors: Rotational Angle 1 [encoder pulses] (number of encoder pulses from origin within one encoder rotation displayed in decimal) Linear Servomotors: Electrical Angle 1 [linear encoder pulses] (linear encoder pulses from the polarity origin displayed in decimal)			
	 Rotary Servomotors: Rotational Angle 2 [deg] (electrical angle from origin within one encoder rotation) Linear Servomotors: Electrical Angle 2 [deg] (electrical angle from polarity origin) 	Un004	Rotary Servomotors: Rotational Angle 2 [deg] (electrical angle from polarity origin) Linear Servomotors: Electrical Angle 2 [deg] (electrical angle from polarity origin)			
	Input Reference Pulse Speed [min ⁻¹]	Un007	Input Reference Pulse Speed [min ⁻¹] (displayed only during position control)			
	Position Deviation [reference units]	Un008	Position Error Amount [reference units] (displayed only during position control)			
Motion Monitor	Accumulated Load Ratio [%]	Un009	Accumulated Load Ratio [%] (percentage of rated torque: effective torque in cycles of 10 seconds)			
	Regenerative Load Ratio [%]	Un00A	Regenerative Load Ratio [%] (percentage of processable regenerative power: regenerative power consumption in cycles of 10 seconds)			
	Dynamic Brake Resistor Power Consumption [%]	Un00B	Power Consumed by DB Resistance [%] (percentage of processable power at DB activation: displayed in cycles of 10 seconds)			
	Input Reference Pulse Counter [reference units]	Un00C	Input Reference Pulse Counter [reference units]			
	Feedback Pulse Counter [encoder pulses]	Un00D	Feedback Pulse Counter [encoder pulses]			
	Fully-closed Loop Feedback Pulse Counter [external encoder resolu- tion]	Un00E	Fully-closed Loop Feedback Pulse Counter [external encoder resolution]			
	Upper Limit Setting of Motor Maximum Speed/Upper Limit Setting of Encoder Output Resolution	Un010*1	Upper Limit Setting of Motor Maximum Speed/ Upper Limit Setting of Encoder Output Resolu- tion			
	Total Operation Time [100 ms]	Un012	Total Operation Time [100 ms]			
	Feedback Pulse Counter [reference units]	Un013	Feedback Pulse Counter [reference units]			
	Overheat Protection Input [0.01 V]	Un02F	Overheat Protection Input [0.01 V]			
	Power Consumption [W]	Un032	Power Consumption [W]			
	Consumed Power [0.001 Wh]	Un033	Consumed Power [0.001 Wh]			
			Continued on next page.			

	SigmaWin+	SERVOPACK				
Button in Menu Dialog Box	Name [Unit]	Un No.	Name [Unit]			
	Cumulative Power Consumption [Wh]	Un034	Cumulative Power Consumption [Wh]			
	Absolute Encoder Multiturn Data	Un040	Absolute Encoder Multiturn Data			
Motion Monitor	Position within One Rotation of Absolute Encoder [encoder pulses]	Un041	Position within One Rotation of Absolute Encoder [encoder pulses]			
Wichitton	Lower Bits of Absolute Encoder Position [encoder pulses]	Un042	Lower Bits of Absolute Encoder Position [encoder pulses]			
	Upper Bits of Absolute Encoder Position [encoder pulses]	Un043	Upper Bits of Absolute Encoder Position [encoder pulses]			
	Polarity Sensor Signal Monitor	Un011	Polarity Sensor Signal Monitor			
Status Monitor	Active Gain Monitor	Un014	Effective Gain Monitor (gain settings 1 = 1, gain settings 2 = 2)			
	Safety I/O Signal Monitor	Un015	Safety I/O Signal Monitor			
Input Sig- nal Moni- tor	Input Signal Monitor	Un005	Input Signal Monitor			
Output Signal Monitor	Output Signal Monitor	Un006	Output Signal Monitor			
	Installation Environment Monitor – SERVOPACK	Un025	SERVOPACK Installation Environment Monitor [%]			
	Installation Environment Monitor – Servomotor*2	Un026*2	Servomotor Installation Environment Monitor [%]			
Service Life Moni-	Service Life Prediction Monitor – Built-in Fan	Un027	Built-in Fan Remaining Life Ratio [%]			
tor	Service Life Prediction Monitor – Capacitor	Un028	Capacitor Remaining Life Ratio [%]			
D.::	Service Life Prediction Monitor – Surge Prevention Circuit	Un029	Surge Prevention Circuit Remaining Life Ratio [%]			
Driv	Service Life Prediction Monitor – Dynamic Brake Circuit	Un02A	Dynamic Brake Circuit Remaining Life Ratio [%]			
Product Informa-	Motor – Resolution	Un084	Linear Encoder Pitch (Scale pitch = Un084 \times 10 ^{Un085} [pm])			
tion	INIOLOI — NESUIULIOII	Un085	Linear Encoder Pitch Exponent (Scale pitch = Un084 × 10 ^{Un085} [pm])			
	_	Un020	Rated Motor Speed [min ⁻¹]			
	_	Un021	Maximum Motor Speed [min ⁻¹]			

^{*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.

Output Pulses).

- If $Pn080 = n.0 \square \square \square$, the encoder output resolution (Pn281) that can be set is displayed.
- If $Pn080 = n.1 \square \square \square$, the maximum motor speed (Pn385) that can be set is displayed in mm/s.

You can monitor the upper limit of the encoder output resolution setting (Pn281) for the current maximum motor speed setting (Pn385), or you can monitor the upper limit of the maximum motor speed setting for the current encoder output resolution setting.

Select which signal to monitor with Pn080 = n.X□□□ (Calculation Method for Maximum Speed or Encoder

^{*2.} This applies to the following motors. The display will show 0 for all other models. SGM7J, SGM7A, SGM7P, SGM7G, SGM7E, SGM7F, and SGMCV



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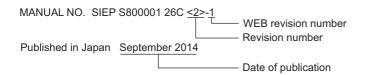
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Revision History

The revision dates and numbers of the revised manuals are given on the bottom of the back cover.



Date of Publication	Rev. No.	Web Rev. No.	Section	Revised Contents
July 2017	<12>	0	Back cover	Revision: Address
March 2017	<11>	0	Preface, 6.1.2, 12.4	Partly revised.
			4.4.3, 5.16.1	Addition: Information on SQ47 and SQ57 Linear Encoders from Magnescale Co., Ltd.
			5.16.1	Addition: Information on LIC2100-Series and LC415 Linear Encoders from Heidenhain Corporation.
			5.16.1, 5.18.1	Addition: Information on RESOLUTE Linear Encoders from Renishaw PLC.
			12.2.2, 14.1.2	Revisions: Reference information
December 2016	<10>	0	Preface	Partly revised.
			1.4.2, 4.4.2, 4.4.3, 5.16.1, 5.17, 6.12	Addition: Information on Rotary Servomotors with 24-bit batteryless absolute encoders.
			Back cover	Revision: Address
November 2016	<9>	0	Preface	Partly revised.
			1.5.2	Addition: Information on Direct Drive Servomotors (SGM7F-□□A, -□□M, -□□N)
			4.4.3, 5.16.1, 5.18.1	Addition: Information on Renishaw PLC EVOLUTE linear scales
September 2016	<8>	0	All chapters	Addition: Information on Direct Drive Servomotors (SGM7E)
			Preface	Partly revised.
			2.1.3, 4.2, 4.5	Revision: "Linear Servomotor overheat protection signal input" changed to "overheat protection input."
)r	IV	3.7 6.18, 8.12.3	Addition: EMC installations for single-phase 200-VAC and single-phase 100-VAC models Newly added.
			Chapter 12	Addition: A.862 and A.93B
			Chapter 14	Addition: Pn022, Pn475, Pn476, Pn61A, Pn61B, Pn61C, and Pn61D
			15.2.2	Addition: Un02F
April 2016	<7>	0	All chapters	Addition: Information on SGM7F Direct Drive Servomotors Deletion: Information on SGLC Linear Servomotors
			Preface, 9.1, 9.2	Partly revised.
			2.1.1.	Addition: Information on input current of control power supply
			Chapter 14	Deletion: Pn52D
November 2015	<6>	0	All chapters	Addition: Information on SERVOPACKs with single-phase, 100-VAC power supply inputs
			Preface	Revision: Information on certification for standards
			4.4.3, 5.16.1, 6.8.1	Addition: Information on SQ10 Linear Encoder from Magnescale Co., Ltd.
October 2015	<5>	0	All chapters	Revision: Information on SigmaWin+ procedures
			Preface, Chapter 1	Addition: Information on SGMMV Rotary Servomotors
			Preface, 9.4.1	Partly revised.
			1.5.2	Addition: Information on Direct Drive Servomotors (SGMCV-16D and -35D)
			9.5	Newly added.
			Chapter 12	Addition: A.bF5, A.bF6, A.bF7, A.bF8, and FL-6
			Back cover	Revision: Address

Date of Publication	Rev. No.	Web Rev. No.	Section	Revised Contents
April 2015	<4>	0	All chapters	Addition: Information on dynamic brake option
			Preface, 7.6.3, 8.3.3, 8.3.5, 12.3.2	Partly revised.
			12.2.2, 12.4, 14.1.2	Revision: Reference information
			14.1.2	Revision: Information on Pn601 and Pn604
			Front cover, back cover, spine	Revision: Format
March 2015	<3>	0	All chapters	Addition: Information on SERVOPACKs with single-phase, 200-VAC power supply input Addition: Information on BTO specification Addition: Information on Safety Modules Partly revised.
			Preface	Addition: Information on dynamic brake Revision: Information on certification for standards
			2.1.1	Revision: Power loss
			2.3.2	Addition: Information on duct-ventilated SERVOPACKs Revision: External dimensions of the following three-phase, 200-VAC SERVO-PACKs: SGD7S-470A, -550A, -590A, and -780A
			4.3.5	Revision: Illustration of SGD7S-470A, -550A, -590A, and -780A SERVOPACKs
			4.2, 4.4.3, 4.5.3, 6.12.1	Addition: Information on Battery for absolute encoder
			5.16.1, 5.18.1	Addition: Information on Linear Encoders (ST1381 and ST1382) from Mitutoyo Corporation
			8.12.3, 14.1.2	Revision: Information on Current Control Mode Selection
		J	Back cover	Revision: Address
September 2014	<2>	1	12.4	Partly revised.
July 2014		0	-/	Based on Japanese user's manual, SIJP S800001 26C<2> printed in July 2014.
			All chapters	Addition: Information on SGD7S-330A, -470A, -550A, -590A, and -780A
				Addition: Information on supplementary document (Manual No.: SIEP S800001 50)
May 2014	<1>	0	Preface	Revision: Safety Parameters
			3.7	Newly added.
	vi.	10	Chapter 12	Addition: A.EC8 and A.EC9
April 2014	11-11	$V \leftarrow$	5 IVI	First edition

Σ -7-Series AC Servo Drive Σ -7S SERVOPACK with Analog Voltage/Pulse Train References **Product Manual**

IRUMA BUSINESS CENTER (SOLUTION CENTER)
480, Kamifujisawa, Iruma, Saitama, 358-8555, Japan
Phone: +81-4-2962-5151 Fax: +81-4-2962-6138 http://www.yaskawa.co.jp

YASKAWA AMERICA, INC.

2121, Norman Drive South, Waukegan, IL 60085, U.S.A. Phone: +1-800-YASKAWA (927-5292) or +1-847-887-7000 Fax: +1-847-887-7310 http://www.yaskawa.com

YASKAWA ELÉTRICO DO BRASIL LTDA.

777, Avenida Piraporinha, Diadema, São Paulo, 09950-000, Brasil Phone: +55-11-3585-1100 Fax: +55-11-3585-1187 http://www.yaskawa.com.br

YASKAWA EUROPE GmbH

Hauptstraβe 185, 65760 Eschborn, Germany Phone: +49-6196-569-300 Fax: +49-6196-569-398

YASKAWA ELECTRIC KOREA CORPORATION

35F, Three IFC, 10 Gukjegeumyung-ro, Yeongdeungpo-gu, Seoul, 07326, Korea Phone: +82-2-784-7844 Fax: +82-2-784-8495 http://www.yaskawa.co.kr

YASKAWA ELECTRIC (SINGAPORE) PTE. LTD.

151, Lorong Chuan, #04-02A, New Tech Park, 556741, Singapore Phone: +65-6282-3003 Fax: +65-6289-3003 http://www.yaskawa.com.sg

YASKAWA ELECTRIC (THAILAND) CO., LTD.

59, 1st-5th Floor, Flourish Building, Soi Ratchadapisek 18, Ratchadapisek Road, Huaykwang, Bangkok, 10310, Thailand Phone: +66-2-017-0099 Fax: +66-2-017-0799 http://www.yaskawa.co.th

YASKAWA ELECTRIC (CHINA) CO., LTD. 22F, One Corporate Avenue, No.222, Hubin Road, Shanghai, 200021, China Phone: +86-21-5385-2200 Fax: +86-21-5385-3299

YASKAWA ELECTRIC (CHINA) CO., LTD. BEIJING OFFICE Room 1011, Tower W3 Oriental Plaza, No.1, East Chang An Ave., Dong Cheng District, Beijing, 100738, China Phone: +86-10-8518-4086 Fax: +86-10-8518-4082

YASKAWA ELECTRIC TAIWAN CORPORATION

12F, No. 207, Sec. 3, Beishin Rd., Shindian Dist., New Taipei City 23143, Taiwan Phone: +886-2-8913-1333 Fax: +886-2-8913-1513 or +886-2-8913-1519

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MANUAL NO. SIEP S800001 26K <12>-0 Published in Japan July 2017 17-4-13 Original instructions