

AC Servodrive

Σ -V Series

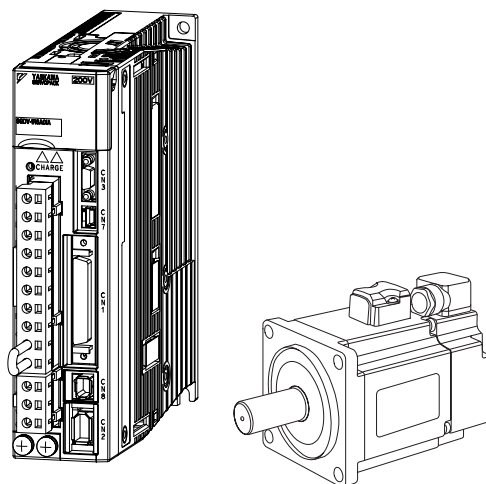
USER'S MANUAL

Design and Maintenance

Rotational Motor

Analog Voltage and Pulse Train Reference

SGMJV/SGMAV/SGMGV/SGMCS Servomotors
SGDV SERVOPACK



Outline	1
Panel Operator	2
Wiring and Connection	3
Trial Operation	4
Operation	5
Adjustments	6
Utility Functions (Fn□□□)	7
Monitor Modes (Un□□□)	8
Fully-closed Loop Control	9
Troubleshooting	10
Appendix	11

Copyright © 2007 YASKAWA ELECTRIC CORPORATION

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form, or by any means, mechanical, electronic, photocopying, recording, or otherwise, without the prior written permission of Yaskawa. No patent liability is assumed with respect to the use of the information contained herein. Moreover, because Yaskawa is constantly striving to improve its high-quality products, the information contained in this manual is subject to change without notice. Every precaution has been taken in the preparation of this manual. Nevertheless, Yaskawa assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained in this publication.

About this Manual

This manual describes informations required for designing, and maintaining Σ -V Series SERVOPACKs.

Be sure to refer to this manual and perform design and maintenance to select devices correctly.

Keep this manual in a location where it can be accessed for reference whenever required.

■ Description of Technical Terms

The following table shows the meanings of terms used in this manual.

Term	Meaning
Servomotor	Σ -V Series SGM _{AV} , SGM _{JV} , SGM _{GV} , SGM _{CV} , or SGM _{CS} (Direct Drive) servomotor
SERVOPACK	Σ -V Series SGD _V SERVOPACK
Servodrive	A set including a servomotor and SERVOPACK (i.e., a servo amplifier)
Servo System	A servo control system that includes the combination of a servodrive with a host controller and peripheral devices
Parameter	A switch or numeric data for a SERVOPACK
Analog Pulse Model	Analog voltage and pulse-train reference used for SERVOPACK interface
M-II Model	MECHATROLINK-II communications reference used for SERVOPACK interface

■ IMPORTANT Explanations

The following icon is displayed for explanations requiring special attention.



IMPORTANT

- Indicates important information that should be memorized, as well as precautions, such as alarm displays, that do not involve potential damage to equipment.

■ Notation Used in this Manual

In this manual, the names of reverse signals (ones that are valid when low) are written with a forward slash (/) before the signal name, as shown in the following example:

Example

$\overline{\text{S-ON}}$ = /S-ON

■ Manuals Related to the Σ -V Series

Refer to the following manuals as required.

Name	Selecting Models and Peripheral Devices	Ratings and Specifications	System Design	Panels and Wiring	Trial Operation	Trial Operation and Servo Adjustment	Maintenance and Inspection
Σ -V Series SGM□V/SGDV User's Manual Setup Rotational Motor (SIEPS80000043)				✓	✓		
Σ -V Series SGM□V/SGDV Catalog (KAEPS80000042)	✓	✓					
Σ -V Series SGM□V/SGDV User's Manual Operation of Digital Operator (SIEPS80000055)					✓	✓	✓
Σ -V Series AC SERVOPACK SGD V Safety Precautions (TOBPC71080010)							✓
Σ Series Digital Operator Safety Precautions (TOBPC73080000)							✓
AC SERVOMOTOR Safety Precautions (TOBPC23020000)							✓

■ Safety Information

The following conventions are used to indicate precautions in this manual. Failure to heed precautions provided in this manual can result in serious or possibly even fatal injury or damage to the products or to related equipment and systems.



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



Indicates precautions that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation. In some situations, the precautions indicated could have series consequences if not heeded.



Indicates prohibited actions that must not be performed. For example, this symbol would be used to indicate that fire is prohibited as follows:



Indicates compulsory actions that must be performed. For example, this symbol would be used as follows to indicate that grounding is compulsory:



Safety Precautions

These safety precautions are very important. Read them before performing any procedures such as checking products on delivery, storage and transportation, installation, wiring, operation and inspection, or disposal. Be sure to always observe these precautions thoroughly.



WARNING

- Never touch any rotating motor parts while the motor is running.
Failure to observe this warning may result in injury.
- Before starting operation with a machine connected, make sure that an emergency stop can be applied at any time.
Failure to observe this warning may result in injury or damage to the product.
- Never touch the inside of the SERVOPACKs.
Failure to observe this warning may result in electric shock.
- Do not remove the cover of the power supply terminal block while the power is ON.
Failure to observe this warning may result in electric shock.
- Do not touch terminals for five minutes after the power is turned OFF.
Residual voltage may cause electric shock.
- Do not touch terminals for five minutes after a voltage resistance test.
Residual voltage in the SERVOPACK may cause electric shock. When voltage has been completely discharged, the CHARGE lamp will turn OFF. Be sure to check the CHARGE lamp before performing the next operation.
- Follow the procedures and instructions provided in this manual for trial operation.
Failure to do so may result not only in faulty operation and damage to equipment, but also in personal injury.
- The multi-turn output range for the Σ -V Series absolute position detecting system is different from that of earlier systems (15-bit and 12-bit encoders). In particular, change the system to configure the Σ series infinite-length positioning system with the Σ -V Series.
- The multi-turn limit value need not be changed except for special applications.
Changing it inappropriately or unintentionally can be dangerous.
- If the Multi-turn Limit Disagreement alarm occurs, check the setting of parameter Pn205 in the SERVOPACK to be sure that it is correct.
If Fn013 is executed when an incorrect value is set in Pn205, an incorrect value will be set in the encoder. The alarm will disappear even if an incorrect value is set, but incorrect positions will be detected, resulting in a dangerous situation where the machine will move to unexpected positions.
- Do not remove the front cover, cables, connectors, or optional items from the upper front of the SERVOPACK while the power is ON.
Failure to observe this warning may result in electric shock.
- Do not damage, press, exert excessive force on, or place heavy objects on the cables.
Failure to observe this warning may result in electric shock, stopping operation of the product, or fire.
- Provide an appropriate stopping device on the machine side to ensure safety. The holding brake on a servomotor with a brake is not a stopping device for ensuring safety.
Failure to observe this warning may result in injury.
- The person who designs a system using the safety function (Hard Wire Baseblock function) must have full knowledge of the related safety standards and full understanding of the instructions in this manual.
Failure to observe this warning may result in injury.
- Do not come close to the machine immediately after resetting a momentary power loss. The machine may restart unexpectedly. Take appropriate measures to ensure safety against an unexpected restart.
Failure to observe this warning may result in injury.
- Connect the ground terminal according to local electrical codes (100 Ω or less for a SERVOPACK with a 200 V power supply, 10 Ω or less for a SERVOPACK with a 400 V power supply).
Improper grounding may result in electric shock or fire.
- Installation, disassembly, or repair must be performed only by authorized personnel.
Failure to observe this warning may result in electric shock or injury.



■ Storage and Transportation



CAUTION

- Do not store or install the product in the following locations.
Failure to observe this caution may result in fire, electric shock, or damage to the product.
 - Locations subject to direct sunlight
 - Locations subject to temperatures outside the range specified in the storage/installation temperature conditions
 - Locations subject to humidity outside the range specified in the storage/installation humidity conditions
 - Locations subject to condensation as the result of extreme changes in temperature
 - Locations subject to corrosive or flammable gases
 - Locations subject to dust, salts, or iron dust
 - Locations subject to exposure to water, oil, or chemicals
 - Locations subject to shock or vibration
- Do not hold the product by the cables or motor shaft while transporting it.
Failure to observe this caution may result in injury or malfunction.
- Do not place any load exceeding the limit specified on the packing box.
Failure to observe this caution may result in injury or malfunction.

■ Installation



CAUTION

- Never use the product in an environment subject to water, corrosive gases, inflammable gases, or combustibles.
Failure to observe this caution may result in electric shock or fire.
- Do not step on or place a heavy object on the product.
Failure to observe this caution may result in injury.
- Do not cover the inlet or outlet ports and prevent any foreign objects from entering the product.
Failure to observe this caution may cause internal elements to deteriorate resulting in malfunction or fire.
- Be sure to install the product in the correct direction.
Failure to observe this caution may result in malfunction.
- Provide the specified clearances between the SERVOPACK and the control panel or with other devices.
Failure to observe this caution may result in fire or malfunction.
- Do not apply any strong impact.
Failure to observe this caution may result in malfunction.

■ Wiring



CAUTION

- Do not connect a commercial power supply to the U, V, or W terminals for the servomotor connection.
Failure to observe this caution may result in injury or fire.
- Securely connect the main circuit power supply terminal screws and servomotor connection terminal screws.
Failure to observe this caution may result in fire.
- Do not bundle or run the main circuit cables together with the input/output signal lines or the encoder cables in the same duct. Keep them separated by at least 30 cm.
Failure to do so may result in malfunction.
- Use shielded twisted-pair wires or multi-core shielded twisted-pair wires for input/output signal lines and the encoder cables.
- I/O signal cables must be no longer than 3 m, encoder cables must be no longer than 20 m.
- Do not touch the power terminals for 5 minutes after turning power OFF because high voltage may still remain in the SERVOPACK.
Make sure the charge indicator is out first before starting an inspection.
- Observe the following precautions when wiring main circuit terminal blocks.
 - Do not turn ON the power to the SERVOPACK until all wiring has been completed, including the main circuit terminals.
 - Remove detachable main circuit terminals from the SERVOPACK prior to wiring.
 - Insert only one power line per opening in the main circuit terminals.
 - Make sure that no part of the core wire comes into contact with (i.e., short-circuit) adjacent wires.
- Install a battery at either the host controller or the battery unit of the encoder, but not both.
It is dangerous to install batteries at both ends simultaneously, because that sets up a loop circuit between the batteries.
- Be sure to wire correctly and securely.
Failure to observe this caution may result in motor overrun, injury, or malfunction.
- Always use the specified power supply voltage.
An incorrect voltage may result in fire or malfunction.
- Take appropriate measures to ensure that the input power supply is supplied within the specified voltage fluctuation range. Be particularly careful in places where the power supply is unstable.
An incorrect power supply may result in damage to the product.
- Install external breakers or other safety devices against short-circuiting in external wiring.
Failure to observe this caution may result in fire.
- Take appropriate and sufficient countermeasures for each form of potential interference when installing systems in the following locations.
 - Locations subject to static electricity or other forms of noise
 - Locations subject to strong electromagnetic fields and magnetic fields
 - Locations subject to possible exposure to radioactivity
 - Locations close to power supplies
Failure to observe this caution may result in damage to the product.
- Do not reverse the polarity of the battery when connecting it.
Failure to observe this caution may damage the battery, the SERVOPACK, or cause an explosion.
- Wiring or inspection must be performed by a technical expert.

■ Operation

CAUTION

- Always use the servomotor and SERVOPACK in one of the specified combinations.
Failure to observe this caution so may result in fire or malfunction.
- Conduct trial operation on the servomotor alone with the motor shaft disconnected from the machine to avoid accidents.
Failure to observe this caution may result in injury.
- Before starting operation with a machine connected, change the settings to match the parameters of the machine.
Starting operation without matching the proper settings may cause the machine to run out of control or malfunction.
- Do not frequently turn power ON and OFF.
Since the SERVOPACK has a capacitor in the power supply, a high charging current flows when power is turned ON. Frequently turning power ON and OFF causes main power devices like capacitors and fuses to deteriorate, resulting in unexpected problems.
- The dynamic brake function using reverse overtravel and forward overtravel does not work during JOG operations using utility function Fn002 and origin search operations using utility function Fn003.
- When using the servomotor for a vertical axis, install safety devices to prevent workpieces from falling due to alarms or overtravels. Set the servomotor so that it will stop in the zero clamp state when overtravel occurs.
Failure to observe this caution may cause workpieces to fall due to overtravel.
- When not using turning-less function, set to the correct moment of inertia ratio (Pn103).
Setting to an incorrect moment of inertia ratio may cause vibration.
- Do not touch the SERVOPACK heatsinks, regenerative resistor, or servomotor while power is ON or soon after the power is turned OFF.
Failure to observe this caution may result in burns due to high temperatures.
- Do not make any extreme adjustments or setting changes of parameters.
Failure to observe this caution may result in injury or damage to the product due to unstable operation.
- When an alarm occurs, remove the cause, reset the alarm after confirming safety, and then resume operation.
Failure to observe this caution may result in damage to the product, fire, or injury.
- Do not use the brake of the servomotor for braking.
Failure to observe this caution may result in malfunction.

■ Maintenance and Inspection

CAUTION



- Do not disassemble the SERVOPACK.
Failure to observe this caution may result in electric shock or injury.
- Do not attempt to change wiring while the power is ON.
Failure to observe this caution may result in electric shock or injury.
- When replacing the SERVOPACK, resume operation only after transferring the previous SERVOPACK parameters to the new SERVOPACK.
Failure to observe this caution may result in damage to the product.

■ Disposal

CAUTION

- When disposing of the products, treat them as ordinary industrial waste.

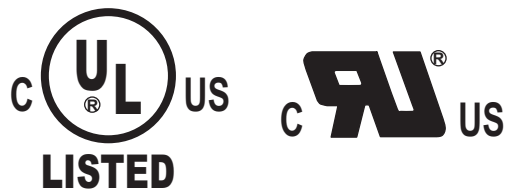
■ General Precautions

Observe the following general precautions to ensure safe application.

- The products shown in illustrations in this manual are sometimes shown without covers or protective guards. Always replace the cover or protective guard as specified first, and then operate the products in accordance with the manual.
- The drawings presented in this manual are typical examples and may not match the product you received.
- This manual is subject to change due to product improvement, specification modification, and manual improvement. When this manual is revised, the manual code is updated and the new manual is published as a next edition. The edition number appears on the front and back covers.
- If the manual must be ordered due to loss or damage, inform your nearest Yaskawa representative or one of the offices listed on the back of this manual.
- Yaskawa will not take responsibility for the results of unauthorized modifications of this product. Yaskawa shall not be liable for any damages or troubles resulting from unauthorized modification.

Applicable Standards

■ North American Safety Standards (UL)



	Model	UL * Standards (UL File No.)
SERVOPACK	• SGD V	UL508C (E147823)
Servomotor	• SGMJV • SGMAV • SGMGV	UL1004 (E165827)

* Underwriters Laboratories Inc.

■ European Standards



	Model	Low Voltage Directive	EMC Directive	
			EMI	EMS
SERVOPACK	• SGD V	EN50178 EN61800-5-1	EN55011 class A group 1	EN61800-3
Servomotor	• SGMJV • SGMAV • SGMGV	IEC60034-1 IEC60034-5 IEC60034-8 IEC60034-9	EN55011 class A group 1	EN61800-3

* TÜV Product Services GmbH

Note: Because SERVOPACKs and servomotors are built into machines, certification is required after installation in the final product.

Contents

About this Manual	iii
Safety Precautions	vi
Applicable Standards	xi
Chapter 1 Outline	1-1
1.1 Σ -V Series SERVOPACKs	1-2
1.2 Part Names	1-2
1.3 SERVOPACK Ratings and Specifications	1-3
1.3.1 Ratings	1-3
1.3.2 Basic Specifications	1-4
1.3.3 Speed/Position/Torque Control Modes	1-6
1.4 Examples of Servo System Configurations	1-7
1.4.1 Connecting to SGD Σ - $\square\square\square$ A01A SERVOPACK	1-7
1.4.2 Connecting to SGD Σ - $\square\square\square$ D01A SERVOPACK	1-8
1.5 SERVOPACK Model Designation	1-9
1.6 Inspection and Maintenance	1-10
Chapter 2 Panel Operator	2-1
2.1 Panel Operator	2-2
2.2 Display Mode Selection	2-2
2.3 Status Display Mode	2-3
2.4 Utility Function Mode (Fn $\square\square\square$)	2-4
2.5 Parameter Setting Mode (Pn $\square\square\square$)	2-5
2.5.1 Parameter Setting Mode for Parameter Setting Type	2-5
2.5.2 Parameter Setting Mode for Function Selection Type	2-7
2.5.3 How to Read a Parameter Explanation	2-8
2.6 Monitor Mode (Un $\square\square\square$)	2-10
Chapter 3 Wiring and Connection	3-1
3.1 Main Circuit Wiring	3-2
3.1.1 Names and Functions of Main Circuit Terminals	3-2
3.1.2 SERVOPACK Main Circuit Wire Size	3-3
3.1.3 Typical Main Circuit Wiring Examples	3-5
3.1.4 General Precautions for Wiring	3-6
3.1.5 Precautions When Using the SERVOPACK with a DC Power Input	3-7
3.1.6 Precautions When Using More Than One SERVOPACK	3-9
3.1.7 Precautions When Using 400 V Power Supply Voltage	3-10
3.1.8 Designing a Power ON Sequence	3-11
3.2 I/O Signal Connections	3-12
3.2.1 I/O Signal (CN1) Names and Functions	3-12
3.2.2 I/O Signal Connector (CN1) Terminal Layout	3-14
3.2.3 Safety Function Signal (CN8) Names and Functions	3-15
3.2.4 Safety Function Signal (CN8) Terminal Layout	3-15
3.2.5 Example of I/O Signal Connections in Speed Control	3-16
3.2.6 Example of I/O Signal Connections in Position Control	3-17
3.2.7 Example of I/O Signal Connections in Torque Control	3-18

3.3 I/O Signal Allocation	3-19
3.3.1 Input Circuit Signal Allocation	3-19
3.3.2 Checking Input Signals	3-22
3.3.3 Output Circuit Signal Allocation	3-22
3.3.4 Checking Output Signals	3-25
3.4 Examples of Connection to Host Controller	3-26
3.4.1 Connection Examples of Reference Input Circuits to SERVOPACK	3-26
3.4.2 Connection Examples of Sequence Input Circuits to SERVOPACK	3-28
3.4.3 Connection Examples of Output Circuits to SERVOPACK	3-29
3.5 Examples of Encoder Connection	3-32
3.5.1 Connection Example of an Encoder	3-32
3.5.2 CN2 Encoder Connector Terminal Layout	3-33
3.6 Connecting Regenerative Resistors	3-34
3.6.1 Connecting Regenerative Resistors	3-34
3.6.2 Setting Regenerative Resistor Capacity	3-35
3.7 Noise Control and Measures for Harmonic Suppression	3-36
3.7.1 Wiring for Noise Control	3-36
3.7.2 Precautions on Connecting Noise Filter	3-38
3.7.3 Connecting DC Reactor for Harmonic Suppression	3-40

Chapter 4 Trial Operation4-1

4.1 Inspection and Checking before Trial Operation	4-2
4.2 Trial Operation for Servomotor without Load	4-2
4.3 Aligning with Origin Search (Fn003)	4-2
4.4 Trial Operation for Servomotor without Load from Host Reference	4-4
4.4.1 Inspecting Connection and Status of Input Signal Circuits	4-6
4.4.2 Trial Operation in Speed Control	4-8
4.4.3 Trial Operation under Position Control from the Host with the SERVOPACK Used for Speed Control	4-8
4.4.4 Trial Operation in Position Control	4-9
4.5 Trial Operation with the Servomotor Connected to the Machine	4-10
4.6 Trial Operation of Servomotor with Brakes	4-11
4.7 Test Without Motor Function	4-12
4.7.1 Limitations	4-12
4.7.2 Operating Procedure	4-13
4.7.3 Related Parameters	4-14
4.7.4 Operator Display during Testing without Motor	4-14

Chapter 5 Operation5-1

5.1 Control Selection	5-3
5.2 Setting Common Basic Functions	5-4
5.2.1 Servo ON Signal	5-4
5.2.2 Servomotor Rotation Direction	5-5
5.2.3 Overtravel	5-6
5.2.4 Holding Brakes	5-8
5.2.5 Stopping Method for Servomotor after Servo OFF or Alarm Occurrence	5-13
5.2.6 Power Loss Settings	5-15
5.2.7 Torque Limit Function for Low Power Supply Voltage for Main Circuit (SEMI-F47 Function)	5-16
5.3 Operating Using Speed Control with Analog Voltage Reference	5-17
5.3.1 Basic Settings for Speed Control	5-17
5.3.2 Reference Offset Adjustment	5-19
5.3.3 Soft Start	5-21
5.3.4 Speed Reference Filter	5-22
5.3.5 Zero Clamp Function	5-23
5.3.6 Encoder Pulse Output	5-25

5.3.7 Encoder Pulse Output Setting	5-26
5.3.8 Speed Coincidence Signal Setting	5-27
5.4 Operating Using Position Control with Pulse Train Reference	5-28
5.4.1 Basic Settings for Position Control Mode	5-28
5.4.2 Clear Signal	5-33
5.4.3 Electronic Gear	5-34
5.4.4 Smoothing	5-36
5.4.5 Positioning Completed Output Signal	5-38
5.4.6 Positioning Near Signal	5-39
5.4.7 Reference Pulse Inhibit Function	5-40
5.5 Operating Using Torque Control with Analog Voltage Reference	5-42
5.5.1 Basic Settings for Torque Control Mode	5-42
5.5.2 Adjustment of Reference Offset	5-43
5.5.3 Speed Limit in Torque Control	5-45
5.6 Operating Using Speed Control with an Internally Set Speed	5-48
5.6.1 Basic Settings for Speed Control with an Internally Set Speed	5-48
5.6.2 Example of Operating with Internally Set Speed	5-50
5.7 Control Selection	5-52
5.7.1 Combination of Control Modes	5-52
5.7.2 Switching Internally Set Speed Control (Pn000.1 = 4, 5, or 6)	5-52
5.7.3 Switching Other Than Internally Set Speed Control (Pn000.1 = 7, 8, 9, A, or B)	5-53
5.8 Limiting Torque	5-54
5.8.1 Internal Torque Limit	5-54
5.8.2 External Torque Limit	5-55
5.8.3 Torque Limiting Using an Analog Voltage Reference	5-56
5.8.4 Torque Limiting Using an External Torque Limit and Analog Voltage Reference	5-57
5.8.5 Checking Output Torque Limiting during Operation	5-59
5.9 Absolute Encoders	5-60
5.9.1 Encoder Resolutions	5-60
5.9.2 Standard Connection Diagram for an Absolute Encoder and Setting the SEN Signal	5-61
5.9.3 Absolute Encoder Data Backup	5-62
5.9.4 Encoder Battery Alarm (A. 830)	5-63
5.9.5 Absolute Encoder Setup	5-64
5.9.6 Absolute Encoder Reception Sequence	5-65
5.9.7 Multiturn Limit Setting	5-68
5.9.8 Multiturn Limit Disagreement Alarm (A.CC0)	5-69
5.10 Output Signals Used in All Control Modes	5-70
5.10.1 Servo Alarm Output Signal (ALM) and Alarm Code Output Signals (ALO1, ALO2, and ALO3)	5-70
5.10.2 Warning Output Signal (/WARN)	5-71
5.10.3 Rotation Detection Output Signal (/TGON)	5-72
5.10.4 Servo Ready Output Signal (/S-RDY)	5-72
5.11 Safety Function	5-73
5.11.1 Hard Wire Base Block (HWBB) Function	5-73
5.11.2 External Device Monitor (EDM1)	5-77
5.11.3 Application Example of Safety Functions	5-79
5.11.4 Confirming Safety Functions	5-80
5.11.5 Precautions for Safety Functions	5-80

Chapter 6 Adjustments 6-1

6.1 Adjustments and Basic Adjustment Procedure	6-3
6.1.1 Adjustments	6-3
6.1.2 Basic Adjustment Procedure	6-4
6.1.3 Monitoring Analog Signals	6-5
6.1.4 Safety Precautions on Adjustment of Servo Gains	6-7
6.2 Tuning-less Function (Fn200)	6-10
6.2.1 Tuning-less Function	6-10
6.2.2 Tuning-less Operating Procedure	6-11

6.3 Advanced Autotuning (Fn201)	6-15
6.3.1 Advanced Autotuning	6-15
6.3.2 Advanced Autotuning Procedure	6-19
6.3.3 Related Parameters	6-24
6.4 Advanced Autotuning by Reference (Fn202)	6-25
6.4.1 Advanced Autotuning by Reference	6-25
6.4.2 Advanced Autotuning by Reference Procedure	6-29
6.4.3 Related Parameters	6-31
6.5 One-parameter Tuning (Fn203)	6-32
6.5.1 One-parameter Tuning	6-32
6.5.2 One-parameter Tuning Procedure	6-34
6.5.3 One-parameter Tuning Example	6-38
6.5.4 Related Parameters	6-39
6.6 Anti-Resonance Control Adjustment Function (Fn204)	6-40
6.6.1 Anti-Resonance Control Adjustment Function	6-40
6.6.2 Anti-Resonance Control Adjustment Function Operating Procedure	6-41
6.6.3 Related Parameters	6-45
6.7 Vibration Suppression Function (Fn205)	6-46
6.7.1 Vibration Suppression Function	6-46
6.7.2 Vibration Suppression Function Operating Procedure	6-47
6.7.3 Related Parameters	6-49
6.8 Servo Gain Adjustment Application Function	6-50
6.8.1 Feedforward Reference	6-51
6.8.2 Torque Feedforward	6-52
6.8.3 Speed Feedforward	6-53
6.8.4 Proportional Control Operation (Proportional Operation Reference)	6-54
6.8.5 Using the Mode Switch (P/PI Switching)	6-55
6.8.6 Switching Gain Settings	6-59
6.8.7 Torque Reference Filter	6-63
6.8.8 Position Integral Time Constant	6-65
6.8.9 Friction Compensation	6-66

Chapter 7 Utility Functions (Fn□□□) 7-1

7.1 List of Utility Functions	7-2
7.2 Alarm History Display (Fn000)	7-4
7.3 JOG Operation (Fn002)	7-5
7.4 Origin Search (Fn003)	7-6
7.5 Program JOG Operation (Fn004)	7-8
7.6 Initializing Parameter Settings (Fn005)	7-13
7.7 Clearing Alarm History (Fn006)	7-14
7.8 Manual Zero-adjustment of Analog Monitor Output (Fn00C)	7-15
7.9 Manual Gain-adjustment of Analog Monitor Output (Fn00D)	7-17
7.10 Automatic Offset-Signal Adjustment of the Motor Current Detection (Fn00E)	7-19
7.11 Manual Offset-Signal Adjustment of the Motor Current Detection (Fn00F)	7-20
7.12 Write Prohibited Setting (Fn010)	7-21
7.13 Servomotor Model Display (Fn011)	7-23
7.14 Software Version Display (Fn012)	7-24
7.15 Resetting Configuration Error of Option Card (Fn014)	7-25
7.16 Vibration Detection Level Initialization (Fn01B)	7-26
7.17 Display of SERVOPACK and Servomotor ID (Fn01E)	7-28
7.18 Display of Servomotor ID in Feedback Option Card (Fn01F)	7-29
7.19 EasyFFT (Fn206)	7-30
7.20 Online Vibration Monitor (Fn207)	7-34

7.21 Origin Setting (Fn020)	7-36
7.22 Software Reset (Fn030)	7-37

Chapter 8 Monitor Modes (Un□□□) 8-1

8.1 List of Monitor Modes	8-2
8.2 Operation in Monitor Mode	8-3
8.3 Reading 32-bit Decimal Displays	8-4
8.4 Monitoring Input Signals	8-5
8.4.1 Checking Input Signal Status	8-5
8.4.2 Interpreting Input Signal Display Status	8-5
8.4.3 Input Signal Display Example	8-6
8.5 Monitoring Output Signals	8-7
8.5.1 Checking Output Signal Status	8-7
8.5.2 Interpreting Output Signal Display Status	8-7
8.5.3 Output Signal Display Example	8-7
8.6 Monitor Display at Power ON	8-8
8.7 Monitoring I/O Signals	8-8

Chapter 9 Fully-closed Loop Control 9-1

9.1 System Configuration and Connection Example for SERVOPACK with Fully-closed Loop Control	9-2
9.1.1 System Configuration	9-2
9.1.2 Internal Configuration of Fully-closed Loop Control	9-3
9.1.3 Serial Converter Unit	9-4
9.1.4 Analog Signal Input Timing	9-5
9.1.5 Connection Example of External Encoder by Heidenhain	9-6
9.1.6 Connection Example of External Encoder by Mitutoyo	9-7
9.1.7 Connection Example of External Encoder by Renishaw	9-8
9.1.8 Encoder Output Pulse Signals from SERVOPACK with a External Encoder by Renishaw	9-9
9.2 Related Parameters	9-10
9.2.1 Setting Order of Related Parameters	9-10
9.2.2 Speed Feedback Method during Fully-closed Loop Control	9-10
9.2.3 Motor Rotation Direction	9-10
9.2.4 Sine Wave Pitch (Frequency) for an External Encoder	9-12
9.2.5 Number of Encoder Output Pulses (PAO, PBO, and PCO) from the SERVOPACK	9-13
9.2.6 Electronic Gear	9-14
9.2.7 Alarm Detection	9-14
9.2.8 Analog Monitor Signal	9-15

Chapter 10 Troubleshooting 10-1

10.1 Troubleshooting	10-2
10.1.1 List of Alarms	10-2
10.1.2 Troubleshooting of Alarms	10-6
10.2 Warning Displays	10-22
10.2.1 List of Warnings	10-22
10.2.2 Troubleshooting of Warnings	10-23
10.3 Troubleshooting Malfunction Based on Operation and Conditions of the Servomotor	10-25

Chapter 11 Appendix	11-1
11.1 Connection to Host Controller	11-2
11.1.1 Example of Connection to MP2200/MP2300 Motion Module SVA-01	11-2
11.1.2 Example of Connection to MP920 4-axes Analog Module SVA-01	11-3
11.1.3 Example of Connection to OMRON's Motion Control Unit	11-4
11.1.4 Example of Connection to OMRON's Position Control Unit	11-5
11.1.5 Connection to MITSUBISHI's AD72 Positioning Unit (SERVOPACK in Speed Control Mode)	11-6
11.1.6 Connection to MITSUBISHI's AD75 Positioning Unit (SERVOPACK in Position Control Mode)	11-7
11.2 List of Parameters	11-8
11.2.1 Utility Functions	11-8
11.2.2 Parameters	11-9
11.3 Monitor Modes	11-30
11.4 Parameter Recording Table	11-31

Revision History

Outline

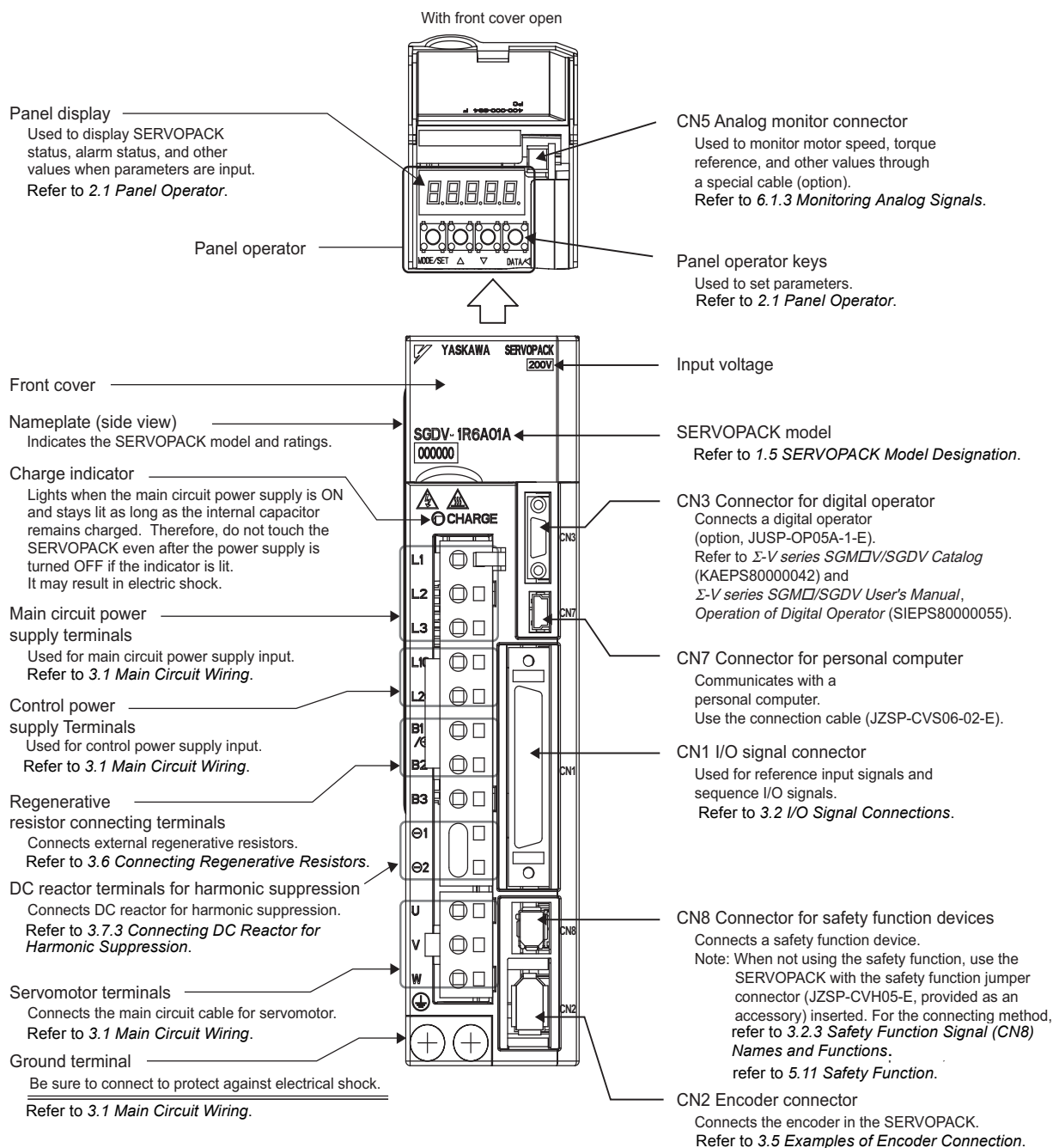
1.1 Σ -V Series SERVOPACKs	1-2
1.2 Part Names	1-2
1.3 SERVOPACK Ratings and Specifications	1-3
1.3.1 Ratings	1-3
1.3.2 Basic Specifications	1-4
1.3.3 Speed/Position/Torque Control Modes	1-6
1.4 Examples of Servo System Configurations	1-7
1.4.1 Connecting to SGD \square \square \square A01A SERVOPACK	1-7
1.4.2 Connecting to SGD \square \square \square D01A SERVOPACK	1-8
1.5 SERVOPACK Model Designation	1-9
1.6 Inspection and Maintenance	1-10

1.1 Σ -V Series SERVOPACKs

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

1.2 Part Names

This section describes the part names of SGD-V type SERVOPACK for analog voltage and pulse train reference.



1.3 SERVOPACK Ratings and Specifications

This section describes the ratings and specifications of SERVOPACKs.

1.3.1 Ratings

Ratings of SERVOPACKs are as shown below.

(1) 200 VAC Rating

SGDV (200 VAC)		R70	R90	1R6	2R8	3R8	5R5
200 V	Continuous Output Current [Arms]	0.66	0.91	1.6	2.8	3.8	5.5
	Max. Output Current [Arms]	2.1	2.9	6.5	9.3	11.0	16.9
Input Power Supply	200 V	Main Circuit	Three-phase, 200 to 230 VAC $+10\%$ -15% , 50/60 Hz				
		Control Circuit	Single-phase, 200 to 230 VAC $+10\%$ -15% , 50/60 Hz				
	Overvoltage Category		III				

(2) 400 VAC Rating

SGDV (400 VAC)		1R9	3R5	5R4	8R4	120	170
400 V	Continuous Output Current [Arms]	1.9	3.5	5.4	8.4	11.9	16.5
	Max. Output Current [Arms]	5.5	8.5	14	20	28	42
Input Power Supply	400 V	Main Circuit	Three-phase, 380 to 480 VAC $+10\%$ -15% , 50/60 Hz				
		Control Circuit	24 VDC $\pm 15\%$ $+10\%$ -15%				
	Overvoltage Category		III				

1.3.2 Basic Specifications

Basic specifications of SERVOPACKs are shown below.

Control Method			Single or three-phase full-wave rectification IGBT-PWM (sine-wave driven)		
Feedback			Serial encoder: 13-bit (incremental), 20-bit (incremental/absolute)		
Operating Conditions	Ambient/Storage Temperature		0 to +55°C/ -20 to +85°C		
	Ambient/Storage Humidity		90% RH or less (with no condensation)		
	Vibration/Shock Resistance		4.9 m/s ² / 19.8 m/s ²		
	Protection Class/ Pollution Degree		Protection class: IP1X, Pollution degree: 2 An environment that satisfies the following conditions. <ul style="list-style-type: none">• Free of corrosive or explosive gases• Free of exposure to water, oil or chemicals• Free of dust, salts or iron dust		
	Altitude		1000 m or less		
	Others		Free of static electricity, strong electromagnetic fields, magnetic fields or exposure to radioactivity		
Applicable Standards			UL508C EN50178, EN55011 group1 classA, EN61000-6-3		
Configuration			Base-mounted *1		
Performance	Speed Control Range		1:5000		
	Speed Regulation*2	Load Regulation	0 to 100% load: ±0.01% max. (at rated speed)		
		Voltage Regulation	Rated voltage ±10%: 0% (at rated speed)		
		Temperature Regulation	25 ± 25 °C: ±0.1% max. (at rated speed)		
	Torque Control Tolerance (Repeatability)		±1%		
	Soft Start Time Setting		0 to 10 s (Can be set individually for acceleration and deceleration.)		
I/O Signals	Encoder Output Pulses		Phase-A, -B, -C: line driver Encoder output pulse: any setting ratio		
	Sequence Input	Number of Channels	7 ch		
		Functions	The signal allocation and positive/negative logic can be modified. Servo ON (/SVON), proportional control (/P-CON), alarm reset (/ALM-RST), forward run prohibited (P-OT), reverse run prohibited (N-OT), forward torque limit (/P-CL), reverse torque limit (/N-CL), internal set speed selection (/SPD-D, /SPD-A, /SPD-B), control selection (/C-SEL), zero clamping (/ZCLAMP), reference pulse inhibit (/INHIBIT), gain selection (/G-SEL)		
	Sequence Output	Fixed Output	Servo alarm (ALM), alarm code (AL01, AL02, AL03) outputs		
		Number of Channels	3 ch		
		Functions	The signal allocation and positive/negative logic can be modified. Positioning completion (/COIN), speed coincidence detection (/V-CMP), servomotor rotation detection (/TGON), servo ready (/S-RDY), torque limit detection (/CLT), speed limit detection (/VLT), brake interlock (/BK), warning (/WARN), near (/NEAR)		

Communi- cations Function	RS422A Communi- cations	Interface	Digital operator (JUSP-OP05A-1-E), personal computer (can be con- nected with SigmaWin+), etc.
		1:N Communications	N = Up to 15 stations possible at RS422A
		Axis Address Setting	Set by parameter
		Function	Status display, parameter setting, tuning function, utility function, parameter copy function
	USB Communi- cations	Interface	Personal computer (can be connected with SigmaWin+.)
		Communications Standard	Complys with standard USB1.1. (12 Mbps)
		Function	Status display, parameter setting, tuning function, utility function
LED Display			CHARGE, five 7-segment LEDs
Analog Monitor (CN5)			Number of channels: 2 ch Output voltage: $\pm 10\text{V DC}$ (linearity effective range $\pm 8\text{V}$) Resolution: 16 bit Accuracy: $\pm 20\text{ mV (Typ)}$ Max. output current: $\pm 10\text{ mA}$ Settling time ($\pm 1\%$): 1.2 ms (Typ)
Dynamic Brake (DB)			Operated at main power OFF, servo alarm, servo OFF or overtravel
Regenerative Processing			Built-in or external regenerative resistor (option)
Overtravel Prevention (OT)			Dynamic brake stop at P-OT or N-OT, deceleration to a stop, or free run to a stop
Protection Function			Overcurrent, overvoltage, insufficient voltage, overload, regenera- tion error, and so on.
Utility Function			Gain adjustment, alarm history, JOG operation, origin search, and so on.
Safety Function	Input	/HWBB1, /HWBB2: Baseblock signal for power module	
	Output	EDM1: Monitoring status of internal safety circuit (fixed output)	
Option Card Adding Function	Fully-closed Loop Interface Card	Serial communications interface for fully-closed loop control	

*1. Rack mounting and duct-ventilated type available as an option.

*2. Speed regulation is defined as follows:

$$\text{Speed regulation} = \frac{\text{No-load motor speed} - \text{Total load motor speed}}{\text{Rated motor speed}} \times 100\%$$

The motor speed may change due to voltage variations or amplifier drift and changes in processing resistance due to temperature variation. The ratio of speed changes to the rated speed represent speed regulation due to voltage and temperature variations.

1.3.3 Speed/Position/Torque Control Modes

The following table shows the basic specifications at speed/position/torque control mode.

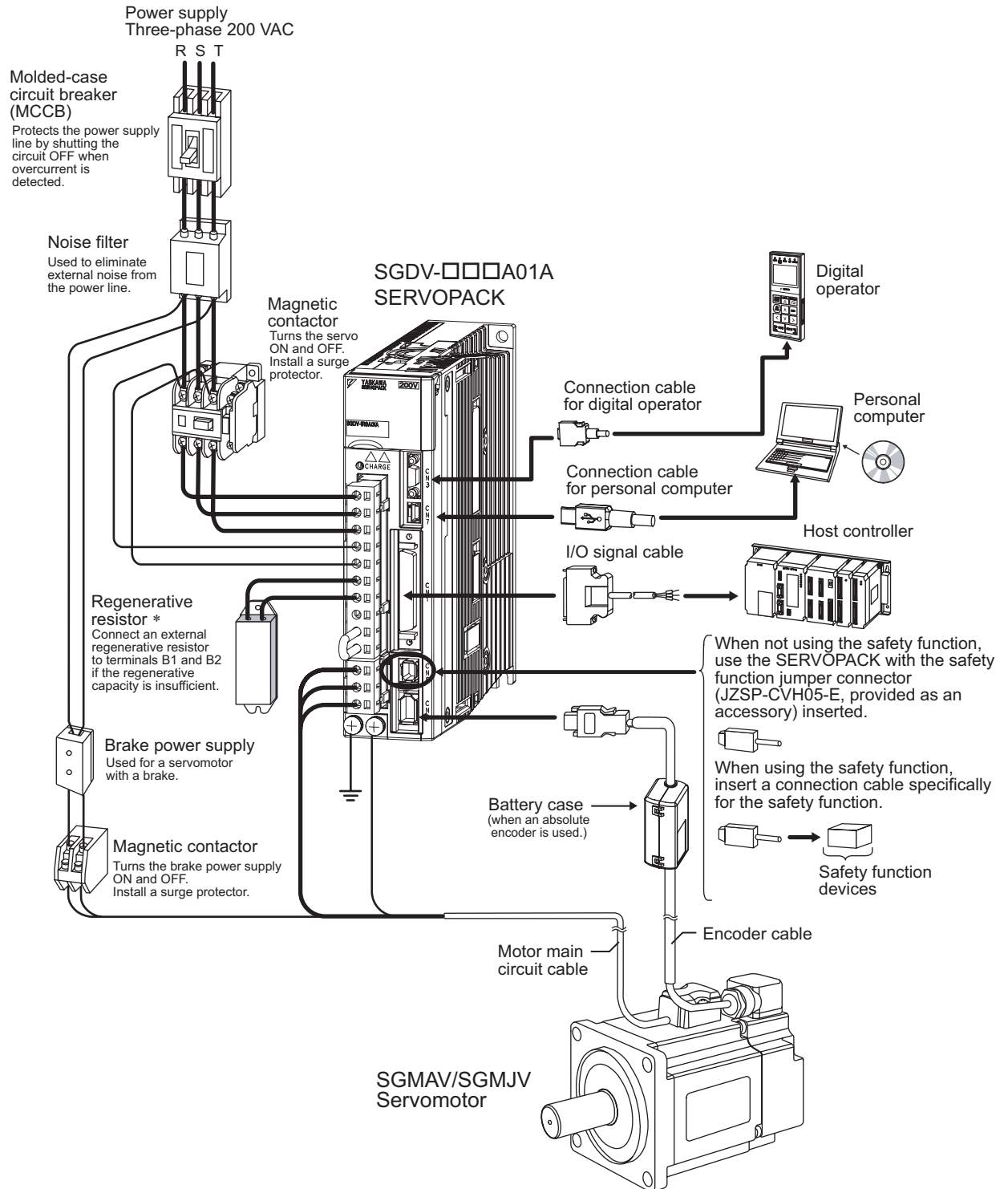
Control Mode		Specifications	
Speed Control	Performance	Soft Start Time Setting	0 to 10 s (Can be set individually for acceleration and deceleration.)
	Input Signals	Reference Voltage	Max. input voltage: ± 12 V (forward speed reference with positive reference) Factory setting: ± 6 VDC at rated speed Input gain setting can be varied. ± 1.5 to ± 30 VDC at rated speed (Input voltage range: within max. input voltage)
		Input Impedance	About 14 k Ω minimum
		Circuit Time Constant	30 μ s
	Internal Set Speed Control	Rotation Direction Selection	With proportional control signal
		Speed Selection	With forward/reverse torque limit signal (speed 1 to 3 selection), servomotor stops or another control method is used when both are OFF.
Position Control	Performance	Feedforward Compensation	0 to 100% (setting resolution: 1%)
		Positioning Completed Width Setting	0 to 1073741824 reference units (setting resolution: 1 reference unit)
	Input Signals	Reference Pulse	Type Sign + pulse train, 90° phase difference 2-phase pulse (phase A + phase B), or CW + CCW pulse train
			Form For line driver, open collector
		Max. Input Pulse Frequency*	Sign + pulse train, CW + CCW phase train: 4 Mpps 90° phase difference 2-phase pulse \times 1 multiplier: 4 Mpps 90° phase difference 2-phase pulse \times 2 multiplier: 2 Mpps 90° phase difference 2-phase pulse \times 4 multiplier: 1 Mpps Open collector: 200 kpps
			Clear Signal Error pulse clear. For line driver, open collector
Torque Control	Input Signals	Reference Voltage	Max. input voltage: ± 12 V (forward torque reference with positive reference) Factory setting: ± 3 VDC at rated torque Input gain setting can be varied. ± 1 to ± 10 VDC at rated torque (Input voltage range: within max. input voltage)
		Input Impedance	About 14 k Ω minimum
		Circuit Time Constant	16 μ s

* When duty cycle changes from the specifications, frequency decreases.

1.4 Examples of Servo System Configurations

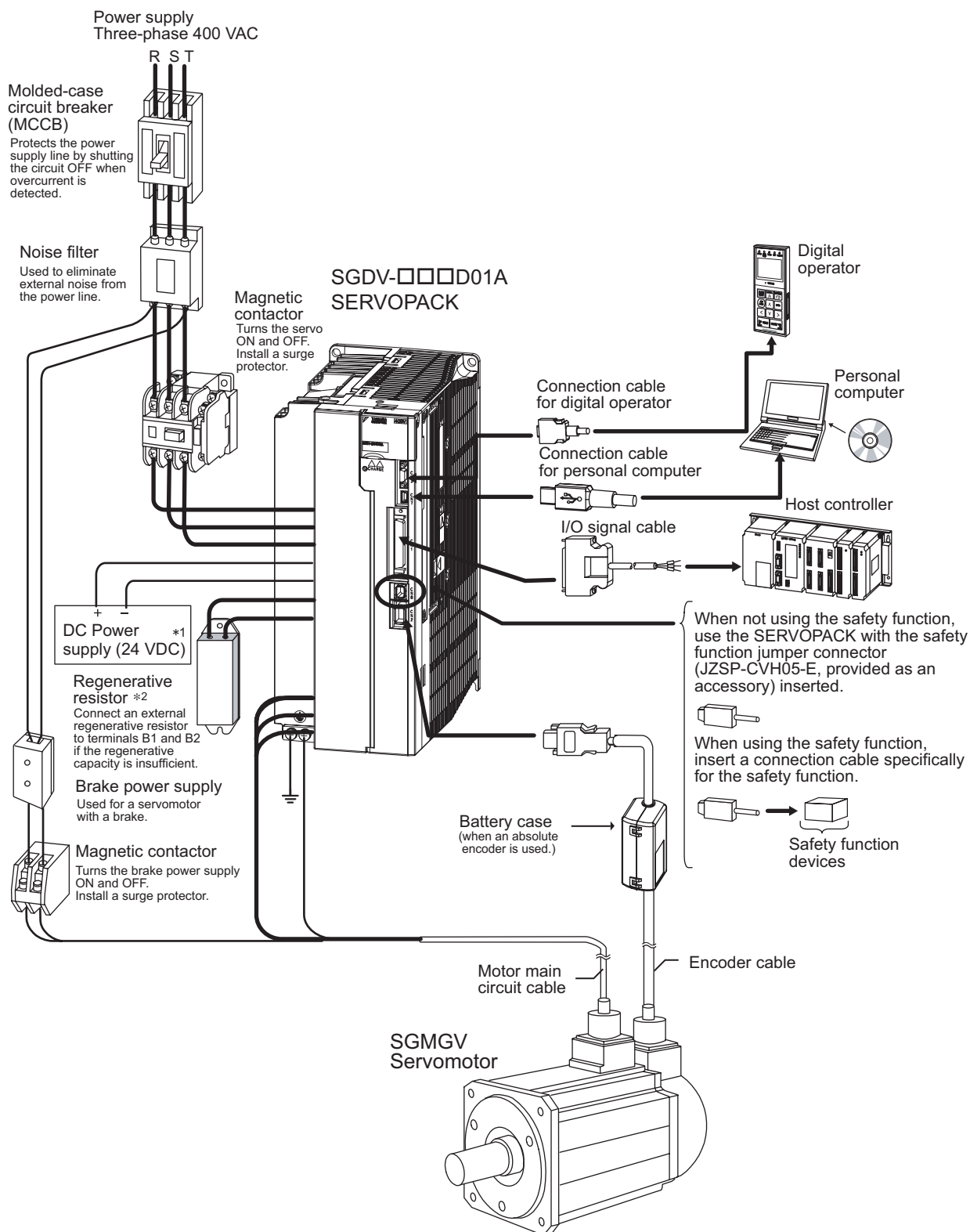
This section describes examples of basic servo system configuration.

1.4.1 Connecting to SGDV-□□□A01A SERVOPACK



* Remove the lead wire between the terminal B2 and B3 on the SERVOPACK before connecting an external regenerative resistor to the SERVOPACK.

1.4.2 Connecting to SGD V-□□□D01A SERVOPACK

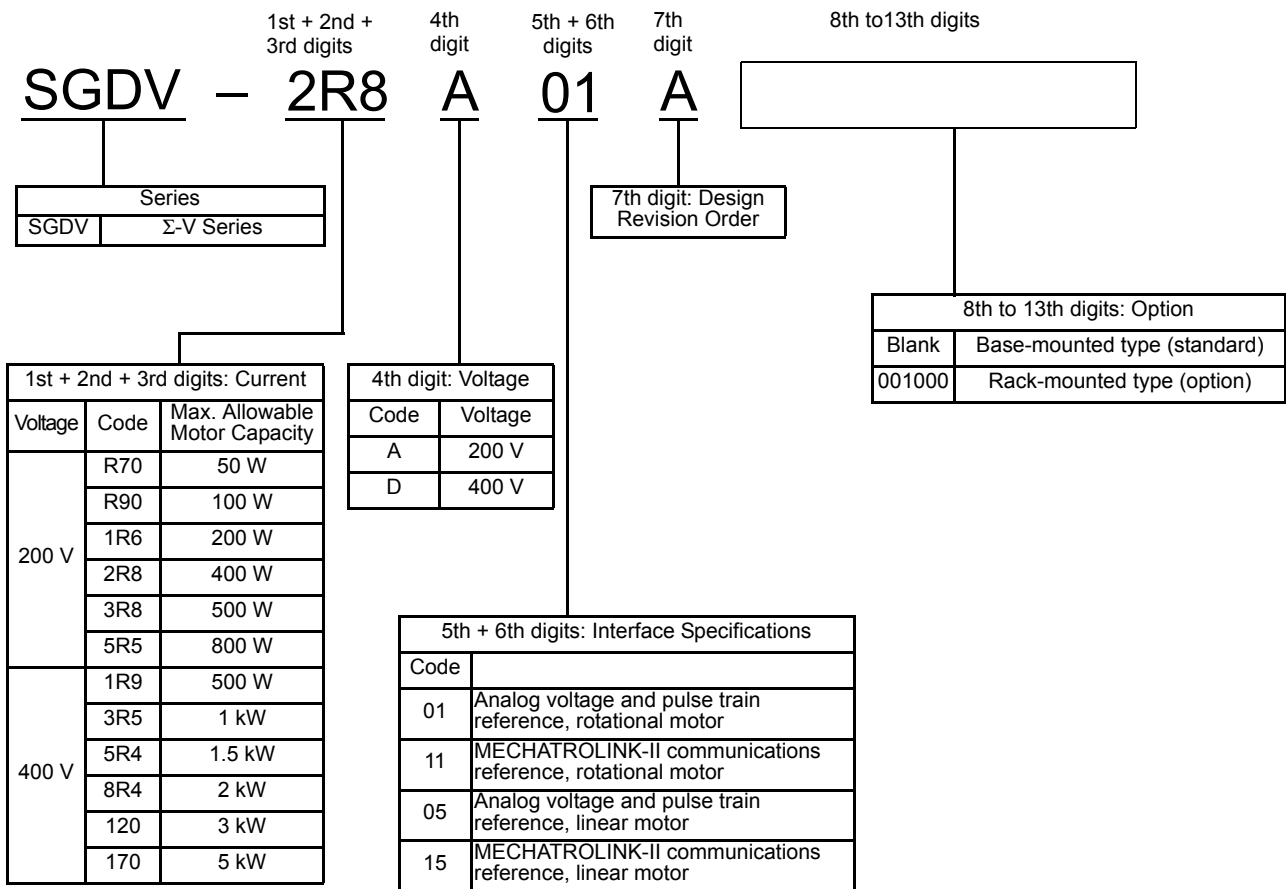


*1. Use a 24 VDC power supply. (Must be prepared by the user.)

*2. Remove the lead wire between the terminals B2 and B3 on the SERVOPACK before connecting an external regenerative resistor to the SERVOPACK.

1.5 SERVOPACK Model Designation

Select the SERVOPACK according to the applied servomotor.



1.6 Inspection and Maintenance

This section describes the inspection and maintenance of SERVOPACK.

(1) SERVOPACK Inspection


For inspection and maintenance of the SERVOPACK, follow the inspection procedures in the following table at least once every year. Other routine inspections are not required.

Item	Frequency	Procedure	Comments
Exterior	At least once a year	Check for dust, dirt, and oil on the surfaces.	Clean with compressed air.
Loose Screws		Check for loose terminal block and connector screws.	Tighten any loose screws.

(2) SERVOPACK's Parts Replacement Schedule

The following electric or electronic parts are subject to mechanical wear or deterioration over time. To avoid failure, replace these parts at the frequency indicated.

Refer to the standard replacement period in the following table, contact your Yaskawa representative. After an examination of the part in question, we will determine whether the parts should be replaced or not.

 IMPORTANT	<p>The parameters of any SERVOPACKs overhauled by Yaskawa are reset to the factory settings before shipping. Be sure to confirm that the parameters are properly set before starting operation.</p>
--	---

Part	Standard Replacement Period	Operating Conditions
Cooling Fan	4 to 5 years	<ul style="list-style-type: none"> • Ambient Temperature: Annual average of 30°C • Load Factor: 80% max. • Operation Rate: 20 hours/day max.
Smoothing Capacitor	7 to 8 years	
Relays	-	
Fuses	10 years	
Aluminum Electrolytic Capacitor on Circuit Board	5 years	

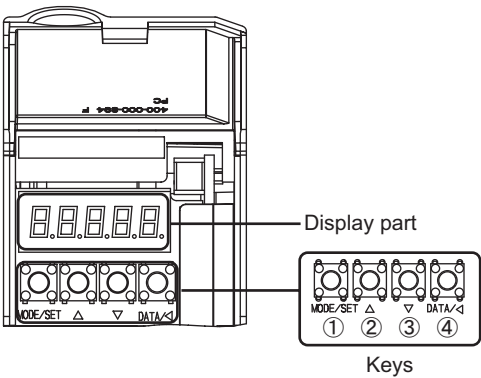
Panel Operator

2.1 Panel Operator	2-2
2.2 Display Mode Selection	2-2
2.3 Status Display Mode	2-3
2.4 Utility Function Mode (Fn□□□)	2-4
2.5 Parameter Setting Mode (Pn□□□)	2-5
2.5.1 Parameter Setting Mode for Parameter Setting Type	2-5
2.5.2 Parameter Setting Mode for Function Selection Type	2-7
2.5.3 How to Read a Parameter Explanation	2-8
2.6 Monitor Mode (Un□□□)	2-10

2.1 Panel Operator

Panel operator consists of display part and keys.
Parameter setting, status display and JOG operation are enabled using the panel operator.

The names and functions of the keys on the panel operator are as follows.



Display part

Keys

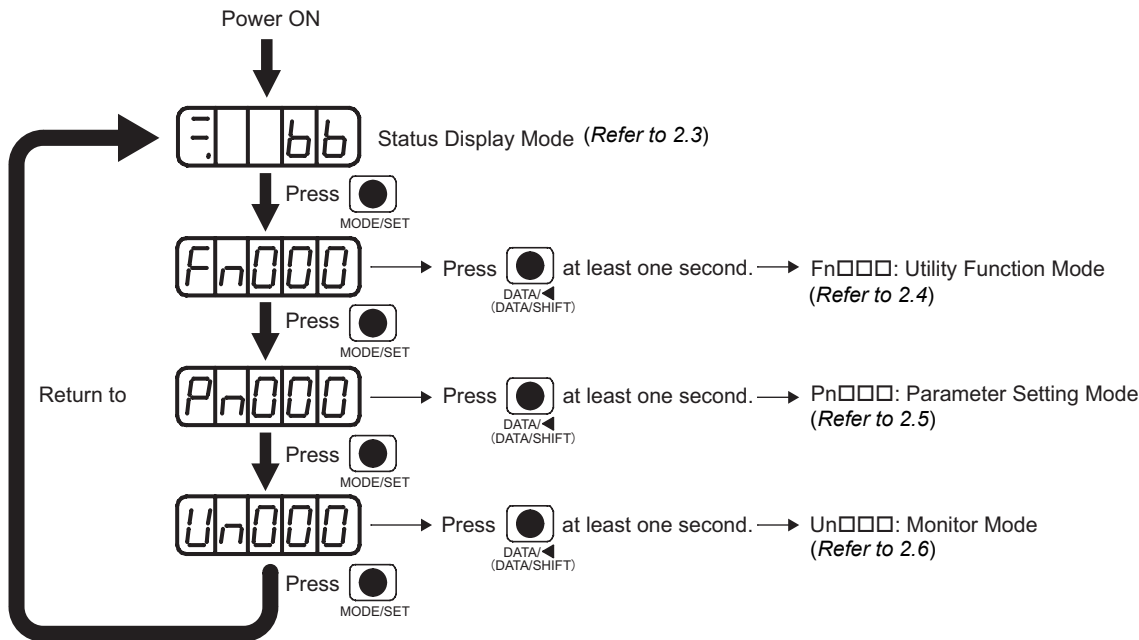
① ② ③ ④

Key No.	Key Name	Function
①	MODE/SET Key	To select a display mode. Refer to 2.2 <i>Display Mode Selection</i> .
②	UP Key	Press the UP Key to increase the set value.
③	DOWN Key	Press the DOWN Key to decrease the set value.
④	DATA/SHIFT Key	To set and display the set value. To shift to the next digit on the left at blinking.

Note: To reset the servo alarm, press the UP Key and the DOWN Key simultaneously. Be sure to remove the cause and then reset the alarm.

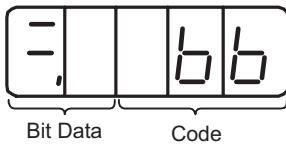
2.2 Display Mode Selection

Press the MODE/SET Key to select a display mode in the following order.



2.3 Status Display Mode

The display shows the following status.



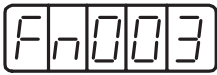
Code	Meaning	Code	Meaning
	Baseblock Servo OFF (servomotor power OFF)		Reverse Run Prohibited N-OT is OFF.
	Run Servo ON (servomotor power ON)		Hard Wire Base Block The SERVOPACK is baseblocked by the safety function.
	Forward Run Prohibited P-OT is OFF.	(Example: Run Status) Run Status Test without Motor	Mode Test without Motor Status display differs depending on the status of motor and SERVOPACK. Refer to 4.7 <i>Test Without Motor Function</i> .
			Alarm Blinks the alarm number.

Display	Meaning
	Control Power ON Light when SERVOPACK control power is ON. Does not light when SERVOPACK control power is OFF.
	Baseblock Light for baseblock. Does not light when servo is ON.
	In speed/torque control: Speed Coincidence (/V-CMP) Light when the difference between the servomotor speed and reference speed is the same as or less than the value set in Pn503. (Factory setting: 10 min ⁻¹) * Always light in torque control mode. In position control: Positioning Completion (/COIN) Light if error between position reference and actual motor position is less than the value set in Pn522. (Factory setting: 7 reference units)
	Rotation Detection (/TGON) Light if motor speed exceeds the value set in Pn502. (Factory setting: 20 min ⁻¹)
	In speed/torque control mode: Speed Reference Input Light if input speed reference exceeds the value set in Pn502. (Factory setting: 20 min ⁻¹). In position control mode: Reference Pulse Input Light if reference pulse is input. Does not light if no reference pulse is input.
	In speed/torque control mode: Torque Reference Input Light if input torque reference exceeds preset value (10% of the rated torque). Does not light if input torque reference is below preset value. In position control mode: Clear Signal Input Light when clear signal is input. Does not light when clear signal is not input.
	Power Ready Light when main power supply circuit is normal. Does not light when power is OFF.

2.4 Utility Function Mode (Fn□□□)

The operation and adjustment functions of the servomotor are executed in this mode.

The panel operator displays numbers beginning with Fn.



Display Example for Origin Search

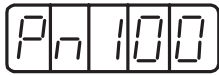
An operation example in Utility Function Mode is shown below for Origin Search (Fn003).

Step	Display after Operation	Keys	Description											
1			Press the MODE/SET Key to select the utility function mode.											
2			Press the UP or the DOWN Key to select the Fn003.											
3			Press the DATA/SHIFT Key for approximately one second, and the display shown on the left appears.											
4			Press the MODE/SET Key. The servomotor is turned to Servo ON.											
5			<div>Pressing the UP Key will rotate the motor in the forward direction. Pressing the DOWN Key will rotate the motor in the reverse direction. The rotation of the servomotor changes according to the setting of Pn000.0.</div> <table><tr><th colspan="2">Parameter</th><th>UP key (Forward)</th><th>DOWN key (Reverse)</th></tr><tr><td rowspan="2">Pn000</td><td>n.□□□0</td><td>CCW</td><td>CW</td></tr><tr><td>n.□□□1</td><td>CW</td><td>CCW</td></tr></table> <div>Note: Direction when viewed from the load of the servomotor.</div>	Parameter		UP key (Forward)	DOWN key (Reverse)	Pn000	n.□□□0	CCW	CW	n.□□□1	CW	CCW
Parameter		UP key (Forward)	DOWN key (Reverse)											
Pn000	n.□□□0	CCW	CW											
	n.□□□1	CW	CCW											
6	 Display blinks.		When the servomotor origin search is completed, the display blinks. At this moment, the motor is servo-locked at the origin pulse position.											
7			Press the DATA/SHIFT Key for approximately one second. "Fn003" is displayed again.											

2.5 Parameter Setting Mode (Pn□□□)

Parameters related to the operation and adjustment of the servomotor are set in this mode.

The panel operator displays numbers beginning with Pn.



Display Example for Speed Loop Gain

There are two types of parameters. One type requires value setting (parameter setting type) and the other requires selecting the function allocated to each digit of the panel operator (function selection type).

The operation method differs between two types.

As for the operation method of parameter setting type, refer to 2.5.1.

As for the operation method of function selection type, refer to 2.5.2.

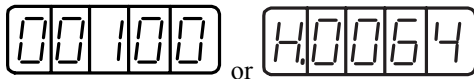
2.5.1 Parameter Setting Mode for Parameter Setting Type

This section describes how to set parameters for the parameter setting type in parameter setting mode.

<Supplementary Information>

Display Method for Set Values

The set values of the parameter setting type are expressed in five decimal or hexadecimal digits or more.



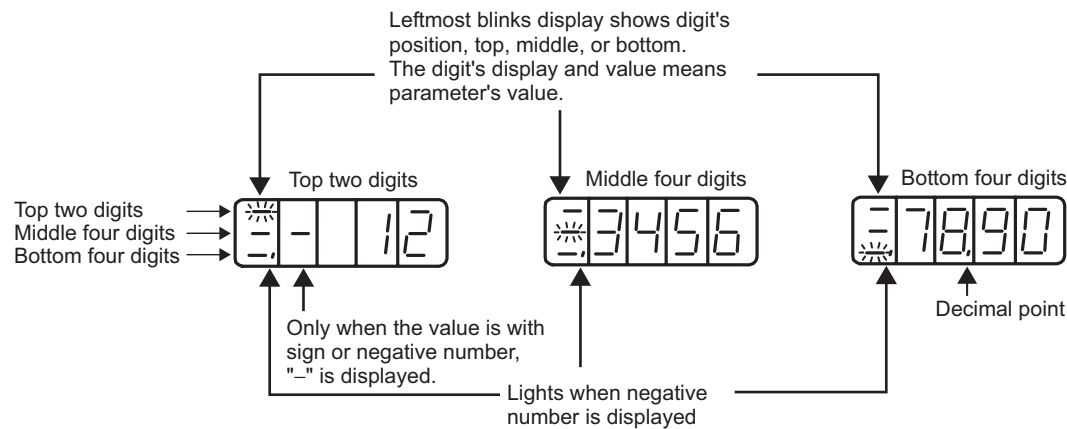
(1) Parameters with Setting Ranges of Up to Five Digits

The example below shows how to change parameter Pn100 (speed loop gain) from "40.0" to "100.0."

Step	Display after Operation	Keys	Description
1			Press the MODE/SET Key to select the parameter setting mode. If Pn100 is not displayed, press the UP or the DOWN Key to select Pn100.
2			Press the DATA/SHIFT Key for approximately one second. The current data of Pn100 is displayed.
3			Press the DATA/SHIFT Key to select the digit to be set.
4			Press the UP or the DOWN Key to change the data. Keep pressing the UP or the DOWN Key until "0100.0" is displayed.
5			Press the DATA/SHIFT Key for approximately one second. The value blinks and is saved. The data for the speed loop gain (Pn100) is changed from "40.0" to "100.0."
6			Press the DATA/SHIFT Key for approximately one second. "Pn100" is displayed again.

(2) Parameters with Setting Ranges of Six Digits or More

Panel operator displays five digits. When the parameters have more than six digits, values are displayed and set as shown below.



Procedures for display and setting of "Pn20E = 1234567890" are shown below.

Step	Display after Operation	Keys	Description
1			Press the MODE/SET Key to select the parameter setting mode. If Pn20E is not displayed, press the UP Key or the DOWN Key to select Pn20E.
2	Bottom four digits 		Press the DATA/SHIFT Key for approximately one second. The current data of Pn20E are displayed. The bottom four digits are displayed first, and rightmost digit's value will blink and be selected. When move to other digits, press the DATA/SHIFT Key. Change the digit's value by pressing the UP/DOWN Key. When the DATA/SHIFT Key is pressed on fourth digit "7," middle four digits are displayed.
3	Middle four digits 		Each time the DATA/SHIFT Key is pressed, the value from fifth digits to eighth digits are selected. Changed the digits value by pressing the UP/DOWN Key. When the DATA/SHIFT Key is pressed on eighth digit "3," the top two digits are displayed.
4	Top two digits 		Change the digits value by pressing the UP/DOWN Key. Press the MODE/SET Key for approximately one second. "Pn20E" is displayed again. If the DATA/SHIFT Key is pressed when tenth value "1" is selected, the bottom four digits are displayed again.

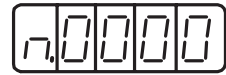
2.5.2 Parameter Setting Mode for Function Selection Type

The parameter setting mode of the function selection type is used to select and set the function allocated to each digit displayed on the panel operator.

<Supplementary Information>

Display Method for Set Values

The set values for the function selection type are expressed in hexadecimal.



(1) Changing Function Selection Parameter Settings

The example below shows how to change the setting of control method selection (Pn000.1) of the function selection basic switch Pn000 from speed control to position control.

Step	Display after Operation	Keys	Description
1			Press the MODE/SET Key to select the parameter setting mode. If Pn000 is not displayed, press the UP or the DOWN Key to select Pn000.
2			Press the DATA/SHIFT Key for approximately one second. The current data of Pn000 is displayed.
3			Press the DATA/SHIFT Key once to select the first digit of current data.
4			Press the UP Key once to change "n.0010." (Set the control method to position control.)
5			Press the DATA/SHIFT Key for approximately one second. The value blinks and is saved. The control method is changed to position control.
6			Press the DATA/SHIFT Key for approximately one second. "Pn.000" is displayed again.
7	To enable the change in the setting, turn OFF the power and ON again.		

2.5.3 How to Read a Parameter Explanation

In this manual, each parameter is explained using the following example.

(1) Explanation Method for Parameter Setting Type

Control mode for which the parameter is available

Speed : Speed control and internally set speed control

Position : Position control

Torque : Torque control

Pn406	Emergency Stop Torque				
	Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
	0 to 800%	1%	800%	After restart	Setup

Indicates setting range for the parameter. The range is decided so that the maximum value can be set even in combination with a servomotor with different specifications.

Indicates minimum setting unit for the parameter.

Indicates parameter value before shipment (Factory setting).

Indicates if the power has to be turned OFF and ON again to validate setting changes. "After restart" indicates the change will be effective after turning OFF the power and ON again, or resetting software (Fn030).

"Setup" indicates the parameter used for basic setting for operation. "Tuning" indicates the parameter used for tuning of servo performance. Note: The parameters classified as "tuning" are not displayed at shipment. For displaying the tuning parameters, refer to (3) *Explanation Method for Tuning Parameters*.

(2) Explanation Method for Function Selection Type

Parameter	Meaning		When Enabled	Classification
Pn50A	n.2□□□	Input the forward run prohibited signal (P-OT) from CN1-42 (Factory setting).	After restart	Setup
	n.8□□□	Forward run prohibited signal (P-OT) is disabled (Forward rotation allowed).		

The number of the parameter

This blank shows the setting value of the function selection, as well as the status condition on the panel operator and the digital operator (JUSP-OP05A).

This section explains the details of the function selection.

Parameters of the function selection type are used to select and set the function allocated to each digit displayed on the panel operator. Each digit is expressed as explained below.

Display Example for Pn000

Indications	Meaning
Pn000.0 or n.□□□x	Indicates the value for the 0th digit of parameter Pn000.
Pn000.1 or n.□□x□	Indicates the value for the 1st digit of parameter Pn000.
Pn000.2 or n.□x□□	Indicates the value for the 2nd digit of parameter Pn000.
Pn000.3 or n.x□□□	Indicates the value for the 3rd digit of parameter Pn000.

Diagram showing the display format for Pn000: n.□□□□. The digits are labeled as 0th digit, 1st digit, 2nd digit, and 3rd digit.

(3) Explanation Method for Tuning Parameters

Only setup parameters are displayed at shipment. To display tuning parameters, change the following parameter.

Application Function Selection Switch B

Parameter	Contents	When Enabled	Classification
Pn00B	n.□□□0	After restart	Setup
	n.□□□1		

Classification	Meaning	Display Method	Setting Method
Setup Parameters	Parameters needed for setup	Displayed with factory setting	Sets parameter individually.
Tuning Parameters	Parameters needed for tuning of servo gain	Displayed by setting Pn00B.0.	Can set parameter using utility function without regarding parameter number.

[Main Setup Parameters]

Function selection switch (Pn000 to Pn080)	Vibration detection switch (Pn310)	Brake (Pn506 to Pn508, Pn583)
Axis address selection (Pn010)	Tuning (Pn324, Pn560)	Instantaneous power cut hold time (Pn509)
Application function for gain select switch (Pn10B)	Motor max. speed (Pn385)	Input/output signal selection (Pn50A to Pn513)
Position control function switch (Pn200, Pn207)	Torque reference input gain (Pn400)	Excessive position error (Pn51B to Pn520, Pn526 to Pn529, Pn584)
Encoder (Pn205, Pn20A, Pn22A, Pn282)	Torque limit (Pn402 to Pn406, Pn483 to Pn484)	Positioning completed signal (Pn522, Pn524)
Electronic gear ratio (Pn20E, Pn210)	Speed limit during torque control (Pn407, Pn480)	Monitor display at power ON (Pn52F)
Encoder output (Pn212, Pn281)	Torque limit related switch (Pn408)	Program JOG (Pn530 to Pn536, Pn585)
Position reference filter (Pn216 to Pn217)	T-REF filter time constant (Pn415)	Analog monitor (Pn550 to Pn553)
Speed reference input gain (Pn300)	Torque compensation switch (Pn423)	Motor running air-cooling ratio (Pn586)
Internal set speed (Pn301 to Pn303, Pn380 to Pn382)	Zero clamp level (Pn501, Pn580)	Absolute scale (Pn587)
JOG speed (Pn304, Pn383)	Rotation detection level (Pn502, Pn581)	Regenerative resistor capacity (Pn600)
Soft start (Pn305, Pn306)	Speed coincidence signal output width (Pn503, Pn582)	
Speed reference filter time constant (Pn307)		About 80 parameters

[Main Tuning Parameters]

Speed loop gain (Pn100, Pn104)	Position integral time constant (Pn11F)	Torque reference filter (Pn401, Pn412)
Speed loop integral time constant (Pn101, Pn105)	Friction compensation (Pn121 to Pn125)	Notch filter (Pn409 to Pn40E)
Position loop gain (Pn102, Pn106)	Gain switching (Pn131 to Pn139)	EasyFFT (Pn456)
Moment of inertia ratio (Pn103)	Model following control (Pn140 to Pn14B)	Tuning (Pn460)
Feed forward (Pn109 to Pn10A)	Anti-resonance control (Pn160 to Pn165)	Polarity detection (Pn481 to Pn482, Pn485 to Pn48F)
Mode switch (Pn10C to Pn10F, Pn181 to Pn182)	Vibration detection (Pn311 to Pn312, Pn384)	Fully-closed control (Pn52A)
		About 60 parameters

2.6 Monitor Mode (Un□□□)


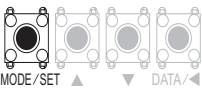
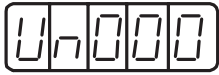
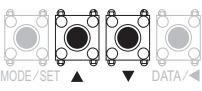

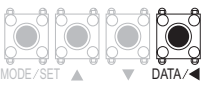

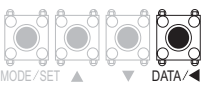
The monitor mode can be used for monitoring the reference values, I/O signal status, and SERVOPACK internal status.

The panel operator display numbers beginning with Un.



Display Example for Motor Speed

The example below shows how to display the contents of monitor number Un000.

Step	Display after Operation	Keys	Description
1			Press the MODE/SET Key to select the monitor mode.
2			Press the UP or the DOWN Key to select the monitor number to be displayed.
3			Press the DATA/SHIFT Key for approximately one second to display the data of Un000.
4			Press the DATA/SHIFT Key for approximately one second to return to the display of monitor number (step 1).

Wiring and Connection

3.1	Main Circuit Wiring	3-2
3.1.1	Names and Functions of Main Circuit Terminals	3-2
3.1.2	SERVOPACK Main Circuit Wire Size	3-3
3.1.3	Typical Main Circuit Wiring Examples	3-5
3.1.4	General Precautions for Wiring	3-6
3.1.5	Precautions When Using the SERVOPACK with a DC Power Input	3-7
3.1.6	Precautions When Using More Than One SERVOPACK	3-9
3.1.7	Precautions When Using 400 V Power Supply Voltage	3-10
3.1.8	Designing a Power ON Sequence	3-11
3.2	I/O Signal Connections	3-12
3.2.1	I/O Signal (CN1) Names and Functions	3-12
3.2.2	I/O Signal Connector (CN1) Terminal Layout	3-14
3.2.3	Safety Function Signal (CN8) Names and Functions	3-15
3.2.4	Safety Function Signal (CN8) Terminal Layout	3-15
3.2.5	Example of I/O Signal Connections in Speed Control	3-16
3.2.6	Example of I/O Signal Connections in Position Control	3-17
3.2.7	Example of I/O Signal Connections in Torque Control	3-18
3.3	I/O Signal Allocation	3-19
3.3.1	Input Circuit Signal Allocation	3-19
3.3.2	Checking Input Signals	3-22
3.3.3	Output Circuit Signal Allocation	3-22
3.3.4	Checking Output Signals	3-25
3.4	Examples of Connection to Host Controller	3-26
3.4.1	Connection Examples of Reference Input Circuits to SERVOPACK	3-26
3.4.2	Connection Examples of Sequence Input Circuits to SERVOPACK	3-28
3.4.3	Connection Examples of Output Circuits to SERVOPACK	3-29
3.5	Examples of Encoder Connection	3-32
3.5.1	Connection Example of an Encoder	3-32
3.5.2	CN2 Encoder Connector Terminal Layout	3-33
3.6	Connecting Regenerative Resistors	3-34
3.6.1	Connecting Regenerative Resistors	3-34
3.6.2	Setting Regenerative Resistor Capacity	3-35
3.7	Noise Control and Measures for Harmonic Suppression	3-36
3.7.1	Wiring for Noise Control	3-36
3.7.2	Precautions on Connecting Noise Filter	3-38
3.7.3	Connecting DC Reactor for Harmonic Suppression	3-40

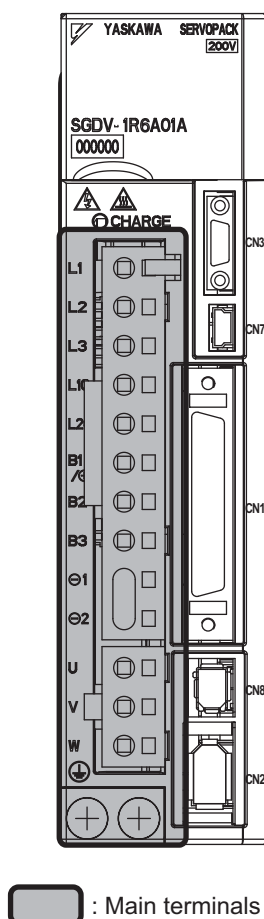
3.1 Main Circuit Wiring

The names, specifications, and functions of the main circuit terminals are given below.


Also this section describes the general precautions for wiring and precautions under special environments.

3.1.1 Names and Functions of Main Circuit Terminals

Names, functions and specifications are shown in the following table.



Terminal Symbols	Name	Model SGDV-□□□□	Description
L1, L2, L3	Main circuit input terminals	R70A, R90A, 1R6A, 2R8A, 3R8A, 5R5A	Three-phase 200 to 230 V, +10%, -15% (50/60 Hz)
		1R9D, 3R5D, 5R4D, 8R4D, 120D, 170D	Three-phase 380 to 480 V, +10%, -15% (50/60 Hz)
L1C, L2C	Control power input terminals	R70A, R90A, 1R6A, 2R8A, 3R8A, 5R5A	Single-phase 200 to 230 V, +10%, -15% (50/60 Hz)
		1R9D, 3R5D, 5R4D, 8R4D, 120D, 170D	24 VDC, +10%, -15% (50/60 Hz)
B1/ ⊕, B2, B3 or B1, B2, B3	External regenerative resistor terminals	R70A, R90A, 1R6A, 2R8A	If the regenerative capacity is insufficient, connect an external regenerative resistor (option) between B1/ ⊕ and B2.
		3R8A, 5R5A, 1R9D, 3R5D, 5R4D, 8R4D, 120D, 170D	Normally short B2 and B3. If the internal regenerative resistor is insufficient, remove the wire between B2 and B3 and connect an external regenerative resistor between B1/ ⊕ and B2.

Terminal Symbols	Name	Model SGDV-□□□□	Description
⊖ 1, ⊖ 2	DC reactor connection terminal for power supply harmonic suppression	□□□A □□□D	Normally short ⊖ 1 and ⊖ 2. If a countermeasure against power supply harmonic waves is needed, connect a DC reactor between ⊖ 1 and ⊖ 2.
B1/ ⊕ or B1	Main circuit plus terminal	□□□A □□□D	Use when DC power supply input is used.
⊖ or ⊖ 2	Main circuit minus terminal	□□□A □□□D	
U, V, W	Servomotor connection terminals	Use for connecting to the servomotor.	
	Ground terminals (× 2)	Use for connecting the power supply ground terminal and servomotor ground terminal.	

3.1.2 SERVOPACK Main Circuit Wire Size

This section describes the SERVOPACK Main Circuit Wire Size.



IMPORTANT

1. Wire sizes are selected for three cables per bundle at 40°C ambient temperature with the rated current.
2. Use a cable with a minimum withstand voltage of 600 V for the main circuit.
3. If cables are bundled in PVC or metal ducts, take into account the reduction of the allowable current.
4. Use a heat-resistant cable under high ambient or panel temperatures, where normal vinyl cables will rapidly deteriorate.

(1) Cable Types

Use the following type of cable for main circuit.

Cable Type		Allowable Conductor Temperature °C
Symbol	Name	
PVC	Normal vinyl cable	-
IV	600 V vinyl cable	60
HIV	Heat resistant vinyl cable	75

The following table shows the wire sizes and allowable currents for three cables. Use cables with specifications equal to or less than those shown in the table.

- 600 V Heat-resistant Vinyl Cable (HIV)

AWG Size	Nominal Cross Section Diameter (mm ²)	Configuration (Number of Wires/mm ²)	Conductive Resistance (Ω/km)	Allowable Current at Ambient Temperature (A)		
				30°C	40°C	50°C
20	0.5	19/0.18	39.5	6.6	5.6	4.5
19	0.75	30/0.18	26.0	8.8	7.0	5.5
18	0.9	37/0.18	24.4	9.0	7.7	6.0
16	1.25	50/0.18	15.6	12.0	11.0	8.5
14	2.0	7/0.6	9.53	23	20	16
12	3.5	7/0.8	5.41	33	29	24
10	5.5	7/1.0	3.47	43	38	31
8	8.0	7/1.2	2.41	55	49	40
6	14.0	7/1.6	1.35	79	70	57

Note: The values in the table are for reference only.

(2) Three-phase, 200 V

External Terminal Name	Terminal Symbols	SERVOPACK Model SGD V-					
		R70A	R90A	1R6A	2R8A	3R8A	5R5A
Main circuit power input terminals	L1, L2, L3	HIV1.25			HIV2.0		
Control power input terminals	L1C, L2C	HIV1.25					
Servomotor connection terminals	U, V, W	HIV1.25					HIV2.0
External regenerative resistor connection terminals	B1/ ⊕ , B2	HIV1.25					
Ground terminal	⊕	HIV2.0 or higher					

(3) Three-phase, 400 V

External Terminal Name	Terminal Symbols	SERVOPACK Model SGD V-					
		1R9D	3R5D	5R4D	8R4D	120D	170D
Main circuit power input terminals	L1, L2	HIV1.25			HIV2.0		HIV3.5
Control power input terminals	L1C, L2C	HIV1.25					
Servomotor connection terminals	U, V, W	HIV1.25			HIV2.0		HIV3.5
External regenerative resistor connection terminals	B1/⊖, B2	HIV1.25					HIV2.0
Ground terminal	⊕	HIV2.0 or higher					

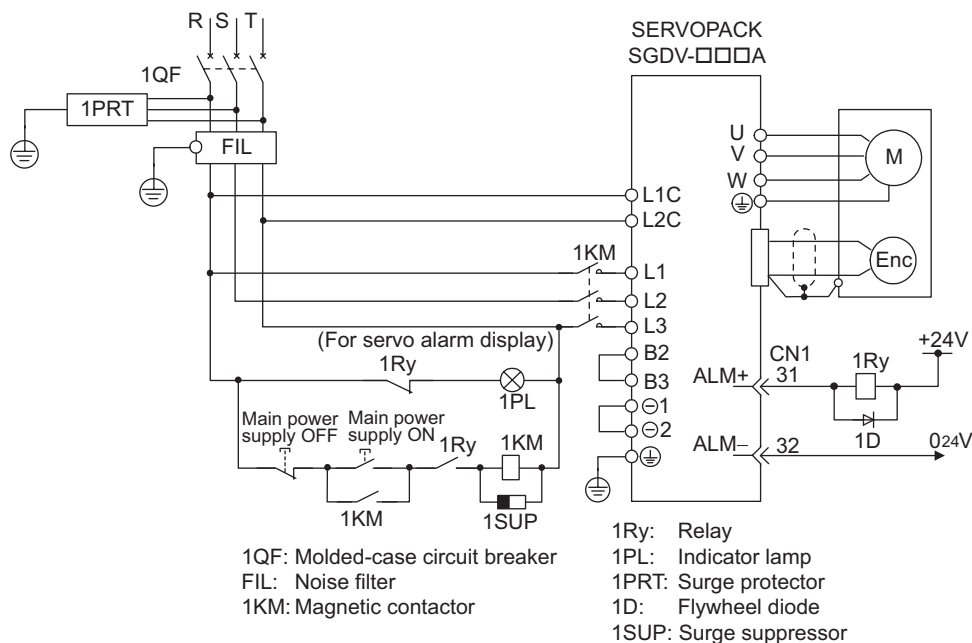
3.1.3 Typical Main Circuit Wiring Examples

This section describes the typical main circuit wiring examples.

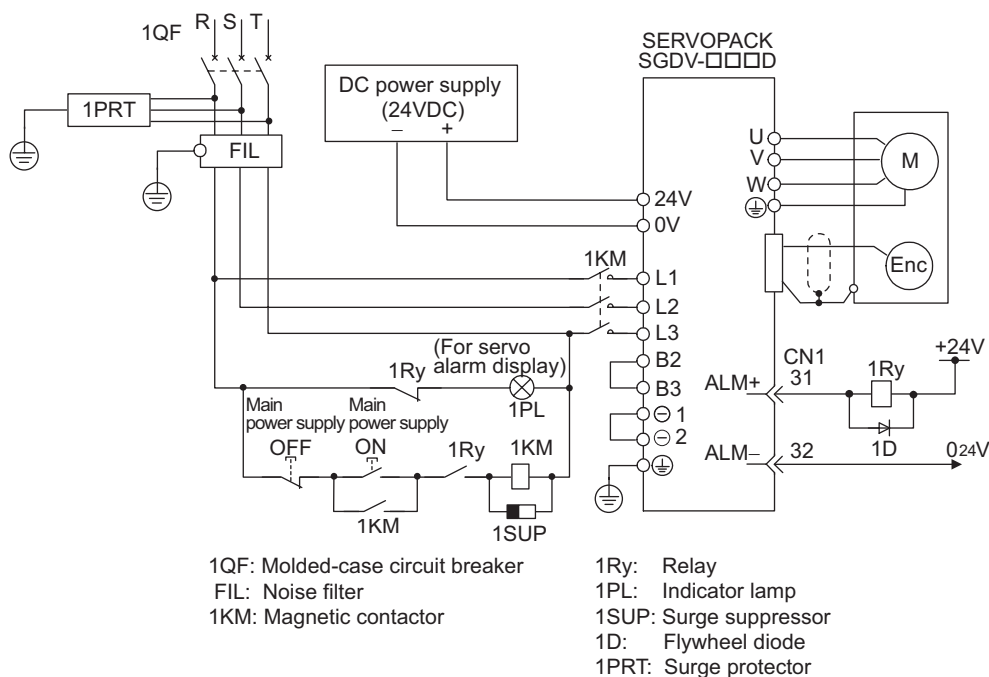
⚠ WARNING

- Do not touch the power terminals for five minutes after turning OFF the power. High voltage may still remain in the SERVOPACK. When the voltage is discharged, the charge indicator will turn OFF. Make sure the charge indicator is OFF before starting wiring or inspections.

■ Three-phase 200 V, SGD V-R70A, -R90A, -1R6A, -2R8A, -3R8A, -5R5A



■ Three-phase 400 V, SGD V-1R9D, -3R5D, -5R4D, -8R4D, -120D, -170D



3.1.4 General Precautions for Wiring



IMPORTANT

Use a molded-case circuit breaker (QF) or fuse to protect the power line.

- 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 (QF) or fuse to protect the servo system from accidents involving different power system voltages or other accidents.

The SERVOPACK does not have a built-in protective circuit for grounding.

- 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 power ON and OFF frequently.

- The power supply in the SERVOPACK contains a capacitor, which causes a high charging current to flow when power is turned ON. Frequently turning power ON and OFF will cause the main circuit elements in the SERVOPACK to deteriorate.

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

Use the connecting cables specified in the *Σ -V Series SGM Δ V/SGDV Catalog* (KAEPS80000042). Design and arrange the system so that each cable will be as short as possible.

Observe the following precautions when wiring the main circuit.

- Use shielded twisted-pair wires or shielded multi-core twisted-pair wires for signal lines and encoder lines.
- The maximum wiring length is 3 m for signal lines and 50 m for encoder lines.

Observe the following precautions when wiring the ground.

- Use a cable as thick as possible (at least 2.0 mm²)
- Grounding to a resistance of 100 Ω or less is recommended.
- Be sure to ground at only one point.
- Ground the servomotor directly if the servomotor is insulated from the machine.

The signal cable conductors are as thin as 0.2 mm or 0.3 mm. Do not impose excessive bending force or tension.

3.1.5 Precautions When Using the SERVOPACK with a DC Power Input

When using the SERVOPACK with a DC power input, set parameter Pn001.2 to 1, and pay attention to the following items.

WARNING

- Either AC or DC power can be input to the 200 V, 400 V SERVOPACKs.
Always set Pn001.2 to 1 to specify a DC power input before inputting DC power.
If DC power is input without changing the parameter setting, the SERVOPACK's internal elements will burn and may cause fire or equipment damage.
- With a DC power 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 wires if DC power is used.

(1) DC Power Supply Input Terminals for the Main and Control Circuits

■ Three-phase, 200 V

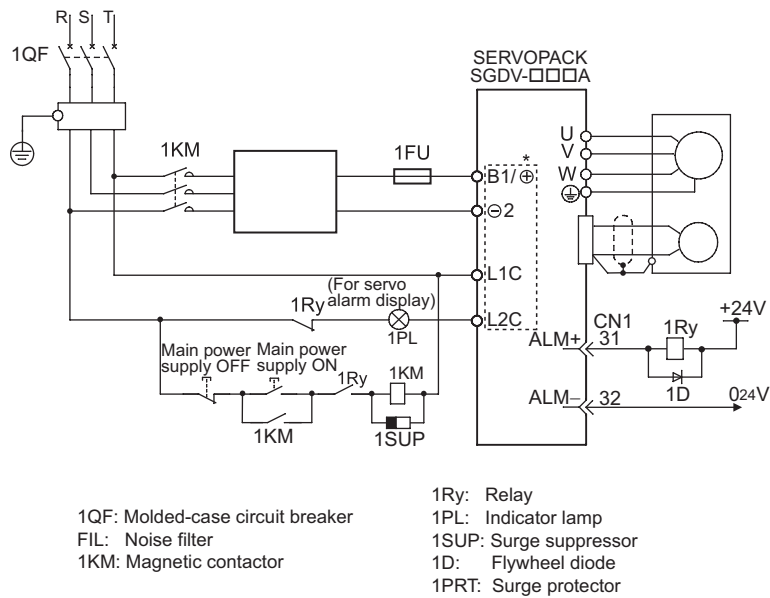
SERVOPACK model SGDV	Terminal Name and Description		
	Main circuit plus terminal	Main circuit minus terminal	Control power supply input terminal
	270 V to 320 VDC	0 VDC	270 V to 320 VDC (No polarity) 200 V to 230 VAC
-R70A, -R90A, -1R6A, -2R8A, -3R8A, -5R5A	B1/ ⊕	⊖ 2	+24 V, 0 V

■ Three-phase, 400 V

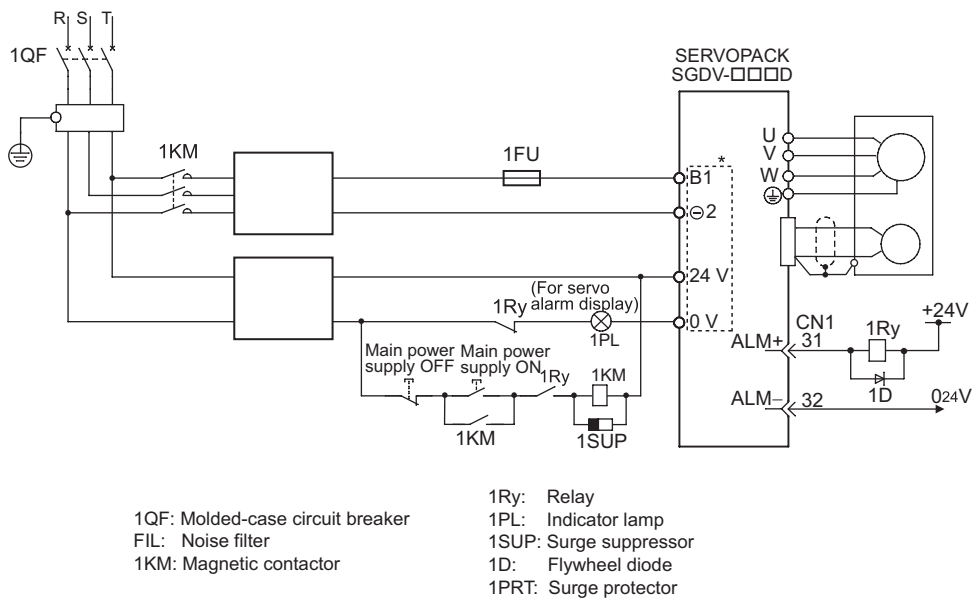
SERVOPACK model SGDV	Terminal Name and Description		
	Main circuit plus terminal	Main circuit minus terminal	Control power supply input terminal
	513 V to 648 VDC	0 VDC	24VDC (± 15%)
-1R9D, -3R5D, -5R4D, -8R4D, -120D	B1	⊖ 2	+24 V, 0 V
-170D	B1/ ⊕	⊖ 2	+24 V, 0 V

(2) Wiring Example with DC Power Supply Input

■ 200 V SERVOPACK SGDV-□□□A



■ 400 V SERVOPACK SGDV-□□□D



* Terminal names differ from model of SERVOPACK. Refer to (1) DC Power Supply Input Terminals for the Main and Control Circuits.

Note: The SERVOPACK that can use a DC power supply is not capable of processing the regenerated energy. Provide measures to process the regenerated energy on the power supply.

(3) Parameter Setting

When using a DC power supply, make sure to set the parameter Pn001.2 to "1" (DC power input supported) before inputting DC power.

Parameter		Meaning	When Enabled	Classification
Pn001	n.□0□□	AC power input supported	After restart	Setup
	n.□1□□	DC power input supported		

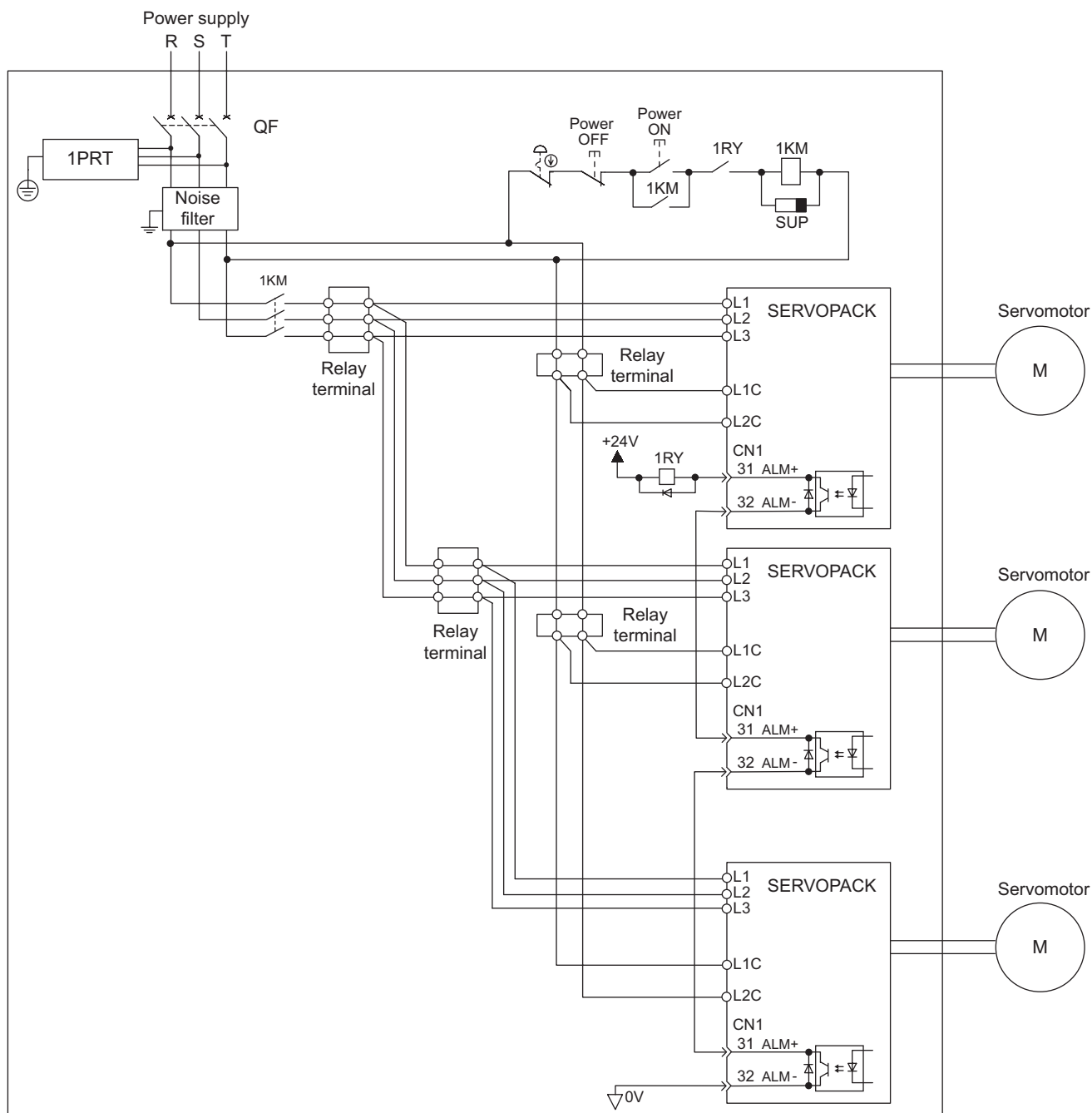
3.1.6 Precautions When Using More Than One SERVOPACK

This section shows an example of the wiring when more than one SERVOPACK is used and the precautions.

(1) Wiring Example

Connect the alarm output (ALM) terminals for the three SERVOPACKs in series to enable alarm detection relay 1RY to operate.

When the alarm occurs, the ALM output signal transistor is turned OFF.




(2) Precautions

Multiple servos can share a single molded-case circuit breaker (QF) or noise filter. Always select a QF or noise filter that has enough capacity for the total power capacity (load conditions) of those servos.

3.1.7 Precautions When Using 400 V Power Supply Voltage

This section shows the precautions when SERVOPACK is used with 400 V power supply voltage.



WARNING

- Do not connect the SERVOPACK for 200 V directly to a voltage of 400 V.
The SERVOPACK will be destroyed.
- Control the AC power supply ON and OFF sequence at the primary side of voltage conversion transfer.
Voltage conversion transfer inductance will cause a surge voltage if the power is turned ON and OFF at the second-ary, damaging the SERVOPACK.

(1) Voltage Conversion Transfer

When using SERVOPACK for three-phase 200 V with the three-phase 400 VAC class (380 V to 480 V), pre-pare the following voltage conversion transfers (three-phase).

Primary Voltage	Secondary Voltage
380 to 480 VAC	200 VAC

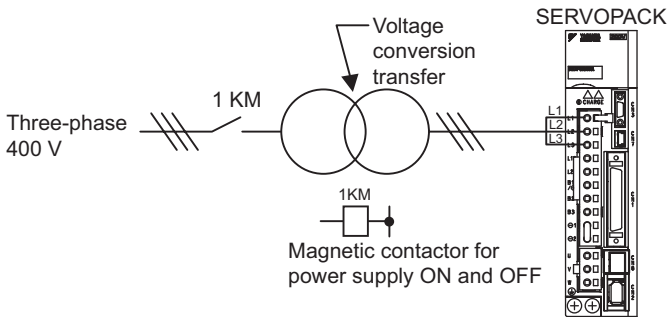
When selecting a voltage conversion transfer, refer to the capacities shown in the following table.

Main Power Supply	Maximum Applicable Servomotor Capacity [kW]	SERVOPACK Model SGDv-	Voltage Capacity per SERVOPACK [kVA]	Current Capacity		Inrush Current	
				Main Circuit [Arms]	Control Circuit [Arms]	Main Circuit [A0-p]	Control Circuit [A0-p]
Three-phase 200 V	0.05	R70A	0.2	1.0	0.2	33	70
	0.1	R90A	0.3	1.0			
	0.2	1R6A	0.6	2.0		33	33
	0.4	2R8A	1	3.0			
	0.5	3R8A	0.9	3.0		33	33
	0.75	5R5A	1.6	6.0			

Note: To comply with the Low Voltage Directive, connect a UL-approved fuse or circuit breaker to the input side to pro- vide protection from short-circuits.

(2) Connection Example

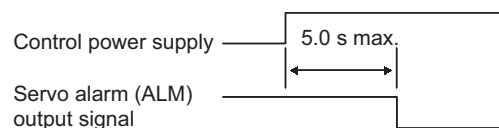
The following diagram shows the connection example of voltage conversion transfer.



3.1.8 Designing a Power ON Sequence

Note the following points when designing the power ON sequence.

- Design the power ON sequence so that main power is turned OFF when a servo alarm signal is output.
- The ALM signal is output for five seconds max. when the power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop main circuit power supply to the SERVOPACK.



- Select the power supply specifications for the parts in accordance with the input power supply.

3.2 I/O Signal Connections

This section describes the names and functions of I/O signals (CN1). Also terminal layout and connection examples by control method are shown.

3.2.1 I/O Signal (CN1) Names and Functions

The following table shows the names and functions of I/O signals (CN1).

(1) Input Signals

Control Method	Signal Name	Pin No.	Function		Reference Section
Common	/S-ON	40	Servo ON/OFF: Turns ON/OFF the servomotor.		5.2.1
	/P-CON	41	Function selected by parameter.		—
			Proportional control reference	Switches the speed control loop from PI (proportional/integral) to P (proportional) control when ON.	6.8.4
			Direction reference	For the internal set speed selection: Switches the rotation direction.	5.6.1
			Control switching	Position ↔ speed Position ↔ torque Torque ↔ speed } Enables control switching.	5.7.3
			Zero-clamp reference	Speed control with zero-clamp function: Reference speed is zero when ON.	5.3.5
			Reference pulse block	Position control with reference pulse stop: Stops reference pulse input when ON.	5.4.7
	P-OT N-OT	42 43	Forward run prohibited, Reverse run prohibited	Overtravel prohibited: Stops servomotor when movable part travels beyond the allowable range of motion.	5.2.3
	/P-CL /N-CL	45 46	Function selected by parameter.		5.10.1
			Forward external torque limit ON, Reverse external torque limit ON	Torque limit function used when ON.	5.8.2 5.8.4
			Internal speed switching	With internal reference speed selected: Switches the internal speed settings.	5.6.1
	/ALM-RST	44	Alarm reset: Releases the servo alarm state.		—
	+24VIN	47	Control power supply input for sequence signals: Users must provide the +24 V power supply. Allowable voltage fluctuation range: 11 to 25 V		3.4.2
	SEN	4 (2)	Initial data request signal when using an absolute encoder.		5.9.2
	BAT (+) BAT (-)	21 22	Connecting pin for the absolute encoder backup battery. Do not connect when the encoder cable for the battery case is used.		3.5.1 5.9.2
Speed	V-REF	5 (6)	Inputs speed reference. Input voltage range: ± 12 V max.		5.3.1 5.5.3
Position	PULS / PULS SIGN /SIGN	7 8 11 12	Input pulse modes: Set one of them. • Sign + pulse string • CCW/CW pulse • Two-phase pulse (90° phase differential) Reference pulse input for only line driver		5.4.1
	CLR /CLR	15 14	Position error pulse clear: Clears position error pulse during position control.		5.4.2

Control Method	Signal Name	Pin No.	Function	Reference Section
Torque	T-REF	9 (10)	Inputs torque reference. Input voltage range: ± 12 V max.	5.5.1 5.8.3 5.8.5

Note 1. Pin numbers in parentheses () indicate signal grounds.

2. The functions allocated to /S-ON, /P-CON, P-OT, N-OT, /ALM-RST, /P-CL, and /N-CL input signals can be changed by using the parameters. Refer to 3.3.1 *Input Circuit Signal Allocation*.

(2) Output Signals

Control Method	Signal Name	Pin No.	Function	Reference Section
Common	ALM+ ALM-	31 32	Servo alarm: Turns OFF when an error is detected.	5.10.1
	/TGON+ /TGON-	27 28	Detection during servomotor rotation: Turns ON when the servomotor is rotating at a speed higher than the motor speed setting.	5.10.3
	/S-RDY+ /S-RDY-	29 30	Servo ready: ON if there is no servo alarm when the control/main circuit power supply is turned ON.	5.10.4
	PAO /PAO	33 34	Phase-A signal	5.3.6 5.9.6
	PBO /PBO	35 36	Phase-B signal	
	PCO /PCO	19 20	Phase-C signal	
	ALO1 ALO2 ALO3	37 (1) 38 (1) 39 (1)	Alarm code output: Outputs 3-bit alarm codes.	5.10.1
	FG	Shell	Connected to frame ground if the shield wire of the I/O signal cable is connected to the connector shell.	—
Speed	/V-CMP+ /V-CMP-	25 26	Turns ON when whether the motor speed is within the setting range is detected and if it matches the reference speed value.	5.3.8
Position	/COIN+ /COIN-	25 26	Turns ON when the number of position error pulse reaches the value set.	5.4.5
Reserved	/CLT /VLT /BK /WARN /NEAR	—	Reserved terminals The functions allocated to /TGON, /S-RDY, and /V-CMP (/COIN) can be changed by using the parameters.	5.8.5 5.5.3 5.10.2 5.4.6
	—	3 13 16 17 18 23 24 48 49 50	Terminals not used. Do not connect.	—

Note 1. Pin numbers in parentheses () indicate signal grounds.

2. The functions allocated to /TGON, /S-RDY, and /V-CMP (/COIN) output signals can be changed by using the parameters. Refer to 3.3.3 *Output Circuit Signal Allocation*.

3.2.2 I/O Signal Connector (CN1) Terminal Layout

The following table shows the terminal layout of I/O signal connectors (CN1).

2	SG	GND	1	SG	GND	27	/TGON+	TGON signal output	26	/V-CMP- (/COIN-)	Speed coincidence detection output
4	SEN	SEN signal input	3	PL1	Power supply for open-collector reference	29	/S-RDY+	Servo ready output	28	/TGON-	TGON signal output
6	SG	GND	5	V-REF	Speed reference input	31	ALM+	Servo alarm output	30	/S-RDY-	Servo ready output
8	/PULS	Reference pulse input	7	PULS	Reference pulse input	33	PAO	Encoder output pulse Phase A	32	ALM-	Servo alarm output
10	SG	GND	9	T-REF	Torque reference input	35	PBO	Encoder output pulse Phase B	34	/PAO	Encoder output pulse Phase A
12	/SIGN	Reference sign input	11	SIGN	Reference sign input	37	ALO1	Alarm code output	36	/PBO	Encoder output pulse Phase B
14	/CLR	Clear input	13	PL2	Power supply for open-collector reference	39	ALO3	Alarm code output	38	ALO2	Alarm code output
16	–	–	15	CLR	Clear input	41	/P-CON	P control input	40	/S-ON	Servo ON input
18	PL3	Power supply for open-collector reference	17	–	–	43	N-OT	Reverse run prohibit input	42	P-OT	Forward run prohibit input
20	/PCO	Encoder output pulse Phase C	19	PCO	Encoder output pulse Phase C	45	/P-CL	Forward external torque limit input	44	/ALM-RST	Alarm reset input
22	BAT (-)	Battery (-)	21	BAT (+)	Battery (+)	47	+24 V IN	External input power supply	46	/N-CL	Reverse external torque limit input
24	–	–	23	–	–	49	–	–	48	–	–
			25	/V-CMP+ (/COIN+)	Speed coincidence detection output				50	–	–

Note 1. Do not use unused terminals.

2. Connect the shield of the I/O signal cable to the connector shell.
Connect to the FG (frame ground) at the SERVOPACK connector.

3. The functions allocated to the following input and output signals can be changed by using the parameters. Refer to 3.3.1 *Input Circuit Signal Allocation* and 3.3.3 *Output Circuit Signal Allocation*.

Input signals: /S-ON, /P-CON, P-OT, N-OT, /ALM-RST, /P-CL, and /N-CL

Output signals: /TGON, /S-RDY, and /V-CMP (/COIN)

3.2.3 Safety Function Signal (CN8) Names and Functions

The following table shows the names and functions of safety function signals (CN8).

Signal Name	Pin No.	Function
/HWBB1+	4	Hard wire baseblock input Baseblock (motor current off) when OFF
/HWBB1-	3	
/HWBB2+	6	
/HWBB2-	5	
EDM1+	8	Monitored circuit status output ON when the hard wire baseblock function is normally activated.
EDM1-	7	

3.2.4 Safety Function Signal (CN8) Terminal Layout

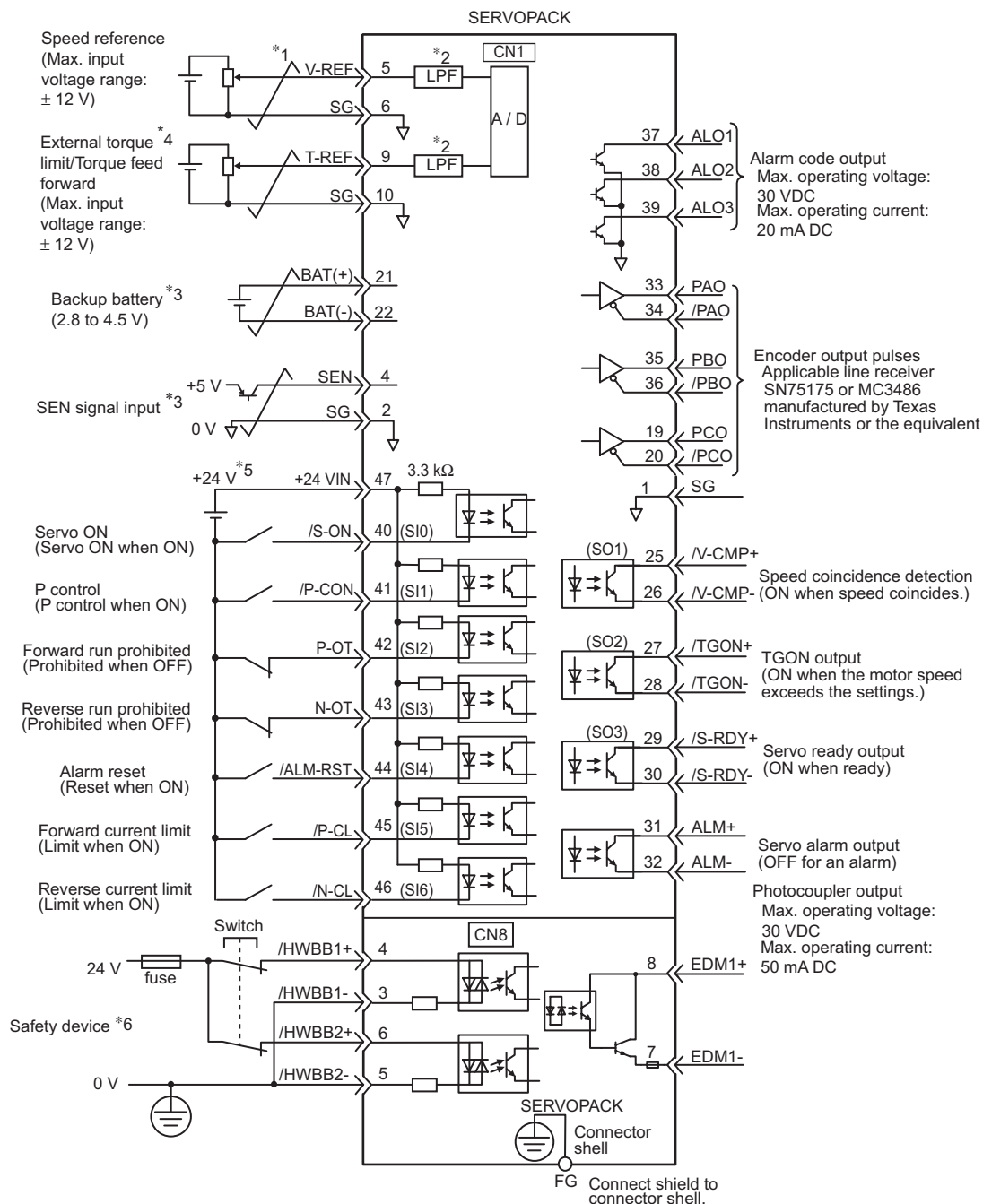
The following table shows the terminal layout of safety function signals (CN8).


Pin No.	Signal Name	Function
1	–	Unused terminal *
2	–	Unused terminal *
3	/HWBB1-	Hard wire baseblock input 1
4	/HWBB1+	Hard wire baseblock input 1
5	/HWBB2-	Hard wire baseblock input 2
6	/HWBB2+	Hard wire baseblock input 2
7	EDM1+	Monitored circuit status output 1
8	EDM1-	Monitored circuit status output 1

* Do not use unused terminals. (connected to the internal circuits)

3.2.5 Example of I/O Signal Connections in Speed Control

Connection example in speed control mode is as shown below.



*1.  represents twisted-pair wires.

*2. The time constant for the primary filter is 30 μ s.

*3. Connect when using an absolute encoder. When the encoder cable for the battery case is connected, do not connect a backup battery.

*4. Enabled by the parameter setting.

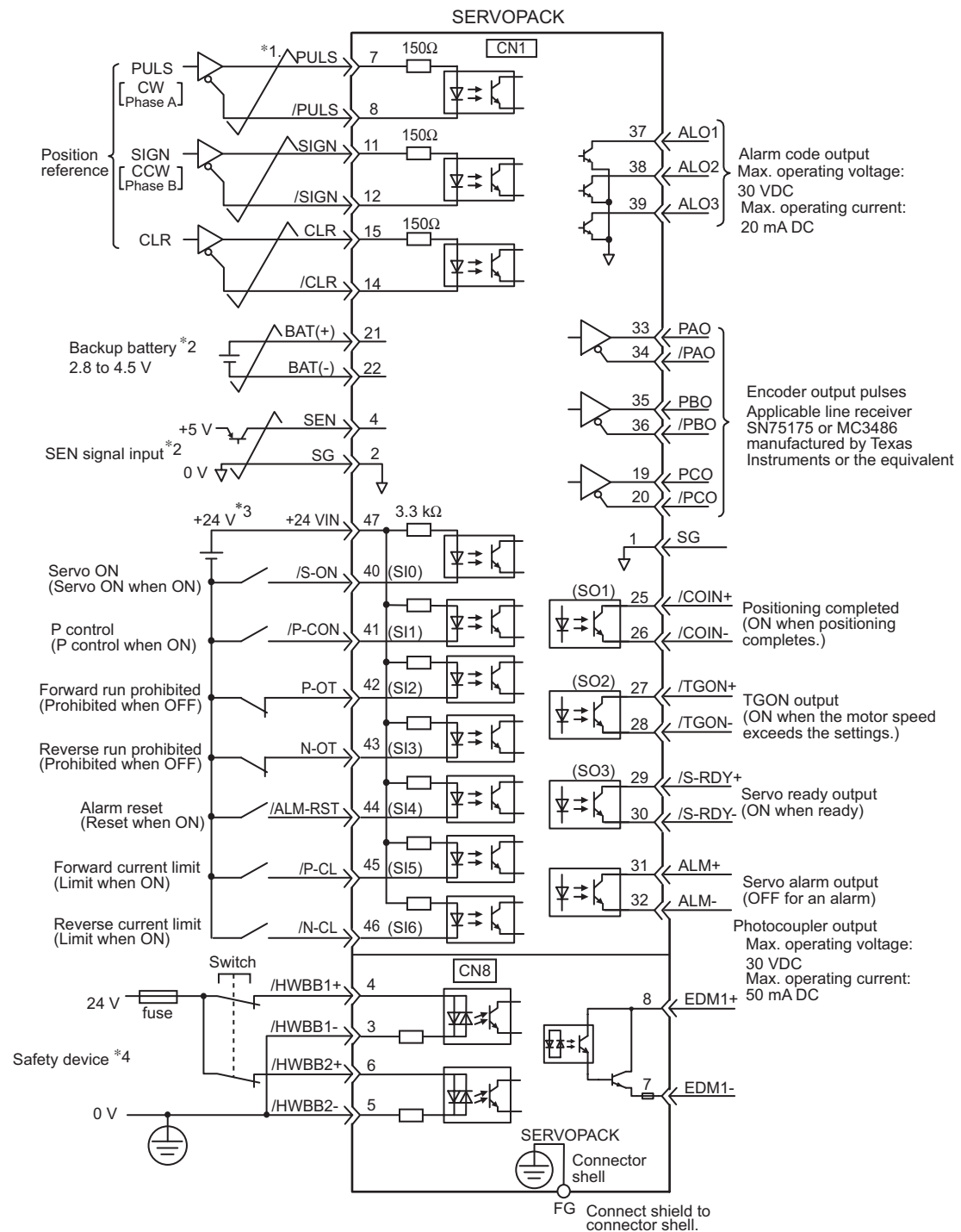
*5. Customers must purchase a 24 VDC power supply with double-shielded enclosure.

*6. For servo ON, connect to safety device and set wiring to enable safety function. When not using the safety function, use the SERVOPACK with the plug (JZSP-CVH05-E, provided as an accessory) inserted into the CN8.

Note: The functions allocated to the input signals SI0 to SI6 and the output signals SO1 to SO3 can be changed by using the parameters. Refer to 3.3.1 Input Circuit Signal Allocation and 3.3.3 Output Circuit Signal Allocation.

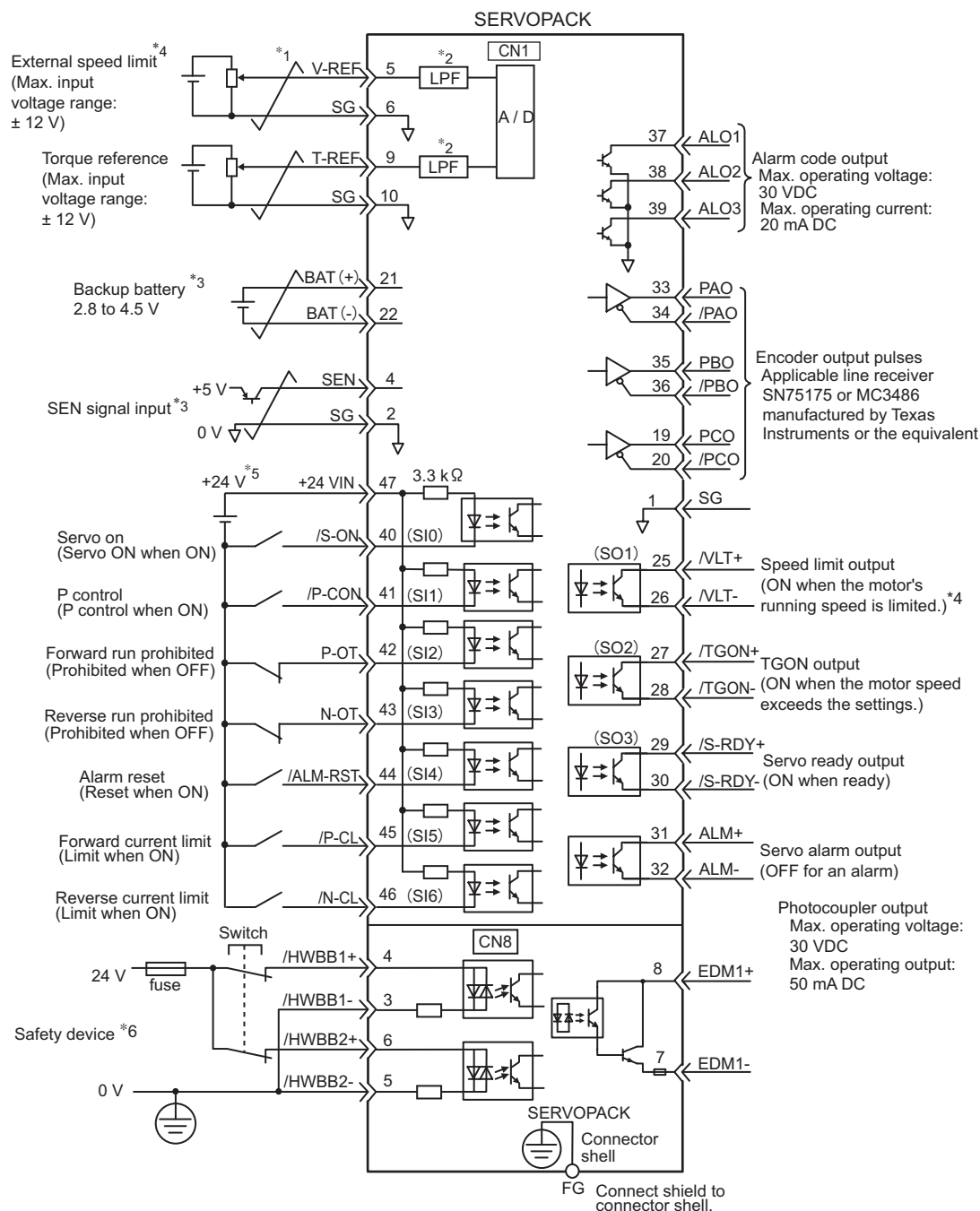
3.2.6 Example of I/O Signal Connections in Position Control


Connection example in position control mode is as shown below.



3.2.7 Example of I/O Signal Connections in Torque Control

Connection example in torque control mode is as shown below.



*1.  represents twisted-pair wires.

*2. The time constant for the primary filter is 30 μ s.

*3. Connect when using an absolute encoder. When the encoder cable for the battery case is connected, do not connect a backup battery.

*4. Enabled by the parameter setting.

*5. Customers must purchase a 24 VDC power supply with double-shielded enclosure.

*6. For servo ON, connect to safety device and set wiring to enable safety function. When not using the safety function, use the SERVOPACK with the plug (JZSP-CVH05-E, provided as an accessory) inserted into the CN8.

Note: The functions allocated to the input signals SI0 to SI6 and the output signals SO1 to SO3 can be changed by using the parameters. Refer to 3.3.1 Input Circuit Signal Allocation and 3.3.3 Output Circuit Signal Allocation.

3.3 I/O Signal Allocation

This section describes the I/O signal allocation and checking method of allocated status.

3.3.1 Input Circuit Signal Allocation

Input signals can be allocated to I/O signal connectors (CN1) in accordance with the parameter setting.

(1) Factory Setting

Input signal allocation can be checked using the parameters Pn50A and Pn50B.

Factory settings are as follows:

Pn50A : n, 2 1 0 0 Pn50B : n, 6 5 4 3

When the control method is changed using Pn000.1, required signals for each control method are automatically allocated to CN1-41 to CN1-46. See the following table.

Pn000.1 Setting	Control Method Selection	CN1 Pin No.						
		40	41	42	43	44	45	46
0	Speed control (analog reference)	/S-ON	/P-CON	P-OT	N-OT	/ALM- RST	/P-CL	/N-CL
1	Position control (pulse train reference)							
2	Torque control (analog reference)		/SPD-D				/SPD-A	/SPD-B
3	Speed control (contact reference)							
4	Speed control (contact reference) ⇔ Speed control (analog reference)							
5	Speed control (contact reference) ⇔ Position control (pulse train reference)							
6	Speed control (contact reference) ⇔ Torque control (analog reference)							
7	Position control (pulse train reference) ⇔ Speed control (analog reference)		/C-SEL				/P-CL	/N-CL
8	Position control (pulse train reference) ⇔ Torque control (analog reference)							
9	Torque control (analog reference) ⇔ Speed control (analog reference)							
A	Speed control (analog reference) ⇔ Zero clamp	/ZCLAMP						
B	Position control (pulse train reference) ⇔ Position control (Inhibit)	/INHIBIT						

(2) Changing the Allocation

Set as Pn50A.0 = 1.

Note: Allocation cannot be changed if 0 is set to Pn50A.0.

(3) Input Signal Allocation

**IMPORTANT**

1. When using Servo ON, Forward Run Prohibited, and Reverse Run Prohibited signals with the setting "Polarity Reversal," the machine may not move to the specified safe direction at occurrence of failure such as signal line disconnection. If such setting is absolutely necessary, confirm the operation and observe safety precautions.
2. When two or more signals are allocated to the same input circuit, input signal level is valid for all allocated signals.

Input signals are allocated as shown in the following table.

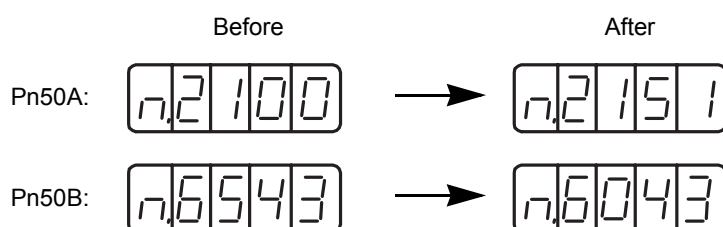
means factory setting.









Signal Name Parameter Setting Allocation	Validity Level	Input Signal	CN1 Pin Numbers								Connection Not required (SERVOPACK judges the connection)	
			40	41	42	43	44	45	46		Always ON	Always OFF
Servo ON Pn50A.1 setting	L	/S-ON	0	1	2	3	4	5	6		7	8
	H	S-ON	9	A	B	C	D	E	F			
Proportional Operation Reference Pn50A.2 setting	L	/P-CON	0	1	2	3	4	5	6		7	8
	H	P-CON	9	A	B	C	D	E	F			
Forward Run Prohibited Pn50A.3 setting	H	P-OT	0	1	2	3	4	5	6		7	8
	L	/P-OT	9	A	B	C	D	E	F			
Reverse Run Prohibited Pn50B.0 setting	H	N-OT	0	1	2	3	4	5	6		7	8
	L	/N-OT	9	A	B	C	D	E	F			
Alarm Reset Pn50B.1 setting	L	/ARM-RST	0	1	2	3	4	5	6		-	8
	H	ARM-RST	9	A	B	C	D	E	F			
Forward External Torque Limit Pn50B.2 setting	L	/P-CL	0	1	2	3	4	5	6		7	8
	H	P-CL	9	A	B	C	D	E	F			
Reserve External Torque Limit Pn50B.3 setting	L	/N-CL	0	1	2	3	4	5	6		7	8
	H	N-CL	9	A	B	C	D	E	F			
Switching Servomotor Rotation Direction Pn50C.0 setting	L	/SPD-D	0	1	2	3	4	5	6		7	8
	H	SPD-D	9	A	B	C	D	E	F			
Internal Set Speed Selection Pn50C.1 setting	L	/SPD-A	0	1	2	3	4	5	6		7	8
	H	SPD-A	9	A	B	C	D	E	F			
Internal Set Speed Selection Pn50C.2 setting	L	/SPD-B	0	1	2	3	4	5	6		7	8
	H	SPD-B	9	A	B	C	D	E	F			
Control Method Selection Pn50C.3 setting	L	/C-SEL	0	1	2	3	4	5	6		7	8
	H	C-SEL	9	A	B	C	D	E	F			

Signal Name	Validity Level	Input Signal	CN1 Pin Numbers							Connection Not required (SERVOPACK judges the connection)	
			40	41	42	43	44	45	46	Always ON	Always OFF
Zero Clamp Pn50D.0 setting	L	/ZCLAMP	0	1	2	3	4	5	6	7	8
	H	ZCLAMP	9	A	B	C	D	E	F		
Reference Pulse Inhibit Pn50D.1 setting	L	/INHIBIT	0	1	2	3	4	5	6	7	8
	H	INHIBIT	9	A	B	C	D	E	F		
Gain Changeover 1 Pn50D.2 setting	L	/G-SEL1	0	1	2	3	4	5	6	7	8
	H	G-SEL1	9	A	B	C	D	E	F		

(4) Example of Input Signal Allocation

The procedure to replace Servo ON (/S-ON) signal mapped on CN1-40 and Forward External Torque Limit (/P-CL) mapped on CN1-45 is shown below.



Step	Display after Operation	Keys	Description
1	Pn50A		Press the MODE/SET Key to select the parameter setting mode. If a parameter other than Pn50A is displayed, press the UP or DOWN Key to set Pn50A.
2	n.2100		Press the DATA/SHIFT Key for approximately one second to display the current data of Pn50A. (/S-ON is mapped on CN1-40.)
3	n.2101		Press the UP key to set to "1." (Sequence input signals can be freely set.)
4	n.2151		Press the DATA/SHIFT Key to select the second digit from the right. Press the UP key to set to "5." (Changes the mapping of /S-ON from CN1-40 to CN1-45.)
5	n.2151 Display blinks.		Press the DATA/SHIFT Key for approximately one second. The data blinks and is saved.
6	Pn50A		Press the DATA/SHIFT Key for approximately one second to return to the display Pn50A.
7	Pn50B		Press the UP key to display Pn50B.
8	n.6543		Press the DATA/SHIFT Key for approximately one second to display the current data of Pn50B. (/P-CL is mapped on CN1-45.)

Step	Display after Operation	Keys	Description
9			Press the DATA/SHIFT Key to select the third digit from the right. Press the DOWN Key to set "0." (Changes the mapping of /P-CL from CN1-45 to CN1-40.)
10	 Display blinks.		Press the DATA/SHIFT Key for approximately one second. The value blinks and is saved.
11			Press the DATA/SHIFT Key for approximately one second to return to the display Pn50B. /S-ON is mapped on CN1-45, and /P-CL is mapped on CN1-40.
12	Turn the power OFF and ON again to enable the change of input signal selections (Pn50A and Pn50B)		

<Input signal polarities>

Input signal polarities are as follows when sequence input circuit is connected to a sink circuit. If connected to a source circuit, polarities are reversed. For details, refer to 3.4.2 *Connection Examples of Sequence Input Circuits to SERVOPACK*.

Signal	Level	Voltage Level	Contact
ON	Low (L) level	0 V	Close
OFF	High (H) level	24 V	Open

3.3.2 Checking Input Signals

Input signal status can be checked using the input signal monitor (Un005). As for the input signal monitor (Un005), refer to 8.4 *Monitoring Input Signals*

3.3.3 Output Circuit Signal Allocation

Output signals can be allocated to I/O signal connectors (CN1) in accordance with the parameter setting.

(1) Factory Setting

Output signal allocation can be checked using the parameters Pn50E, Pn50F, Pn510 and Pn512. Factory settings are as follows:

Pn50E:

Pn50F:

Pn510:

Pn512:

Note: The output signals for Positioning Completion Signal and Speed Coincidence Detection Signal differ depending on the control method.

(2) Output Signal Allocation

**IMPORTANT**

- When two or more signals are allocated to the same output circuit, a signal is output with OR logic circuit.
- The signals not detected are considered as "Invalid." For example, Positioning Completion (/COIN) signal in speed control is "Invalid."

Output signals are allocated as shown in the following table.

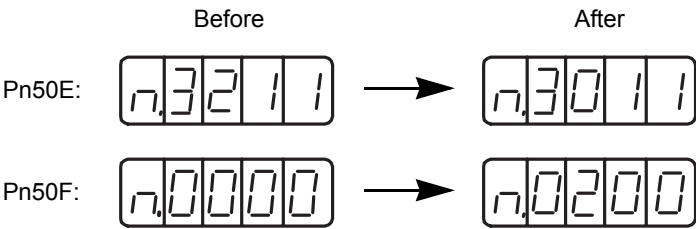
☐ means factory setting.








CN1 Pin No.		25/(26)		27/(28)		29/(30)		Remark
Parameter Setting Allocation		Signal Output Polarity Setting						
		Pn512.0 setting		Pn512.1 setting		Pn512.2 setting		
		0	1 (Reverse)	0	1 (Reverse)	0	1 (Reverse)	
Positioning Completion (/COIN) Pn50E.0 setting	0	Invalid						L: Output signal is L level when the parameter is valid. H: Output signal is H level when the parameter is valid. Invalid: Not use the output signal.
	1	L	H					
	2			L	H			
	3					L	H	
Speed Coincidence Detection (/V-CMP) Pn50E.1 setting	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Rotation Detection (/TGON) Pn50E.2 setting	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Servo Ready (/S-RDY) Pn50E.3 setting	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Torque Limit Detection (/CLT) Pn50F.0 setting	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Speed Limit Detection (/VLT) Pn50F.1 setting	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Brake (/BK) Pn50F.2 setting	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	


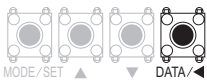

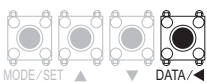

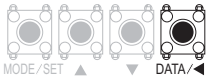
CN1 Pin No.		25/(26)		27/(28)		29/(30)		Remark
Parameter Setting Allocation		Signal Output Polarity Setting						
		Pn512.0 setting		Pn512.1 setting		Pn512.2 setting		
		0	1 (Reverse)	0	1 (Reverse)	0	1 (Reverse)	
Warning (/WARN) Pn50F.3 setting	0	Invalid						L: Output signal is L level when the parameter is valid. H: Output signal is H level when the parameter is valid. Invalid: Not use the output signal.
	1	L	H					
	2			L	H			
	3					L	H	
Near (/NEAR) Pn510.0 setting	0	Invalid						
	1	L	H					
	2			L	H			
	3					L	H	

(3) Example of Output Signal Allocation

The procedure to set Rotation Detection (/TGON) signal of factory setting to "Invalid" and map Brake Interlock (/BK) signal is shown below.



Step	Display after Operation	Keys	Description
1	<div>Pn50E</div>	<div></div>	Press the MODE/SET Key to select the parameter setting mode. If a parameter other than Pn50E is displayed, press the UP or DOWN Key to select Pn50E.
2	<div>n.3211</div>	<div></div>	Press the DATA/SHIFT Key for approximately one second to display the current data of Pn50E. (/TGON is mapped on CN1-27 (28).)
3	<div>n.3011</div>	<div></div>	Press the DATA/SHIFT Key to select the third digit from the right. Press the DOWN Key to set "0." (Sets /TGON "Invalid.")
4	<div>n.3011</div> <div>Display blinks.</div>	<div></div>	Press the DATA/SHIFT Key for approximately one second. The data blinks and is saved.
5	<div>Pn50E</div>	<div></div>	Press the DATA/SHIFT Key for approximately one second to return to the display Pn50E.
6	<div>Pn50F</div>	<div></div>	Press the UP Key to display Pn50F.
7	<div>n.0000</div>	<div></div>	Press the DATA/SHIFT Key for approximately one second to display the current data of Pn50F. (/BK is set to "Invalid.")

Step	Display after Operation	Keys	Description
8			Press the DATA/SHIFT Key to select the third digit from the right. Press the UP Key to set "2." (Allocates /BK to CN1-27 (28).)
9	 Display blinks.		Press the DATA/SHIFT Key for approximately one second. The value blinks and is saved.
10			Press the DATA/SHIFT Key for approximately one second to return to the display Pn50F. /TGON is set as "Invalid" and /BK is mapped on CN1-27 (28).
11	Turn OFF the power and ON again to enable the changes of output signal selection (Pn50E and Pn50F).		

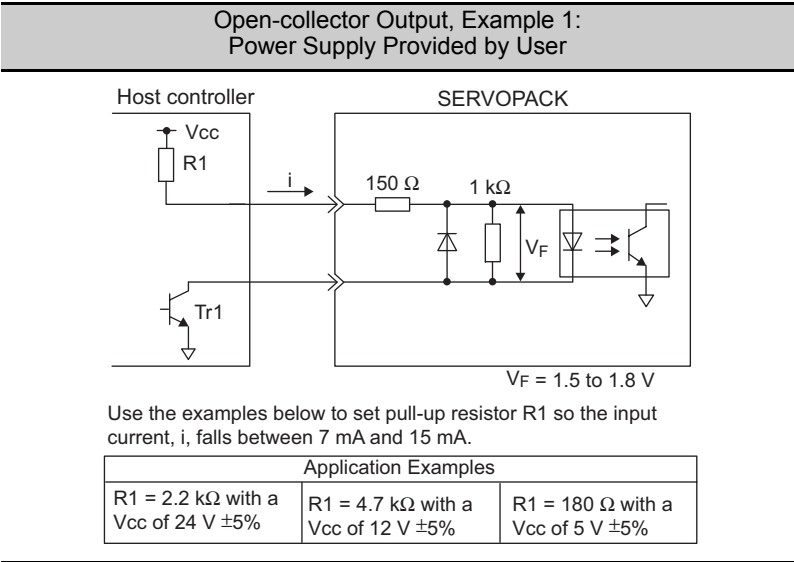
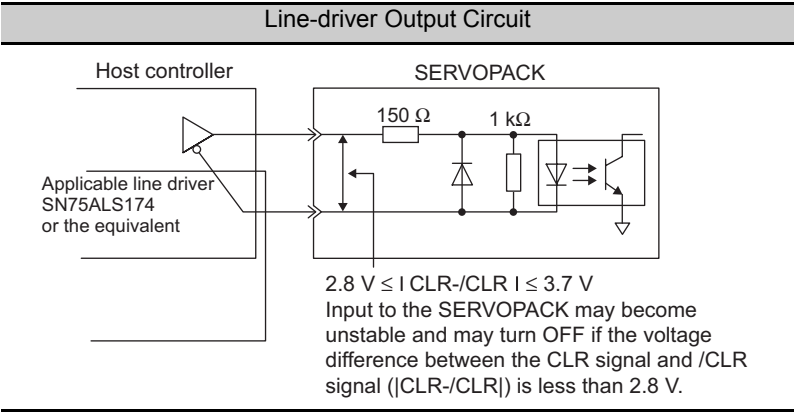
3.3.4 Checking Output Signals

Output signal status can be checked using the output signal monitor (Un006). As for the output signal monitor (Un006), refer to 8.5 *Monitoring Output Signals*.

(3) Clear Input Circuit

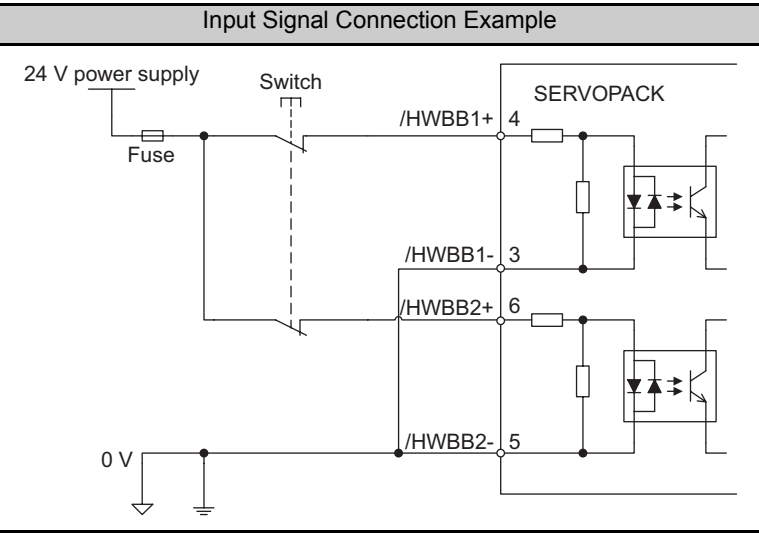
CN1 connector terminals, 15-14: Clear input is explained below.

An output circuit for the reference pulse and position error pulse clear signal at the host controller can be either line-driver or open-collector outputs. The following shows by type.



(4) Safety Input Circuit

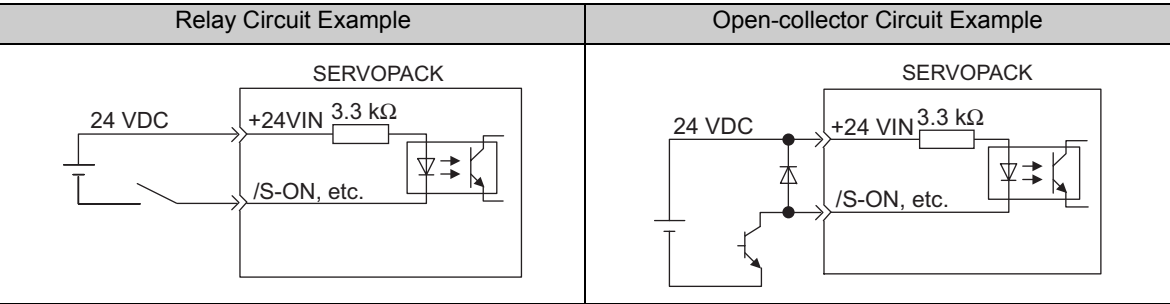
As for wiring input signals for safety function, input signals make common 0 V. It is necessary to make an input signal redundant.



3.4.2 Connection Examples of Sequence Input Circuits to SERVOPACK

CN1 connector terminals 40 to 47 are explained below.

The sequence input circuit interface connects through a relay or open-collector transistor circuit. Select a low-current relay otherwise a faulty contact will result.



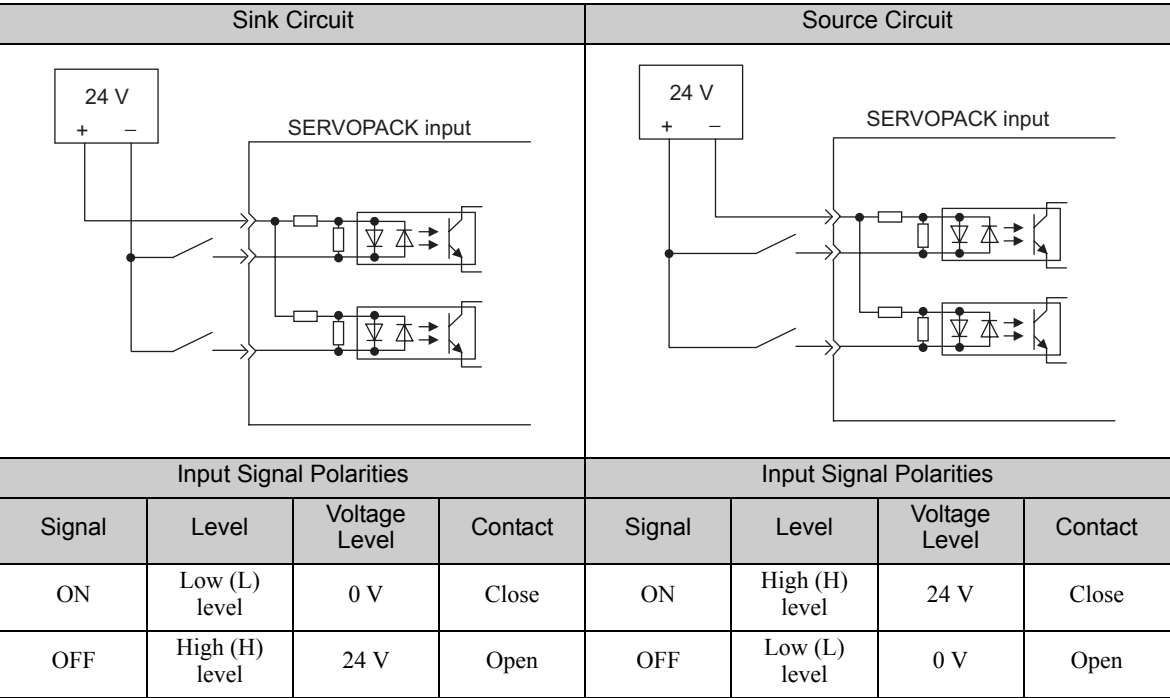
Note: The 24 VDC external power supply capacity must be 50 mA minimum.

<Supplemental Information>

For SEN input signal circuit, refer to 5.9.2 *Standard Connection Diagram for an Absolute Encoder and Setting the SEN Signal*.

The SERVOPACK’s I/O circuit uses bidirectional photocoupler. Select either the sink circuit or the source circuit according to the specifications required for each machine.

- Note:
- The Connection examples in 3.2.5 to 3.2.7 show sink circuits.
 - The ON/OFF polarity differs between when a sink circuit is connected and when a source circuit is connected.

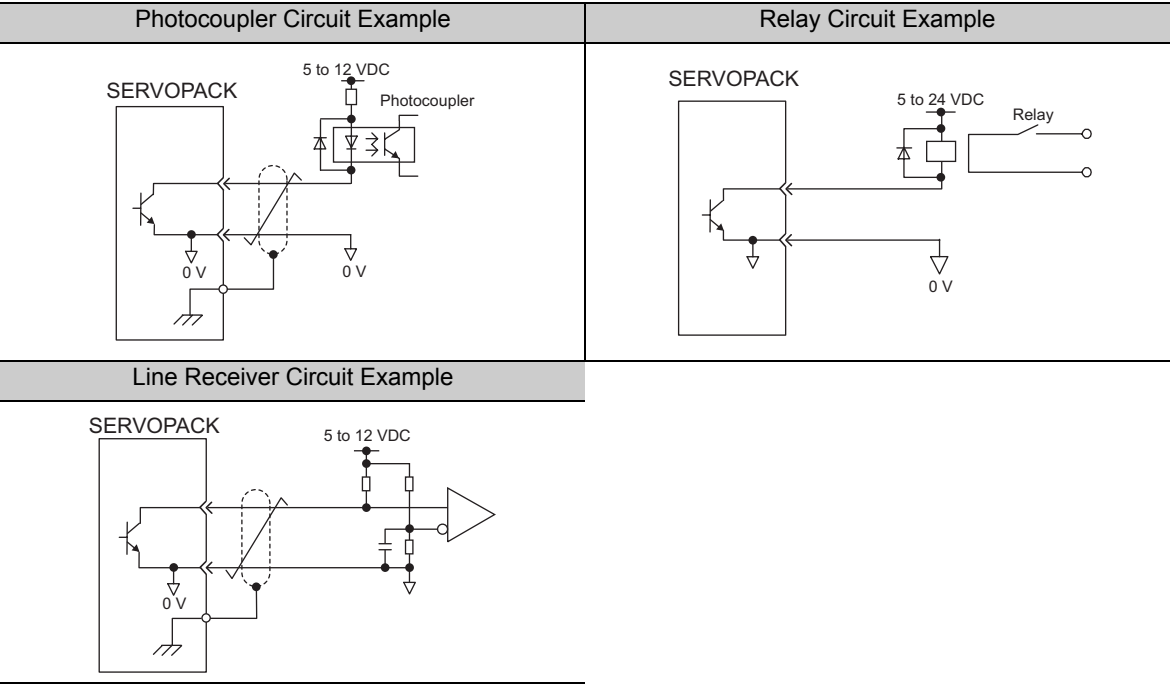


3.4.3 Connection Examples of Output Circuits to SERVOPACK

There are three types of SERVOPACK output circuits:

(1) Open-collector Output Circuit

CN1 connector terminals 37 to 39 (alarm code output) are explained below.
Alarm code signals (ALO1, ALO2, ALO3) are output from open-collector transistor output circuits. Connect an open-collector output circuit through a photocoupler, relay or line receiver circuit.

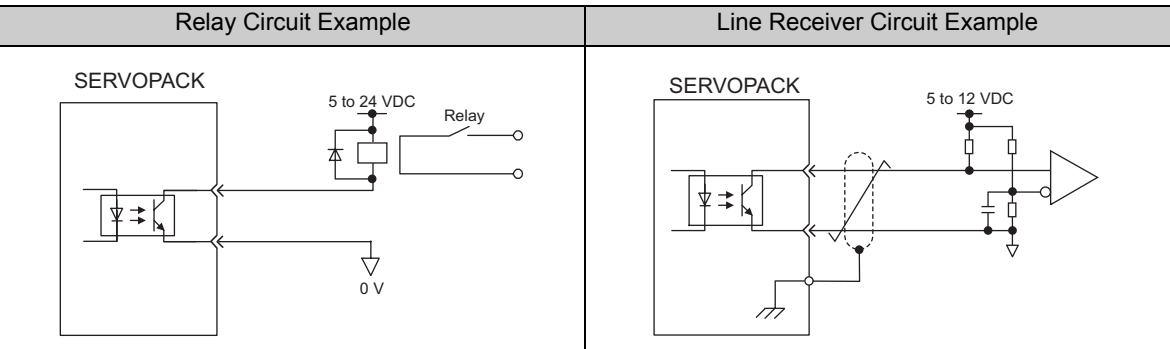


Note: The maximum allowable voltage and current capacities for open-collector output circuits are as follows.

- Voltage: 30 VDC
- Current: 20 mA DC

(2) Photocoupler Output Circuit

Photocoupler output circuits are used for servo alarm (ALM), servo ready (/S-RDY), and other sequence output signal circuits. Connect a photocoupler output circuit through a relay or line receiver circuit.



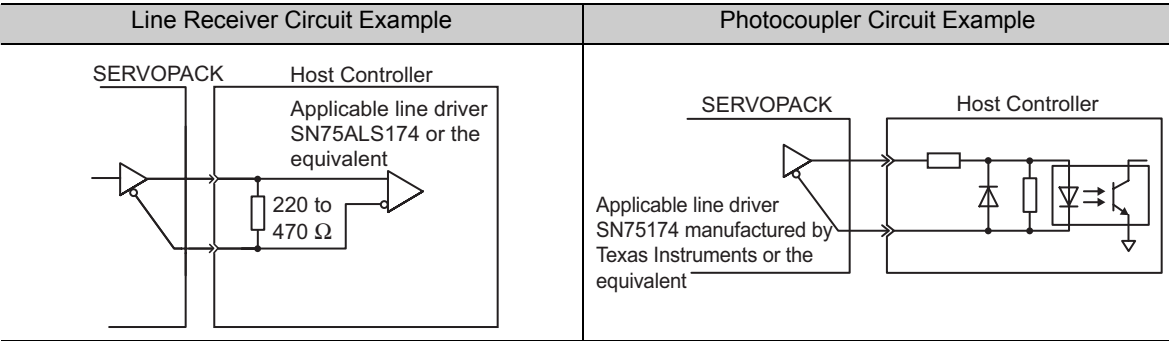
Note: The maximum allowable voltage and current capacities for photocoupler output circuits are as follows.

- Voltage: 30 VDC
- Current: 5 to 50 mA DC

(3) Line Driver Output Circuit

CN1 connector terminals, 33-34 (phase-A signal), 35-36 (phase-B signal), and 19-20 (phase-C signal) are explained below.

Encoder serial data converted to two-phase (phases A and B) pulse output signals (PAO, /PAO, PBO, /PBO) and origin pulse signals (PCO, /PCO) are output via line-driver output circuits. Normally, the SERVOPACK uses this output circuit in speed control to comprise the position control system at the host controller. Connect the line-driver output circuit through a line receiver circuit at the host controller.



(4) Safety Output Circuit

External device monitor (EDM1), an output signal of safety function, is explained below. EDM1 is a function for monitoring a failure of HWBB function. Connect it to safety device as a feedback signal.

The relation between EDM1 and /HWBB1, /HWBB2 signals are explained below.

Signal Name	Logic			
/HWBB1	ON	ON	OFF	OFF
/HWBB2	ON	OFF	ON	OFF
EDM1	OFF	OFF	OFF	ON

When both /HWBB1 and /HWBB2 signals are OFF, EDM1 signal turns ON.

■ EDM1 Signal

Detection of failures in the EDM1 circuit can be checked using the following four status of the EDM1 signal in the table. Failures can be detected if the failure status can be confirmed, e.g., when the power supply is turned ON.

 **WARNING**

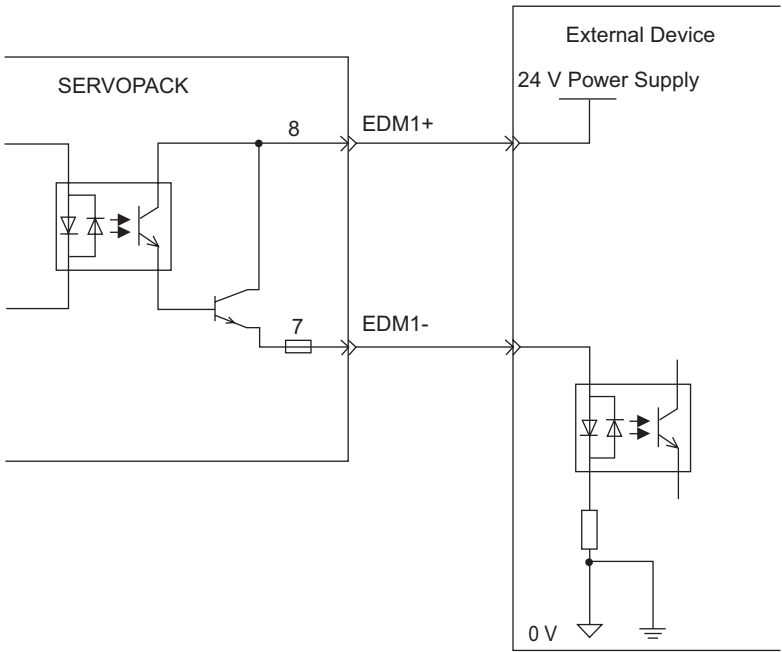
The EDM1 signal is not a safety output. Use it only for monitoring a failure.

(5) Connection Example and Specifications of EDM1 Output Signal

Connection example and specifications of EDM1 output signal are explained below.

■ Connection Example

EDM1 output signal is used for source circuit.



■ Specifications

Type	Signal Name	Pin No.	Input Status	Meaning
Output	EDM1	CN9-8 CN9-7	ON	Both baseblocks by /HWBB1 signal and /HWBB2 signal normally activate.
			OFF	—

Electrical characteristics of EDM1 signal are as follows.

Items	Characteristic	Remarks
Maximum Allowable Voltage	30 VDC	—
Maximum Current	50 m ADC	—
Maximum Voltage Drop at ON	1.0 V	Voltage between EDM1+ to EDM1- at current is 50 mA.
Maximum Delay Time	20 ms	Time from change of /HWBB1, /HWBB2 to change of EDM1

3.5 Examples of Encoder Connection

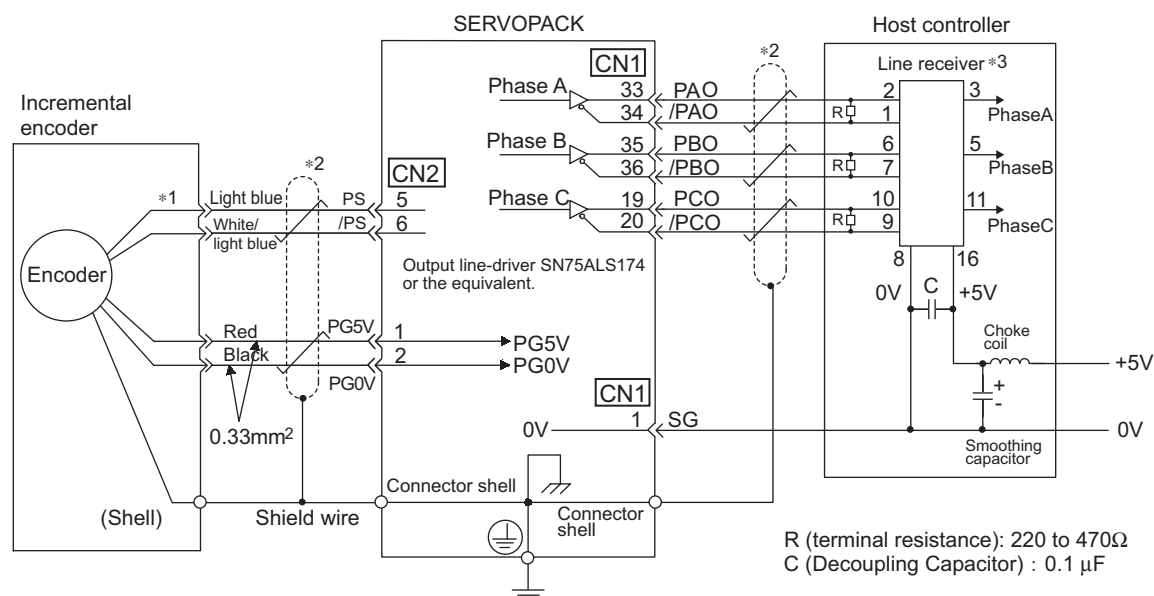
This section describes the connection example of output signals between encoder, SERVOPACK and host controller.

CN2 encoder connector terminal layout is also described.

3.5.1 Connection Example of an Encoder

The following diagram shows the example of connecting encoder.

(1) Incremental Encoder

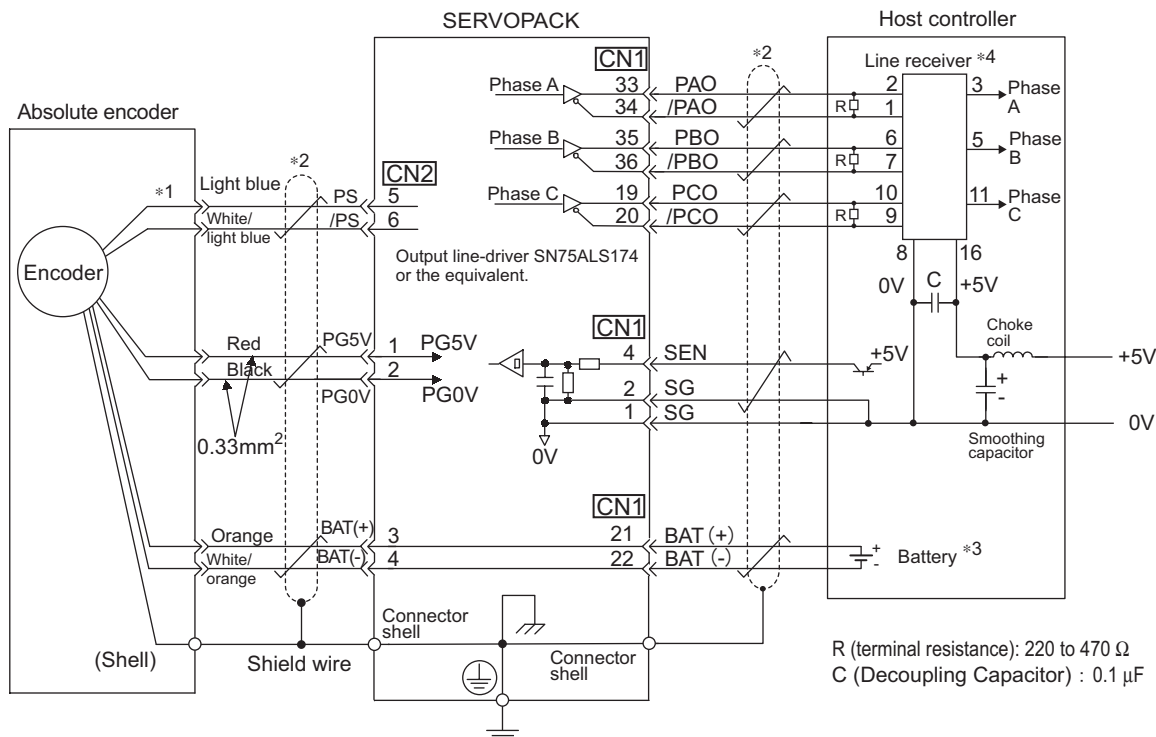


*1. The pin numbers for the connector wiring differ depending on the servomotors.

*2.  : represents twisted-pair wires.

*3. Applicable line receiver: SN75ALS175 manufactured by Texas Instruments or MC3486, or the equivalent.

(2) Absolute Encoders

**3.5.2** CN2 Encoder Connector Terminal Layout

1	PG 5 V	PG power supply +5 V	2	PG 0 V	PG power supply 0 V
3	BAT (+)	Battery (+) (For an absolute encoder)	4	BAT (-)	Battery (-) (For an absolute encoder)
5	PS	PG serial signal input (+)	6	/PS	PG serial signal input (-)
SHELL	Shield	-			

3.6 Connecting Regenerative Resistors

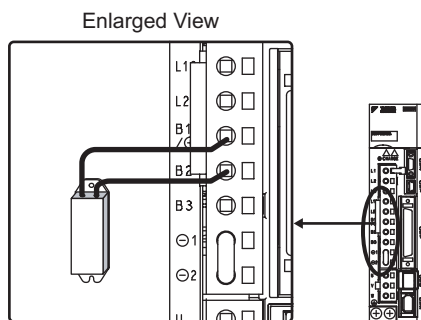
This section describes how to connect the regenerative resistor and set the regenerative resistor capacity. As for precautions on selecting a regenerative resistor and its specifications, refer to *Σ-V series SGD V Catalog* (KAEPS80000042).

3.6.1 Connecting Regenerative Resistors

The following instructions show how to connect the regenerative resistors and SERVOPACKs.

(1) SERVOPACKs: Model SGD V-R70A, -R90A, -1R6A, -2R8A

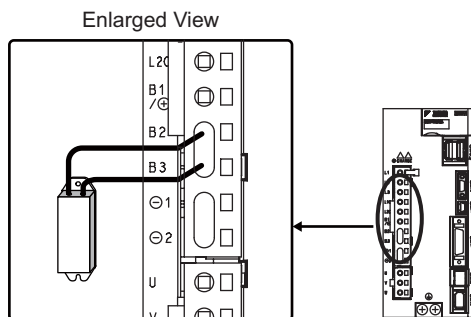
Connect an external regenerative resistor between B1/⊕ and B2 terminals.



(2) SERVOPACKs: Model SGD V-5R5A, -1R9D, -3R5D, -3R8A, -5R4D, -8R4D, -120D, -170D

Disconnect the wiring between the SERVOPACK's B2 and B3 terminals and connect an external regenerative resistor between the B1/⊕ and B2 terminals or between the B1 and B2 terminals.

Note: Be sure to take out the lead wire between the B2 and B3 terminals.




WARNING

- Be sure to connect the regenerative resistor correctly.
Failure to observe this warning may result in fire or damage to the product.

3.6.2 Setting Regenerative Resistor Capacity

When an external regenerative resistor is connected, make sure to set the regenerative resistor capacity using the parameter Pn600.

 **WARNING**

- If 0 is set to the parameter Pn600 while an external regenerative resistor is connected, the generative overload alarm (A.320) may not be detected. If the generative overload alarm (A.320) is not detected correctly, the external regenerative resistor may be damaged and an injury or fire may result.


	Regenerative Resistor Capacity			
Pn600	Setting Range	Unit	Factory Setting	When Enabled
	0 to SERVOPACK capacity	10 W	0	Immediately

Be sure to set this parameter when installing an external regenerative resistor to the SERVOPACK. When set to the factory setting of "0," the SERVOPACK's built-in resistor has been used. Set the regenerative resistor capacity within tolerance value. When the set value is improper, alarm A.320 is detected.

The set value differs depending on the cooling method of external regenerative resistor:

- For natural air cooling method: Set the value maximum 20% of the actually installed regenerative resistor capacity (W).
- For forced air cooling method: Set the value maximum 50 % of the actually installed regenerative resistor capacity (W).

Example: Set 20 W (100 W × 20%) for the 100 W external regenerative resistor with natural cooling method:
Pn600 = 2 (units: 10 W)

 **IMPORTANT**

1. When the external regenerative resistors for power are used at the rated load ratio, the resistor temperature increases to between 200 °C and 300 °C. The resistors must be used at or below the rated values. Check with the manufacturer for the resistor's load characteristics.
2. For safety, use the external resistors with thermoswitches.

3.7 Noise Control and Measures for Harmonic Suppression

This section describes the wiring for noise control and the DC reactor for harmonic suppression.

3.7.1 Wiring for Noise Control

The SERVOPACK uses high-speed switching elements in the main circuit. It may receive "switching noise" from these high-speed switching elements if wiring or grounding around the SERVOPACK is not appropriate. To prevent this, always wire and ground the SERVOPACK correctly.



IMPORTANT

Because the SERVOPACK is designed as an industrial device, it provides no mechanism to prevent noise interference.

If the equipment is to be used near private houses or may receive noise interference, install a noise filter on the input side of the power supply line.

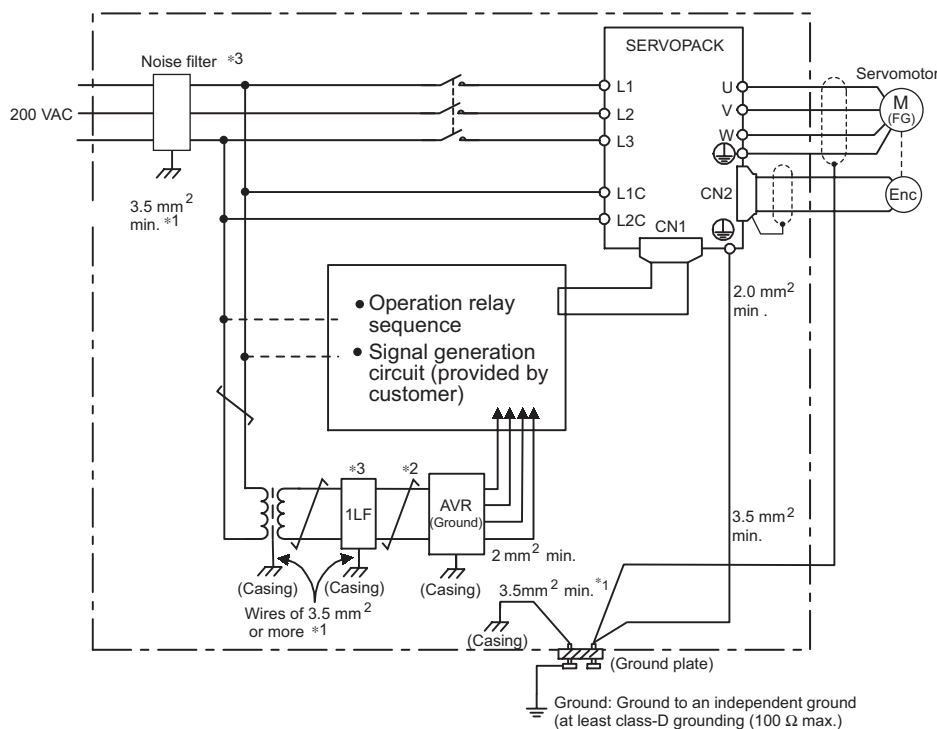
To prevent malfunction due to noise, take the following actions:

- Position the input reference device and noise filter as close to the SERVOPACK as possible.
- Always install a surge suppressor in the relay, solenoid and electromagnetic contactor coils.
- The distance between a power line (servomotor main circuit cable) and a signal line must be at least 30 cm. Do not put the power and signal lines in the same duct or bundle them together.
- Do not share the power supply with an electric welder or electrical discharge machine. When the SERVOPACK is placed near a high-frequency generator, install a noise filter on the input side of the power supply line. As for the wiring of noise filter, refer to (1) *Noise Filter* shown below.
- Take the grounding measures correctly. As for the grounding, refer to (2) *Correct Grounding*.


(1) Noise Filter

The SERVOPACK has a built-in microprocessor (CPU), so protect it from external noise as much as possible by installing a noise filter in the appropriate place.

The following is an example of wiring for noise control.



*1. For ground wires connected to the casing, use a thick wire with a thickness of at least 3.5 mm² (preferably, plain stitch cooper wire).

*2.  should be twisted-pair wires.

*3. When using a noise filter, follow the precautions in 3.7.2 *Precautions on Connecting Noise Filter*.

(2) Correct Grounding

Take the following grounding measures to prevent the malfunction due to noise.

■ Grounding the Motor Frame

Always connect servomotor frame terminal FG to the SERVOPACK ground terminal \oplus . Also be sure to ground the ground terminal \oplus .

If the servomotor is grounded via the machine, a switching noise current will flow from the SERVOPACK power unit through servomotor stray capacitance. The above grounding is required to prevent the adverse effects of switching noise.

■ Noise on the I/O Signal Line

If the I/O signal line receives noise, ground the 0 V line (SG) of the reference input line. If the main circuit wiring for the motor is accommodated in a metal conduit, ground the conduit and its junction box. For all grounding, ground at one point only.

3.7.2 Precautions on Connecting Noise Filter

This section describes the precautions on installing a noise filter.

(1) Noise Filter Brake Power Supply

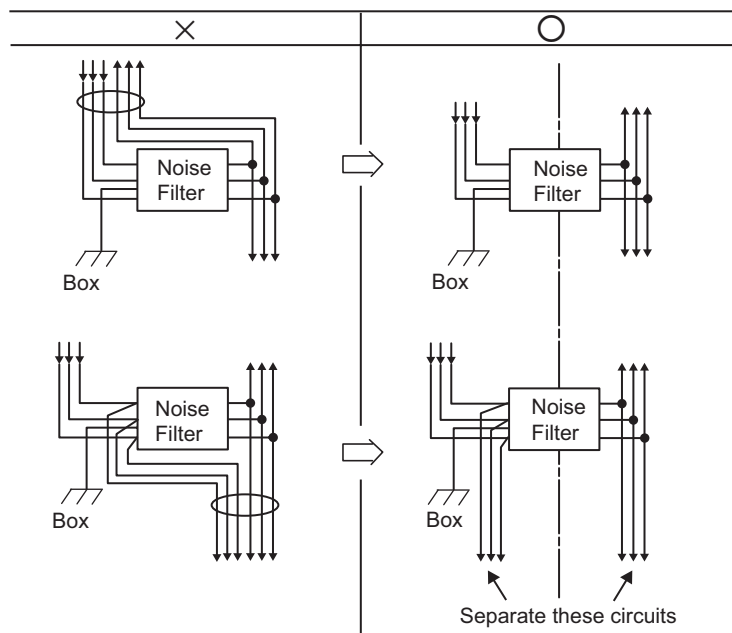
Use the following noise filter at the brake power input for 400 W or less servomotors with holding brakes.

MODEL: FN2070-6/07 (Manufactured by SCHAFFNER Electronic.)

(2) Precautions on Using Noise Filters

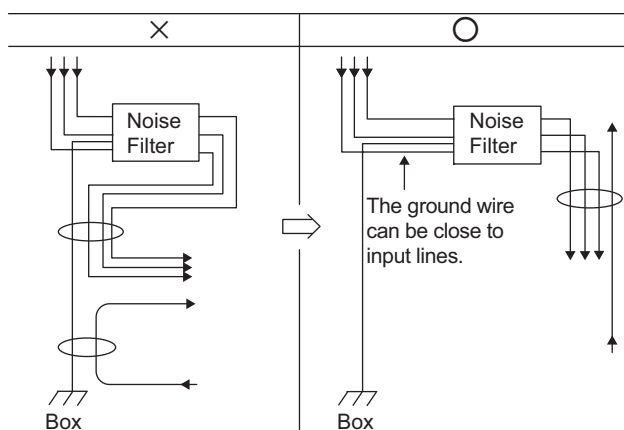
Always observe the following installation and wiring instructions.

Do not put the input and output lines in the same duct or bundle them together.

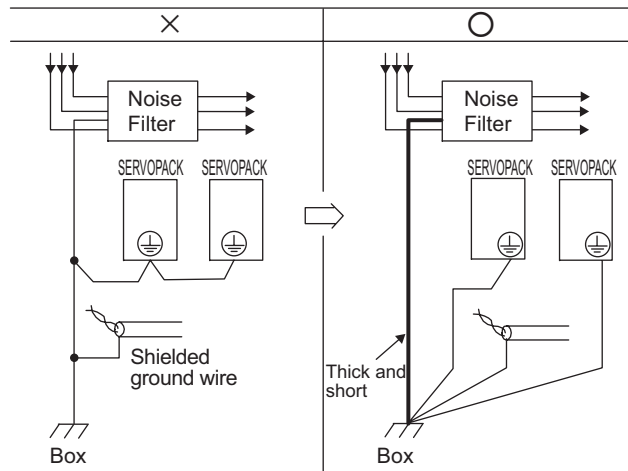


Separate the noise filter ground wire from the output lines.

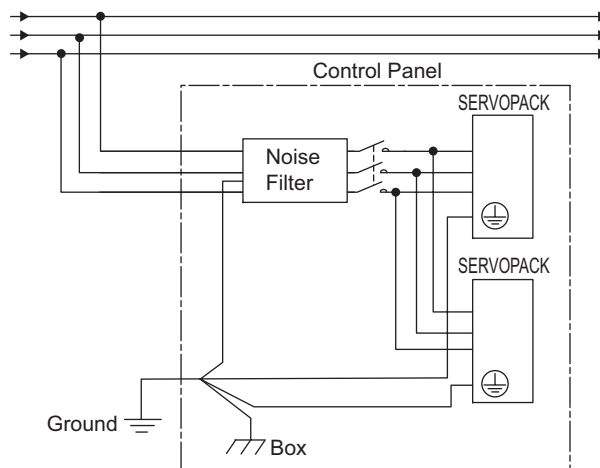
Do not accommodate the noise filter ground wire, output lines and other signal lines in the same duct or bundle them together.



Connect the noise filter ground wire directly to the ground plate.
Do not connect the noise filter ground wire to other ground wires.



If a noise filter is located inside a control panel, connect the noise filter ground wire and the ground wires from other devices inside the control panel to the ground plate for the control panel first, then ground these wires.

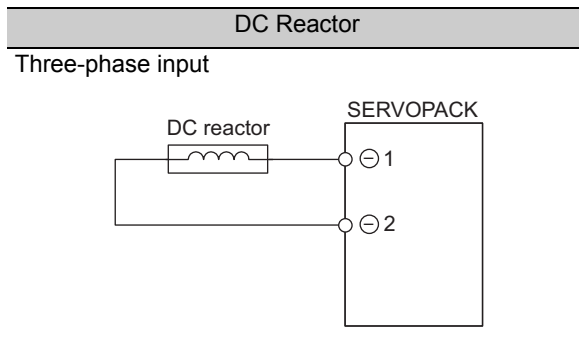


3.7.3 Connecting DC Reactor for Harmonic Suppression

The SERVOPACK has reactor connection terminals for power supply harmonic suppression.

As for the precautions on selecting a DC reactor and its specifications, refer to *Σ-V series SGM□V/SGDV Catalog* (KAEPS80000042).

Connect a reactor as shown in the following diagram.



Trial Operation

4.1	Inspection and Checking before Trial Operation	4-2
4.2	Trial Operation for Servomotor without Load	4-2
4.3	Aligning with Origin Search (Fn003)	4-2
4.4	Trial Operation for Servomotor without Load from Host Reference	4-4
4.4.1	Inspecting Connection and Status of Input Signal Circuits	4-6
4.4.2	Trial Operation in Speed Control	4-8
4.4.3	Trial Operation under Position Control from the Host with the SERVOPACK Used for Speed Control	4-8
4.4.4	Trial Operation in Position Control	4-9
4.5	Trial Operation with the Servomotor Connected to the Machine	4-10
4.6	Trial Operation of Servomotor with Brakes	4-11
4.7	Test Without Motor Function	4-12
4.7.1	Limitations	4-12
4.7.2	Operating Procedure	4-13
4.7.3	Related Parameters	4-14
4.7.4	Operator Display during Testing without Motor	4-14

4.1 Inspection and Checking before Trial Operation

To ensure safe and correct trial operation, inspect and check the following items before starting trial operation.

(1) Servomotors

Inspect and check the following items, and take appropriate measures before performing trial operation if any problem exists.

- Are all wiring and connections correct?
- Are all nuts and bolts securely tightened?
- If the servomotor has an oil seal, is the seal undamaged and is the motor oiled?

Note: When performing trial operation on a servomotor that has been stored for a long period of time, perform the inspection according to the procedures described in *1.6 Inspection and Maintenance*.

(2) SERVOPACKs

Inspect and check the following items, and take appropriate measures before performing trial operation if any problem exists.

- Are all wiring and connections correct?
- Is the correct power supply voltage being supplied to the SERVOPACK?

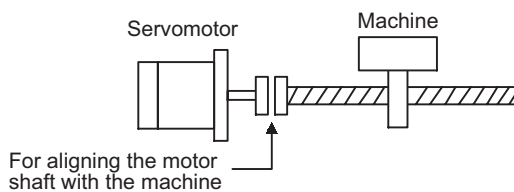
4.2 Trial Operation for Servomotor without Load

For the trial operation for servomotor without load, refer to *Σ-V series User's Manual, Setup, Rotational Motor* (SIEPS80000043).

4.3 Aligning with Origin Search (Fn003)

The origin search is designed to position the origin pulse position of the incremental encoder and to clamp at the position.

This mode is used when the motor shaft needs to be aligned to the machine. Execute the origin search without connecting the couplings.



An origin search can be performed under the following conditions.

- S-ON is not input.
- Parameter Pn50A.1 is not set to 7.

Motor speed at the time of execution: 60 min⁻¹



IMPORTANT

Perform origin searches without connecting the coupling.

The forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are not effective in origin search mode.

Follow the steps below to execute the origin search.

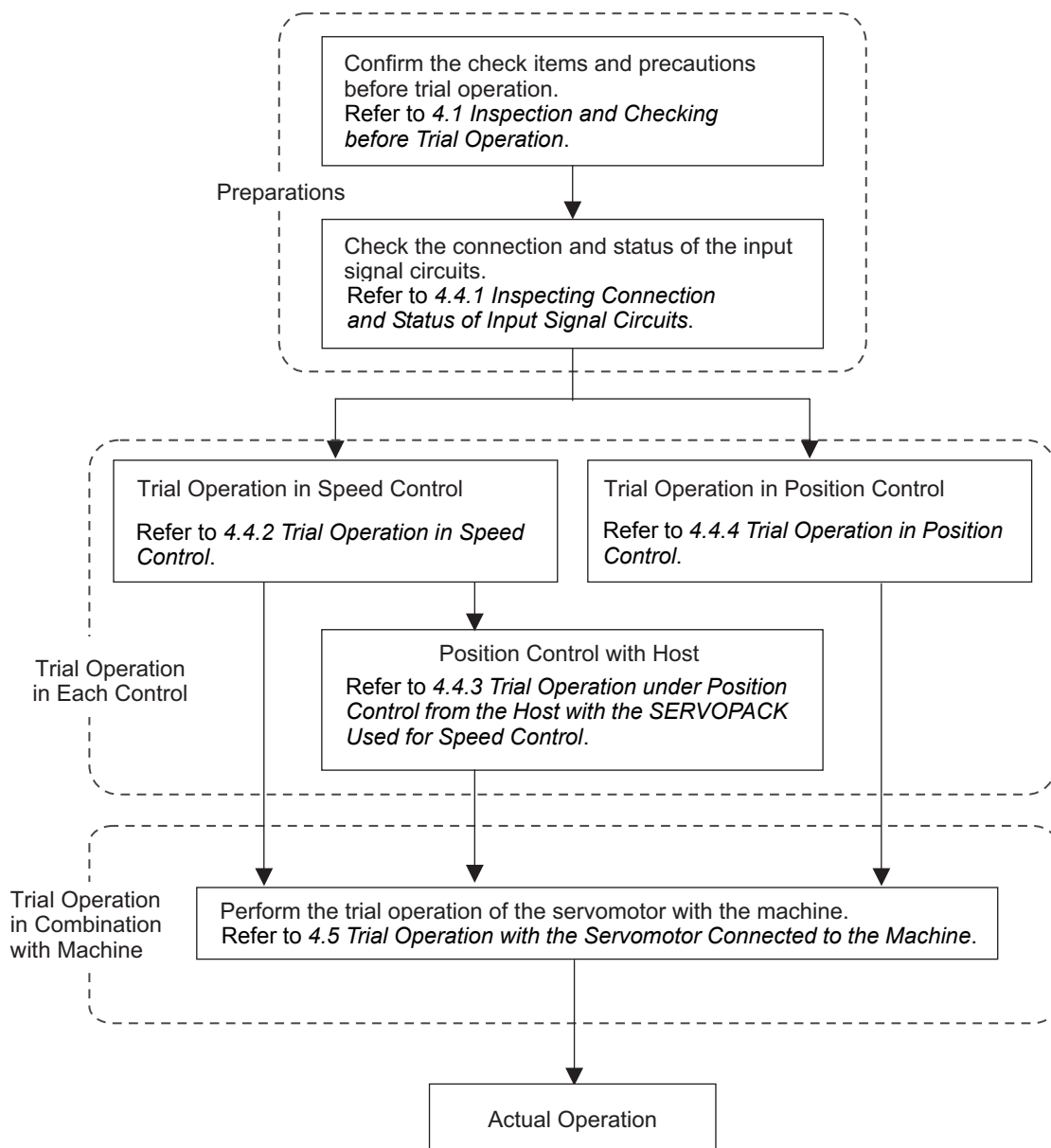
Step	Display after Operation	Keys	Description											
1			Press the MODE/SET Key to select the utility function mode.											
2			Press the UP or DOWN Key to select the Fn003.											
3			Press the DATA/SHIFT Key for approximately one second, and the display shown on the left appears.											
4			Press the MODE/SET Key. The servomotor is turned to Servo ON.											
5			<p>Pressing the UP Key will rotate the motor in the forward direction. Pressing the DOWN Key will rotate the motor in the reverse direction. The rotation of the servomotor changes according to the setting of Pn000.0.</p> <table><tr><th colspan="2">Parameter</th><th>UP key (Forward)</th><th>DOWN key (Reverse)</th></tr><tr><td rowspan="2">Pn000</td><td>n.□□□0</td><td>CCW</td><td>CW</td></tr><tr><td>n.□□□1</td><td>CW</td><td>CCW</td></tr></table> <p>Note: Direction when viewed from the load of the servomotor.</p>	Parameter		UP key (Forward)	DOWN key (Reverse)	Pn000	n.□□□0	CCW	CW	n.□□□1	CW	CCW
Parameter		UP key (Forward)	DOWN key (Reverse)											
Pn000	n.□□□0	CCW	CW											
	n.□□□1	CW	CCW											
6	 Display blinks.		Press the UP or DOWN Key. When the servomotor origin search is completed, the display blinks. At this moment, the motor is servo-locked at the origin pulse position.											
7			Press the DATA/SHIFT Key for approximately one second. "Fn003" is displayed again.											

4.4 Trial Operation for Servomotor without Load from Host Reference

Check the following items before performing trial operation of the servomotor without load from host reference.

- Check that servomotor operation reference input from the host to the SERVOPACK and I/O signals are set properly.
- Check that the wiring between the host and SERVOPACK and the polarity of the wiring are correct.
- Check that all operation settings for the SERVOPACK are correct.

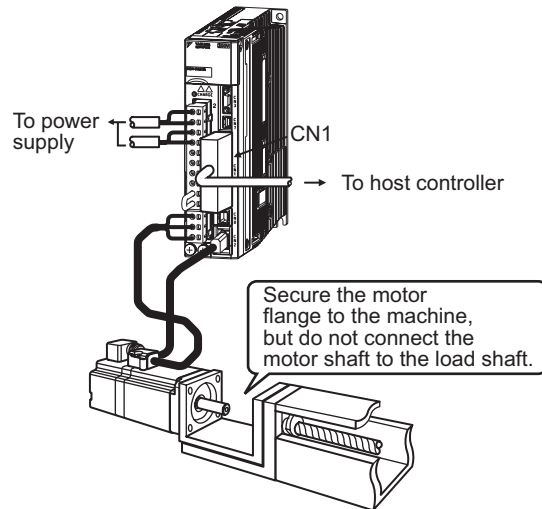
Perform the trial operation using the following procedure.



Note: • If position aligning in origin search is required, refer to 4.3 *Aligning with Origin Search (Fn003)*.
• To perform trial operation of a servomotor with a brake, refer to 4.6 *Trial Operation of Servomotor with Brakes*.

⚠ CAUTION

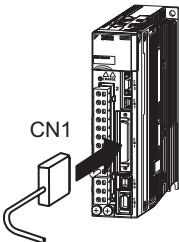
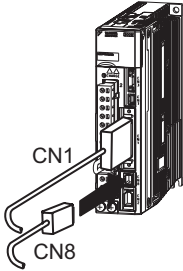
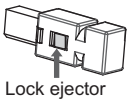
Before performing trial operation of the servomotor alone under references from the host, be sure that the servomotor has no load (i.e., the coupling and belt are separated from the servomotor) to prevent unexpected accidents.



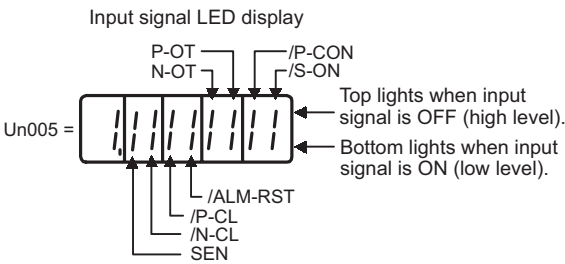
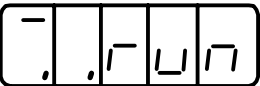


4.4.1 Inspecting Connection and Status of Input Signal Circuits

Check the items in step 1 before trial operation of the servomotor under speed control and position control references from the host.

Check the connection and status of input signals using the following procedure.

Step	Operation	Reference
1	<p>Connect the necessary input signal circuits to the I/O signal connector (CN1) under the following conditions.</p> <ul style="list-style-type: none"> It must be possible to input servo ON input signal (/S-ON). The forward run prohibited (P-OT) and reverse run prohibited (N-OT) input signals must be OFF (i.e., the servomotor must be able to run in forward and reverse). Settings: CN1-42 and CN1-43 must be ON or Pn50A.3 and Pn50B.0 must be set to 8. <p>Note: Return the settings to the previous ones after completing trial operation.</p> <ul style="list-style-type: none"> Make sure that a 0 V or 0-pulse reference is input.  <p><Supplementary Information></p> <ul style="list-style-type: none"> If Pn002 is set to n. <input type="checkbox"/> 1 <input type="checkbox"/> <input type="checkbox"/>, the absolute encoder can temporarily be used as an incremental encoder, which makes it possible to perform trial operation of the servomotor without Fn008 and SEN signal settings <p>Connect a safety device to CN8 when using the safety function.</p> <p>Note:</p> <p>When not using the safety function, use the SERVOPACK with the safety function jumper connector (JZSP-CVH05-E provided as an accessory) inserted in CN8. If the SERVOPACK is used without the jumper connector inserted into CN8, no current will flow to the motor and no torque will be output. In this case, "Hbb" will be displayed on the Panel Operator or the Digital Operator.</p>  <p>Note:</p> <p>When removing the safety function jumper connector (JZSP-CVH05-E) from CN8, remove the motor main circuit connector first, and pull out the jumper connector while pressing the lock ejector located on the side of the jumper connector toward the SERVOPACK. The jumper connector may be damaged if it is pulled out without being unlocked.</p> 	<p>Refer to the following connection diagrams.</p> <p>3.2.5 Example of I/O Signal Connections in Speed Control</p> <p>3.2.6 Example of I/O Signal Connections in Position Control</p> <p>3.2.7 Example of I/O Signal Connections in Torque Control</p> <p>5.9.1 Encoder Resolutions</p>
2	Connect the connector of the host and the I/O signal connector (CN1) together.	

Step	Operation	Reference
3	<p>Turn ON the power and make sure that the panel operator display is as shown below.</p>  <p>The input signal setting is not correct if the display is not the same as above. Check the input signal using the Un005 (input signal monitor) from the panel operator.</p> <p>Un005 = </p> <p>Check input signal wiring in monitor mode using the panel operator. Turn ON and OFF each signal line to see if the LED monitor bit display on the digital operator changes as shown below.</p> <p>Input signal LED display</p>  <p>Note:</p> <ul style="list-style-type: none"> • If an absolute encoder is being used, turn ON the SEN signal. The servo will not turn ON when only servo ON signal (/S-ON) is input. • When the SEN signal is checked in monitor mode, the top of the LED will light because the SEN signal is high when ON. <p><Supplementary Information> Input signals can be also checked using wiring check function of SigmaWin+. For details, refer to help screen of SigmaWin+.</p>	<p>8.4 Monitoring Input Signals 3.3.1 Input Circuit Signal Allocation</p> <p>8.1 List of Monitor Modes</p>
4	<p>Input the /S-ON signal, then make sure that the display of the panel operator is as shown below.</p>  <p>If an alarm display appears, correct it according to 10.1 Troubleshooting.</p> <p><Supplementary Information> If there is noise in the reference voltage during speed control, the horizontal line (-) at the far left edge of the panel operator display may blink. Refer to 3.7.1 Wiring for Noise Control and take a preventive measure.</p>	<p>10.1 Troubleshooting 3.7.1 Wiring for Noise Control</p>
5	<p>This completes all preparations for trial operation. Perform trial operation in each mode.</p>	<p>4.4.2 Trial Operation in Speed Control 4.4.3 Trial Operation under Position Control from the Host with the SERVOPACK Used for Speed Control 4.4.4 Trial Operation in Position Control</p>

4.4.2 Trial Operation in Speed Control

Perform the following steps for trial operation in speed control. The steps are specified on the condition that input signal wiring for the speed control has been completed according to *4.4.1 Inspecting Connection and Status of Input Signal Circuits*.

Step	Operation	Reference
1	Recheck the power supply and the input signal circuits, and turn ON the control power supply and main circuit power supply. Check that the speed reference input (i.e., the voltage between V-REF and SG) is 0 V.	3.2.5 Example of I/O Signal Connections in Speed Control
2	Turn ON the servo ON (/S-ON) input signal. Note: If the servomotor rotates at a minute speed with the speed reference input at 0 V, adjust the reference offset so that the servomotor will not rotate.	5.3.2 Reference Offset Adjustment
3	Gradually increase the voltage of the speed reference input (i.e., the voltage between V-REF and SG) from 0 V. <Supplementary Information> The factory setting is for 6 V at the rated speed.	
4	Check the speed reference value in monitor mode (Un001).	8.1 List of Monitor Modes
5	Check the motor speed in monitor mode (Un000).	8.1 List of Monitor Modes
6	Check that the values in step 4 and step 5 (Un001 and Un000) are equal to each other.	
7	Change the voltage of the speed reference input and check that Un001 and Un000 have the same value. <Supplementary Information> If the values of Un001 and Un000 are not the same, adjust the speed reference input gain (Pn300).	5.3.1 Basic Settings for Speed Control
8	Check the motor rotation direction. <Supplementary Information> To switch the motor rotation direction without changing the polarity of the analog speed reference, refer to 5.2.2 Servomotor Rotation Direction	5.2.2 Servomotor Rotation Direction
9	Return the speed reference input to 0 V.	
10	Turn OFF the servo to complete trial operation in speed control.	

4.4.3 Trial Operation under Position Control from the Host with the SERVOPACK Used for Speed Control

To operate the SERVOPACK in speed control under the position control from the host, check the operation of the servomotor after finishing the trial operation explained in 4.4.2 Trial Operation in Speed Control.

Step	Operation	Reference
1	Turn ON the control power supply and main circuit power supply.	
2	Turn ON the servo ON (/S-ON) input signal. Note: If the servomotor rotates at a minute speed with the speed reference input at 0 V, adjust the reference offset so that the servomotor will not rotate.	5.3.2 Reference Offset Adjustment
3	To check the speed of the servomotor, execute a constant speed reference through the host. Check the speed of the servomotor using the motor speed monitor (Un000). Example: Visually check that the servomotor rotates once per second with a speed reference of 60 min^{-1} . If the speed of the servomotor is not correct, check the followings. • The speed reference input gain (Pn300) is set properly. • Apply forward and reverse rotation references, and check the rotation directions.	4.4.2 Trial Operation in Speed Control 5.2.2 Servomotor Rotation Direction
4	To check the rotation of the servomotor, execute a simple positioning reference through the host. Input a reference equivalent to a single rotation of the servomotor and visually check with the motor rotation angle monitor (Un003 pulses) that the motor axis rotates once. If the servomotor rotation is not correct, check the followings. • The number of dividing pulses set in Pn212 is correct. • Apply forward and reverse rotation references, and check the rotation directions.	5.3.7 Encoder Pulse Output Setting 5.2.2 Servomotor Rotation Direction
5	Return the speed reference input to 0V.	
6	Turn OFF the servo to complete trial operation.	

4.4.4 Trial Operation in Position Control

Perform the following steps for trial operation in position control. The steps are specified on the condition that input signal wiring for the position control has been completed according to 4.4.1 *Inspecting Connection and Status of Input Signal Circuits*.

Step	Operation	Reference
1	Set the reference pulse form according to the output pulse form of the host pulse reference device. Set the reference pulse form with Pn200.0.	5.4.1 <i>Basic Settings for Position Control Mode</i>
2	Set the reference unit, and then set the electronic gear ratio according to the host. The electronic gear ratio is set in Pn20E and Pn210.	5.4.3 <i>Electronic Gear</i>
3	Turn ON the control power supply and main circuit power supply to the SERVOPACK.	
4	Input /S-ON to turn ON the servo.	
5	Output a low-speed pulse reference for an easy-to-check number of rotations (e.g., one rotation) from the host. Note: To ensure safe, set the reference pulse speed so that the motor speed will be around 100 min^{-1} .	
6	Check the number of reference pulses input to the SERVOPACK from the changes in the input reference pulse counter before and after the reference. The input reference pulse counter can be checked with Un00C.	
7	Check the actual number of motor rotations from the changes of the feedback pulse counter before and after the reference. The feedback pulse counter can be checked with Un00D.	
8	Check that step 6 and step 7 satisfy the following formula. $\text{Un00D} = \text{Un00C} \times (\text{Pn20E}/\text{Pn210})$	
9	Check that the servomotor is rotating in the direction specified by the reference. <Supplementary Information> To switch the motor rotation direction without changing the polarity of the analog speed reference, refer to 5.2.2 <i>Servomotor Rotation Direction</i>	5.2.2 <i>Servomotor Rotation Direction</i>
10	Input a pulse reference for a comparatively large number of motor rotations from the host so that the motor will rotate at a constant speed. Note: To ensure safe, set the reference pulse speed so that the motor speed will be around 100 min^{-1} .	
11	Check the reference pulse speed input to the SERVOPACK from the input reference pulse speed (min^{-1}). The input reference pulse speed can be checked with Un007. <Supplementary Information> Obtain Un007 from the following formula (if the model uses a 20-bit encoder). $\text{Un007}(\text{input reference pulse speed}) = \underbrace{\text{input reference pulse [pulses/S]} \times 60}_{\text{Reference input ppm}} \times \underbrace{\frac{\text{Pn20E}}{\text{Pn210}}}_{\text{Electronic gear ratio}} \times \underbrace{\frac{1}{2^{20}(131072)}}_{\text{Encoder pulse}}$	
12	Check the motor speed (min^{-1}). The motor speed can be checked with Un000.	
13	Check that the values in step 11 and step 12 (Un007 and Un000) are equal to each other.	
14	Stop the pulse reference and turn OFF the servo. This completes trial operation.	

4.5 Trial Operation with the Servomotor Connected to the Machine

Perform the following steps for trial operation when the servomotor is connected to the machine. The steps are specified on the condition that trial operation has been completed in each control.



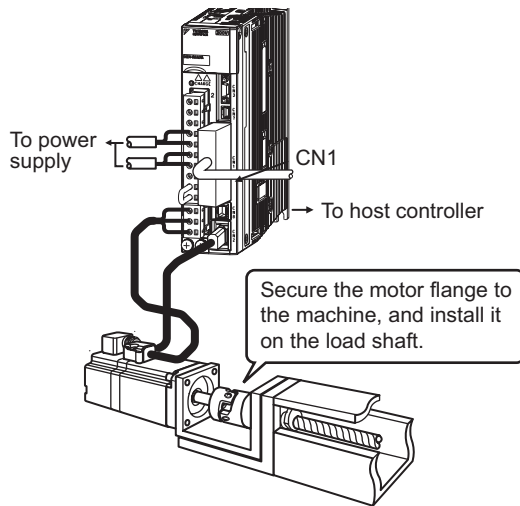
WARNING

- Malfunctions that occur after the servomotor is connected to the machine not only damage the machine, but may also cause an accident resulting death or injury.



IMPORTANT

During trial operation in each control, the overtravel signals (P-OT and N-OT) are OFF. Take an appropriate protective action, such as turning the overtravel signals (P-OT and N-OT) ON.

Step	Operation	Reference
1	<p>Turn ON the control power and main circuit power and make the settings for mechanical configuration related to protective function such as safety function, overtravel and brake.</p> <p>Note:</p> <ul style="list-style-type: none"> • When not using the safety function, use the SERVOPACK with the safety function jumper connector (JZSP-CVH05-E provided as an accessory) inserted. If the SERVOPACK is used without the jumper connector inserted into CN8, no current will flow to the motor and no torque will be output. In this case, "Hbb" will be displayed on the Panel Operator or the Digital Operator. • When a servomotor with brake is used, take advance measures to prevent vibration due to gravity acting on the machine or external forces before checking the brake operation. Check that both servomotor and brake operations are correct. 	<p>5.11 Safety Function</p> <p>5.2.3 Overtravel</p> <p>5.2.4 Holding Brakes</p>
2	Set the necessary parameters for control mode.	<p>5.3 Operating Using Speed Control with Analog Voltage Reference</p> <p>5.4 Operating Using Position Control with Pulse Train Reference</p> <p>5.5 Operating Using Torque Control with Analog Voltage Reference</p>
3	<p>Connect the servomotor to the machine with coupling, etc., while the power is turned OFF.</p>  <p>To power supply</p> <p>CN1</p> <p>To host controller</p> <p>Secure the motor flange to the machine, and install it on the load shaft.</p>	

Step	Operation	Reference
4	Check that the SERVOPACK is servo OFF status and then turn ON the power to the machine (host controller). Check again that the protective function in step 1 operates normally. Note: For steps 4 to 8, take advance measures for emergency stop so that the servomotor can stop safely when an error occurs during operation.	5.2.5 Stopping Method for Servomotor after Servo OFF or Alarm Occurrence
5	Perform trial operation with the servomotor connected to the machine, following each section in 4.4 Trial Operation for Servomotor without Load from Host Reference. Check that the trial operation is completed with as the trial operation for servomotor without load. Also check the settings for machine such as reference unit.	4.4 Trial Operation for Servomotor without Load from Host Reference
6	Check the settings of parameters for control used set in step 2 again. Check that the servomotor rotates matching the machine operating specifications.	
7	Adjust the servo gain and improve the servomotor response characteristics, if necessary. Note: The servomotor will not be broken in completely during the trial operation. Therefore, let the system run for a sufficient amount of additional time to ensure that it is properly broken in.	6 Adjustments
8	Write the parameters set for maintenance in Appendix D Parameter Recording Table. Then the trial operation with the servomotor connected to the machine is completed. <Supplementary Information> If the JUSP-OP05A digital operator is used, parameters can be saved. SigmaWin+, which is a tool for supporting the servodrive, can then manage the saved parameters in files.	

4.6 Trial Operation of Servomotor with Brakes

Observe the following precautions when performing a trial operation of servomotor with brake.

- When checking the brake operation, take advance measures to prevent vibration due to gravity acting on the machine or external forces.
- Check the servomotor operation and holding brake operation with the servomotor separated from the machine. If both operations are correct, connect the servomotor and perform trial operation.

Holding brake operation of the servomotor with brake can be controlled the brake interlock output (/BK) signal of the SERVOPACK.

For wiring on a servomotor with brakes, and setting parameters, refer to 5.2.4 Holding Brakes

4.7 Test Without Motor Function

The test without motor function is used to check the operation of the host and peripheral devices by simulating the operation of the motor in the SERVOPACK, i.e., without actually operating the motor. This function enables checking wiring and verifying the system and parameters when errors occur while debugging the system, thus shortening the time required for setup work and preventing damage to the equipment that may result from possible malfunctions. The operation of the motor can be checked during performing this function regardless of whether the motor is actually connected or not.

Note: Neither the rotation direction of the motor nor the moving direction of the load can be checked with this function. Check them with the motor connected.

4.7.1 Limitations

The following functions cannot be used during the test without motor.

- Regeneration and dynamic brake operation
- Brake output signal (The brake output signal can be checked with the I/O signal monitor function of the SigmaWin+.)
- Items marked with "X" in the utility function table on the next page.

The following utility functions can be used during the test without motor.

Fn No.	Contents	Can be used or not	
		Motor not connect-ed	Motor connect-ed
Fn000	Alarm traceback data display	○	○
Fn002	JOG operation	○	○
Fn003	Origin search	○	○
Fn004	Program JOG operation	○	○
Fn005	Initialize parameter settings	○	○
Fn006	Clear alarm traceback data	○	○
Fn008	Absolute encoder multi-turn reset and encoder alarm reset	×	○
Fn009	Automatic tuning of analog (speed, torque) reference offset	○	○
Fn00A	Manual servo tuning of speed reference offset	○	○
Fn00B	Manual servo tuning of torque reference offset	○	○
Fn00C	Manual zero-adjustment of analog monitor output	○	○
Fn00D	Manual gain-adjustment of analog monitor output	○	○
Fn00E	Automatic offset-adjustment of motor current detection signal	×	○
Fn00F	Manual offset-adjustment of motor current detection signal	×	○
Fn010	Write prohibited setting	○	○
Fn011	Check servomotor models	○	○
Fn012	Software version display	○	○
Fn013	Multi-turn limit value setting change when a Multi-turn Limit Disagreement alarm occurs	×	○
Fn014	Reset configuration error of option card	○	○
Fn01B	Initialize vibration detection level	×	×
Fn01E	SERVOPACK and servomotor ID display	○	○
Fn01F	Display of servomotor ID for feedback option	○	○
Fn200	Tuning-less level setting	×	×
Fn201	Advanced autotuning	×	×

Fn No.	Contents	Can be used or not	
		Motor not connect-ed	Motor connect-ed
Fn202	Advanced autotuning by reference	×	×
Fn203	One-parameter tuning	×	×
Fn204	Anti-resonance control adjustment function	×	×
Fn205	Vibration suppression function	×	×
Fn206	EasyFFT	×	×
Fn207	Online vibration monitor	×	×
Fn020	Origin setting	×	○
Fn030	Software reset	○	○
Fn080	Polarity Detection	×	×

○: can be used

×: cannot be used

4.7.2 Operating Procedure

Follow the steps below to execute the test without motor using panel operator.

Step	Display after Operation	Keys	Description
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select the Pn00C.
3			Press the DATA/SHIFT Key for approximately one second. The current data of Pn00C is displayed.
4			To enable the test without motor, press the UP Key to change the setting from n.□□□0 (factory setting) to n.□□□1. n.□□□0: Test without motor disabled. n.□□□1: Test without motor enabled.
5	 (Display blinks)		Press the MODE/SET Key for approximately one second. The display began to blink and the test without motor is enabled.
6			Press the DATA/SHIFT Key once to select the first digit of the data.
7			Press the UP or DOWN Key to select the encoder resolution. n.□□□□ : 13 bit (factory setting) n.□□1□ : 20 bit
8	 (Display blinks)		Press the MODE/SET Key for approximately one second. The display began to blink and the encoder resolution is set to 20 bit.
9			Press the DATA/SHIFT Key once to select the second digit of the data.

Step	Display after Operation	Keys	Description
10			Press the UP or DOWN Key to select the encoder type. n.□□0□ : incremental encoder (factory setting) n.□□1□ : absolute encoder
11			Press the MODE/SET Key for approximately one second. The display began to blink and the incremental encoder is selected.
12	To enable the change in the setting, turn OFF the power and ON again.		

4.7.3 Related Parameters

The following parameters are used for the test without motor.

(1) Application Function Select Switch C

Parameter	Meaning	When Enabled	Classification
Pn00C	n.□□□0	After restart	Setup
	n.□□□1		
	n.□□0□		
	n.□□1□		
	n.□0□□		
	n.□1□□		

(2) Moment of Inertia Ratio

Pn103	Moment of Inertia Ratio				
			<input type="checkbox"/> Speed	<input type="checkbox"/> Position	<input type="checkbox"/> Torque
	Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
	0 to 20000	%	0	Immediately	Tuning

4.7.4 Operator Display during Testing without Motor

The status display changes as shown below to show that the test without motor is in progress.

(1) Display on Panel Operator

* The test without motor operation is indicated with **tSt**.



Display	Status
run ⇔ tSt	Power is supplied to the motor.
bb ⇔ tSt	Power to the motor is OFF.
P-dt ⇔ tSt	The polarity is being detected.
Pot ⇒ not ⇒ tSt	Forward or reverse rotation is prohibited.
Pot ⇔ tSt	Driving in the forward direction is prohibited.
not ⇔ tSt	Driving in the reverse direction is prohibited.
Hbb ⇔ tSt	In hard-wire base block (safety) state.

The test without motor status is not displayed in the following status.

Display	Status
A.□□□	Alarm occurs.
AdJ (Blinks)	Executing advanced autotuning (Fn201).
no_oP (Blinks one second)	Utility function disabled.
Error (Blinks one second)	Error occurs during executing the utility function.
done (Blinks one second)	Utility function executed correctly.
End (Blinks one second)	Program JOG operation executed correctly.

(2) Display on Digital Operator

* mark is displayed before status display to indicate the test without motor operation is in progress.

* B B	- P R M / M O N -
U n 0 0 0 =	0 0 0 0 0
U n 0 0 2 =	0 0 0 0 0
U n 0 0 8 =	0 0 0 0 0 0 0 0 0 0
U n 0 0 D =	0 0 0 0 0 0 0 0 0 0

(Example: Status of power to the motor is OFF)

Display	Status
*RUN	Power is supplied to the motor.
*BB	Power to the motor is OFF.
*P DET	The polarity is being detected.
*PT NT	Forward or reverse rotation is prohibited.
*P-OT	Driving in the forward direction is prohibited.
*N-OT	Driving in the reverse direction is prohibited.
*HBB	In hard-wire base block (safety) state.

The test without motor status is not displayed in the following status.

Display	Status
A.□□□	Alarm occurs.
AdJ (Blinks)	Executing advanced autotuning (Fn201).
NO_OP (Blinks one second)	Utility function disabled.
ERROR (Blinks one second)	Error occurs during executing the utility function.
doNE (Blinks one second)	Utility function executed correctly.
END (Blinks one second)	Program JOG operation executed correctly.

5.1 Control Selection	5-3
5.2 Setting Common Basic Functions	5-4
5.2.1 Servo ON Signal	5-4
5.2.2 Servomotor Rotation Direction	5-5
5.2.3 Overtravel	5-6
5.2.4 Holding Brakes	5-8
5.2.5 Stopping Method for Servomotor after Servo OFF or Alarm Occurrence	5-13
5.2.6 Power Loss Settings	5-15
5.2.7 Torque Limit Function for Low Power Supply Voltage for Main Circuit (SEMI-F47 Function)	5-16
5.3 Operating Using Speed Control with Analog Voltage Reference	5-17
5.3.1 Basic Settings for Speed Control	5-17
5.3.2 Reference Offset Adjustment	5-19
5.3.3 Soft Start	5-21
5.3.4 Speed Reference Filter	5-22
5.3.5 Zero Clamp Function	5-23
5.3.6 Encoder Pulse Output	5-25
5.3.7 Encoder Pulse Output Setting	5-26
5.3.8 Speed Coincidence Signal Setting	5-27
5.4 Operating Using Position Control with Pulse Train Reference	5-28
5.4.1 Basic Settings for Position Control Mode	5-28
5.4.2 Clear Signal	5-33
5.4.3 Electronic Gear	5-34
5.4.4 Smoothing	5-36
5.4.5 Positioning Completed Output Signal	5-38
5.4.6 Positioning Near Signal	5-39
5.4.7 Reference Pulse Inhibit Function	5-40
5.5 Operating Using Torque Control with Analog Voltage Reference	5-42
5.5.1 Basic Settings for Torque Control Mode	5-42
5.5.2 Adjustment of Reference Offset	5-43
5.5.3 Speed Limit in Torque Control	5-45
5.6 Operating Using Speed Control with an Internally Set Speed	5-48
5.6.1 Basic Settings for Speed Control with an Internally Set Speed	5-48
5.6.2 Example of Operating with Internally Set Speed	5-50

5.7 Control Selection	5-52
5.7.1 Combination of Control Modes	5-52
5.7.2 Switching Internally Set Speed Control (Pn000.1 = 4, 5, or 6)	5-52
5.7.3 Switching Other Than Internally Set Speed Control (Pn000.1 = 7, 8, 9, A, or B)	5-53
5.8 Limiting Torque	5-54
5.8.1 Internal Torque Limit	5-54
5.8.2 External Torque Limit	5-55
5.8.3 Torque Limiting Using an Analog Voltage Reference	5-56
5.8.4 Torque Limiting Using an External Torque Limit and Analog Voltage Reference	5-57
5.8.5 Checking Output Torque Limiting during Operation	5-59
5.9 Absolute Encoders	5-60
5.9.1 Encoder Resolutions	5-60
5.9.2 Standard Connection Diagram for an Absolute Encoder and Setting the SEN Signal	5-61
5.9.3 Absolute Encoder Data Backup	5-62
5.9.4 Encoder Battery Alarm (A. 830)	5-63
5.9.5 Absolute Encoder Setup	5-64
5.9.6 Absolute Encoder Reception Sequence	5-65
5.9.7 Multiturn Limit Setting	5-68
5.9.8 Multiturn Limit Disagreement Alarm (A.CC0)	5-69
5.10 Output Signals Used in All Control Modes	5-70
5.10.1 Servo Alarm Output Signal (ALM) and Alarm Code Output Signals (ALO1, ALO2, and ALO3)	5-70
5.10.2 Warning Output Signal (/WARN)	5-71
5.10.3 Rotation Detection Output Signal (/TGON)	5-72
5.10.4 Servo Ready Output Signal (/S-RDY)	5-72
5.11 Safety Function	5-73
5.11.1 Hard Wire Base Block (HWBB) Function	5-73
5.11.2 External Device Monitor (EDM1)	5-77
5.11.3 Application Example of Safety Functions	5-79
5.11.4 Confirming Safety Functions	5-80
5.11.5 Precautions for Safety Functions	5-80

5.1 Control Selection

The controls supported by the SGD V SERVOPACK are described below.

Control can be selected with parameter Pn000.

Control Selection			
Pn.000	Control	Description	Reference Section
n.□□0□ (Factory setting)	Speed Control (Analog voltage reference)	Controls servomotor speed by means of an analog voltage speed reference. Use in the following instances. <ul style="list-style-type: none"> • To control speed • For position control using the encoder pulse output from the SERVOPACK to form a position loop in the host controller. 	5.3 Operating Using Speed Control with Analog Voltage Reference
n.□□1□	Position Control (Pulse train reference)	Controls the position of the machine by means of a pulse train position reference. Controls the position with the number of input pulses, and controls the speed with the input pulse frequency. Use when positioning is required.	5.4 Operating Using Position Control with Pulse Train Reference
n.□□2□	Torque Control (Analog voltage reference)	Controls the servomotor's output torque by means of an analog voltage torque reference. Use to output the required amount of torque for operations such as pressing.	5.5 Operating Using Torque Control with Analog Voltage Reference
n.□□3□	Speed Control (Internally set speed selection)	Uses the three input signals /P-CON (/SPD-D), /P-CL (/SPD-A), and /N-CL (/SPD-B) to control the speed as set in advance in the SERVOPACK. Three operating speeds can be set in the SERVOPACK. <Supplementary Information> When selecting this control, an analog reference is not necessary.	5.6 Operating Using Speed Control with an Internally Set Speed
n.□□4□ • • • n.□□B□	Control Switching	These are switching modes for using the four controls described above in combination. Select the control switching mode that best suits the application.	5.7 Control Selection

5.2 Setting Common Basic Functions

5.2.1 Servo ON Signal

This sets the servo ON signal (/S-ON) that determines whether the servomotor power is ON or OFF.

(1) Signal Setting

Type	Name	Connector Pin Number	Setting	Meaning
Input	/S-ON	CN1-40 [Factory setting]	ON	Servomotor power ON. Servomotor can be operated.
			OFF	Servomotor power OFF. Servomotor cannot be operated.

A parameter can be used to re-allocate the input connector number for the /S-ON signal. Refer to 3.3.1 *Input Circuit Signal Allocation*.



IMPORTANT

Always input the servo ON signal before inputting the position/speed/torque reference to start or stop the servomotor. Do not input the input reference first and then use the /S-ON signal to start or stop. Doing so will degrade internal elements and lead to malfunction.

(2) Servo ON Condition Constantly

Parameter Pn50A can be used to enable the Servo ON condition constantly.

Parameter		Meaning	When Enabled	Classification
Pn50A	n.□□0□	Inputs the /S-ON signal from the input terminal CN1-40. [Factory setting]	After restart	Setup
	n.□□7□	Constantly enables the /S-ON signal.		



IMPORTANT

SERVOPACK will be possible (i.e., power will be supplied) when the main circuit power is turned ON if the servo ON is set to be always enabled. When inputting position/speed/torque reference, be sure to implement safety measures for unexpected operation of the servomotor and machine.

Operation will be possible when an alarm is reset or after an alarm occurs. The servomotor or machine may operate unexpectedly if an alarm is reset while a reference is being input.

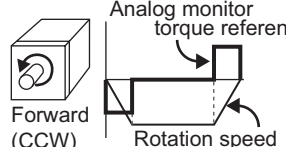


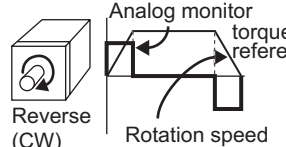


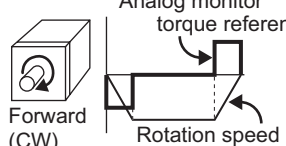


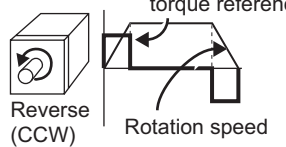


5.2.2 Servomotor Rotation Direction

The servomotor rotation direction can be reversed with parameter Pn000.

This causes the travel direction (+, -) of the shaft reverse, but the encoder pulse output and analog monitor signal polarity do not change.

By selecting the rotation direction with this parameter, the polarity of the reference can be adjusted to the rotation direction without changing the polarity of reference pulses and reference voltage to the SERVOPACK.

* The standard setting for “forward rotation” is counterclockwise as viewed from the drive end.

Parameter	Meaning
Pn000	n.□□□0 Standard setting (CCW = Forward) (Factory setting)
	■ Forward Reference  Encoder output pulse PAO  PBO  Phase B advanced
	■ Reverse Reference  Encoder output pulse PAO  Phase A advanced PBO 
	■ Forward Reference  Encoder output pulse PAO  PBO  Phase B advanced
	■ Reverse Reference  Encoder output pulse PAO  Phase A advanced PBO 


Note: According to the change of motor rotation direction, the direction of overtravel forward/reverse also switched.

For Pn000 = n.□□□0: counterclockwise is P-OT.

For Pn000 = n.□□□1: clockwise is P-OT.

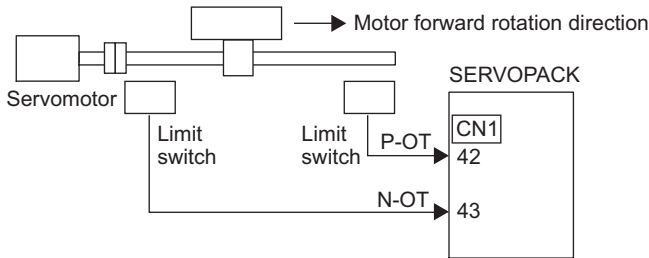
5.2.3 Overtravel

The overtravel limit function forces movable machine parts to stop if they exceed the allowable range of motion and turn ON a limit switch.



CAUTION

- Installing Limit Switches**
Connect limit switches as shown below to prevent damage to the devices during linear motion.
It is recommended to use the normally closed contacts for the limit switches with a minute current applied to prevent the oxidization of the contacts.




- When using the servomotor on a vertical axis**
The workpiece may fall in the overtravel condition.
To prevent this, always set the zero clamp after stopping with Pn001 = n.□□1□.
Refer to (3) *Motor Stopping Method When Overtravel is Used* in this section.

(1) Signal Setting

Type	Name	Connector Pin Number	Setting	Meaning
Input	P-OT	CN1-42	ON	Forward run allowed. Normal operation status.
			OFF	Forward run prohibited. Forward overtravel.
	N-OT	CN1-43	ON	Reverse run allowed. Normal operation status.
			OFF	Reverse run prohibited. Reverse overtravel.

Rotation in the opposite direction is possible during overtravel by inputting the reference.



IMPORTANT

When the servomotor stops due to overtravel during position control, the position error pulses are held. A clear signal (CLR) input is required to clear the error pulses.
For the clear signal, refer to 5.4.2 *Clear Signal*.

(2) Overtravel Function Setting

Parameters Pn50A and Pn50B can be set to specify either using or not using the overtravel function.

If the overtravel function is not used, forward and reverse operation will always be possible for the servomotor, and no wiring for overtravel input signals will be required.

Parameter		Meaning	When Enabled	Classification
Pn50A	n.2□□□	Inputs the Forward Run Prohibited (P-OT) signal from CN1-42. (Factory setting)	After restart	Setup
	n.8□□□	Disables the Forward Run Prohibited (P-OT) signal. (Allows constant forward rotation.)		
Pn50B	n.□□□3	Inputs the Reverse Run Prohibited (N-OT) signal from CN1-43. (Factory setting)		
	n.□□□8	Disables the Reverse Run Prohibited (N-OT) signal. (Allows constant reverse rotation.)		

- A parameter can be used to re-allocate input connector number for the P-OT and N-OT signals. Refer to 3.3.1 *Input Circuit Signal Allocation*.

(3) Motor Stopping Method When Overtravel is Used

The stopping method when an overtravel (P-OT, N-OT) signal is input while the servomotor is operating can be set with parameter Pn001.

Parameter		Stop Mode	Mode After Stopping	Meaning	When Enabled	Classification
Pn001	n.□□00	Stop by dynamic brake	Coast	Immediately stops the servomotor by dynamic braking (DB), then places it into Coast (power OFF) Mode.	After restart	Setup
	n.□□01			Stops the servomotor by coast stop, then places it into Coast (power OFF) Mode.		
	n.□□02	Coast to a stop		Stops the servomotor by coast stop, then places it into Coast (power OFF) Mode.		
	n.□□1□	Decelerate to stop	Zero Clamp	Decelerates the servomotor with emergency stop torque (Pn406), then places it into Zero Clamp (Servolock) Mode.		
	n.□□2□		Coast	Decelerates the servomotor with emergency stop torque (Pn406), then places it into Coast (power OFF) Mode.		

- A servomotor under torque control cannot be decelerated to a stop. The servomotor is stopped with the dynamic braking (DB) or coasts to a stop according to the setting of Pn001.0. After the servomotor stops, the servomotor will enter a coast state.
- For details on stopping methods when the servo turns OFF or when an alarm occurs, refer to 5.2.5 *Stopping Method for Servomotor after Servo OFF or Alarm Occurrence*.

(4) Emergency Stop Torque for Overtravel

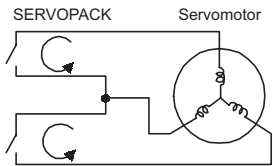
Pn406	Emergency Stop Torque				Classification
			Speed	Position	
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup

- The setting unit is a percentage of the rated torque (i.e., the rated torque is 100%)
- The factory setting is 800% so that the setting is large enough a value to operate the servomotor at maximum torque. The maximum value of emergency stop torque that is actually available, however, is limited to the maximum torque of the servomotor.

(5) Terms

■ Dynamic Brake (DB)

Dynamic braking (DB) is a standard method for stopping the servomotor in emergencies. By short-circuiting the electric circuits, the servomotor comes to a quick stop. The dynamic braking circuit is built into the SERVOPACK.



■ Coast to a stop

Stops naturally, with no brake, by using the friction resistance of the motor in operation.

■ Decelerate to stop

Stops by using deceleration (braking) torque.

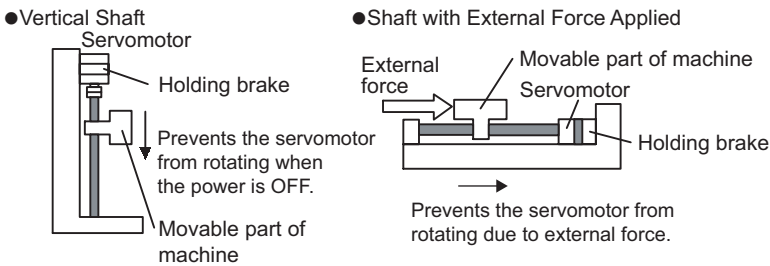
■ Zero Clamp Mode


A mode forms a position loop by using the position reference zero.

5.2.4 Holding Brakes

A holding brake is a brake used to hold the position of the SERVOPACK when the SERVOPACK is turned OFF so that movable parts do not move due to their own weight or external forces. Holding brakes are built into servomotors with brakes.

For example, the holding brake is used when the SERVOPACK controls a vertical axis.

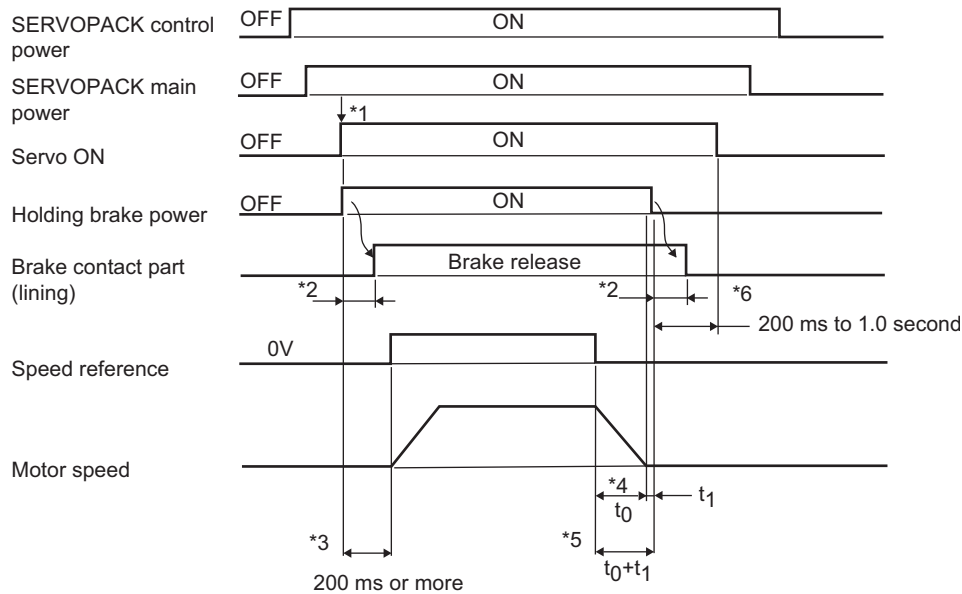




IMPORTANT

- The brake built into the servomotor with brakes is a de-energization brake, which is used only to hold and cannot be used for braking. Use the holding brake only to hold a stopped motor.
- Turn OFF the servo simultaneously when activating the holding brake.

There is a delay in the braking operation. Set the following ON/OFF timing. The timing can be easily set using the brake interlock output signal.



- *1. The servo ON signal and holding brake power supply may be turned ON simultaneously.
- *2. The operation delay time of the brake depends on the model. For details, refer to *Brake Operation Delay Time* shown below.
- *3. Allow a period of 200 ms before the speed reference is input after the brake power supply is turned ON.
- *4. The servomotor stop time is shown by t_0 . Refer to the *Calculation Method for Servomotor Stop Time* shown below for the calculation of t_0 .
- *5. Always turn OFF the brake power supply after the servomotor comes to a stop. Usually, set t_0+t_1 to 1 or 2 seconds.
- *6. Turn OFF the servo ON signal 0.2 to 1.0 second after the brake power supply is turned OFF.

Brake Operation Delay Time

Model	Voltage	Brake Release Time (ms)	Brake Applied Time (ms)
SGMAV-A5 to 04	24 V	60	100
SGMAV-06 to 10		80	100
SGMJV-A5 to 04	24 V	60	100
SGMJV-08		80	100
SGMGV-03, 05	24 V, 90 V	100	80
SGMGV-09, 13, 20		100	80
SGMGV-30, 44		170	100 (24 V), 80 (90 V)

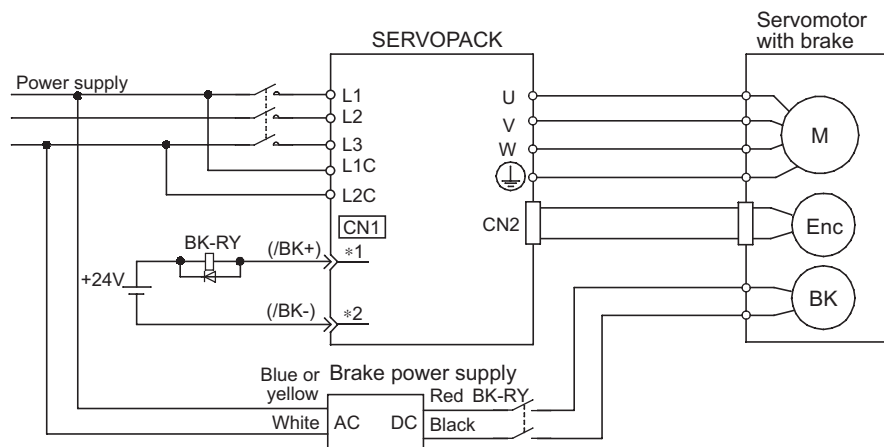
Note: The above operation delay time is an example when the power supply is turned ON and OFF on the DC side.
Be sure to evaluate the above times on the actual equipment before using the application.

Calculation Method for Servomotor Stop Time

Using SI Units	Conventional Method
$t_0 = \frac{(J_M + J_L) \times N_M}{(T_P + T_L)} \times \frac{2\pi}{60} \text{ (sec)}$	$t_0 = \frac{(GD_M^2 + GD_L^2) \times N_M}{375 \times (T_P + T_L)} \text{ (sec)}$
J_M : Rotor moment of inertia ($\text{kg} \cdot \text{m}^2$)	GD_M^2 : Motor GD^2 ($\text{kgf} \cdot \text{m}^2$)
J_L : Load moment of inertia ($\text{kg} \cdot \text{m}^2$)	GD_L^2 : Load inertia GD^2 ($\text{kgf} \cdot \text{m}^2$)
N_M : Motor rotational speed (min^{-1})	N_M : Motor rotational speed (r/min)
T_P : Motor deceleration torque ($\text{N} \cdot \text{m}$)	T_P : Motor deceleration torque ($\text{kgf} \cdot \text{m}$)
T_L : Load torque ($\text{N} \cdot \text{m}$)	T_L : Load torque ($\text{kgf} \cdot \text{m}$)

(1) Wiring Example

Use the SERVOPACK contact output signal /BK and the brake power supply to form a brake ON/OFF circuit. The following diagram shows a standard wiring example.



BK-R Y: Brake control relay

Brake power supply for 90 V Input voltage 200-V models: LPSE-2H01

Input voltage 100-V models: LPDE-1H01

*1 and *2 are the output terminals allocated with Pn50F.2.


IMPORTANT

- The brake signal (/BK) is not used with the factory settings. The output signal must be allocated.
Refer to (3) *Brake Signals (/BK) Allocation* to set the parameter Pn50F.

(2) Signal Setting

This output signal controls the brake and is used only for a servomotor with a brake. The output signal must be allocated with Pn50F.

Type	Name	Connector Pin Number	Setting	Meaning
Output	/BK	Must be allocated	ON (low level)	Releases the brake.
			OFF (high level)	Applies the brake.

 The /BK signal is not output during overtravel.

(3) Brake Signals (/BK) Allocation

The brake signal (/BK) is not allocated at shipment. Use the parameter Pn50F to allocate the /BK signal.

Parameter		Connector Pin Number		Meaning	When Enabled	Classification
		+ Terminal	- Terminal			
Pn50F	n.□0□□	-	-	The /BK signal is not used. [Factory setting]	After restart	Setup
	n.□1□□	CN1-25	CN1-26	The /BK signal is output from output terminal CN1-25, 26.		
	n.□2□□	CN1-27	CN1-28	The /BK signal is output from output terminal CN1-27, 28.		
	n.□3□□	CN1-29	CN1-30	The /BK signal is output from output terminal CN1-29, 30.		



IMPORTANT

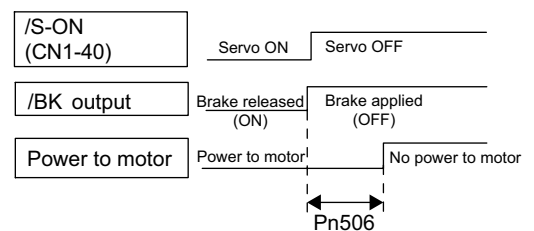
When multiple signals are allocated to the same output terminal, the signals are output with OR logic. To output the /BK signal alone, disable the other output signals or set them to output terminals other than the one allocated to the /BK signal.

(4) Brake ON Timing after the Servomotor Stops

With the factory setting, the /BK signal is output at the same time as the servo is turned OFF. The servo OFF timing can be changed with the parameter Pn506.

Pn506	Brake Reference-Servo OFF Delay Time <div>SpeedPositionTorque</div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 50	10 ms	0	Immediately	Setup

- When using the servomotor to control a vertical axis, the machine movable part may shift slightly depending on the brake ON timing due to gravity or an external force. By using this parameter to delay turning the servo OFF, this slight shift can be eliminated.
- This parameter changes the brake ON timing while the servomotor is stopped.



IMPORTANT

The servomotor will turn OFF immediately when an alarm occurs, regardless of the setting of this parameter. The machine movable part may shift due to gravity or external force during the time until the brake operates.

(5) Brake (/BK) Signal Output Timing during Servomotor Operation

If an alarm occurs while the servomotor is rotating, the servomotor will come to a stop and the brake (/BK) signal will be turned OFF. The timing of brake signal (/BK) output can be adjusted by setting the brake signal output speed level (Pn507) and servo OFF brake reference waiting time (Pn508).

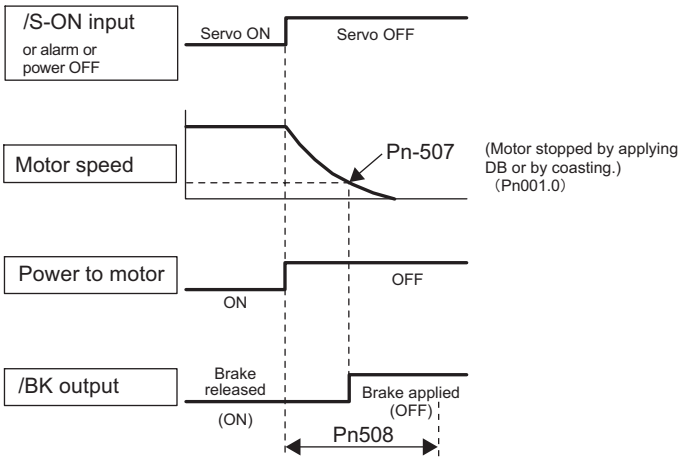
Note: If the servomotor is set so that it comes to a zero-speed stop for an alarm, follow the information in (4) *Brake ON Timing after the Servomotor Stops* after the motor comes to a stop for a zero position reference.


Pn507	Brake Reference Output Speed Level Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	1 min ⁻¹	100	Immediately	Setup
Pn508	Waiting Time for Brake Signal When Motor Running Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	10 ms	50	Immediately	Setup

/BK Signal Output Conditions When Servomotor Running

The /BK signal goes to high level (brake ON) when either of the following conditions is satisfied:

- When the motor speed falls below the level set in Pn507 after the power to the servomotor is turned OFF.
- When the time set in Pn508 is exceeded after the power to the servomotor is turned OFF.





IMPORTANT

- The servomotor will be limited to its maximum speed even if the value set in Pn507 is higher than the maximum speed.
- Do not allocate the motor rotation detection signal (/TGON) and the brake signal (/BK) to the same terminal, or otherwise the /TGON signal will be turned ON by the falling speed on a vertical axis, and the brake may not be turned ON.

5.2.5 Stopping Method for Servomotor after Servo OFF or Alarm Occurrence

The stopping method when the power to the SERVOPACK turns OFF or an alarm occurs can be selected.

(1) Stopping Method for Servomotor When the Servo is Turned OFF

Select the stopping method for the servomotor after servo OFF using Pn001.0

Parameter	Stop Mode	Mode After Stopping	Meaning	When Enabled	Classification
Pn001	n.□□□0	Stop by dynamic brake	Dynamic Brake	After restart	Setup
	n.□□□1		Coast		
	n.□□□2	Coast to a stop	Coast		

Note: Similar to the Coast Mode, the n.□□□0 setting (which stops the servomotor by dynamic braking and then holds it in Dynamic Brake Mode) does not generate any braking force when the servomotor stops or when it rotates at very low speed.

(2) Stopping Method for Servomotor When an Alarm Occurs

Select the stopping method for the servomotor when an alarm occurs using Pn001.0 and Pn00B.1.

Pn001.0 is used to set the stopping method for the servomotor for a G1 alarm (alarms that result in a DB stop).

Pn00B.1 is used to set the stopping method for the servomotor for a G2 alarm (alarms that result in a zero-speed stop).

Note: Refer to the information on alarm stopping methods in 10.1.1 List of Alarms.

■ Stopping Method for Servomotor for G1 Alarms (Alarms that Result in a DB Stop)

The stopping method of the servomotor when a G1 alarm occurs is the same as that for the Servomotor when the servo is turned OFF.

Parameter	Stop Mode	Mode After Stopping	Meaning	When Enabled	Classification
Pn001	n.□□□0	Stop by dynamic brake	Dynamic Brake	After restart	Setup
	n.□□□1		Coast		
	n.□□□2	Coast to a stop	Coast		

■ Stopping Method for Servomotor for G2 Alarms (Alarms that Result in a Zero-speed Stop)

Parameter		Stop Mode	Mode After Stopping	Meaning	When Enabled	Classification
Pn00B	Pn001					
n.□□□□ [Factory setting]	n.□□□0 [Factory setting]	Zero-speed stopping	Dynamic Brake	Stops the servomotor by zero-speed stop, then holds it in Dynamic Brake Mode.	After restart	Setup
	n.□□□1		Coast	Stops the servomotor by zero-speed stop, then places it into Coast (power OFF) Mode.		
	n.□□□2			Stops the servomotor by zero-speed stop, then places it into Coast (power OFF) Mode.		
n.□□1□	n.□□□0 [Factory setting]	Stops by dynamic brake	Dynamic Brake	Stops the servomotor by dynamic braking (DB), then holds it in Dynamic Brake Mode.		
	n.□□□1	Coast to stop	Coast	Stops the servomotor by dynamic braking (DB), then places it into Coast (power OFF) Mode.		
	n.□□□2			Stops the servomotor by coasting, then places it into Coast (power OFF) Mode.		

Note: The setting of Pn00B.1 is effective for position control and speed control. Pn00B.1 will be ignored for torque control and only the setting of Pn001.0 will be valid.



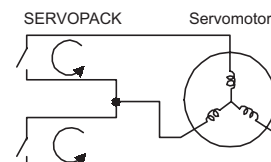
IMPORTANT

- Dynamic braking (DB) is used for emergency stops. The DB circuit will operate frequently if the power is turned ON and OFF with a reference input applied, which may result in deterioration of the internal elements in the SERVOPACK. Use speed input references or position references to start and stop the servomotor.
- The SERVOPACK is forced to stop by dynamic braking despite the above parameter settings when the main circuit power supply (L1, L2, L3) or control power supply (L1C, L2C) turns OFF.
- If the servomotor must be stopped by coasting rather than by dynamic braking when the main circuit power supply (L1, L2, L3) or the control power supply (L1C, L2C) turns OFF, arrange the sequence externally so the servomotor wiring (U, V, W) will be interrupted.
- To minimize the coasting distance of the motor to come to a stop, the zero-speed stopping method is factory-set for alarms to which the zero-speed stop method is applicable. The DB stopping method may be more suitable than the zero-speed stopping method, however, depending on the application. Change the method to the DB stopping method as required by the application. For example, for a twin-drive coupling operation, machinery damage may result if a zero-speed stop alarm occurs for one of the coupled shafts.

<Terms>

Dynamic brake (DB)

A common method for quickly stopping a servomotor. The servomotor is stopped by short-circuiting the servomotor circuit. This circuit is built into the SERVOPACK.

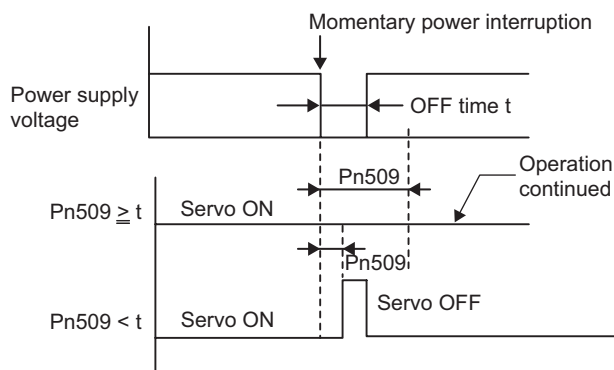


5.2.6 Power Loss Settings

Determines whether to continue operation or turn the servo OFF when the power supply voltage is interrupted.

Pn509	Instantaneous Power Cut Hold Time <div><div>Speed</div><div>Position</div><div>Torque</div></div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	20 to 1000	1 ms	20	Immediately	Setup

An instantaneous power interruption will be detected when the main circuit power supply is turned OFF. If the time required to restore the main circuit power supply is less than the parameter set value, the servo will continue operation. If the restoration time is the equal to or greater than the set value, the servo will be turned OFF.



IMPORTANT

- The holding time of the control power supply for the SERVOPACK is approximately 100 ms. If the control power supply makes control impossible during an instantaneous power interruption, the same operation will be performed as for normally turning OFF the power supply, and the setting of the parameter will be ignored.
- The holding time of the main circuit power supply varies with the output of the SERVOPACK. If the load on the servomotor is large and an undervoltage alarm (A.410) occurs, the parameter will be ignored.

<Supplementary Information>

If the uninterruptible power supplies are used for the control power supply and main circuit power supply, the SERVOPACK can withstand an instantaneous power interruption period in excess of 1000 ms.

5.2.7 Torque Limit Function for Low Power Supply Voltage for Main Circuit (SEMI-F47 Function)

The torque limit function detects a low voltage and limits the output current if the power supply voltage for the main circuit drops to 200 V or below.

This function allows the servomotor to continue operating without stopping for an alarm or without recovery work even if the power supply voltage drops.



IMPORTANT

The following environment is required to use this function.

- Provide the control power supply from an uninterruptible power supply (UPS).
- Set the host controller and servo set time so that no torque reference that exceeds the specified acceleration will be output when the power supply for the main circuit is restored.
- Do not limit the torque to values lower than the hold torque for a vertical axis.

(1) Execution Method

This function can be executed either with the host controller or independently with the SERVOPACK.

■ Execution with Host Controller

The host controller limits the torque in response to a low-voltage warning.
The limited torque is reset when the low-voltage warning is cleared.

■ Execution Independently with SERVOPACK

The torque is limited in the SERVOPACK in response to a low-voltage warning.
The SERVOPACK resets the limited torque in the set time when the low-voltage warning is cleared. Pn008.1 is used to specify whether the function is executed with the host controller or independently with the SERVOPACK.

(2) Related Parameters

Parameter	Meaning	When Enabled	Classification
Pn008	n.□□0□ A main circuit low voltage is not detected [Factory setting].	After restart	Setup
	n.□□1□ A main circuit low voltage is detected, and the host controller limits the torque.		
	n.□□2□ A main circuit low voltage is detected, and the SERVOPACK independently limits the torque using Pn424 and Pn425.		

Pn424	Torque Limit at Main Circuit Voltage Drop				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	%	50	Immediately	Setup
Pn425	Release Time for Torque Limit at Main Circuit Voltage Drop				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	ms	100	Immediately	Setup

5.3 Operating Using Speed Control with Analog Voltage Reference

This section describes the operation in speed control with analog voltage reference.

Select the speed control with the parameter Pn000.

Parameter	Meaning	When Enabled	Classification
Pn000	n.□□0□ Control mode selection: Speed control (analog voltage reference) [Factory setting]	After restart	Setup

5.3.1 Basic Settings for Speed Control

Set the following signal and parameter for speed control with analog voltage reference.

(1) Speed Reference Input

Input the speed reference to the SERVOPACK using the analog voltage reference to control the servomotor speed in proportion to the input voltage.

Type	Signal Name	Connector Pin Number	Name
Input	V-REF	CN1-5	Speed Reference Input
	SG	CN1-6	Signal Ground

Input Specifications

Input range: ± 2 VDC to ± 10 VDC/rated speed

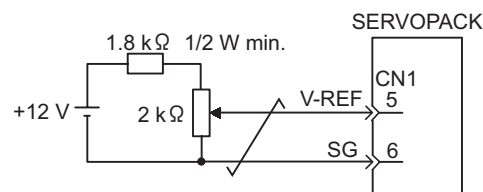
Maximum allowable input voltage: ± 12 VDC

<Setting Example>

Pn300 = 600: 6 V input/Motor rated speed [Factory setting]

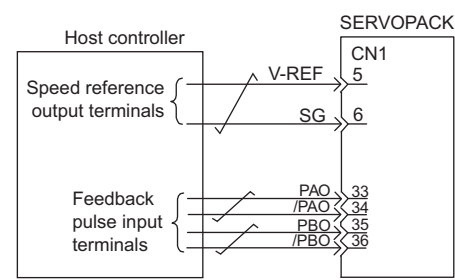
Speed Reference Input	Rotation Direction	Motor Speed	SGMAV Servomotor
+6 V	Forward	Rated motor speed	3000 min^{-1}
+1 V	Forward	1/6 rated motor speed	500 min^{-1}
-3 V	Reverse	1/2 rated motor speed	1500 min^{-1}

Input Circuit Example



Recommended variable resistor: Model 25HP-10B manufactured by Sakae Tsushin Kogyo Co., Ltd.

Connect V-REF and SG to the speed reference output terminals on the host controller when using a host controller, such as a programmable controller, for position control.



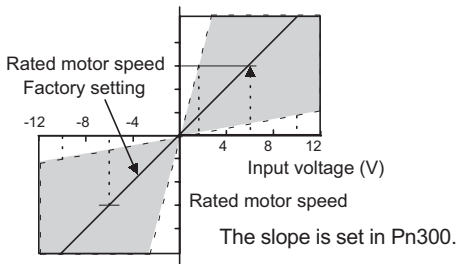
 : represents twisted-pair wires.

Note: Always use twisted-pair cable to control noise.

(2) Setting Speed Reference Input Gain

Sets the analog voltage level for the speed reference (V-REF) necessary to operate the servomotor at the rated speed.

Pn300	Speed Reference Input Gain <div><div>Speed</div><div>Position</div><div>Torque</div></div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	150 to 3000 (1.50 to 30.00 V/rated speed)	0.01 V/rated speed	600 (6.00 V/rated speed)	Immediately	Setup



5.3.2 Reference Offset Adjustment

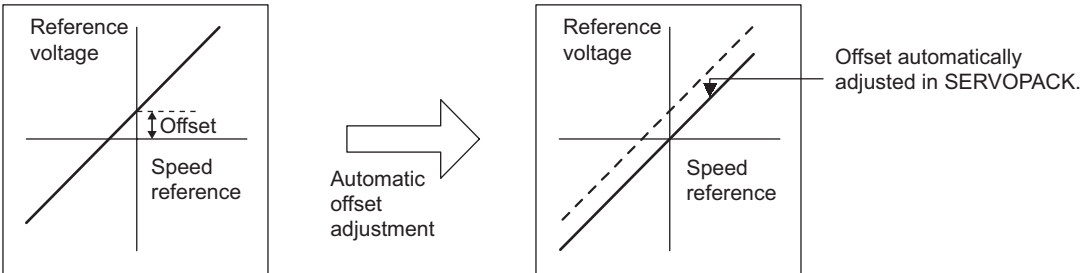
In speed control, the servomotor may rotate at a minute speed with an analog voltage reference of 0 V. This occurs because the reference voltage of the host or external circuit has a minute offset of a few millivolts.

If the servomotor rotates at a minute speed, the offset needs to be eliminated using the offset adjustment function.

Use either automatic adjustment or manual adjustment. Automatic adjustment uses the automatic adjustment parameter for analog (speed and torque) reference offset (Fn009). Manual adjustment uses the manual adjustment parameter for speed reference offset (fn00A).

(1) Automatic Adjustment of the Speed Reference Offset

The automatic adjustment of the offset automatically measures the amount of offset and adjusts the reference voltage.

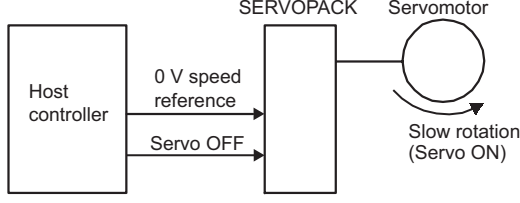



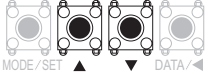

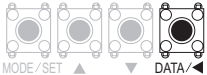



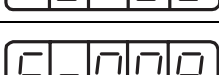



After completion of the automatic adjustment, the amount of offset is stored in the SERVOPACK.

Adjust the speed reference offset automatically using the following steps.

The speed reference offset must be automatically adjusted with the servo OFF.

IMPORTANT

Step	Display after Operation	Keys	Description
1			<p>Turn OFF the SERVOPACK, and input the 0 V reference voltage from the host controller or external circuit.</p> 
2			Press the MODE/SET Key to select the utility function mode.
3			Press the UP or the DOWN Key to select Fn009.
4			Press the DATA/SHIFT Key for approximately one second. "rEF_o" is displayed.
5			Press the MODE/SET Key. The reference offset is automatically adjusted. When completed, "donE" blinks for approximately one second.
6			After "donE" is displayed, "rEF_o" is displayed again.
7			Press the DATA/SHIFT Key for approximately one second. "Fn009" is displayed again.

Note: The automatic adjustment of reference offset (Fn009) cannot be used when a position loop has been formed with a host controller. Use the speed reference offset adjustment manual mode described in (2) *Manual Servo Tuning of the Speed Reference Offset*.

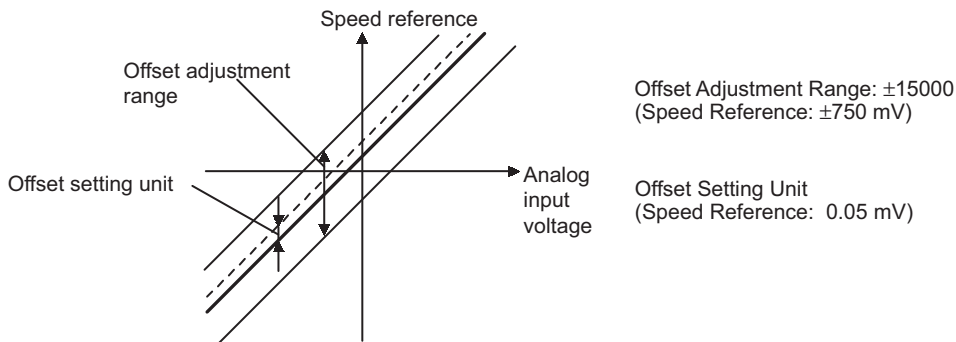
(2) Manual Servo Tuning of the Speed Reference Offset

This method adjust the offset inputting the amount of offset.

Use the speed reference offset manual servo tuning (Fn00A) in the following situations:

- If a position loop is formed with the host controller and the error is zeroed when servolock is stopped.
- To deliberately set the offset to some value.
- To check the offset data set in the speed reference offset automatic adjustment mode.

The offset setting range and setting units are as follows:



Adjust the speed reference offset using following steps.

Step	Display after Operation	Keys	Description
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or the DOWN Key to select Fn00A.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Turn ON the servo ON (/S-ON) signal from the host controller. The display shown on the left appears.
5			Press the DATA/SHIFT Key for less than one second. The speed reference offset amount is displayed.
6			Press the UP or the DOWN Key to adjust the amount of off-set.
7			Press the MODE/SET Key for less than one second. The display shown on the left appears. Then "don E" blinks on the display, and offset amount is set.
8			Press the DATA/SHIFT Key for approximately one second. "Fn00A" is displayed again.

5.3.3 Soft Start

The soft start is a function to convert stepped speed reference input into constant acceleration and deceleration. The time can be set separately for acceleration and deceleration.

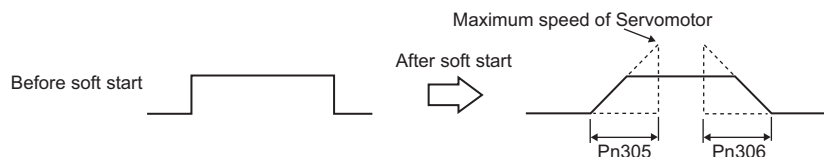
Use this function to smooth speed control in speed control (including selection of internally set speeds).

Note: Set both parameters Pn305 and Pn306 to "0" (factory setting) for normal speed control.

Pn305	Soft Start Acceleration Time Speed				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 ms	0	Immediately	Setup
Pn306	Soft Start Deceleration Time Speed				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 ms	0	Immediately	Setup

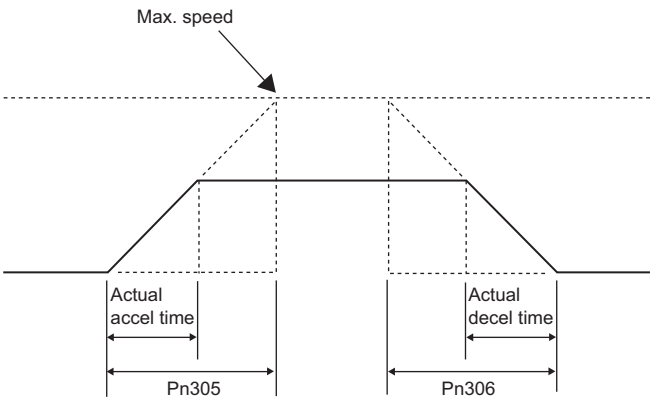
Pn305: The time interval from the time the motor starts until the motor maximum speed is reached.

Pn306: The time interval from the time the motor is operating at the motor maximum speed until it stops.



Actual accel/decel time can be calculated with the following equation.

Actual (accel/decel) time = $\frac{\text{Speed reference}}{\text{Max. speed}} \times \text{Soft start time (accel time Pn305/decel time Pn306)}$



5.3.4 Speed Reference Filter

This smoothens the speed reference by applying a first order lag filter to the analog speed reference (V-REF) input.

Note: A value that is too large, however, will slow down response.

Pn307	Speed Reference Filter Time Constant				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535 (0.00 to 655.35 ms)	0.01 ms	40 (0.40 ms)	Immediately	Setup

5.3.5 Zero Clamp Function

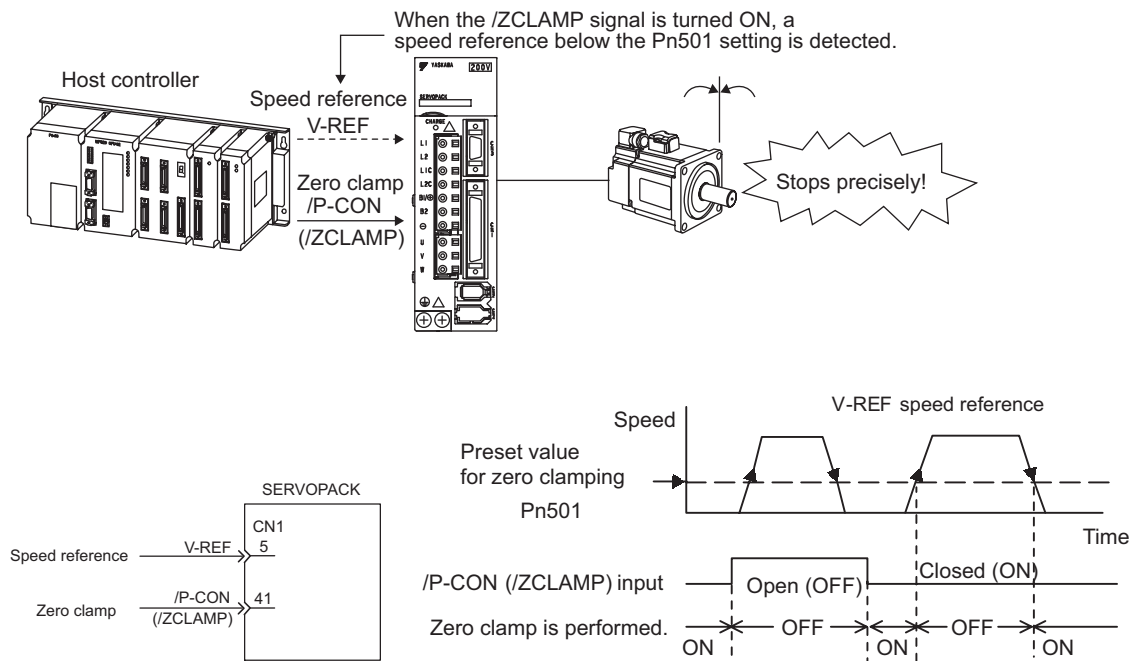
The zero clamp function locks the servo when the input voltage of the speed reference (V-REF) drops below the set speed in the zero clamp level parameter (Pn501) while the zero clamp signal (/P-CON or /ZCLAMP) is ON. The SERVOPACK internally forms a position loop, ignoring the speed reference.

The servomotor is clamped within one pulse of when the zero clamp function is turned ON, and will still return to the zero clamp position even if it is forcibly rotated by external force.

The zero clamp function is used for systems where the host controller does not form a position loop for the speed reference input.

<Terms>

Servo lock: A stopped state of the motor in which a position loop is formed with a position reference of 0.



Adjust the position loop gain in Pn102 if the servomotor oscillates in the zero clamp state. If the gain switching function is used, adjusting the 2nd position loop gain in Pn106 is required as well. For details, refer to 6.8.6 *Switching Gain Settings*.

(1) Signal Setting

■ Factory-set Sequence Signal Allocations (Pn50A.0 = 0)

Use the /P-CON signal to switch to the zero clamp state.

Type		Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-41 [Factory setting]	ON	If the input voltage of the speed reference (V-REF) drops below the set speed in the zero clamp level (Pn501), the zero clamp function will turn ON.
			OFF	Turns OFF the zero clamp function.

To use the zero clamp function, set Pn000.1 to A.

Parameter		Control Method	Input Signal Used	When Enabled	Classification
Pn000	n.□□A□	Speed control (analog reference) The zero clamp function uses /P-CON.	/P-CON	After restart	Setup

Note: If Pn000.1 is set to A, the /P-CON signal cannot be used for any function other than the zero clamp function.

■ Changing Sequence Signal Allocations for Each Signal (Pn50A.0 = 1)

Use the /ZCLAMP signal when switching to zero clamp operation.

To use the /ZCLAMP signal, the input signal must be allocated. For details, refer to 3.3.1 *Input Circuit Signal Allocation*.

Type		Connector Pin Number	Setting	Meaning
Input	/ZCLAMP	CN1-□□ Must be allocated.	ON	The zero clamp function will be turned ON if the input voltage of the speed reference (V-REF) drops below the set speed in the zero clamp level.
			OFF	Turns OFF the zero clamp function.

To use the zero clamp function, set Pn000.1 to 0, 3, 4, 5, 6, 7 or 9.

Parameter		Control Method	Input Signal Used	When Enabled	Classification
Pn000	n.□□0□	Speed control (analog reference)	/ZCLAMP	After restart	Setup
	n.□□3□	Internally set speed control (contact reference)	/ZCLAMP		
	n.□□4□	Internally set speed control (contact reference) <=> Speed control (analog reference)	/ZCLAMP		
	n.□□5□	Internally set speed control (contact reference) <=> Position control (pulse strain reference)	/ZCLAMP		
	n.□□6□	Internally set speed control (contact reference) <=> Torque control (analog reference)	/ZCLAMP		
	n.□□7□	Position control (pulse train reference) <=> Speed control (analog reference)	/ZCLAMP		
	n.□□9□	Torque control (analog reference) <=> Speed control (analog reference)	/ZCLAMP		

<Supplementary Information>

If Pn000.1 is set to 5, 6, 7, or 9, the zero clamp function will become invalid when the control is changed to any modes other than speed control.

Set the speed at which to enter zero clamp operation.

Pn501	Zero Clamp Level Speed				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000 min ⁻¹	1 min ⁻¹	10 min ⁻¹	Immediately	

Note: Even if a value that exceeds the speed of the servomotor is set, the actual speed will be limited to the maximum speed of the servomotor.

5.3.6 Encoder Pulse Output

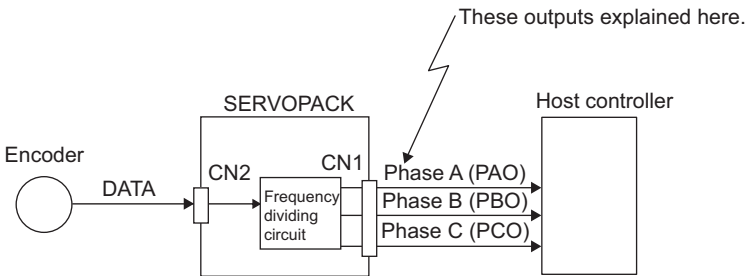
Encoder pulse output shows the feedback of position.
This signal processes the encoder output inside the SERVOPACK and then outputs externally in the pulse form.

Signals and output phase form are as shown below.

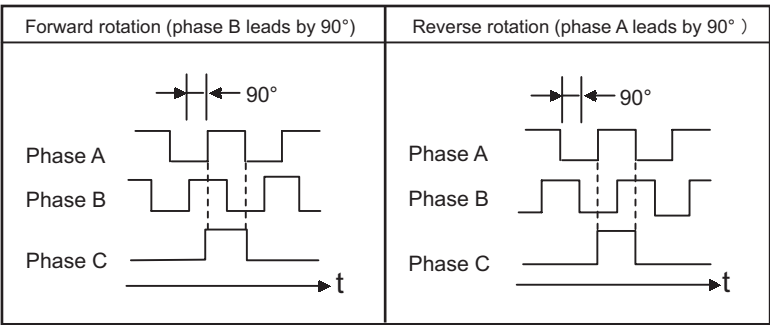
(1) Signals

Type	Signal Name	Connector Pin Number	Name	Remarks
Output	PAO	CN1-33	Encoder output phase A	Output pulses per motor rotation set in the encoder output pulses (Pn212), and phase A and phase B are different from each other in phase by an electric angle of 90°.
	/PAO	CN1-34	Encoder output phase /A	
	PBO	CN1-35	Encoder output phase B	
	/PBO	CN1-36	Encoder output phase /B	
	PCO	CN1-19	Encoder output phase C	Pulses that are output once per motor rotation.
	/PCO	CN1-20	Encoder output phase /C	

* Phase C: Output one pulse per motor rotation.



(2) Output Phase Form



Note: The pulse width of the (Phase C origin pulse) changes according to the setting of the Pn212 and becomes the same as that for phase A.
Even in reverse rotation mode (Pn000.0 = 1), the output phase form is the same as that for the standard setting (Pn000.0 = 0).

(3) When Using an Absolute Encoder

When absolute encoder is used, add the following signals.

Type	Signal Name	Connector Pin Number	Name
Input	SEN	CN1-4	SEN Signal Input
	SG	CN1-2	Signal Ground
	BAT (+)	CN1-21	Battery (+)
	BAT (-)	CN1-22	Battery (-)
Output	SG*	CN1-1, CN1-2	Signal Ground

* SG (CN1-1, 2): Connect to 0 V on the host controller.



IMPORTANT

If using the SERVOPACK's phase-C pulse output for a zero point return, rotate the servomotor twice before starting a zero point return. If the configuration prevents the servomotor from returning to the zero point, perform a zero point return at a motor speed of 600 min⁻¹ or below. If the motor speed is faster than 600 min⁻¹, the phase-C pulse output may not be output correctly.

5.3.7 Encoder Pulse Output Setting

Set the encoder pulse output using the following parameter.

Pn212	Encoder Output Pulses				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	16 to 1073741824(2 ³⁰)	1 P/Rev	2048	After restart	Setup

Feedback pulses from the encoder per revolution are divided inside the SERVOPACK by the number set in this parameter before being output. Set according to the system specifications of the machine or host controller.

According to the encoder resolution, the number of encoder pulses are limited. Set the encoder output pulses (Pn212) by the following setting unit.

Encoder Output Pulses (P/Rev)	Setting Unit (pulse)	Encoder Resolution		Upper Limit of Servomotor Speed (min ⁻¹)
		13 bits	20 bits	
16 to 2048	1	✓	✓	6000
2049 to 16384	1		✓	6000
16386 to 32768	2		✓	3000
32772 to 65536	4		✓	1500
65544 to 131072	8		✓	750
131088 to 262144	16		✓	375

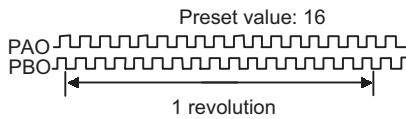
- Note 1. The setting range varies with the encoder output pulses for the servomotor used.
A parameter setting error alarm (A.041) will occur if the setting is outside the allowable range or does not satisfy the setting conditions.
2. The upper limit of the pulse frequency is approx. 1.6 Mpps.
The servomotor speed is limited by the setting value of the number of the output pulse for Pn212.
An overspeed alarm (A.511) will occur if the motor speed exceeds the upper limit at the preset number of pulses.

<Setting Example>

Pn212 = 25000 (P/Rev) is accepted, but

Pn212 = 25001 (P/Rev) is not accepted. The alarm A.041 is output.

Output Example: When Pn212 = 16 (16-pulse output per one revolution), PAO and PBO are output as shown below.



5.3.8 Speed Coincidence Signal Setting

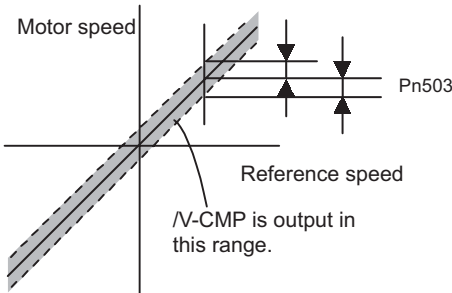
The speed coincidence (/V-CMP) output signal is output when the actual servomotor speed during speed control is the same as the speed reference input. The host controller uses the signal as an interlock.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/V-CMP	CN1-25, 26	ON (close)	Speed coincides.
			OFF (open)	Speed does not coincide.

This output signal can be allocated to another output terminal with parameter Pn50E.
Refer to 3.3.3 Output Circuit Signal Allocation.

Pn503	Speed Coincidence Signal Output Width Speed				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1 min ⁻¹	10	Immediately	Setup

The /V-CMP signal is output when the difference between the speed reference and actual motor speed is below this setting.



<Supplementary Information>

/V-CMP is a speed control output signal. With the factory setting without mapping output terminal in Pn50E, this signal is automatically used as the positioning completed signal /COIN for position control, and it is always OFF (open) for torque control.

<Example>

The /V-CMP signal is output at 1900 to 2100 min⁻¹ if the Pn503 is set to 100 and the reference speed is 2000 min⁻¹.

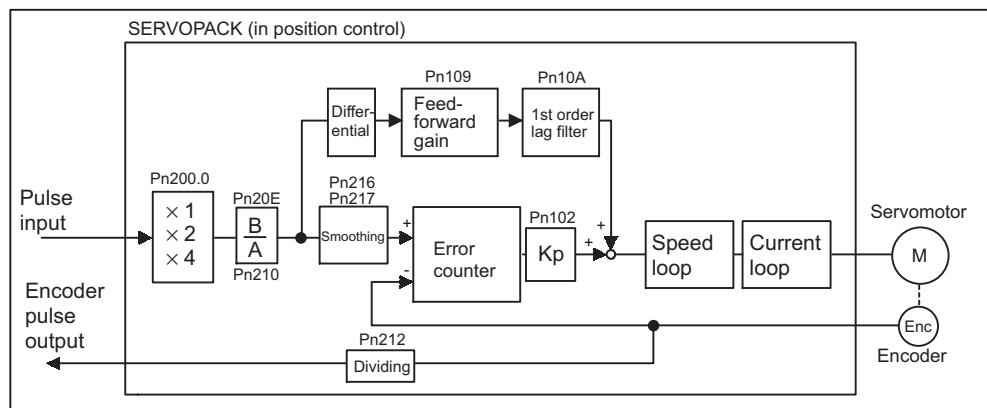
5.4 Operating Using Position Control with Pulse Train Reference

This section describes the operation in position control with pulse train reference. Select the position control with Pn000.

Parameter	Meaning	When Enabled	Classification
Pn000	n.□□1□	Control mode: Position control (pulse train reference)	After restart
			Setup

■ Block Diagram for Position Control

A block diagram for position control is shown below.



5.4.1 Basic Settings for Position Control Mode

Set the following signal and parameter for position control with pulse train reference.

(1) Signal Setting

Set the input form for the SERVOPACK using Pn200.0 according to the host controller specifications.

Type	Signal Name	Connector Pin Number	Name
Input	PULS	CN1-7	Reference Pulse Input
	/PULS	CN1-8	Reference Pulse Input
	SIGN	CN1-11	Sign Input
	/SIGN	CN1-12	Sign Input

(2) Reference Input Filter for Signals

The noise margin for input signals will drop if an open-collector pulse reference is input. Set Pn200.3 to 1 if position error occurs due to a reduced noise margin.

Parameter	Meaning	When Enabled	Classification
Pn200	n.0□□□	After restart	Setup
	n.1□□□		
	n.2□□□		

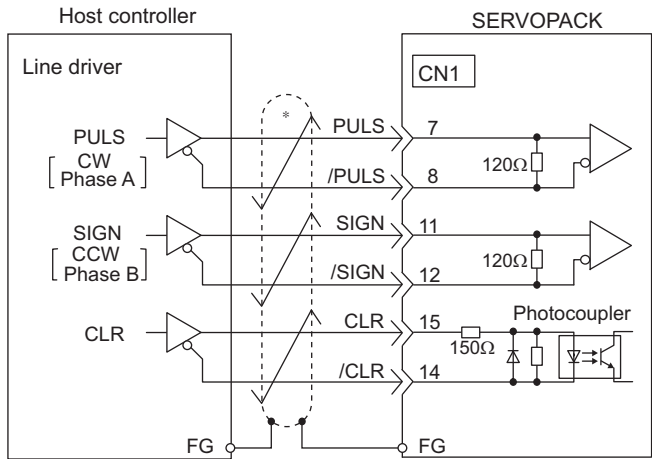
Note:


- Set Pn200 to n.2□□□ if the maximum reference frequency exceeds 1 Mpps.
- Use a shielded cable for I/O signals and ground both ends of the shield.
- Connect the shield at the SERVOPACK to the connector shell so that the shield will be connected to the frame ground (FG) through the connector.

(3) Connection Example

Applicable line driver: SN75174 manufactured by Texas Instruments Inc., or MC3487 or equivalent

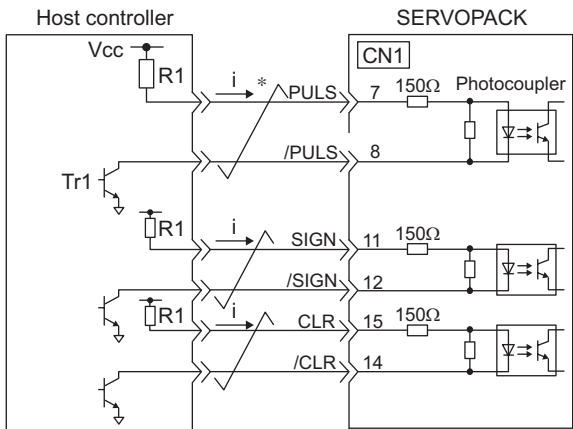
Line Driver Output




*  represents twisted-pair wires.

Open-collector Output

Set limit resistor R1 so the input current, i , falls between 7 mA to 15 mA.



*  represents twisted-pair wires.

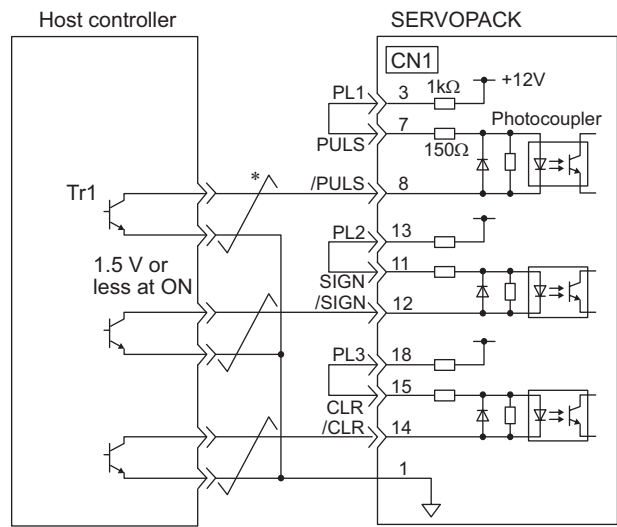
Example


- When Vcc is +24 V: R1 = 2.2 kΩ
- When Vcc is +12 V: R1 = 1 kΩ
- When Vcc is +5 V: R1 = 180 Ω

Note: In case of open-collector outputs, the signal logic is as follows.

When Tr1 is ON	H level input or equivalent
When Tr1 is OFF	L level input or equivalent

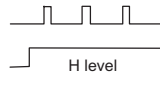
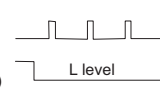
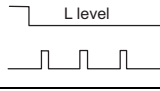
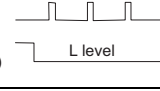



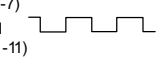
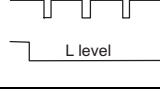

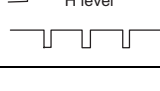
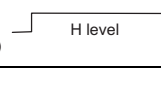
The built-in power supply of the SERVOPACK can be used. With an external power supply, a photocoupler isolation circuit will be used. A non-isolated circuit will be used if the built-in power supply is used.



*  represents twisted-pair wires.

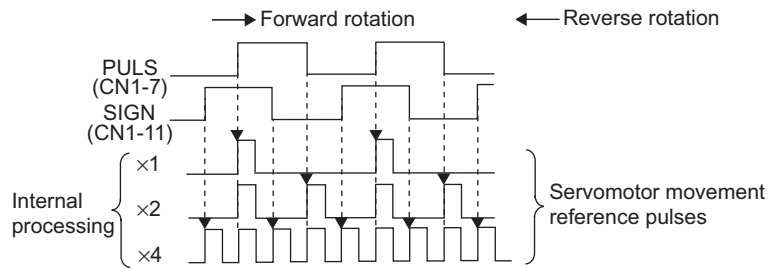
(4) Pulse Reference Input Signal Form

Set the pulse reference input signal form using Pn200.0.

Parameter		Reference Pulse Form	Input Pulse Multiplier	Forward Rotation Reference	Reverse Rotation Reference
Pn200	n.□□□0	Sign + pulse train (Positive logic) (Factory setting)	—	PULS (CN1-7) SIGN (CN1-11) 	PULS (CN1-7) SIGN (CN1-11) 
	n.□□□1	CW pulse + CCW pulse (Positive logic)	—	PULS (CN1-7) SIGN (CN1-11) 	PULS (CN1-7) SIGN (CN1-11) 
	n.□□□2	Two-phase pulse train with 90° phase differential	×1	 PULS (CN1-7) SIGN (CN1-11) 	 PULS (CN1-7) SIGN (CN1-11) 
	n.□□□3		×2		
	n.□□□4		×4		
	n.□□□5	Sign + pulse train (negative logic)	—	PULS (CN1-7) SIGN (CN1-11) 	PULS (CN1-7) SIGN (CN1-11) 
	n.□□□6	CW pulse + CCW pulse (negative logic)	—	PULS (CN1-7) SIGN (CN1-11) 	PULS (CN1-7) SIGN (CN1-11) 

<Supplementary Information>

The input pulse multiplier can be set for the 2-phase pulse train with 90° phase differential reference pulse form.



(5) Reference Pulse Input Timing

Reference pulse form and input timing are as shown below.

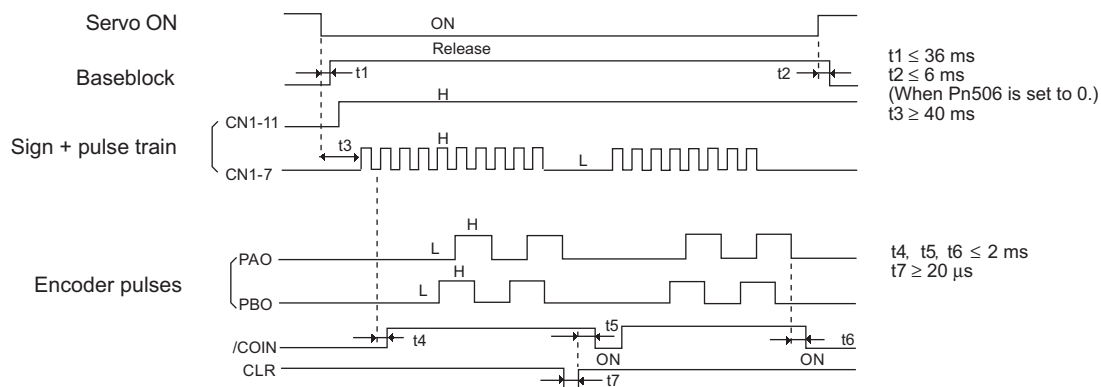
Reference Pulse Form	Electrical Specifications		Remarks
Sign + pulse train input (SIGN + PULS signal) Maximum reference frequency: 4 Mpps* (In case of open-collector output, maximum reference frequency: 200 kpps)		$t1, t2, t3, t7 \leq 0.025 \mu s$ $t4, t5, t6 \geq 0.5 \mu s$ $\tau \geq 0.125 \mu s$ $T - \tau = 0.125 \mu s$	Sign (SIGN) H = Forward reference L = Reverse reference
CW pulse + CCW pulse Maximum reference frequency: 4 Mpps* (In case of open-collector output, maximum reference frequency: 200 kpps)		$t1, t2 \leq 0.025 \mu s$ $t3 \geq 0.5 \mu s$ $\tau \geq 0.125 \mu s$ $T - \tau = 0.125 \mu s$	
Two-phase pulse train with 90° phase differential (phase A + phase B) Maximum reference frequency: 4 Mpps* (In case of open-collector output, maximum reference frequency: 200 kpps)		$t1 \leq 0.1 \mu s$ $t2 \geq 0.1 \mu s$ $\tau \geq 0.5 \mu s$ $T - \tau = 0.5 \mu s$	Switching of the input pulse multiplier mode is done with Pn200.0 setting.

* Maximum reference frequency by each multiplier are as follows.

- ×1 input pulse multiplier: 1 Mpps
- ×2 input pulse multiplier: 1 Mpps
- ×3 input pulse multiplier: 1 Mpps

(6) I/O Signal Timing Example

Input/Output signal timing are as shown below.



- Note 1. The interval from the time the servo ON signal is turned ON until a reference pulse is input is must be at least 40 ms. Otherwise the reference pulse may not be received by the SERVOPACK (t_3).
2. The error counter clear signal must be ON for at least 20 μs (t_7).

5.4.2 Clear Signal

Set the clear signal and select the reference form using Pn200.1.

(1) Signal Setting

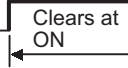
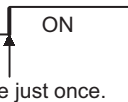
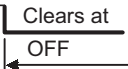
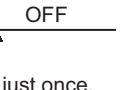
Type	Signal Name	Connector Pin Number	Name
Input	CLR	CN1-15	Clear Input
	/CLR	CN1-14	Clear Input

<Supplementary Information>

CLR Signal wiring is not required if the clear operation is not needed.
Set the Pn201.1 to 0 and the error pulse is not cleared.

(2) Clear Input Signal Form

Set the clear input signal form using Pn200.1.

Parameter	Description	Timing	When Enabled	Classification
Pn200	n.□□0□ Clears at ON. Position error pulses do not accumulate while the signal is at ON. [Factory setting]	CLR (CN1-15) 	After restart	Setup
	n.□□1□ Clears at the rising edge.	CLR (CN1-15) 		
	n.□□2□ Clears at OFF. Position error pulses do not accumulate while the signal is at OFF.	CLR (CN1-15) 		
	n.□□3□ Clears at the falling edge.	CLR (CN1-15) 		

The following are executed when the clear operation is enabled.

- The SERVOPACK error counter is set to 0.
- Position loop operation is disabled.

Note: Holding the clear status may cause the servo clamp to stop functioning and the servomotor to rotate slowly due to drift in the speed loop.

(1) Clear Operation

This parameter determines when the error pulse should be cleared according to the condition of the SERVOPACK. Either of three clearing modes can be selected with Pn200.2.

Parameter	Description	When Enabled	Classification
Pn200	n.□0□□ Clears the error pulse during the baseblock (at the Servo OFF and alarm occurred). [Factory setting]	After restart	Setup
	n.□1□□ Does not clear the error pulse. Clears only with the/CLR signal.		
	n.□2□□ Clears the error pulse when an alarm occurs.		

5.4.3 Electronic Gear

(1) Encoder Resolution

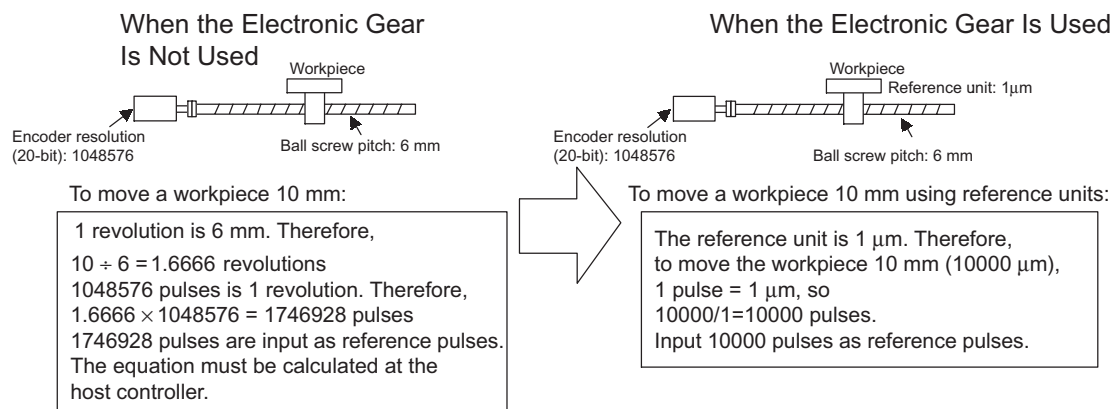
SGM□V-□□□□□□ (Servomotor model)



Serial Encoder Specifications		
Symbol	Specification	Encoder Resolution
A	13-bit incremental	8192
3	20-bit absolute	1048576
D	20-bit incremental	1048576

(2) Electronic Gear

The electronic gear enables the workpiece travel distance per input reference pulse from the host controller to be set to any value. The minimum position data moving a load is called a reference unit.



(3) Electric Gear Ratio

Set the electric gear ratio using Pn20E and Pn210.

Pn20E	Electronic Gear Ratio (Numerator)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824 (2^{30})	-	4	After restart	Setup
Pn210	Electronic Gear Ratio (Denominator)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824 (2^{30})	-	1	After restart	Setup

If the deceleration ratio of the motor and the load shaft is given as n/m where m is the rotation of the motor and n is the rotation of the load shaft,

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

**IMPORTANT**

Electronic gear ratio setting range: $0.001 \leq \text{Electronic gear ratio (B/A)} \leq 1000$

If the electronic gear ratio is outside this range, a parameter setting error (A.040) will be output, and the SERVOPACK will not operate properly. In this case, modify the load configuration or reference unit.

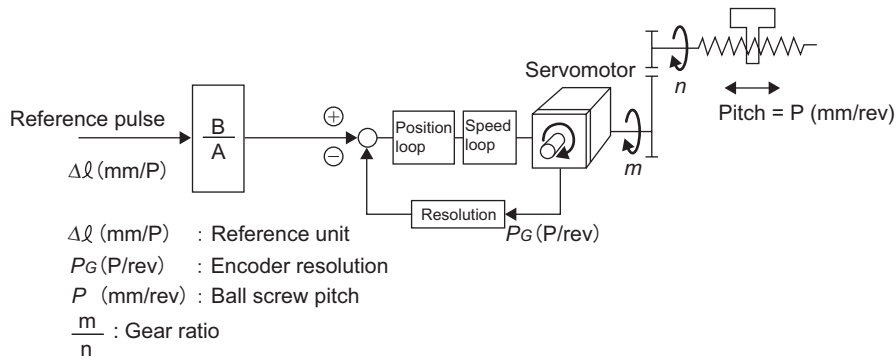
(4) Procedure for Setting the Electronic Gear Ratio

Set value electric gear differs depending on the machine specifications. Use the following procedure to set the electronic gear ratio.

Step	Operation
1	Check machine specifications. Check the deceleration ratio, ball screw pitch, and pulley diameter.
2	Check the encoder resolution. Check the encoder resolution for the servomotor used.
3	Determine the reference unit used. Determine the reference unit from the host controller, considering the machine specifications and positioning accuracy.
4	Calculate the travel distance per load shaft revolution. Calculate the number of reference units necessary to turn the load shaft one revolution based on the previously determined reference units.
5	Calculate the electronic gear ratio. Use the electronic gear ratio equation to calculate the ratio (B/A).
6	Set parameters. Set parameters Pn20E and Pn210 using the calculated values.

(5) Electronic Gear Ratio Equation

Refer to the following equation to determine the electric gear ratio.



$$\frac{n \times P}{\Delta l} \times \left(\frac{B}{A} \right) = P_G \times m$$

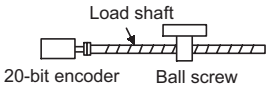
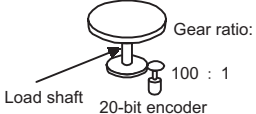
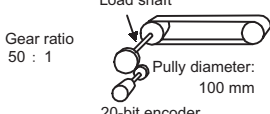
$$\left(\frac{B}{A} \right) = \frac{P_G \times m \times \Delta l}{n \times P} = \frac{P_G}{\frac{P}{\Delta l}} \times \frac{m}{n}$$

Set A and B with the following parameters.

A: Pn210 **B**: Pn20E

(6) Electronic Gear Ratio Setting Examples

The following examples show electronic gear ratio settings for different load configurations.

Step	Operation	Load Configuration		
		Ball Screw	Disc Table	Belt and Pulley
		Reference unit: 0.001 mm 	Reference unit: 0.01° 	Reference unit: 0.005 mm 
1	Check machine specifications.	• Ball screw pitch: 6 mm • Gear ratio: 1/1	Rotation angle per revolution: 360° Gear ratio: 100/1	Pulley diameter: 100 mm (pulley circumference: 314 mm) • Gear ratio: 50/1
2	Check the encoder resolution.	20-bit	20-bit	20-bit
3	Determine the reference unit used.	Reference unit: 0.001 mm (1 μm)	Reference unit: 0.01°	Reference unit: 0.005 mm (5 μm)
4	Calculate the travel distance per load shaft revolution.	6 mm/0.001 mm=6000	360°/0.01°=36000	314 mm/0.005 mm=62800
5	Calculate the electronic gear ratio.	$\frac{B}{A} = \frac{1048576}{6000} \times \frac{1}{1}$	$\frac{B}{A} = \frac{1048576}{36000} \times \frac{100}{1}$	$\frac{B}{A} = \frac{1048576}{628000} \times \frac{50}{1}$
6	Set parameters.	Pn20E: 1048576	Pn20E: 104857600	Pn20E: 52428800
		Pn210: 6000	Pn210: 36000	Pn210: 62800

5.4.4 Smoothing

Applying a filter to a reference pulse input, this function provides smooth servomotor operation in the following cases.

- When the host controller that outputs a reference cannot perform acceleration/deceleration processing.
- When the reference pulse frequency is too low.
- When the reference electronic gear ratio is too high (i.e., 10 times or more).

Note: This function does not affect the travel distance (i.e., the number of pulses).

(1) Related Parameters

Set the following filter-related parameters.

Pn216	Position Reference Acceleration/Deceleration Time Constant				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535 (0 to 6553.5 ms)	0.1 ms	0 (0.0 ms)*	Immediately	
Pn217	Average Movement Time of Position Reference				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000 (0.0 to 1000.0 ms)	0.1 ms	0 (0.0 ms)*	Immediately	

* When set to 0, a filter becomes ineffective.

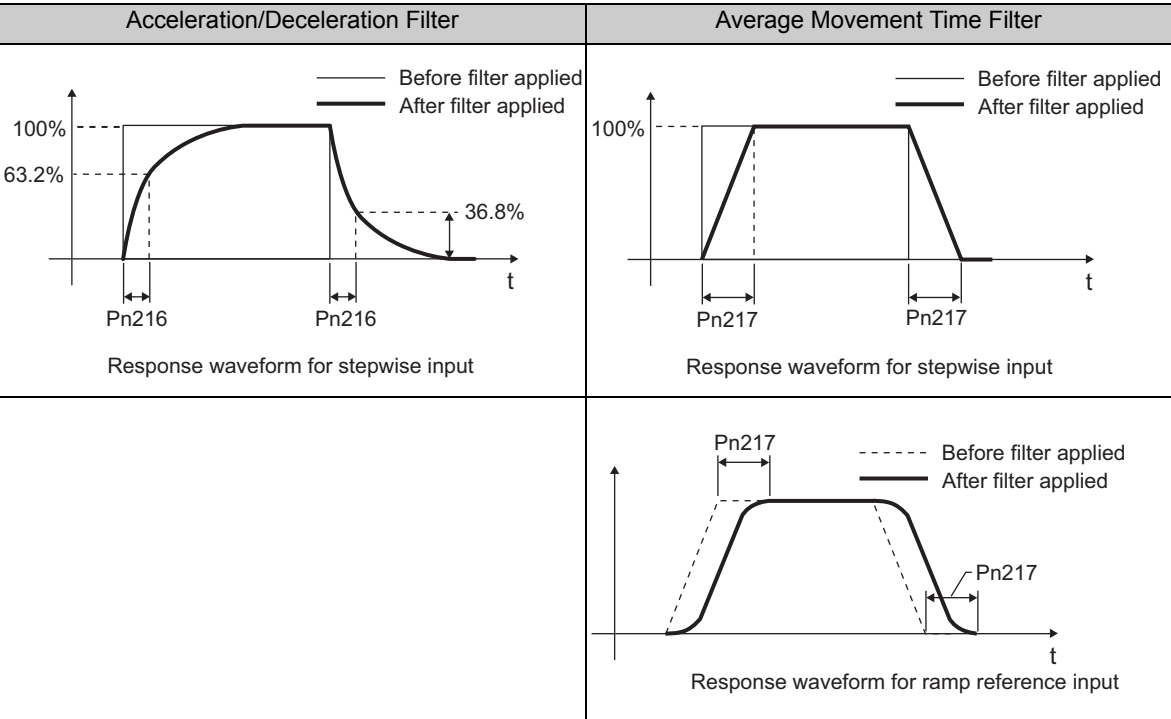


IMPORTANT

While the motor is rotating, changes in Pn216 or Pn217 will not be reflected. The changes will be effective after the motor comes to a stop with no reference pulse input.

<Supplementary Information>

The difference between the position reference acceleration/deceleration time constant (Pn216) and the position reference movement averaging time (Pn217) is shown below.



5.4.5 Positioning Completed Output Signal

This signal indicates that servomotor movement has been completed during position control.

If the difference between the number of reference pulses from the host controller and the movement of the servomotor (the number of position error pulses) drops below the set value in the parameter, the positioning completion signal will be output.

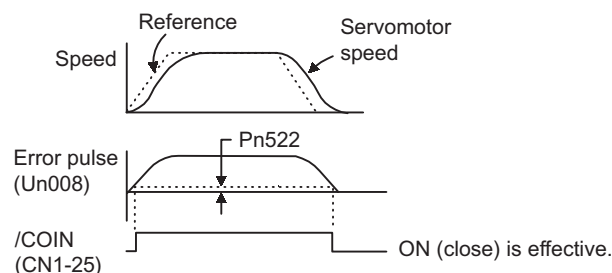
Use this signal to check the completion of positioning from the host controller.

Type	Signal Name	Connector Pin Number	Output Status Close	Meaning
Output	/COIN	CN1-25, 26 [Factory setting]	ON (close)	Positioning has been completed.
			OFF (open)	Positioning is not completed.

- This output signal can be allocated to another output terminal with Pn50E. Refer to 3.3.3 *Output Circuit Signal Allocation*.
- If the servomotor is used with the factory settings, the function will be automatically set to /V-CMP while in speed control mode and always OFF while in torque control mode.

Pn522	Positioning Completed Width Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1073741824(2 ³⁰)	Reference unit	7	Immediately	Setup

- Set the number of error pulses in reference units (the number of input pulses defined using the electronic gear.)
- The positioning completed width setting has no effect on final positioning accuracy.



Note: Too large a value at this parameter may output only a small error during low-speed operation that will cause the /COIN signal to be output continuously.

<Supplementary Information>

If a servo gain is set that keeps the position error small when the positioning completed width is small, use Pn207 = 3 to change output timing for the COIN signal.

Parameter	Name	Meaning	When Enabled	Classification
Pn207	n.0□□□	When the absolute value of the position error is below the positioning completed width setting.	After restart	Setup
	n.1□□□	When the absolute value of the position error is below the positioning completed width setting, and the reference after applying the position reference filter is 0.		
	n.2□□□	When the absolute value of the position error is below the positioning completed width (Pn522) setting, and the position reference input is 0.		

5.4.6 Positioning Near Signal

The host controller receives the positioning near signal prior to confirming the positioning-completed signal, and performs the following operating sequence after positioning has been completed to shorten the time required for operation.

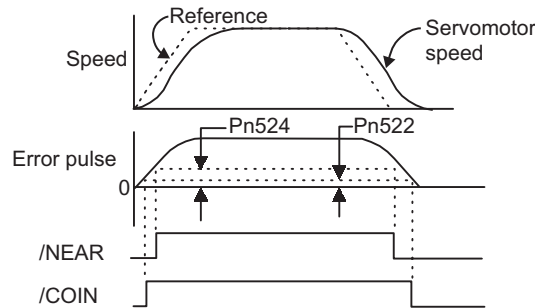
This signal is generally used in combination with the positioning completed output signal.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/NEAR	Must be allocated	ON (close)	The servomotor has reached a point near to positioning completed.
			OFF (open)	The servomotor has not reached a point near to positioning completed.

The output terminal must be allocated with Pn510 in order to use Positioning Near signal. Refer to 3.3.3 *Output Circuit Signal Allocation* for details.

Pn524	NEAR Signal Width Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824(2 ³⁰)	Reference unit	1073741824	Immediately	Setup

- Set the number of error pulses in reference units (the number of input pulses defined using the electronic gear.)
- The positioning near (/NEAR) signal is output when the difference (error) between the number of reference pulses output by the host controller and the travel distance of the servomotor is less than the value set in this parameter.



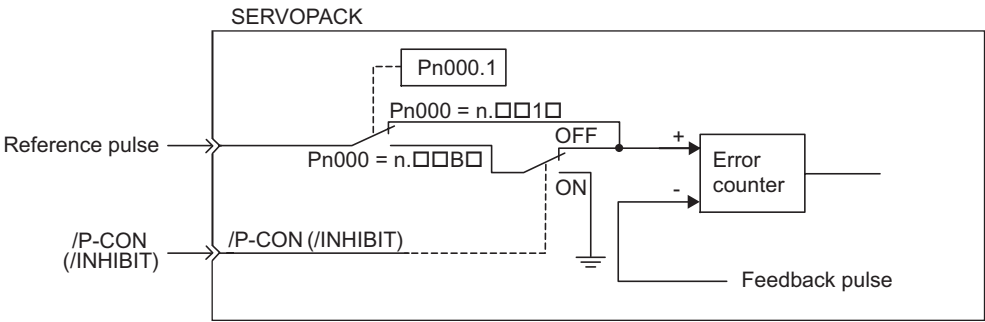
Note: Normally, the setting should be larger than that for the positioning completed width (Pn522).

5.4.7 Reference Pulse Inhibit Function

This function inhibits the SERVOPACK from counting input pulses during position control. The servomotor remains locked (clamped) while pulse are inhibited.

<Terms>

Servo lock: A stopped state of the motor in which a position loop is formed with a position reference of 0.



(1) Signal Setting

■ Factory-set Sequence Signal Allocations (Pn50A.0 = 0)

Use the /P-CON signal to switch to the reference pulse inhibit function.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-41 [Factory setting]	ON	Turns ON the INHIBIT function to inhibit the SERVOPACK from counting reference pulses.
			OFF	Turns OFF the INHIBIT function to count reference pulses.

To use the reference pulse inhibit function, set Pn000.1 to B.

Parameter		Control Method	Input Signal Used	When Enabled	Classification
Pn000	n.□□B□	The INHIBIT function in position control mode uses /P-CON.	/P-CON	After restart	Setup

Note: If Pn000.1 is set to B, the /P-CON signal cannot be used for any function other than the reference pulse inhibit function.

■ Changing Sequence Signal Allocations for Each Signal (Pn50A.0 = 1)

Use the /INHIBIT signal to switch to the reference pulse inhibit function.

To use the /INHIBIT signal, the input signal must be allocated. For details, refer to 3.3.1 *Input Circuit Signal Allocations to Input Terminals*.

<Supplementary Information>

Reference pulse inhibit function is effective only with position control.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/INHIBIT	CN1-□□ Must be allocated.	ON	Turns ON the INHIBIT function to inhibit the SERVOPACK from counting reference pulses.
			OFF	Turns OFF the INHIBIT function to count reference pulses.

To use the reference pulse inhibit function, set Pn000.1 to 1, 5, 7 or 9.

Parameter		Control Method	Input Signal Used	When Enabled	Classification
Pn000	n.□□1□	Position control (pulse train reference)	/INHIBIT	After restart	Setup
	n.□□5□	Internal set speed control (contact reference)↔Position control (pulse train reference)	/INHIBIT		
	n.□□7□	Position control (pulse train reference)↔Speed control (analog reference)	/INHIBIT		
	n.□□8□	Position control (pulse train reference)↔Torque control (analog reference)	/INHIBIT		

5.5 Operating Using Torque Control with Analog Voltage Reference

This section describes the operation in torque control with analog voltage reference.

Input the torque reference using analog voltage reference and control the SERVOPACK operation with the torque in proportion to the input voltage.

Select the torque control with analog voltage reference with Pn000.

Parameter	Meaning	When Enabled	Classification
Pn000	n.□□2□	Control mode: Torque control (analog voltage reference)	After restart
			Setup

5.5.1 Basic Settings for Torque Control Mode

Set the following signal and parameter for torque control with analog voltage reference.

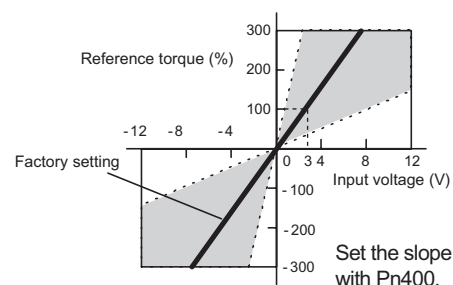
(1) Signal Setting

Set the following input signals.

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Torque Reference Input
	SG	CN1-10	Signal Ground for Torque Reference Input

Input Specifications:

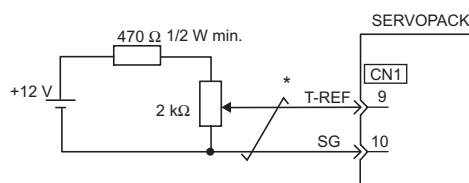
- Input range: ± 1 to ± 10 VDC/rated torque
- Max. allowable input voltage: ± 12 VDC
- The voltage input range can be changed with Pn400.




<Input Circuit Example>

Use twisted-pair wires as a countermeasure against noise.

Variable resistor example: Model 25HP-10B manufactured by Sakae Tsushin Kogyo Co., Ltd.



*  represents twisted-pair wires.

<Supplementary Information>

- Checking the Internal Torque Reference

Use the following method to check the internal torque reference.

1. With the panel operator:

Use the Monitor Mode (Un002). Refer to *Chapter 8 Monitor Modes (Un□□□□)*.

2. With an analog monitor:

The internal torque reference can also be checked with an analog monitor. Refer to *6.1.3 Monitoring Analog Signals*.

(2) Parameter Setting

This sets the analog voltage level for the torque reference (T-REF) that is necessary to operate the servomotor at the rated torque.

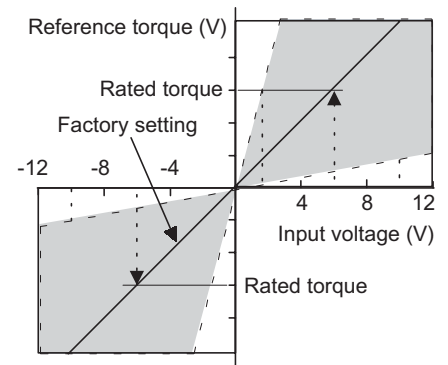
Pn400	Torque Reference Input Gain <div><div>Speed</div><div>Position</div><div>Torque</div></div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100 (1.0 to 10.0 V/rated torque)	0.1 V/rated torque	30 (3.0 V/rated torque)	Immediately	Setup

<Example>

Pn400 = 30: The servomotor operates at the rated torque with 3 V input [factory setting].

Pn400 = 100: The servomotor operates at the rated torque with 10 V input.

Pn400 = 20: The servomotor operates at the rated torque with 2 V input.



5.5.2 Adjustment of Reference Offset

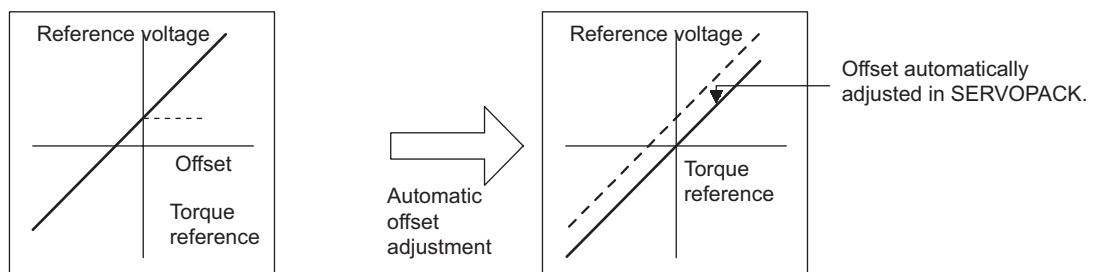
In torque control, the servomotor may rotate at a minute speed with an analog voltage reference of 0 V. This occurs because the reference voltage of the host controller or external circuit has a minute offset of a few millivolts. It is called "offset".

If the servomotor rotates at a minute speed, the offset needs to be eliminated with the offset adjustment function.

Use either automatic adjustment or manual adjustment. Automatic adjustment uses the automatic adjustment parameter for analog (speed and torque) reference offset (Fn009). Manual adjustment uses the manual adjustment parameter for torque reference offset (Fn00B).


(1) Automatic Adjustment of Torque Reference Offset

The automatic adjustment of torque reference offset (Fn009) automatically measures the offset and adjusts the reference voltage.



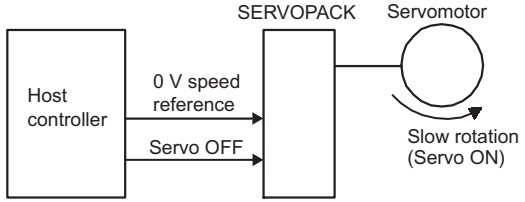






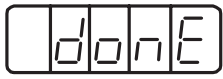

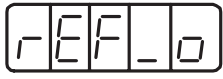


After completion of the steps adjustment, the amount of offset is stored in the SERVOPACK.

Use the following steps for automatic adjustment of the torque reference offset.



IMPORTANT

Automatic adjustment of the analog reference offset must be performed with the servo OFF.

Step	Display after Operation	Keys	Description
1			Turn OFF the SERVOPACK, and input the 0 V reference voltage from the host controller or external circuit. 
2			Press the MODE/SET Key to select the utility function mode.
3			Press the UP or the DOWN Key to select Fn009.
4			Press the DATA/SHIFT Key for approximately one second. "rEF_o" is displayed.
5			Press the MODE/SET Key. The reference offset is automatically adjusted. When completed, "donE" blinks for approximately one second.
6			After "donE" is displayed, "rEF_o" is displayed again.
7			Press the DATA/SHIFT Key for approximately one second. "Fn009" is displayed again.

Note: The automatic adjustment of reference offset (Fn009) cannot be used when a position loop has been formed with the host controller. In this case, use the manual servo tuning of torque reference offset described in (2) *Manual Adjustment of Reference Offset*.

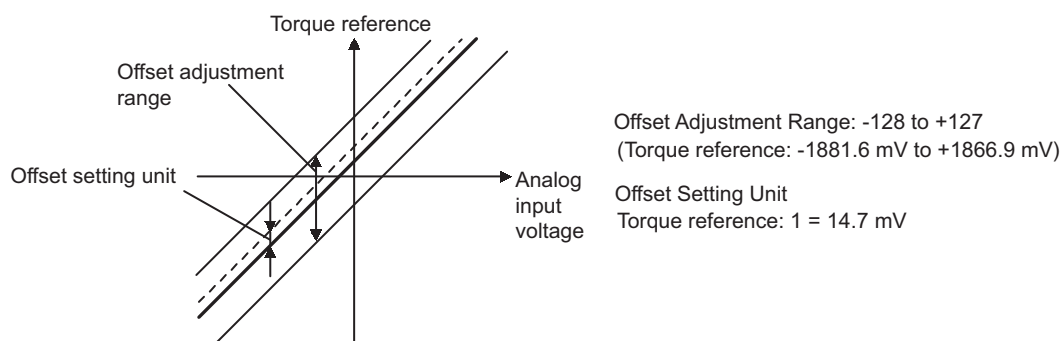
(2) Manual Adjustment of Reference Offset

This mode adjusts the offset by inputting the amount of torque reference offset directly.

Manual servo tuning of the torque reference offset (Fn00B) is used in the following cases.

- If a loop is formed with the host controller and the error is zeroed when servolock is stopped.
- To deliberately set the offset to some value.
- To check the offset data that was set in the automatic adjustment mode of the torque reference offset.

The offset adjustment range and setting units are as follows:



Use the following steps to manually adjust the torque reference offset.

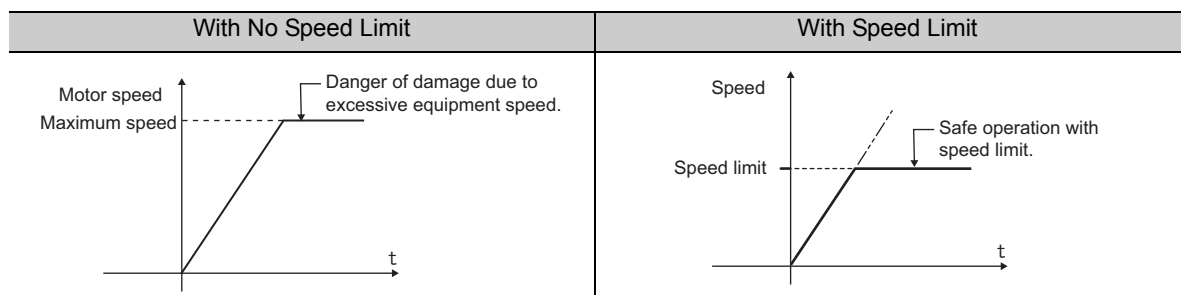
Step	Display after Operation	Keys	Description
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or the DOWN Key to select Fn00B.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Turn ON the servo ON (/S-ON) signal. The display shown on the left appears.
5			Press the DATA/SHIFT Key for less than one second. The torque reference offset amount is displayed.
6			Press the UP or the DOWN Key to adjust the amount of offset.
7			Press the DATA/SHIFT Key for less than one second. The display shown on the left appears. Then "donE" blinks on the display, and offset amount is set.
8			Press the DATA/SHIFT Key for approximately one second. "Fn00b" is displayed again.

5.5.3 Speed Limit in Torque Control

This function limits the speed of the servomotor to protect the machine.

A servomotor in torque control is controlled by the specified torque output, but the motor speed is not controlled. Therefore, if an excessive reference torque is set for the load torque on the machinery side, the speed may out run the torque of the machine and the speed of the motor may increase greatly. If that may occur, use this function to limit the speed.

Note: If the control speed is not within the limit, the function tries to return the speed within the limit using a negative feedback of torque in proportion to the difference from the limited speed. Therefore, the actual limit value of motor speed depends on the load conditions of the motor.



Refer to the following parameters for speed limit.

(1) Signals Output during Servomotor Speed Limit

The following signal is output when the motor speed reaches the limit speed.

Type	Signal Name	Connector Pin Number	Name	Meaning
Output	/VLT	Must be allocated	ON (close)	Servomotor speed limit being applied.
			OFF (open)	Servomotor speed limit not being applied.

For use, this output signal must be allocated with Pn50F. For details, refer to 3.3.3 *Output Circuit Signal Allocation*.

(2) Speed Limit Mode Selection (Torque Limit Option)

Select the speed limit mode with Pn002.

Parameter		Meaning	When Enabled	Classification
Pn002	n.□□0□	Uses the value set in Pn407 as the speed limit (internal speed limit function).	After restart	Setup
	n.□□1□	Uses V-REF (CN1-5, 6) as an external speed limit input. Applies a speed limit using the input voltage of V-REF and the setting in Pn300 (external speed limit function).		

(3) Internal Speed Limit Function

If the internal speed limit function is selected in Pn002, set the limit of the maximum speed of the motor in Pn407.

The limit of the speed in Pn408 can be selected from the maximum speed of the motor or the overspeed detection speed.

Pn407	Speed Limit During Torque Control Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min ⁻¹	10000	Immediately	Setup

Note:

- The setting in this parameter is enabled when Pn002.1 is set to 0.
- The servomotor's maximum speed will be used when the setting in this parameter exceeds the maximum speed of the servomotor used.

Parameter		Meaning	When Enabled	Classification
Pn408	n.□□0□	Use the smaller value between maximum motor rotation number and the value of Pn407 as speed limit value.	After restart	Setup
	n.□□1□	Use the smaller value between excessive speed detection speed and the value of Pn407 as speed limit value.		

(4) External Speed Limit Function

If the external speed limit function is selected in Pn002, set the V-REF input signal and Pn300.

Type	Signal Name	Connector Pin Number	Name
Input	V-REF	CN1-5	External Speed Limit Input
	SG	CN1-6	Signal Ground

Inputs an analog voltage reference as the servomotor speed limit value during torque control.

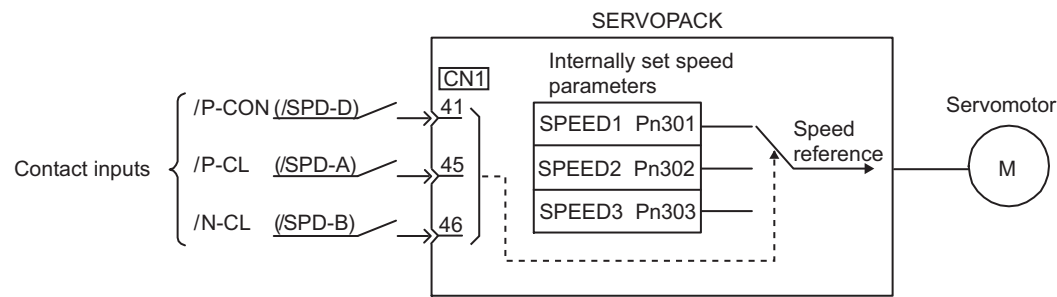
<Supplementary Information>

- The smaller value of the speed limit input from the V-REF on the Pn407 (Speed Limit during Torque Control) is enabled when Pn002.1 is set to 0.
- The setting in Pn300 determines the voltage level to be input as the limit value. Polarity has no effect.

Pn300	Speed Reference Input Gain <div><div>Speed</div><div>Position</div><div>Torque</div></div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	150 to 3000 (1.50 to 30.00 V/rated speed)	0.01 V/rated speed	600 (6.00 V/rated speed)	Immediately	Setup

5.6 Operating Using Speed Control with an Internally Set Speed

This function allows speed control operation by externally selecting an input signal from among three servomotor speed settings made in advance with parameters in the SERVOPACK. Since controlling a speed with a parameter inside the SERVOPACK, there is no need for an external speed of pulse generator.



5.6.1 Basic Settings for Speed Control with an Internally Set Speed

Set the following signal and parameter for speed control with an internally set speed.

(1) Signal Setting

The following input signals are used to switch the operating speed.

Type	Signal Name	Connector Pin Number	Meaning
Input	/P-CON	CN1-41	Switches the servomotor rotation direction.
	(/SPD-D)	Must be allocated	
	/P-CL	CN1-45	Selects the internally set speed.
	(/SPD-A)	Must be allocated	
	/N-CL	CN1-46	Selects the internally set speed.
	(/SPD-B)	Must be allocated	

(2) Speed Control with an Internally Set Speed Selection

Select the speed control with an internally set speed with Pn000.

Parameter		Meaning	When Enabled	Classification
Pn000	n.□□3□	Control mode: Internally set speed control (contact reference)	After restart	Setup

(3) Parameter Setting

Set the internally set speed with Pn301, Pn302 and Pn303.

Pn301	Internally Set Speed 1 Speed				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min ⁻¹	100	Immediately	Setup
Pn302	Internally Set Speed 2 Speed				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min ⁻¹	200	Immediately	Setup
Pn303	Internally Set Speed 3 Speed				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min ⁻¹	300	Immediately	Setup

Note: The maximum speed of the servomotor is used whenever the value exceeds the maximum speed is set in the Pn301 to Pn303.

(4) Operating Using an Internally Set Speed

Use ON/OFF combinations of the following input signals to operate with the internally set speeds. Following two kinds of input signals are available.

■ Using input signals /P-CON, /P-CL, /N-CL [factory setting]

Input Signal			Motor Rotation Direction	Speed
/P-CON	/P-CL	/N-CL		
OFF	OFF	OFF	Forward	Stops at 0 of the internally set speed.
	OFF	ON		Pn301: Internally Set Speed 1 (SPEED1)
	ON	ON		Pn302: Internally Set Speed 2 (SPEED2)
	ON	OFF		Pn303: Internally Set Speed 3 (SPEED3)
ON	OFF	OFF	Reverse	Stops at 0 of the internally set speed.
	OFF	ON		Pn301: Internally Set Speed 1 (SPEED1)
	ON	ON		Pn302: Internally Set Speed 2 (SPEED2)
	ON	OFF		Pn303: Internally Set Speed 3 (SPEED3)

■ Using input signals /SPD-D, /SPD-A, /SPD-B

Input Signal			Motor Rotation Direction	Speed
/SPD-D	/SPD-A	/SPD-B		
OFF	OFF	OFF	Forward	Stops at 0 of the internally set speed.
	OFF	ON		Pn301: Internally Set Speed 1 (SPEED1)
	ON	ON		Pn302: Internally Set Speed 2 (SPEED2)
	ON	OFF		Pn303: Internally Set Speed 3 (SPEED3)
ON	OFF	OFF	Reverse	Stops at 0 of the internally set speed.
	OFF	ON		Pn301: Internally Set Speed 1 (SPEED1)
	ON	ON		Pn302: Internally Set Speed 2 (SPEED2)
	ON	OFF		Pn303: Internally Set Speed 3 (SPEED3)

<Supplementary Information>

When Pn000.1 = 4, 5, or 6, and both /P-CL and /N-CL are OFF, the control mode can be switched.

Example:

Pn000.1 = 5: Internally set speed selection (contact reference) \Leftrightarrow Position control (pulse train reference)

■ Factory-set Sequence Signal Allocations: (Pn50A.0 = 0)

Input Signal		Speed
/P-CL	/N-CL	
OFF	OFF	Pulse train reference input (position control)
OFF	ON	Pn301: Internally Set Speed 1 (SPEED1)
ON	ON	Pn302: Internally Set Speed 2 (SPEED2)
ON	OFF	Pn303: Internally Set Speed 3 (SPEED3)

■ Changing Sequence Signal Allocations for Each Signal (Pn50A.0 = 1)

Input Signal			Speed
/SPD-A	/SPD-B	/C-SEL	
OFF	OFF	OFF	Stops at 0 of the Internally Set Speed
OFF	ON	OFF	Pn301: Internally Set Speed 1 (SPEED1)
ON	ON	OFF	Pn302: Internally Set Speed 2 (SPEED2)
ON	OFF	OFF	Pn303: Internally Set Speed 3 (SPEED3)
—	—	ON	Pulse train reference input (position control)

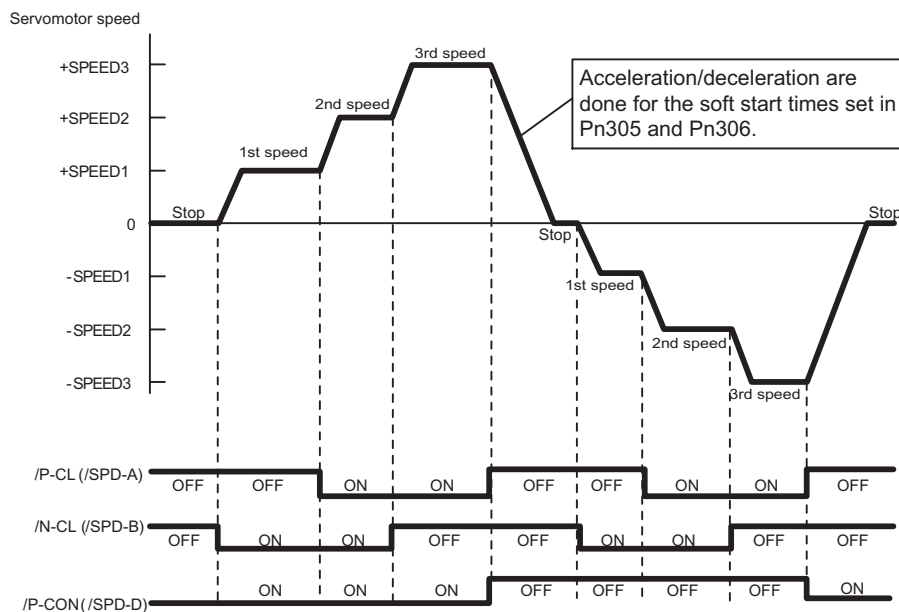
Note: Allocate /C-SEL signal to switch the control mode. For details, refer to 3.3.1 *Input Circuit Signal Allocation to Input Terminals*.

5.6.2 Example of Operating with Internally Set Speed

Operating example of speed control with internally set speed is as shown below.

This example combines speed control with internally set speed with soft start function.

The shock that results when the speed is changed can be reduced by using the soft start function.

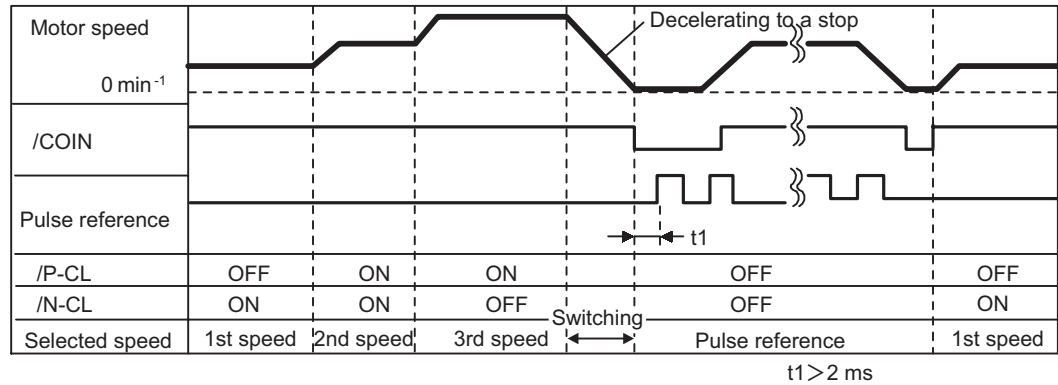




IMPORTANT

- When Pn000.1 = 5 (Internally set speed control \Leftrightarrow Position control), the soft start function will operate only when selecting the internally set speed. The soft start function cannot be used with pulse reference input.
- When switching to pulse reference input during operation at either of the three speeds (1st speed to 3rd speed), the pulse reference will not be received by the SERVOPACK until after the positioning completed (/COIN) signal is output. Always begin the output of the pulse reference from the host controller after the positioning completed (/COIN) signal is output from the SERVOPACK.

Signal Timing in Position Control



- Note 1. The soft start function is used in the above figure.
- The t_1 value is not affected by whether the soft start function is used. A maximum delay of 2 ms occurs in loading /P-CL and /N-CL.
 - The speed is decelerated for the time set in Pn306, and the speed control will be changed to the position control after the motor comes to a stop.
 - The position control can be changed to the speed control while the motor is rotating.

5.7 Control Selection

SERVOPACK can switch the control mode. Select the control mode with Pn000.

5.7.1 Combination of Control Modes

The following combinations of control modes can be selected with Pn000.

Parameter		Combination of Control Modes	When Enabled	Classification
Pn000	n.□□4□	Internally set speed control (contact reference) ↔ Speed control (analog voltage reference)	After restart	Setup
	n.□□5□	Internally set speed control (contact reference) ↔ Position control (pulse train reference)		
	n.□□6□	Internally set speed control (contact reference) ↔ Torque control (analog voltage reference)		
	n.□□7□	Position control (pulse train reference) ↔ Speed control (analog voltage reference)		
	n.□□8□	Position control (pulse train reference) ↔ Torque control (analog voltage reference)		
	n.□□9□	Torque control (analog voltage reference) ↔ Speed control (analog voltage reference)		
	n.□□A□	Uses /P-CON for zero clamp function.		
	n.□□B□	Uses /P-CON for reference pulse inhibit function.		

5.7.2 Switching Internally Set Speed Control (Pn000.1 = 4, 5, or 6)

Conditions for switching in internally set speed control are as shown below.

(1) Factory-set Sequence Signal Allocations (Pn50A.0 = 0)

The control mode can be switched when both /P-CL and /N-CL signals are OFF (high level).

(2) Changing Sequence Signal Allocations for Each Signal (Pn50A.0 = 1)

Allocate the /C-SEL to an input terminal to change modes with the /C-SEL signal.

Type	Signal Name	Connector Pin Number	Setting	Pn000 Setting and Control Mode		
				n.□□4□	n.□□5□	n.□□6□
Input	/C-SEL	Must be allocated	ON	Speed	Position	Torque
			OFF	Internally set speed	Internally set speed	Internally set speed

Note: To use the /C-SEL signal, the input signal must be allocated. For details, refer to 3.3.1 *Input Circuit Signal Allocation*.

5.7.3 Switching Other Than Internally Set Speed Control (Pn000.1 = 7, 8, 9, A, or B)

Use the following signals to switch control modes. The control modes switch depending on the signal status as shown below.

(1) Factory-set Sequence Signal Allocations (Pn50A.0 = 0)

Type	Signal Name	Connector Pin Number	Setting	Pn000 Setting and Control Mode				
				n.□□7□	n.□□8□	n.□□9□	n.□□A□	n.□□B□
Input	/P-CON	CN1-41	ON	Speed	Torque	Speed	Zero clamp	INHIBIT
			OFF	Position	Position	Torque	Speed	Position

(2) Changing Sequence Signal Allocations for Each Signal (Pn50A.0 = 1)

Type	Signal Name	Connector Pin Number	Setting	Pn000 Setting and Control Mode				
				n.□□7□	n.□□8□	n.□□9□	n.□□A□	n.□□B□
Input	/C-SEL	Must be allocated	ON	Speed	Torque	Speed	Can not be switched.	Cannot be switched.
			OFF	Position	Position	Torque		
	/ZCLAMP		ON	Cannot be switched.	Cannot be switched.	Cannot be switched.	Zero clamp	Cannot be switched.
			OFF				Speed	
	/INHIBIT		ON	Cannot be switched.	Cannot be switched.	Cannot be switched.	Cannot be switched.	Reference pulse inhibited
			OFF					Position

5.8 Limiting Torque

The SERVOPACK provides the following four methods for limiting output torque to protect the machine.

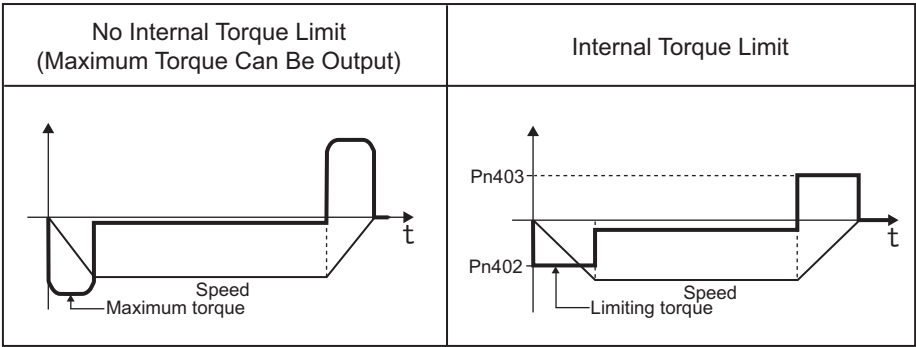
Limiting Method	Description	Reference Section
Internal torque limit	Always limits torque by setting the parameter.	5.8.1
External torque limit	Limits torque by input signal from the host controller.	5.8.2
Torque limiting by analog voltage reference	Assigns a torque limit by analog voltage reference.	5.8.3
External torque limit + Torque limiting by analog voltage reference	Combines torque limiting by an external input and by analog voltage reference.	5.8.4

5.8.1 Internal Torque Limit

This function always limits maximum output torque by setting values of following parameters.

Pn402	Forward Torque Limit <div>SpeedPositionTorque</div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup
Pn403	Reverse Torque Limit <div>SpeedPositionTorque</div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup

Alalog Monitor Output



The setting unit is a percentage of rated torque.

- Note 1. Too small a torque limit setting will result in insufficient torque during acceleration and deceleration.
2. The maximum torque of the servomotor is used whenever the value exceeds the maximum torque is set. (factory setting is 800%: maximum torque)

5.8.2 External Torque Limit

Use this function to limit torque by inputting a signal from the host controller at a specific times during machine operation, such as forced stop or hold operations for robot workpieces.

(1) Input Signals

Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit value
Input	/P-CL	CN1-45 [Factory setting]	ON	Forward external torque limit ON	The value set in Pn402 or Pn404 (whichever is smaller)
			OFF	Forward external torque limit OFF	Pn402
Input	/N-CL	CN1-46 [Factory setting]	ON	Reverse external torque limit ON	The value set in Pn403 or Pn405 (whichever is smaller)
			OFF	Reverse external torque limit OFF	Pn403

Note: When using external torque limit, make sure that there are no other signals allocated to the same terminals as /P-CL and /N-CL. When multiple signals are allocated to the same terminal, the signals are handled with OR logic, which affects the ON/OFF state of the other signals. Refer to 3.3.1 *Input Circuit Signal Allocation*.

(2) Related Parameters

Set the following parameters for external torque limit.

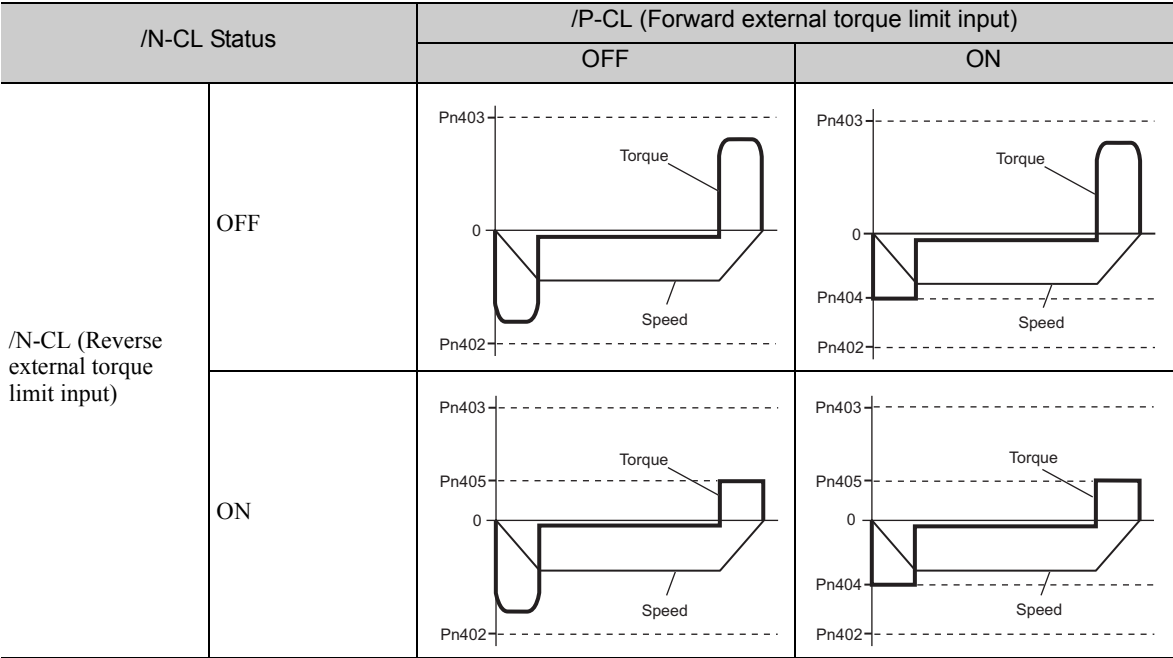
Pn404	Forward External Torque Limit Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	100	Immediately	Setup
Pn405	Reverse External Torque Limit Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled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

Note: Setting unit is percentage to the servomotor rated torque. (Rated torque limits 100 %).

(3) Changes in Output Torque during External Torque Limiting

Changes in output torque when external torque limit is set to 800% are as shown below.

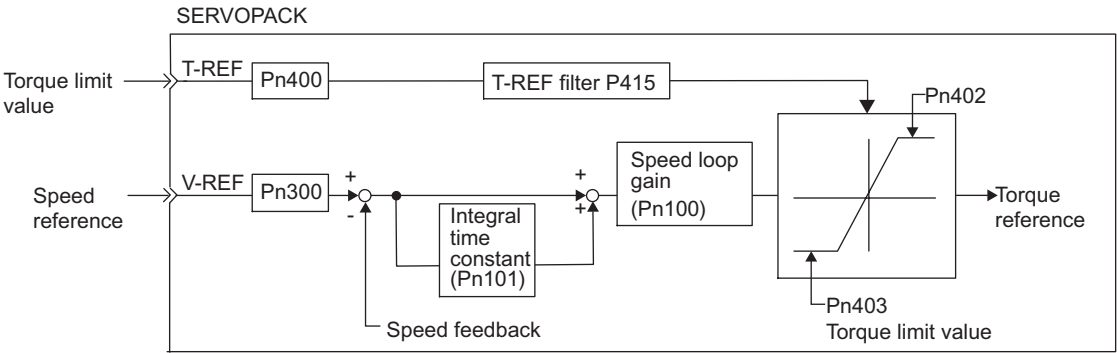
In this example, the servomotor rotation direction is Pn000.0 = 0 (CCW = forward).



5.8.3 Torque Limiting Using an Analog Voltage Reference

Torque limiting by analog voltage reference limits torque by assigning a torque limit in an analog voltage to the T-REF terminals (CN1-9 and 10). This function can be used only during speed or position control, not during torque control.

The following chart shows when the torque limiting using an analog voltage reference in the speed control.



<Supplementary Information>

There is no polarity in the input voltage of the analog voltage reference for torque limiting. The absolute values of both + and - voltages are input, and a torque limit value corresponding to that absolute value is applied in the forward and reverse direction.

(1) Input Signals

Use the following input signals to limit a torque by analog voltage reference.

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Torque reference input
	SG	CN1-10	Signal ground for torque reference input

The torque limit input gain is set with Pn400. Refer to *5.5.1 Basic Settings for Torque Control Mode*.

Input Specifications

- Input range: ± 1 VDC to ± 10 VDC/rated torque
- Maximum allowable input voltage: ± 12 VDC

(2) Related Parameter

Set the following parameter for torque limit by analog voltage reference.

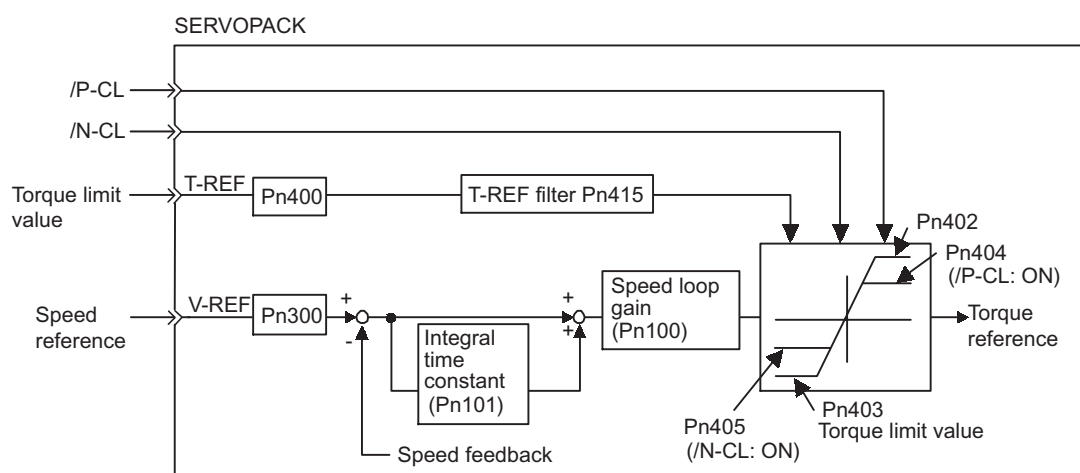
Parameter		Meaning		When Enabled	Classification
Pn002	n.□□□1	Speed control option: Uses the T-REF terminal to be used as an external torque limit input.		After restart	Setup

Pn415	T-REF Filter Time Constant Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535 (0 to 655.35 ms)	0.01 ms	0 (0.00 ms)	Immediately	Setup

5.8.4 Torque Limiting Using an External Torque Limit and Analog Voltage Reference

This function can be used to combine torque limiting by an external input and by analog voltage reference.

When /P-CL (or /N-CL) is ON, either the torque limit by analog voltage reference or the setting in Pn404 (or Pn405) will be applied as the torque limit, whichever is smaller.



Note: This function cannot be used during torque control since the torque limit by analog voltage reference is input from T-REF (CN1-9, 10).

(1) Input Signals

Use the following input signals to limit a torque by external torque limit and analog voltage reference.

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Torque reference input
	SG	CN1-10	Signal ground for torque reference input

The torque limit input gain is set with Pn400. Refer to 5.5.1 *Basic Settings for Torque Control Mode*.

Input Specifications

- Input range: ± 1 VDC to ± 10 VDC/rated torque
- Maximum allowable input voltage: ± 12 VDC

Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit Value
Input	/P-CL	CN1-45 [Factory setting]	ON	Forward external torque limit ON	The analog voltage reference limit or the value set in Pn402 or Pn404 (whichever is smaller)
			OFF	Forward external torque limit OFF	Pn402
Input	/N-CL	CN1-46 [Factory setting]	ON	Reverse external torque limit ON	The analog voltage reference limit or the value set in Pn403 or Pn405 (whichever is smaller)
			OFF	Reverse external torque limit OFF	Pn403

Note: When using the torque limit by external torque limit and analog voltage reference, make sure that there are no other signals allocated to the same terminals as /P-CL and /N-CL. When multiple signals are allocated to the same terminal, the signals are handled with OR logic, which affects the ON/OFF state of the other signals. Refer to 3.3.1 *Input Circuit Signal Allocation*.

(2) Related Parameters

Set the following parameters for torque limit by external torque limit and analog voltage reference.

Parameter		Meaning	When Enabled	Classification
Pn002	n.□□□3	Speed control option: When /P-CL or /N-CL is enabled, the T-REF terminal is used as the external torque limit input.	After restart	Setup
Pn404	Forward External Torque Limit Speed Position Torque			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled
	0 to 800	1%	100	Immediately
Pn405	Reverse External Torque Limit Speed Position Torque			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled
	0 to 800	1%	100	Immediately

Note: Setting unit is percentage to the servomotor rated torque. (Rated torque limits 100%).

Pn415	T-REF Filter Time Constant Speed Position Torque			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled
	0 to 65535 (0 to 655.35 ms)	0.01 ms	0 (0.00 ms)	Immediately

5.8.5 Checking Output Torque Limiting during Operation

The following signal can be output to indicate that the servomotor output torque is being limited.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/CLT	Must be allocated	ON (close)	Servomotor output torque is being limited.
			OFF (open)	Torque is not being limited.

For the allocation method, refer to 3.3.1 *Input Circuit Signal Allocation*.

5.9 Absolute Encoders

If a motor with an absolute encoder is used, a system to detect the absolute position can be made in the host controller. Consequently, operation can be performed without zero point return operation immediately after the power is turned ON.



IMPORTANT

The output range of multiturn data for the Σ -V series absolute detection system differs from that for conventional systems (15-bit encoder and 12-bit encoder). When an infinite length positioning system of the conventional type is to be configured with the Σ -V series, be sure to make the following system modification.

Absolute Encoder Type	Resolution	Output Range of Multiturn Data	Action when Limit Is Exceeded
Σ Series SGD SGDA SGDB	12-bit 15-bit	-99999 to + 99999	<ul style="list-style-type: none"> When the upper limit (+99999) is exceeded in the forward direction, the multiturn data is 0. When the lower limit (-99999) is exceeded in the reverse direction, the multiturn data is 0.
Σ -II, Σ -III Series SGDM SGDH SGDS	17-bit	-32768 to + 32767	<ul style="list-style-type: none"> When the upper limit (+32767) is exceeded in the forward direction, the multiturn data is -32768.* When the lower limit (-32767) is exceeded in the reverse direction, the multiturn data is +32768.*
Σ -V Series	20-bit	-32768 to + 32767	<ul style="list-style-type: none"> When the upper limit (+32767) is exceeded in the forward direction, the multiturn data is -32768.* When the lower limit (-32767) is exceeded in the reverse direction, the multiturn data is +32768.*

* The action differs when the Multiturn Limit Setting (Pn205) is changed.

5.9.1 Encoder Resolutions

The following table shows the encoder resolutions for each servomotor model.

Servomotor Model	Encoder Resolution
SGMJV	13-bit
SGMAV / SGMJV / SGMGV / SGMCS	20-bit

<Supplementary Information>

Absolute encoder can be used as an incremental encoder by setting with Pn002.

Parameter	Meaning	When Enabled	Classification
Pn002	n.□0□□	After restart	Setup
	n.□1□□		

The SEN signal and back-up battery are not required when using the absolute encoder as an incremental encoder.

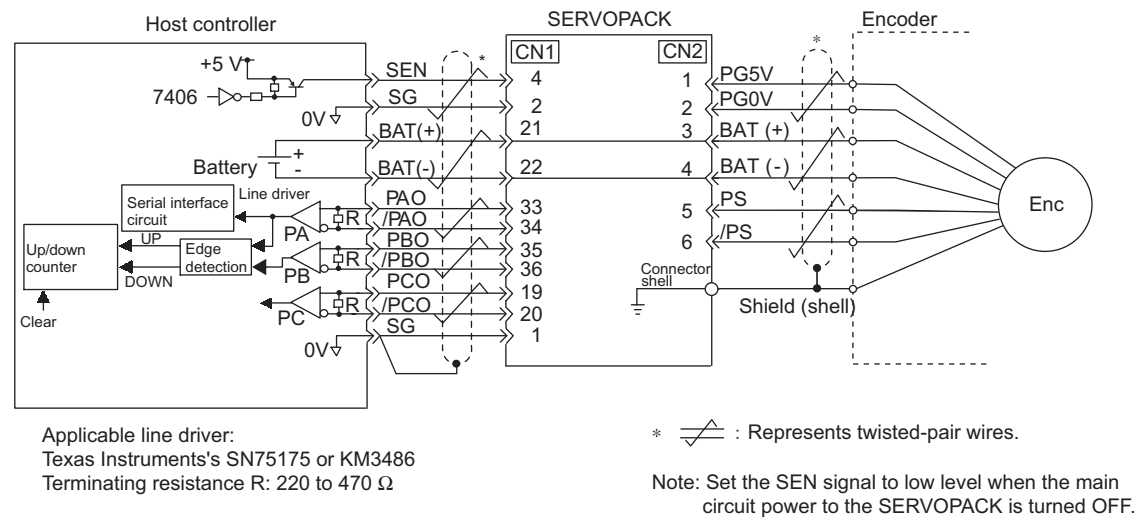
5.9.2 Standard Connection Diagram for an Absolute Encoder and Setting the SEN Signal

A standard connection example for a servomotor with an absolute encoder, the SERVOPACK, and host controller is shown below.

The SEN signal must be set for the SERVOPACK to output absolute data. For details, refer to (2) *Setting the SEN Signal*.


(1) Standard Connection Diagram

The following diagram shows the standard connections for an absolute encoder.



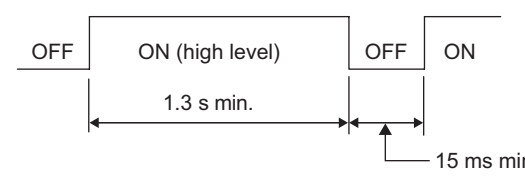
Note: The connection cable models and wiring pin numbers depend on the servomotor.

(2) Setting the SEN Signal



IMPORTANT

- Maintain the high level for at least 1.3 seconds when the SEN signal is turned OFF and then ON, as shown in the figure below.

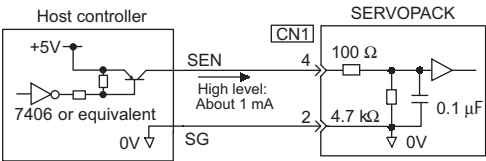


- SEN Signal cannot be received during Servo ON.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	SEN	CN1-4	OFF (low level)	Input when power is turned ON
			ON (high level)	Input at absolute data request

For the details of the absolute data reception sequence, refer to 5.9.6 *Absolute Encoder Reception Sequence*.

- Note 1. After turning the power ON, turn ON the SEN signal after/ ALM signal is turned ON and then OFF.
2. When the SEN signal changes from low level to high level, the multiturn data and initial incremental pulses are output. Until these operations have been completed, the motor cannot be operated regardless of the status of the servo ON. The panel operator display will also remain "bb."



We recommend a PNP transistor.
Signal levels
High: 4.0 V min., Low: 0.8 V max.

5.9.3 Absolute Encoder Data Backup

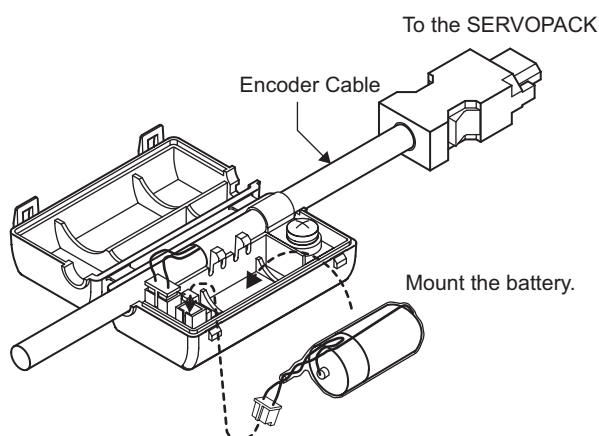
In order for the absolute encoder to retain position data when the power is turned OFF, the data must be backed up by a battery.

PROHIBITED

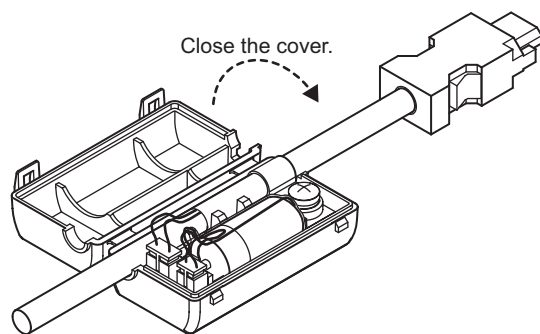
- Do not install the battery at both the host controller and the SERVOPACK.
It is dangerous because a loop circuit between the batteries is set up. Install the battery in the host controller or SERVOPACK.

(1) Battery Provided for SERVOPACK

- Open the battery case cover.
- Mount the battery (JZSP-BA01) as shown below.



- Close the battery case cover.



(2) Installing the Battery at the Host Controller

Prepare following the host controller specification. Use an ER6VC3 battery (3.6 V, 200 mAh; manufactured by Toshiba Battery Co., Ltd.) or an equivalent.

5.9.4 Encoder Battery Alarm (A. 830)

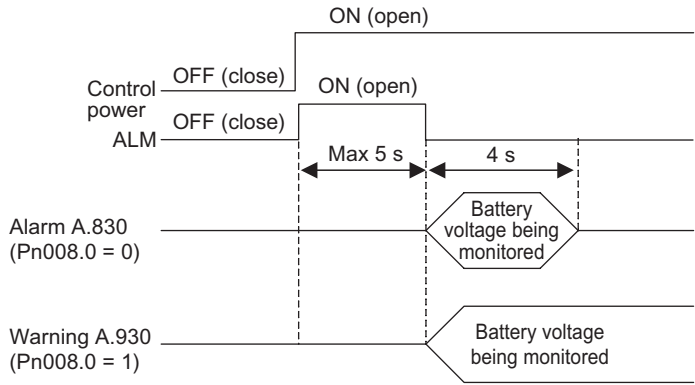
If the battery voltage drops to approximately 2.7 V, an encoder battery alarm (A.830) or encoder battery warning (A.930) will be displayed.

If an alarm or warning is displayed, replace the batteries using the following procedure.

Use Pn008 to set either an alarm (A830) or a warning (A.930).


Parameter		Meaning	When Enabled	Classification
Pn008	n.□□□0	Outputs the alarm A.830 when the battery voltage drops. (Factory setting)	After restart	Setup
	n.□□□1	Outputs the warning A.930 when the battery voltage drops.		

- If Pn008.0 is set to 0, alarm detection will be enabled for 4 seconds after the ALM signal turns ON when the power is turned ON.
Note: No alarm will be displayed even if the battery is disconnected after 4 seconds.
- The battery voltage will be always monitored if Pn008.0 is set to 1.



(1) Battery Replacement Procedure

1. Turn ON only the SERVOPACK control power supply.
2. Replace the battery.
3. After replacing the battery, turn OFF the SERVOPACK power to cancel the absolute encoder battery alarm (A.830).
4. Turn ON the SERVOPACK power back again.
5. Check that the error display is cancelled and it operates without any problems.



IMPORTANT

If the SERVOPACK control power supply is turned OFF and the battery is disconnected (which includes disconnecting the encoder cable), the absolute encoder data will be deleted.

5.9.5 Absolute Encoder Setup

CAUTION

- If the absolute value encoder is initialized, multiturn data will be set to 0 and the reference position of the machine system will change.
If the machine is operated in this state, the machine may move unexpectedly and injury, death, or machine damage may result. Be sufficiently careful when initializing the absolute encoder.

Setting up the absolute encoder is necessary in the following cases.

- When starting the machine for the first time
- When an encoder backup error alarm (A.810) is generated
- When an encoder checksum error alarm (A.820) is generated
- To set the absolute encoder multiturn data to 0

Setup the absolute encoder with Fn008.

(1) Precautions on Setup

- Encoder setup operation is only possible when the servo is OFF.
- If the following absolute encoder alarms are displayed, cancel the alarm by using the same method as the setup (initializing). They cannot be canceled with the SERVOPACK alarm reset input signal (/ALM-RST).
- Encoder backup error alarm (A.810)
- Encoder checksum error alarm (A.820)
- Any other alarms that monitor the inside of the encoder should be canceled by turning OFF the power, then canceling the alarm.

(2) Procedure for Setup

Follow the steps below to setup the absolute encoder.

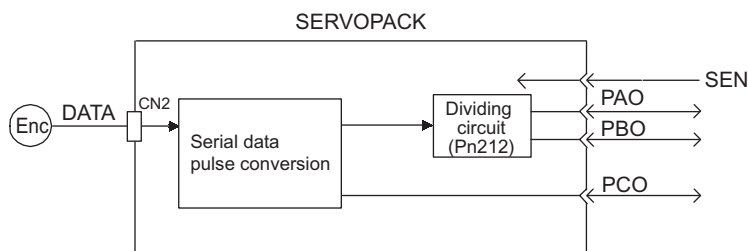
Step	Display after Operation	Keys	Description
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or the DOWN Key to select Fn008.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Continue pressing the UP Key until "PGCL5" is displayed. *If there is a mistake in the key operation, "nO_OP" will blink for approximately one second. Start the operation from the beginning.
5			Press the MODE/SET Key. The absolute encoder is initialized. When completed, "donE" blinks for approximately one second.
6			"PGCL5" is displayed again.
7			Press the DATA/SHIFT Key for approximately one second. "Fn008" is displayed again.
8	Turn OFF the power, and then turn it ON again to make the setting valid.		

5.9.6 Absolute Encoder Reception Sequence

The sequence in which the SERVOPACK receives outputs from the absolute encoder and transmits them to host device is shown below.

(1) Outline of Absolute Signals

The serial data, pulses, etc., of the absolute encoder that are output from the SERVOPACK are output from the PAO, PBO, and PCO signals as shown below.

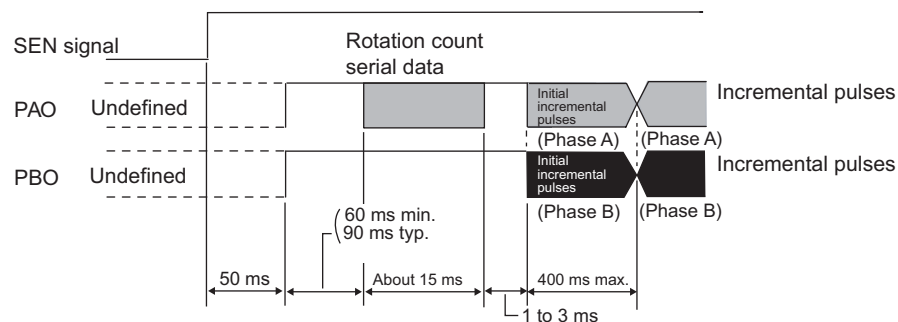


Signal Name	Status	Contents
PAO	At initialization	Serial data Initial incremental pulses
	Normal time	Incremental pulses
PBO	At initialization	Initial incremental pulses
	Normal time	Incremental pulses
PCO	Always	Origin pulses

(2) Absolute Encoder Transmission Sequence and Contents

■ Absolute Encoder Transmission Sequence

1. Set the SEN signal at ON (high level).
2. After 100 ms, set the system to serial data reception-waiting-state. Clear the incremental pulse up/down counter to zero.
3. Receive eight bytes of serial data.
4. The system enters a normal incremental operation state about 400 ms after the last serial data is received.

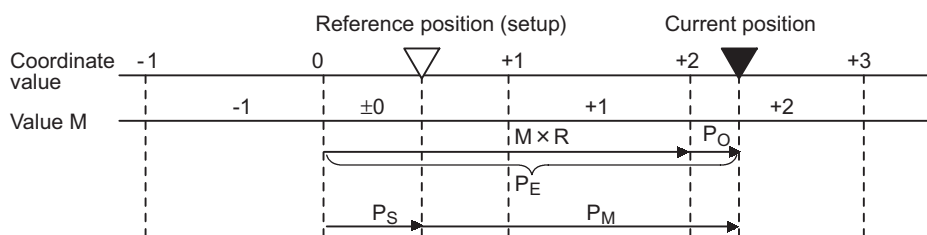


Serial data:

Indicates how many turns the motor shaft has made from the reference position (position specified at setup).

Initial incremental pulses:

Outputs pulses at the same pulse rate as when the motor shaft rotates from the origin to the current position at about 1250 min^{-1} (for 17 bits when the encoder output pulse is at the factory setting)



Final absolute data P_M is calculated by following formula.

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

$$P_M = P_E - P_S$$

Signal	Meaning
P_E	Current value read by encoder
M	Multiturn data (rotation count data)
P_O	Number of initial incremental pulses
P_S	Number of initial incremental pulses read at setup (This is saved and controlled by the host controller.)
M_S	Multiturn data read at setup
P_S'	Initial incremental pulses read at setup
P_M	Current value required for the user's system.
R	Number of pulses per encoder revolution (pulse count after dividing, value of Pn212)

(3) Detailed Signal Specifications

Refer to the following detailed signal specifications.

■ PAO Serial Data Specifications

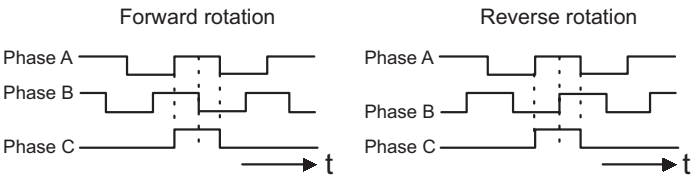
The number of revolutions is output in five digits.

Data Transfer Method	Start-stop Synchronization (ASYNC)
Baud rate	9600 bps
Start bits	1 bit
Stop bits	1 bit
Parity	Even
Character coder	ASCII 7-bit coder
Data format	<div>8 characters, as shown below.<div><div><div>"P"</div><div>"+" or "-"</div><div>"0" to "9"</div><div>"CR"</div></div><div><div>0 0 0 0 0 1 0 1 0 1</div><div>Start bit</div><div>Data</div><div>Even parity</div><div>Stop bit</div></div></div></div> <div>Note:<ul style="list-style-type: none">• Data is "P+00000" (CR) or "P-00000" (CR) when the number of revolutions is zero.• The revolution range is "+32767" to "-32768." When this range is exceeded, the data changes from "+32767" to "-32768" or from "-32768" to "+32767." When changing multi-turn limit, the range changes. For details, refer to 5.9.7 <i>Multiturn Limit Setting</i>.</div>

■ Incremental Pulses and Origin Pulses

Just as with normal incremental pulses, initial incremental pulses which provide absolute data are first divided by the frequency divider inside the SERVOPACK and then output.

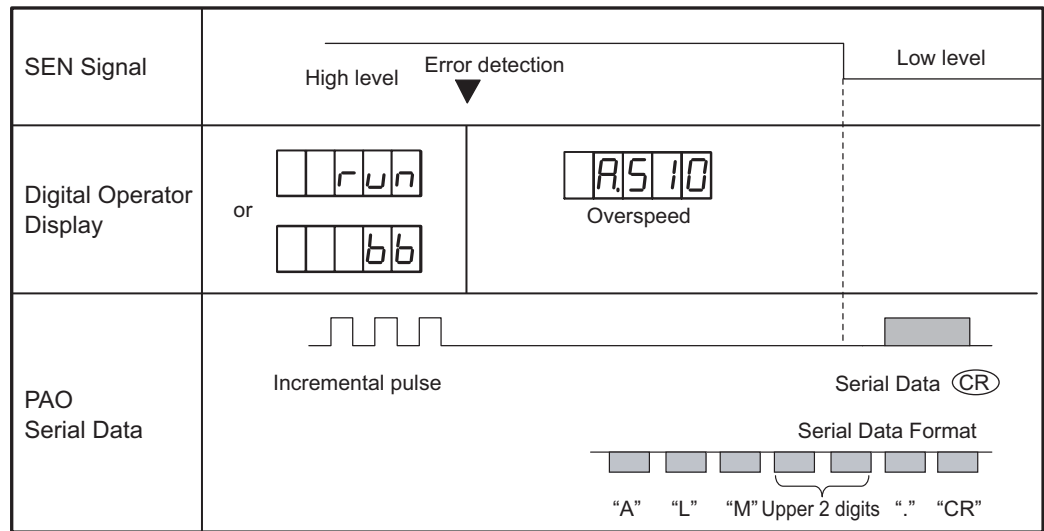
For details, refer to 5.3.6 *Encoder Pulse Output*.




(4) Transferring Alarm Contents

If an absolute encoder is used, the contents of alarms detected by the SERVOPACK can be transmitted in serial data to the host controller from the PAO output when the SEN signal changes to low level from high level.

Note: SEN signal cannot be received during Servo ON.
Output example of alarm contents are as shown below.



5.9.7 Multiturn Limit Setting

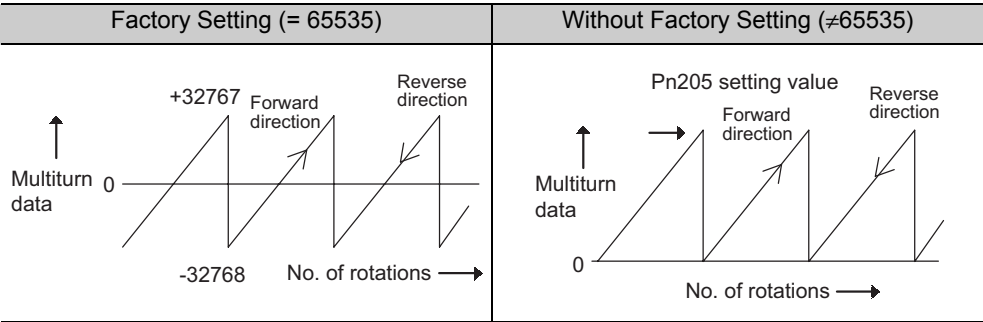
 **WARNING**

- The multiturn limit value must be changed only for special applications. Changing it inappropriately or unintentionally can be dangerous.

The parameter for the multiturn limit setting sets the upper limit for the multiturn data from the encoder when using an absolute encoder. When the rotation amount exceeds this setting, the encoder rotation amount returns to 0.

Pn205	Multiturn Limit Setting				Classification
			<div>Speed</div>	<div>Position</div>	
			<div>Torque</div>		
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 Rev	65535	After restart	Setup

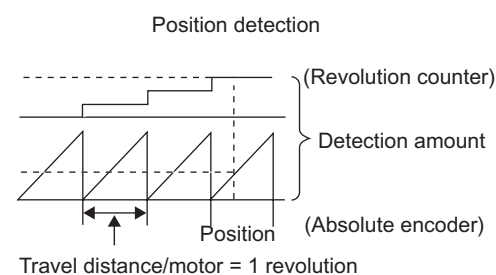
- Note 1. This parameter is valid when the absolute encoder is used.
2. The range of the multiturn data will vary when this parameter is set to anything other than the factory setting.



- When Set to Anything Other than the Factory Setting (≠ 65535)

1. When the motor rotates in the reverse direction with the multiturn data at 0, the multiturn data will change to the setting of Pn205.
2. When the motor rotates in the forward direction with the multiturn data at the Pn205 setting, the multiturn data will change to 0.

Set the value, the desired multiturn amount -1, to Pn205.



5.9.8 Multiturn Limit Disagreement Alarm (A.CC0)

When the multiturn limit set value is changed with parameter Pn205, an alarm A.CC0 (multiturn limit disagreement) will be displayed.

Alarm Display	Alarm Name	Alarm Code Output			Meaning
A.CC0	Multiturn Limit Disagreement	ALO1	ALO2	ALO3	Different multiturn limits have been set in the encoder and SERVOPACK.
		ON (L)	OFF (H)	ON (L)	

If this alarm is displayed, perform the operation described below and change the multiturn limit value in the encoder to the value set in Pn205.

Step	Display after Operation	Keys	Description
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn013.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Press the MODE/SET Key. The multiturn limit setting in the absolute encoder is changed. When the setting is completed, "donE" blinks for approximately one second.
5			"PGSEt" is displayed again.
6			Press the DATA/SHIFT Key for approximately one second. "Fn013" is displayed again.
7	Turn OFF the power, and then turn it ON again to make the setting valid.		

5.10 Output Signals Used in All Control Modes

This section explains other output signals that are not directly related to any specific control mode.

Use these signals according to the application needs, e.g., for machine protection.

5.10.1 Servo Alarm Output Signal (ALM) and Alarm Code Output Signals (ALO1, ALO2, and ALO3)

This section describes signals that are output when the SERVOPACK detects errors and resetting methods.

(1) Servo Alarm Output Signal (ALM)

This signal is output when the SERVOPACK detects an error.



IMPORTANT

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

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	ALM	CN-31, 32	OFF (close)	Normal SERVOPACK status
			ON (open)	SERVOPACK alarm status

(2) Alarm Code Output Signals (ALO1, ALO2, and ALO3)

The ON/OFF combination of these signals specifies the type of alarm detected by the SERVOPACK.


Use these signals as required to display the contents of the alarm at the host.

For details, refer to *10.1.1 List of Alarms*.

Type	Signal Name	Connector Pin Number	Meaning
Output	ALO1	CN1-37	Alarm code output
	ALO2	CN1-38	Alarm code output
	ALO3	CN1-39	Alarm code output
	SG	CN1-1	Signal ground for alarm code output

(3) Alarm Reset Method

If a servo alarm (ALM) occurs, use one of the following methods to reset the alarm after eliminating the cause of the alarm.



Be sure to eliminate the cause before resetting the alarm.

IMPORTANT

■ Resetting Alarms by Turning ON the /ALM-RST Signal (High Level to Low Level)

Type	Signal Name	Connector Pin Number	Meaning
Input	/ALM-RST	CN1-44	Alarm reset

Note 1. The /ALM-RST signal will not always reset encoder-related alarms. If an alarm cannot be reset with /ALM-RST, cycle the control power supply.

2. The /ALM-RST signal cannot be set so that it is always enabled by assigning an external input signal. Reset alarms by turning ON the /ALM-RST signal (high level to low level).

<Supplementary Information>

The /ALM-RST signal can be allocated to another output terminal using Pn50E. For details, refer to 3.3.3 *Output Circuit Signal Allocation*.

■ 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.

5.10.2 Warning Output Signal (/WARN)

This signal is output if a warning, such an overload alarm (A.710) or regenerative overload alarm (A.320), occurs.

(1) Signal Specifications

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/WARN	Must be allocated	ON (close)	Normal status
			OFF (open)	Warning status

Note: The /WARN signal must be allocated. For details, refer to 3.3.3 *Output Circuit Signal Allocation*.

(2) Related Parameters

Set the output method for alarm codes using the following parameter.


For details on alarm codes, refer to 5.10.1 *Servo Alarm Output Signal (ALM) and Alarm Code Output Signals (ALO1, ALO2, and ALO3)*.

Parameter	Meaning	When Enabled	Classification
Pn001	n.0□□□	After restart	Setup
	n.1□□□		

5.10.3 Rotation Detection Output Signal (/TGON)

This output signal indicates that the servomotor is rotating at the speed set for Pn502 or a higher speed.

The status of the signal can be checked with the panel operator or digital operator.

 IMPORTANT	<p>Do not allocate the motor rotation detection signal (/TGON) and the brake signal (/BK) to the same terminal. If they are allocated to the same terminal, an OR of the signals will be output and if the /TGON signal is turned ON (low level) by a falling vertical axis, the brake may not turn OFF (high level). Always allocate /TGON and /BK to different terminals.</p>
---	---

(1) Signal Specifications

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/TGON	CN1-27, 28 [Factory setting]	ON (close)	Servomotor is rotating (motor speed is above the setting in Pn502.)
			OFF (open)	Servomotor is rotating (motor speed is below the setting in Pn502.)

<Supplementary Information>

The /TGON signal can be allocated to another output terminal using Pn50E. For details, refer to 3.3.3 *Output Circuit Signal Allocation*.

(2) Related Parameters

Set the range in which the /TGON signal is output using the following parameter.

Pn502	Rotation Detection Level				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 10000	1 min ⁻¹	20	Immediately	Setup

5.10.4 Servo Ready Output Signal (/S-RDY)

This signal is output when the SERVOPACK is ready to accept the servo ON signal, i.e., the main circuit power supply is ON with no servo alarms.

* If an absolute encoder is used, the output of absolute value data to the host must have been completed when the SEN signal is ON (high level) before /S-RDY is output.

(1) Signal Specifications

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/S-RDY	CN1-29, 30 [Factory setting]	ON (close)	Servo is ready.
			OFF (open)	Servo is not ready.

<Supplementary Information>

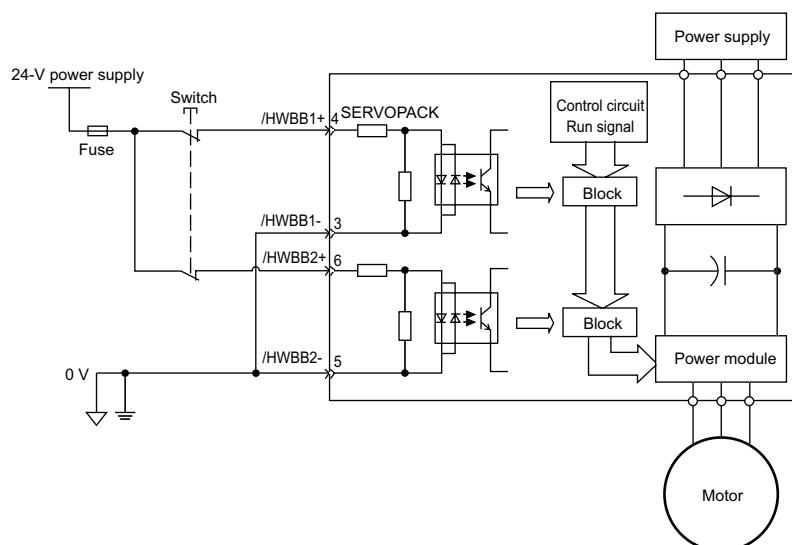
The /S-RDY signal can be allocated to another output terminal using Pn50E. For details, refer to 3.3.3 *Output Circuit Signal Allocation*.

5.11 Safety Function

The safety function is incorporated in the SERVOPACK to reduce the risk associated with the machine by protecting workers from injury and by securing safe machine operation. Especially when working in hazardous areas inside the safeguard, as for machine maintenance, it can be used to avoid adverse machine movement.

5.11.1 Hard Wire Base Block (HWBB) Function

The Hard Wire Base Block function (hereinafter referred to as HWBB function) is a safety function designed to baseblock the motor (shut off the motor current) by using the hardwired circuits: Each circuit for two channel input signals blocks the run signal to turn off the power module, and the motor current is shut off. (Refer to the diagram below.)



(1) Risk Assessment

Perform risk assessment for the system and confirm that the safety requirements with the following standards are fulfilled before using the HWBB function.

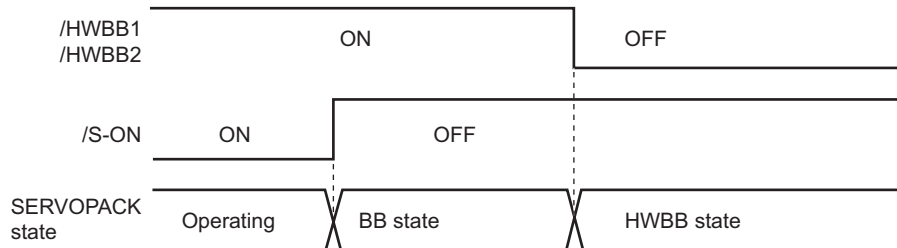
EN954 Category3
IEC61508 SIL2

The following risks can be estimated even if the HWBB function is used. These risks must be included in the risk assessment.

- The motor will rotate in an application where external force is applied to the motor (for example, gravity on the vertical axis). Take measures to secure the motor, such as installing a mechanical brake.
- The motor may move within the electric angle of 180 degrees in case of the power module failure, etc. The number of rotations or movement distance depends on the motor type as shown below.
 - Rotary motor: 1/6 rotation max. (rotation angle at the motor shaft)
 - Direct-drive motor: 1/20 rotation max. (rotation angle at the motor shaft)
 - Linear motor: 30 mm max.
- The HWBB function does not shut off the power to the servodrive or electrically isolates it. Take measures to shut off the power to the servodrive when performing maintenance on it, etc.

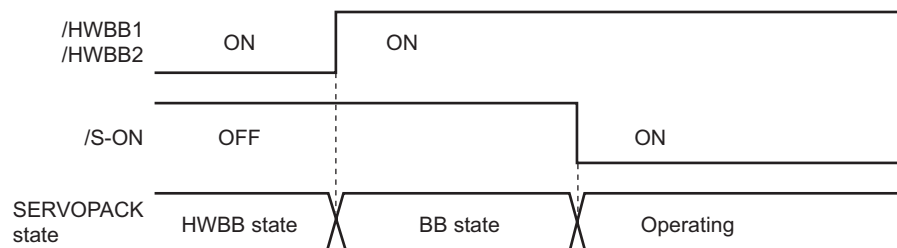
(2) Hard Wire Base Block (HWBB) State

The SERVOPACK will be in the following state if the HWBB function operates. If the /HWBB1 or /HWBB2 signal is OFF, the HWBB function will operate and the SERVOPACK will enter a hard wire baseblock (HWBB) state.



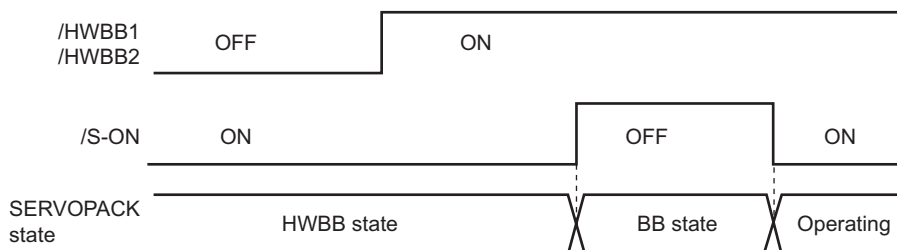
(3) Resetting the HWBB State

Usually, after a baseblock state is set (servomotor turned OFF) with the servo OFF command, the SERVOPACK will enter an HWBB state with the /HWBB1 and /HWBB2 signals turned OFF. By turning /HWBB1 and /HWBB2 signals ON in this state, the SERVOPACK will enter a baseblock (BB) state and can accept the servo ON command.



If the /HWBB1 and /HWBB2 signals are OFF and the servo ON command is input, the HWBB state will be maintained after the /HWBB1 and /HWBB2 signals are turned ON.

Input the servo OFF command and set the SERVOPACK to BB state. Then input the servo ON command again.



- Note 1. If the SERVOPACK is set to BB state with the main power supply turn OFF, the HWBB state will be maintained until the servo OFF command is input.
- Note 2. The HWBB state cannot be reset if the /S-ON signal is set to be constantly enabled in the /S-ON signal allocation (Pn50A.1). Do not make this setting if the HWBB function is being used.


(4) Error Detection in HWBB Signal

If only the /HWBB1 or /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 the HWBB signals.

Note: The A.Eb1 alarm (Safety Function Signal Input Timing Error) is not related to the safety function. Keep this in mind in the system design.

(5) Connection Example and Specifications of Input Signals (HWBB Signals)

The input signals must be redundant. A connection example and specifications of input signals (HWBB signals) are shown below.



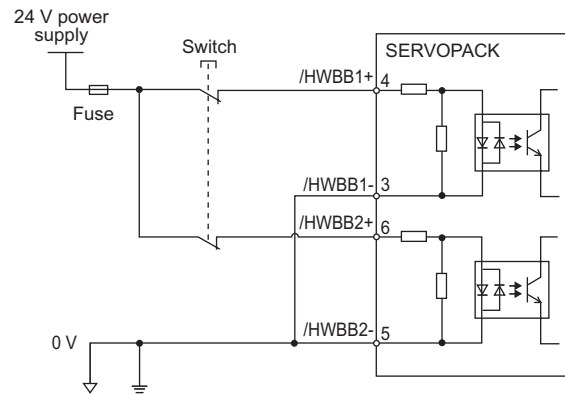
IMPORTANT

For safety function signal connections, the input signal is the 0V common and the output signal is the source output. This is opposite to other signals described in this manual. To avoid confusion is signal status, the ON and OFF status of signals for safety functions 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.

■ Connection Example for Input Signals (HWBB Signals)



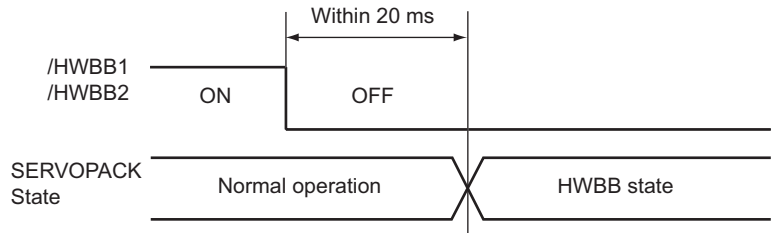
■ Specifications of Input Signals (HWBB Signals)

Type	Signal Name	Pin Number	State	Meaning
Input	/HWBB1	CN8-4	ON	Normal operation
		CN8-3	OFF	Requires the HWBB function by using the hardwired circuits.
	/HWBB2	CN8-6	ON	Normal operation
		CN8-5	OFF	Requires the HWBB function by using the hardwired circuits.

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

Items	Characteristics	Remarks
Internal impedance	3.3 kΩ	
Operation movable voltage range	+11 V to + 25 V	
Maximum delay time	20 ms	Time from the /HWBB1 and /HWBB2 signals are OFF to the HWBB function operates.

Note: Use a relay or switch that has micro-current contacts.
If the HWBB function is requested by turning OFF the /HWBB1 and /HWBB2 input signals on the two channels, power supply to the motor will be turned OFF within 20 ms (see below).



Note: The OFF status is not recognized if the /HWBB1 and /HWBB2 signals are 0.5 ms or shorter.

(6) Operation with Utility Functions

The HWBB function works while the SERVOPACK operates in utility function mode.

If any of the following utility functions is being used with the /HWBB1 and /HWBB2 signals turned OFF, the SERVOPACK cannot be operated by turning ON the /HWBB1 and /HWBB2 signals. Cancel the utility function first, and then set the SERVOPACK to the utility function mode again and restart operation.

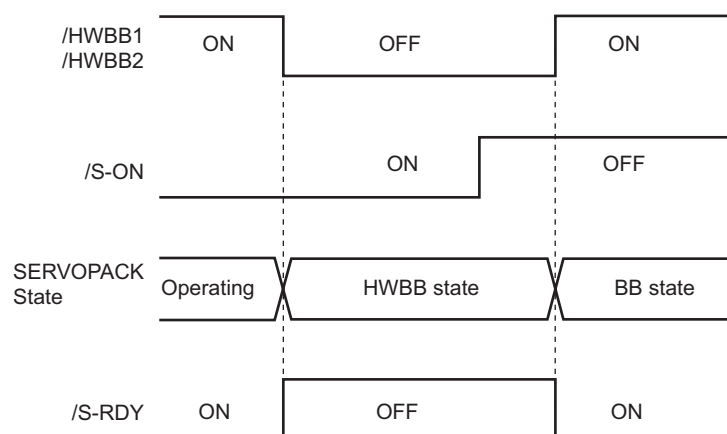
- JOG operation (Fn002)
- Origin search (Fn003)
- Program JOG operation (Fn004)
- Advanced autotuning (Fn201)
- EasyFFT (Fn206)
- Automatic offset-adjustment of motor current detection signal (Fn00E)

(7) Servo Ready Output (/S-RDY)

The servo ON command will not be accepted in the HWBB state. Therefore, the servo ready output will turn OFF.

The servo ready output will turn ON if the /S-ON signal is turned OFF (set to BB state) when both the /HWBB1 and /HWBB2 signals are ON.

The following diagram shows an example where the main circuit is turned power ON, the SEN signal is turned ON (with an absolute encoder), and no servo alarm occurs.



(8) Brake Signal (/BK)

When the /HWBB1 or /HWBB2 signal is OFF and the HWBB function operates, the brake signal (/BK) will turn OFF. At that time, 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 brake signal (/BK) turns ON.

Note: The brake signal output is not related to safety functions. Be sure to design the system so that the system will not be put into danger if the brake signal fails in the HWBB state. Moreover, if a servomotor with a brake is used, keep in mind that the brake for the servomotor is used only to stop the motor from moving and it cannot be used to brake the motor.

(9) Dynamic Brake

If the dynamic brake is enabled in Pn001.0 (stopping method after servo OFF), the servomotor will come to a stop under the control of the dynamic brake when the HWBB function works while the /HWBB1 or /HWBB2 signal is OFF.

Note: The dynamic brake is not related to safety function. Be sure to design the system so that the system will not be put into danger if the servomotor coasts to a stop in the HWBB state. Usually, use a sequence in which the HWBB state occurs after the servomotor is stopped using a command.

! CAUTION

If the application frequently uses the HWBB function, do not use the dynamic brake to stop the motor, or otherwise element deterioration in the SERVOPACK may result. Use a sequence in which the HWBB state occurs after the servomotor has come to a stop.

(10) Position Error Clear Section

A position error in the HWBB state is cleared according to the setting in Pn200.2 for the clear operation selection.

If Pn200.2 is set to 1 (i.e., the position error is not cleared for position control), the position error pulses will be accumulated unless the position reference from the host is canceled in the HWBB state, and the following condition may result.

- A position error pulse overflow alarm (A.d00) occurs.
- If the servo is turned ON after changing from HWBB state to BB state, the motor will move for the accumulated position error.

Therefore, stop the position reference through the host while in HWBB state. If Pn200.2 is set to 1 (i.e., the position error is not cleared), input the clear (CLR) signal while in HWBB or BB state to clear the position error.

5.11.2 External Device Monitor (EDM1)

The external device monitor (EDM1) functions to monitor failures in the HWBB function. Connect the monitor to feedback signals to the safety unit. The relation of the EDM1, /HWBB1, and /HWBB2 signals is shown below.

Signal Name	Logic			
/HWBB1	ON	ON	OFF	OFF
/HWBB2	ON	OFF	ON	OFF
EDM1	OFF	OFF	OFF	ON

When both /HWBB1 and /HWBB2 signals are OFF, EDM1 signal turns ON.

■ Failure Detection Signal for EDM1 Signal

Detection of failures in the EDM1 circuit can be checked using the following four status of the EDM1 signal in the table. Failures can be detected if the failure status can be confirmed, e.g., when the power supply is turned ON.

! WARNING

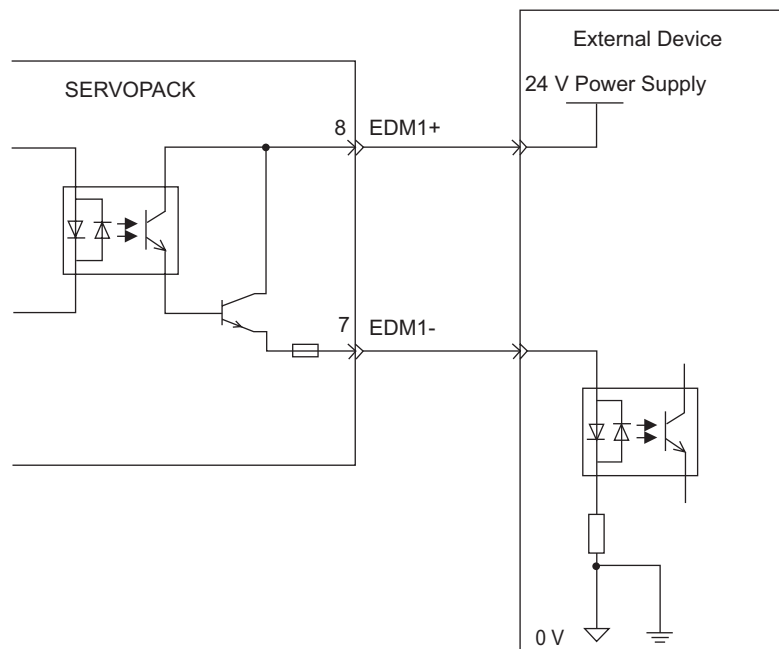
The EDM1 signal is not a safety output. Use it only for monitoring a failure.

(1) Connection Example and Specifications of EDM1 Output Signal

Connection example and specifications of EDM1 output signal are explained below.

■ Connection Example

EDM1 output signal is used for source circuit.



■ Specifications

Type	Signal Name	Pin No.	Input Status	Meaning
Output	EDM1	CN9-8 CN9-7	ON	Both baseblocks by /HWBB1 signal and /HWBB2 signal normally activate.
			OFF	—

Electrical characteristics of EDM1 signal are as follows.

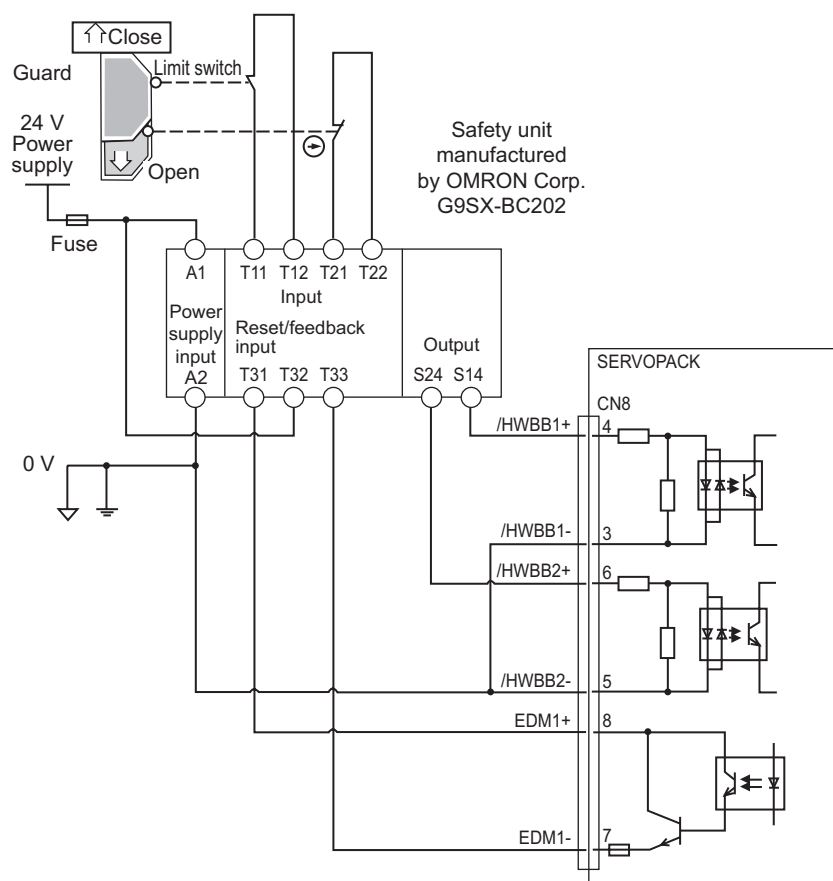
Items	Characteristics	Remarks
Maximum Allowable Voltage	30 VDC	—
Maximum Current	50 m ADC	—
Maximum Voltage Drop at ON	1.0 V	Voltage between EDM1+ to EDM1- at current is 50 mA.
Maximum Delay Time	20 ms	Time from change of /HWBB1, /HWBB2 to change of EDM1

5.11.3 Application Example of Safety Functions

An example of using safety functions is shown below.

(1) Connection Example

In the following example, a safety unit is used and the HWBB function operates when the guard opens.



When a guard opens, both of signals, the /HWBB1 and the /HWBB2, turn OFF, and the EDM1 signal is ON. Since the feedback is ON when the guard closes, the safety unit is reseted, and the /HWBB1 and the /HWBB2 signals turn ON, and the operation becomes possible.

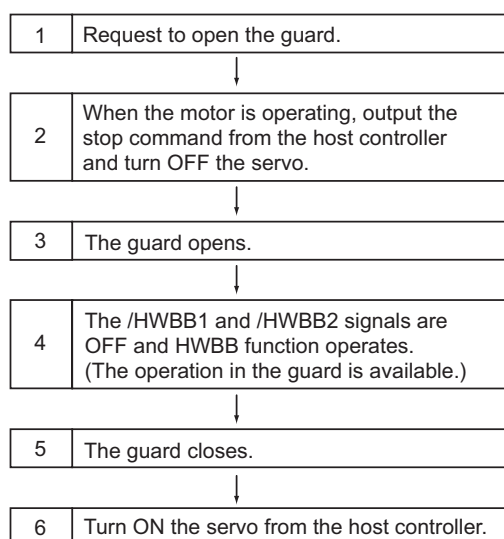
Note: Connect the EDM1 as the direction of current flows from EDM1+ to EDM1-, because the EDM1 has polarity with a transistor output.

(2) Failure Detection Method

In case of a failure such as the /HWBB1 or the /HWBB2 signal remains ON, the safety unit is not reseted because the EDM1 signal keeps OFF. Therefore starting is impossible, then the failure is detected.

An error in the external device, disconnection or short-circuiting of the external wiring, or a failure in the SERVOPACK must be considered. Find the cause and correct the problem.

(3) Usage Example

**5.11.4 Confirming Safety Functions**

When starting the equipment or replacing the SERVOPACK for maintenance, be sure to conduct the following confirmation test on the HWBB function after wiring.

- When the /HWBB1 and /HWBB2 signals turn OFF, check that the panel operator or digital operator displays "Hbb" and that the motor does not operate.
- Check the ON/OFF states of the /HWBB1 and /HWBB2 signals with bits 0 and 1 of Un015.
→ If the ON/OFF states of the signals do not coincide with the display, an error in the external device, disconnection or short-circuiting of the external wiring, or a failure in the SERVOPACK must be considered. Find the cause and correct the problem.
- Check with the display of the feedback circuit input of the connected device to confirm that the EDM1 signal is OFF while in normal operation.

5.11.5 Precautions for Safety Functions
 **WARNING**

- To check that the HWBB function satisfies the safety requirements of the system, be sure to conduct a risk assessment of the system.
Incorrect use of the machine may cause injury.
- The motor rotates if there is external force (e.g., gravity in a vertical axis) when the HWBB function is operating. Therefore, use an appropriate device independently, such as a mechanical brake, that satisfies safety requirements.
Incorrect use of the machine may cause injury.
- While the HWBB function is operating, the motor may rotate within an electric angle of 180° or less as a result of a SERVOPACK failure. Use the HWBB function for applications only after checking that the rotation of the motor will not result in a dangerous condition.
Incorrect use of the machine may cause injury.
- The dynamic brake and the brake signal are not related to safety functions. Be sure to design the system that these failures will not cause a dangerous condition when the HWBB function operates.
Incorrect use of the machine may cause injury.
- Connect devices meeting safety standards for the signals for safety functions.
Incorrect use of the machine may cause injury.
- If the HWBB function is used for an emergency stop, turn OFF the power supply to the motor with independent electric or mechanical parts.
Incorrect use of the machine may cause injury.
- The HWBB function does not turn OFF the power supply to the servodrive or electrically insulate the servodrive. When maintaining the servodrive, be sure to turn OFF the power supply to the servodrive independently.
Failure to observe this warning may cause an electric shock.

Adjustments

6.1 Adjustments and Basic Adjustment Procedure	6-3
6.1.1 Adjustments	6-3
6.1.2 Basic Adjustment Procedure	6-4
6.1.3 Monitoring Analog Signals	6-5
6.1.4 Safety Precautions on Adjustment of Servo Gains	6-7
6.2 Tuning-less Function (Fn200)	6-10
6.2.1 Tuning-less Function	6-10
6.2.2 Tuning-less Operating Procedure	6-11
6.3 Advanced Autotuning (Fn201)	6-15
6.3.1 Advanced Autotuning	6-15
6.3.2 Advanced Autotuning Procedure	6-19
6.3.3 Related Parameters	6-24
6.4 Advanced Autotuning by Reference (Fn202)	6-25
6.4.1 Advanced Autotuning by Reference	6-25
6.4.2 Advanced Autotuning by Reference Procedure	6-29
6.4.3 Related Parameters	6-31
6.5 One-parameter Tuning (Fn203)	6-32
6.5.1 One-parameter Tuning	6-32
6.5.2 One-parameter Tuning Procedure	6-34
6.5.3 One-parameter Tuning Example	6-38
6.5.4 Related Parameters	6-39
6.6 Anti-Resonance Control Adjustment Function (Fn204)	6-40
6.6.1 Anti-Resonance Control Adjustment Function	6-40
6.6.2 Anti-Resonance Control Adjustment Function Operating Procedure	6-41
6.6.3 Related Parameters	6-45
6.7 Vibration Suppression Function (Fn205)	6-46
6.7.1 Vibration Suppression Function	6-46
6.7.2 Vibration Suppression Function Operating Procedure	6-47
6.7.3 Related Parameters	6-49
6.8 Servo Gain Adjustment Application Function	6-50
6.8.1 Feedforward Reference	6-51
6.8.2 Torque Feedforward	6-52
6.8.3 Speed Feedforward	6-53
6.8.4 Proportional Control Operation (Proportional Operation Reference)	6-54

6.8.5 Using the Mode Switch (P/PI Switching)	6-55
6.8 Servo Gain Adjustment Application Function	6-50
6.8.1 Feedforward Reference	6-51
6.8.2 Torque Feedforward	6-52
6.8.3 Speed Feedforward	6-53
6.8.4 Proportional Control Operation (Proportional Operation Reference)	6-54
6.8.5 Using the Mode Switch (P/PI Switching)	6-55
6.8.6 Switching Gain Settings	6-59
6.8.7 Torque Reference Filter	6-63
6.8.8 Position Integral Time Constant	6-65
6.8.9 Friction Compensation	6-66

6.1 Adjustments and Basic Adjustment Procedure

This section describes adjustments and the basic adjustment procedure.

6.1.1 Adjustments

Tuning is performed to optimize the responsiveness of the SERVOPACK.

The responsiveness is determined by the servo gain that is set in the SERVOPACK.

The servo gain is set using a combination of parameters. These parameters influence each other. Therefore, the servo gain must be set considering the balance between the set values.

Generally, the responsiveness of a machine with high rigidity can be improved by increasing the servo gain. If the servo gain of a machine with low rigidity is increased, however, the machine will vibrate and the responsiveness may not be improved.

It is possible to suppress the vibration with a variety of vibration suppression functions in the SERVOPACK.

The servo gains are factory-set to stable values, and responsiveness can be increased depending on the actual machine conditions.

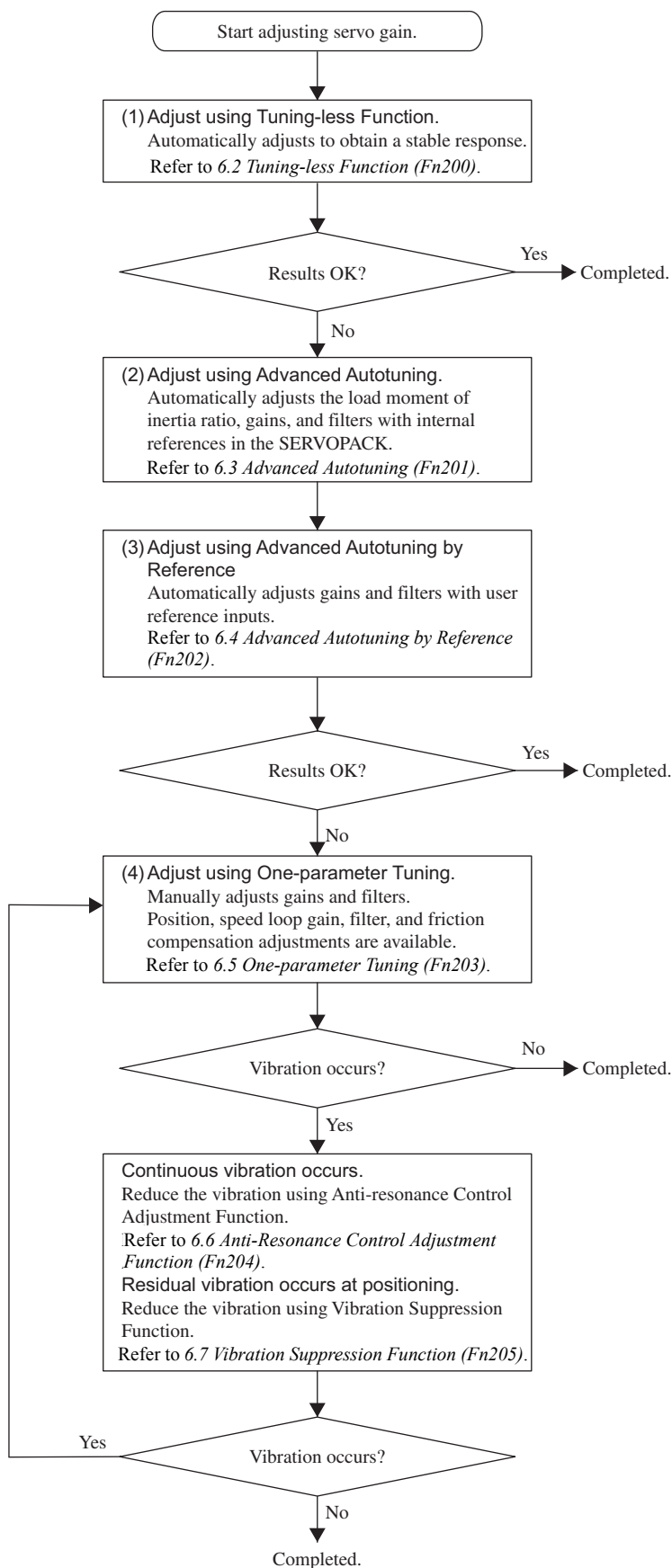
This section describes the following utility adjustment functions.

Utility Function for Adjustment	Outline	Applicable Control Mode	Operation
Tuning-less Function (Fn200)	This function obtains a stable response without adjustment regardless of the type of machine or changes in the load.	Speed and Position	Operate from the panel operator, digital operator or SigmaWin+.
Advanced Autotuning (Fn201)	Advanced autotuning automatically adjusts the load moment of inertia, gains, and filters with internal references in the SERVOPACK.	Speed and Position	Operate from the digital operator or SigmaWin+.
Reference Input-type Advanced Autotuning (Fn202)	Reference input-type advanced autotuning automatically makes adjustments with the position reference input from the host controller while the machine is in operation.	Position	Operate from the digital operator or SigmaWin+.
One-parameter Tuning (Fn203)	One-parameter tuning is used to manually make gain and filter adjustments. Position, speed loop gain, filter, and friction compensation adjustments are possible.	Speed and Position	Operate from the panel operator, * digital operator or SigmaWin+.
Anti-Resonance Control Adjustment Function (Fn204)	This function effectively suppresses vibration between 100 and 1000 Hz.	Speed and Position	Operate from the digital operator or SigmaWin+.
Vibration Suppression Function (Fn205)	This function effectively suppresses residual vibration if it occurs when positioning.	Position	Operate from the digital operator or SigmaWin+.

* Some functions will be limited if the SERVOPACK is operated from the panel operator.

6.1.2 Basic Adjustment Procedure

The basic adjustment procedure is shown in the following flowchart. Make suitable adjustments considering the conditions and operating requirements of the machine.



6.1.3 Monitoring Analog Signals

The servo gain adjustments must be made while checking the signal status. Connect a measuring instrument, such as a memory recorder, to connector CN5 on the SERVOPACK to monitor analog signals.

Specifications of analog monitoring are as follows.

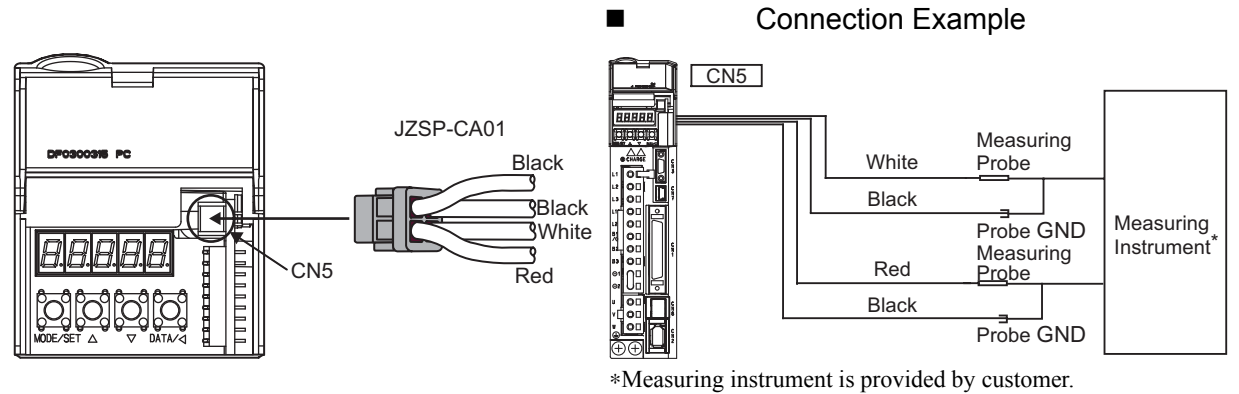
Item	Specifications	Remarks
Number of Channels	2 CH	
Output Range	-10 V to +10 V	Linear effective range: Within ± 8V
Resolution	16-bit	
Accuracy	± 20 mV	Standard value
Allowable Max. Load Current	± 1 mA	
Settling Time (± 1%)	1.2 ms	Standard value

Note: After the control power supply is turned ON, the analog monitor output may output approximately 10 V for a maximum of 200 ms. Allow for this when using the SERVOPACK.

The settings and parameters related to monitoring analog signals are described below.

(1) Connector CN5 for Analog Monitor

To monitor analog signals, connect a measuring instrument with cable (JZSP-CA01) to the connector CN5.



Line Color	Signal Name	Factory Setting
White	Analog monitor 1	Torque reference: 1 V/100% rated torque
Red	Analog monitor 2	Motor speed: 1 V/10000 min ⁻¹
Black (2 lines)	GND	Analog monitor GND: 0 V

(2) Setting Monitor Factor

The output voltages on analog monitor 1 and 2 are calculated by the following equations.

Analog monitor 1 output voltage = (-1) × $\left(\frac{\text{Signal selection}}{(\text{Pn006}=\text{n.00}\square\square)} \times \frac{\text{Signal multiplier}}{(\text{Pn552})} + \frac{\text{Offset voltage [V]}}{(\text{Pn550})} \right)$

Analog monitor 2 output voltage = (-1) × $\left(\frac{\text{Signal selection}}{(\text{Pn007}=\text{n.00}\square\square)} \times \frac{\text{Signal multiplier}}{(\text{Pn553})} + \frac{\text{Offset voltage [V]}}{(\text{Pn551})} \right)$

(3) Related Parameters

The monitor factor can be changed by setting following parameters.

Pn006.0, Pn006.1	Analog Monitor 1 Signal Selection Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	00 to 0D	–	02	Immediately	Setup
Pn007.0, Pn007.1	Analog Monitor 2 Signal Selection Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	00 to 0D	–	02	Immediately	Setup
Pn550	Analog Monitor 1 Offset Voltage Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.1 V	0	Immediately	Setup
Pn551	Analog Monitor 2 Offset Voltage Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.1 V	0	Immediately	Setup
Pn552	Analog Monitor Magnification (×1) Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.01 times	100	Immediately	Setup
Pn553	Analog Monitor Magnification (×2) Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.01 times	100	Immediately	Setup

(4) Monitor Signals

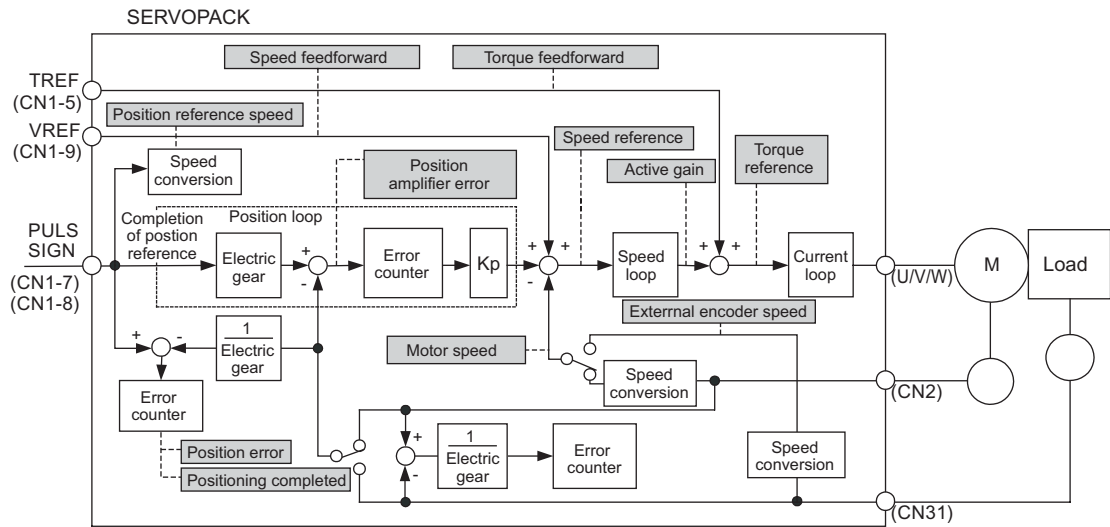
The following signals can be monitored by selecting functions of parameters Pn006 and Pn007.

Parameter		Description		
		Monitor Signal	Measurement Gain	Remarks
Pn006 Pn007	n.□□00	Motor speed	1 V/1000 min ⁻¹	Pn007 Factory Setting
	n.□□01	Speed reference	1 V/1000 min ⁻¹	
	n.□□02	Torque reference	1 V/100% rated torque	Pn006 Factory Setting
	n.□□03	Position error*	0.05 V/reference unit	0 V at speed/torque control
	n.□□04	Position amp error*	0.05 V/encoder pulse unit	Position error after electronic gear conversion
	n.□□05	Position reference speed	1 V/1000 min ⁻¹	–
	n.□□06	Reserved	–	–
	n.□□07	Motor-load position error	0.01 V/reference unit	–
	n.□□08	Positioning completed	Positioning completed: 5 V Positioning not completed: 0 V	–
	n.□□09	Speed feedforward	1 V/1000 min ⁻¹	–
	n.□□0A	Torque feedforward	1 V/100% rated torque	–
	n.□□0B	Active gain	1 st gain: 1 V 2 nd gain: 2 V	
	n.□□0C	Completion of position reference	Completed: 5 V Not completed: 0 V	

Parameter		Description		
		Monitor Signal	Measurement Gain	Remarks
Pn006 Pn007	n.□□0D	External encoder speed	1 V/10000 min ⁻¹	Value at motor shaft

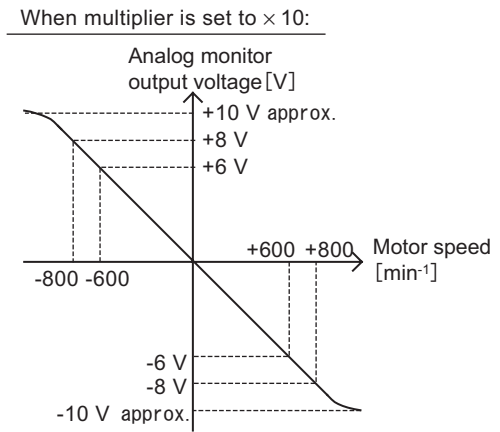
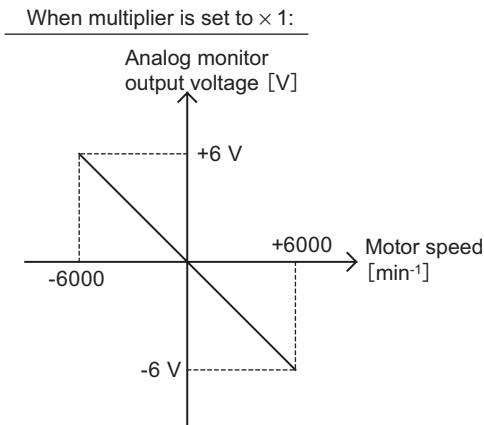
* When using speed control, the position error monitor signal is 0.

The following diagram shows the analog monitor output at position control.



<Example>

Analog monitor output at n.□□00 (motor speed setting)



Note: Linear effective range: within $\pm 8V$

6.1.4 Safety Precautions on Adjustment of Servo Gains

CAUTION

- If adjusting the servo gains, observe the following precautions.
 - Do not touch the rotating section of the motor while power is being supplied to the motor.
 - Before starting the servomotor, make sure that the emergency-stop circuit works correctly.
 - Make sure that a trial run has been performed without any trouble.
 - Install a safety brake on the machine.

Yaskawa recommends that the following protective functions of the SERVOPACK are set to the correct settings before starting to adjust the servo gains.

(1) Overtravel Function

Set the overtravel function. For details on how to set the overtravel function, refer to 5.2.3 *Overtravel*.

(2) Torque Limit

Calculate the torque required to operate the machine. Set the torque limits so that the output torque will not be greater than required. Setting the torque limits can reduce the amount of shock applied to the machine in collisions and other cases.

Use the following parameters to set the torque limits.

Pn402: Forward Torque Limit [%]

Pn403: Reverse Torque Limit [%]

For details, refer to 5.8.1 *Internal Torque Limit*, and 5.8.2 *External Torque Limit*.

(3) Excessive Position Error Alarm Level

The excessive position error alarm is a protective function that will be enabled when the servo drive is used in position control mode.

For the optimum setting, the servomotor will be stopped after the error occurs if the servomotor performs unpredictably after receiving a reference.

The position error is the difference between the position reference and the actual position. The position error can be calculated from the position loop gain and the motor speed with the following equation.

$$\text{Position Error} = \frac{\text{Motor Speed} [\text{min}^{-1}]}{60} \times \frac{\text{Number of Pulses per Motor Rotation [reference unit]}}{\text{Pn102} / 10}$$

Note: Pn102: Position Loop Gain [0.1/s]

- Excessive Position Error Alarm Level (Pn520 [reference unit])

$$\text{Pn520} > \frac{\text{Max. Motor Speed} [\text{min}^{-1}]}{60} \times \frac{\text{Number of Pulses per Motor Rotation [reference unit]}}{\text{Pn102} / 10} \times \underline{\underline{(1.2 \text{ to } 2)}}$$

Set the level to a value that satisfies these equations, and no alarm will be generated during normal operation. The servomotor will be stopped, however, if the servomotor runs unpredictably after a reference is input or if a position error in accordance with the value set in Pn520 occurs. At the end of the equation, a coefficient is shown as "× (1.2 to 2)." This coefficient is used to add a margin that prevents a faulty alarm from occurring in actual operation of the servomotor.

If the acceleration/deceleration of the position reference exceeds the capacity of the servomotor, the servomotor cannot perform at the requested speed, and the allowable level for position error will be increased as not to satisfy these equations. If so, lower the level of the acceleration/deceleration for the position reference so that the servomotor can perform at the requested speed or raise the allowable level of the position errors.

■ Related Parameter

Pn520	Excessive Position Error Alarm Level Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741823 (2 ³⁰ -1)	1 reference unit	5242880	Immediately	Setup

(4) Vibration Detection Function

Set the vibration detection function to an appropriate value. For details on how to set the vibration detection function, refer to 7.16 *Vibration Detection Level Initialization (Fn01B)*

(5) Excessive Position Error Alarm Level at Servo ON

If Pn200.2 (Clear Operation) is set to value other than zero, the position error pulses will remain at the base-block. If the servomotor is moved by an external force while it is being baseblocked, the servomotor will return to the original position so that the position error pulses are cleared and reset to zero after the servo is turned ON. This setting is used to limit such motions and to detect any errors.

■ Related Parameters

Pn520	Excessive Position Error Alarm Level Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741823 ($2^{30}-1$)	1 reference unit	5242880	Immediately	Setup

Pn526	Excessive Position Error Alarm Level at Servo ON Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 107374183 ($2^{30}-1$)	1 reference unit	5242880	Immediately	Setup

Pn529	Speed Limit Level at Servo ON Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 10000	1 min ⁻¹	10000	Immediately	Setup

The parameter Pn529 (Speed Limit Level at Servo ON) is used to limit the servomotor speed when returning to the original position to clear the accumulated position error pulses and reset the pulses to 0. The speed will be limited until the position error pulses are reset to 0.

■ Related Alarm

Alarm Display	Alarm Name	Alarm Contents
A.d01	Position Error Pulse Overflow Alarm at Servo ON	If the servomotor runs without clearing the position error pulses while the servo is OFF, excessive position error pulses are accumulated.
A.d02	Position Error Pulse Overflow Alarm by Speed Limit at Servo ON	If the servo turns ON with position error pulses accumulated, the speed is limited by Pn529. In this state, the reference pulse is input without resetting the speed limit, and the position error pulses exceeds the value set for the parameter Pn520.

These alarms will occur if the number of position error pulses accumulated before the servo turns ON is greater than the setting of Pn526 (Excessive Position Error Alarm Level at Servo ON).

When an alarm occurs, refer to *10 Troubleshooting* and take the corrective actions.

(6) Excessive Position Error Alarm Level between the Motor and Load

This setting is used to prevent motor overrun resulting from damage to the external encoder or to detect the sliding of a belt mechanism.

If the SERVOPACK is under fully-closed loop control, refer to *9 Fully-closed Loop Control* and set protective functions.

■ Related Parameter

Pn51B	Excessive Error Level Between Servomotor and Load Position Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824	1 reference unit	1000	Immediately	Setup

6.2 Tuning-less Function (Fn200)

This section describes the tuning-less function.



CAUTION

- The tuning-less function is enabled in the factory settings. A sound may be heard for a moment when the servo is turned ON for the first time after the SERVOPACK is mounted to the machine. This sound does not indicate any problems; it means that the automatic notch filter was set. The sound will not be heard from the next time the servo is turned ON. For details on the automatic notch filter, refer to (3) *Automatically Setting the Notch Filter* on the next page.
- Set the mode to 2 in Fn200 if a 13-bit encoder is used with the load moment of inertia ratio set to x10 or higher.
- The servomotor may vibrate if the load moment of inertia ratio exceeds the allowable moment of inertia of the servomotor.
If vibration occurs, set the mode to 2 in Fn200 or lower the level.

6.2.1 Tuning-less Function

The tuning-less function obtains a stable response without adjustment regardless of the type of machine or changes in the load.

(1) Enabling/Disabling Tuning-less Function

The following parameter is used to enable or disable the tuning-less function.

Parameter		Meaning	When Enabled	Classification
Pn170	n.□□□0	Disables tuning-less function	After restart	Tuning
	n.□□□1	Enables tuning-less function. [Factory setting]		

(2) Application Restrictions

The following application restrictions apply to the tuning-less function depending on the control mode and other functions used at the same time.

■ Control Mode Restrictions

The tuning-less function can be used in position control or speed control. The function is disabled in torque control.

■ Control Function Restrictions

Control Function	Possible/Impossible	Remarks
Anti-resonance control	Impossible	
Friction compensation	Impossible	
Gain switching	Impossible	
One-parameter tuning (Fn203)	Impossible	
EasyFFT (Fn206)	Possible	While this function operates, the tuning-less function cannot be used temporarily.
Initialize vibration detection level (Fn01B)	Possible	
Advanced autotuning (Fn201)	Possible	<ul style="list-style-type: none"> • This function can be used when Jcalc is set to ON. • While this function operates, the tuning-less function cannot be used temporarily.
Advanced autotuning by reference (Fn202)	Impossible	
Anti-resonance control adjustment function (Fn204)	Impossible	
Vibration suppression function (Fn205)	Impossible	

Control Function	Possible/Impossible	Remarks
Offline Moment of Inertia Setting *	Possible	While this function operates, the tuning-less function cannot be used temporarily.
Mechanical analysis *	Possible	While this function operates, the tuning-less function cannot be used temporarily.

* Operate using SigmaWin+.

(3) Automatically Setting the Notch Filter

Usually, set this function to Auto Setting. (The notch filter is factory-set to Auto Setting.)


If this function is set to Auto Setting, vibration will be detected automatically and the notch filter will be set.

Set this function to Not Auto Setting only if you do not change the notch filter setting before executing tuning-less function.

Parameter	Meaning	When Enabled	Classification
Pn460	n.□□□0	Immediately	Tuning
	n.□□□1 [Factory setting]		

(4) Tuning-less Level Settings (Fn200)

The tuning-less level is set in Fn200.

 CAUTION
To ensure safety, always implement the tuning-less function in a state where an emergency stop is possible.

6.2.2 Tuning-less Operating Procedure

The procedure to use the tuning-less function is given below.


















Operate the tuning-less function from the panel operator, digital operator (optional), or SigmaWin+.

(1) Check Points for Settings

Check the following settings before performing the tuning-less function, or otherwise "NO-OP" will be displayed during the tuning-less operation.

- The tuning-less function must be enabled. (Pn170.0 = 1)
- The write prohibited setting (Fn010) must not be set.

(2) Operating Procedure with Digital Operator

Step	Display after Operation	Keys	Operation
1	<pre> RUN —FUNCTION— Fn080:Pole Detect Fn200:TuneLvl Set Fn201:AAT Fn202:Ref-AAT </pre>	 	Display the main menu of the utility function mode, and select Fn200.
2	<pre> RUN —TuneLvlSet— Mode=1 </pre>		<p>Press the  Key to display the tuning-less mode setting screen.</p> <p>Note:</p> <ul style="list-style-type: none"> • If the display does not switch and NO-OP is displayed, the write prohibited setting is set in Fn010. Change the setting in Fn010 and press the key again after enabling writing. • If the response waveform causes overshooting or if the load moment of inertia exceeds the allowable level (i.e., outside the scope of product guarantee), press the  Key and change the mode to 2.
3	<pre> RUN —TuneLvlSet— Level=4 </pre>		Press the  Key to display the tuning level setting screen.
4	<pre> RUN —TuneLvlSet— Level=4 NF 2 ↑ 2nd notch filter </pre>	  	<p>Press the  or  Key to select the tuning level. Select the tuning level from 0 to 4. The larger the value, the higher the gain is and the better response performance will be. (The factory setting is 4.)</p> <p>Note: Vibration may occur if the tuning level is too high. Lower the tuning level if vibration occurs.</p> <p>If high-frequency noise is generated, press the  Key to automatically set a notch filter for the vibration frequency.</p>
5	<pre> Done —TuneLvlSet— Level=4 </pre>		Press the  Key. "Done" will blink and the settings will be saved in EEPROM.
6	<pre> RUN —FUNCTION— Fn030 Fn200 Fn201 Fn202 </pre>		Press the  Key to complete the tuning-less operation. The screen in step 1 will appear again.

- Note 1. For the basic operation of the digital operator, refer to *Σ-V series SGM□V/SGDV User's Manual, Operation of Digital Operator* (SIEPS80000055).
2. If the gain level is changed, the automatically set notch filter will be canceled. If vibration occurs, however, the notch filter will be set again.

(3) Operating Procedure with Panel Operator

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or the DOWN Key to select the Fn200.
3			Press the MODE/SET Key to change to setting screen. Note: If the display does not switch and NO-OP is displayed, the write prohibited setting is set in Fn010. Change the setting in Fn010 and press the key again after enabling writing.
4			If the noise is generated, change the setting using the UP Key.
5			Press the DATA/SHIFT Key for approximately one second to change to tuning level setting screen.
6			Press the UP or the DOWN Key to select the tuning level. Select the tuning level from 0 to 4. The larger the value, the higher the gain is and the better response performance will be. (The factory setting is 4.) Note: Vibration may occur if the tuning level is too high. Lower the tuning 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.
7			Press the MODE/SET Key. "donE" will blink and the settings will be saved in EEPROM.
8			Press the DATA/SHIFT Key for more than one second. "Fn200" is displayed again.

(4) Alarm and Corrective Actions

The autotuning alarm (A.521) will occur if resonance is generated or excessive vibration occurs during position control. Take the following actions to correct the problem.

■ Resonance Sound

Reduce the set value in Pn170.3 or Pn170.2.

■ Excessive Vibration during Position Control

Increase the set value in Pn170.3 or reduce the set value in Pn170.2.

(5) Parameters Disabled by Tuning-less Function

Item	Name	Pn Number	Function to use parameters					Remarks
			Speed Limit during Torque Control	Zero Clamp during Torque Control	Zero-speed Stop during Torque Control	Easy FFT	Mechanical Analysis (Vertical Axis Mode)	
Gain	Speed Loop Gain	Pn100 Pn104	○	○	○	○	○	
	Speed Loop Integral Time Constant	Pn101 Pn105	×	○	○	○	○	
	Position Loop Gain	Pn102 Pn106	×	×	×	○	○	
	Moment of Inertia Ratio	Pn103	○	○	○	○	○	
Advanced Control	Friction Compensation Switch	Pn408.3	×	×	×	×	×	
	Anti-resonance Control Switch	Pn160.0	×	×	×	×	×	
Gain Switching	Gain Switching Switch	Pn139.0	×	×	×	×	×	
	Manual Gain Switching	—	○	○	○	○	○	

Note: ○: Uses the setting value.

×: Does not use the setting value.

6.3 Advanced Autotuning (Fn201)

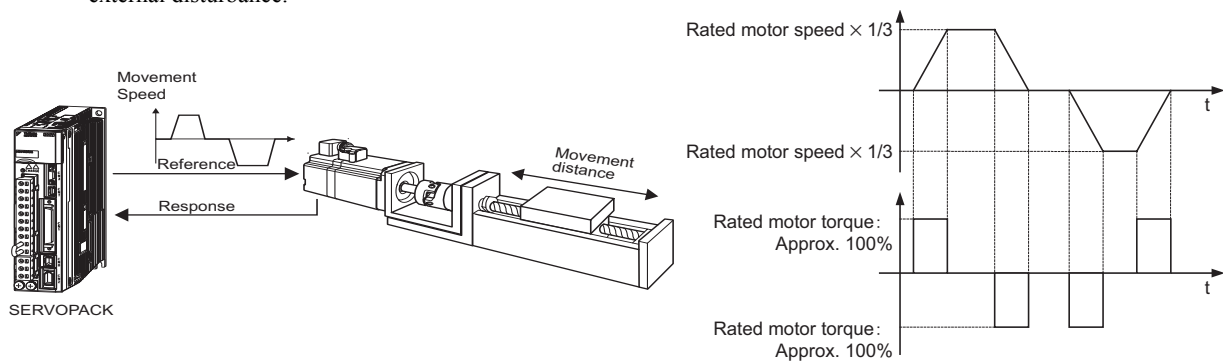
This section describes the adjustment using advanced autotuning.

6.3.1 Advanced Autotuning

Advanced autotuning automatically operates the SERVOPACK (in reciprocating movement in the forward and reverse directions) within set limits and makes adjustment automatically according to the mechanical characteristics while the SERVOPACK is operating.

Advanced autotuning can be performed without connecting the host.
The following automatic operation specifications apply.

- Motor speed: Rated motor speed $\times 2$
 - Acceleration torque*: Approximately 100% of rated motor torque force
 - Movement distance: Set in unit of 1000 reference unit. Factory setting is 3 motor rotations.
- * The acceleration torque varies with the influence of the load moment of inertia ratio (Pn103), machine friction, and external disturbance.



Advanced autotuning performs the following adjustments.

- Moment of inertia ratio
- Gains (e.g., position loop gain and speed loop gain)
- Filters (torque reference filter and notch filter)
- Friction compensation
- Anti-resonance control
- Vibration suppression (Mode = 2 or 3)

Refer to 6.3.3 *Related Parameters* for parameters used for adjustments.

A mode can be set to select whether to calculate the load moment of inertia.

Setting	Contents
Jcalc = ON	Calculates the load moment of inertia.
Jcalc = OFF	Does not calculate the load moment of inertia.

Tuning level can be set to select an adjustment type.

Tuning Level	Adjustment Type
Mode 1	Standard
Mode 2	Make adjustments for positioning.
Mode 3	Make adjustments for positioning, giving priority to overshooting suppression.

A filter type can be set to select a machine resonance reduction filter according to the mechanical element.

Filter Type	Contents
Type = 1	Select a filter suitable for the belt drive mechanism or other mechanism.
Type = 2	Selects a filter suitable for a ball screw drive mechanism.
Type = 3	Selects a filter suitable for a rigid system, such as a gear.



CAUTION

- Because advanced autotuning adjusts the SERVOPACK during automatic operation, vibration or overshooting may occur. To ensure safety, perform advanced autotuning in a state where the SERVOPACK can come to an emergency stop at any time.
- When using the SERVOPACK with Jcalc = OFF (load moment of inertia is not calculated) be sure to set a suitable value for the moment of inertia ratio (Pn103). If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.



IMPORTANT

- Advanced autotuning starts adjustments based on the set speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when starting adjustments. In this case, make adjustments after setting a fully stable gain using one-parameter tuning (Fn203).

(1) Check Points for Settings

Check the following settings before performing advanced autotuning, or otherwise "NO-OP" will be displayed during advanced autotuning.

- The main circuit power supply must be ON.
- The servo must be OFF.
- Forward run prohibited (P-OT) and reverse run prohibited (N-OT) signal must not be in an overtravel state.
- The clear signal must be at low level (not cleared).
- The control must not be set to torque control.
- Automatic gain switching must be disabled.
- The write prohibited setting (Fn010) must not be set.

<Supplementary Information>

If advanced autotuning is started while the SERVOPACK is in speed control, the mode will change to position control automatically to perform advanced autotuning. The mode will return to speed control after completing the adjustment.

(2) Check Points for Operating Conditions

Advanced autotuning cannot be performed normally under the following conditions. If any of the following conditions exists, calculate the load moment of inertia ratio from the specifications of the machine and perform reference input-type advanced autotuning or one-parameter tuning.

Refer to 6.4 *Advanced Autotuning by Reference (Fn202)* and 6.5 *One-parameter Tuning (Fn203)* for details.

- The machine system can work only in a single direction.
- The operating range is 0.5 rotation or less.

(3) Items Influencing Performance

Advanced autotuning may not be performed normally under the following conditions. If the result of autotuning is not satisfactory, perform reference input-type advanced autotuning or one-parameter tuning.

Refer to 6.4 *Advanced Autotuning by Reference (Fn202)* and 6.5 *One-parameter Tuning (Fn203)* for details.

- The load moment of inertia changes within the set operating range.
- The machine has high friction.
- The rigidity of the load is low and vibration occurs when positioning is performed.
- The position integration function is used.
- P control operation (proportional control) is performed.

Note: If a setting is made for calculating the moment of inertia, an error will result when P control operation is used while the moment of inertia is being calculated.

- The mode switch is used.

Note: If a setting is made for calculating the moment of inertia, the mode switch function will be disabled while the moment of inertia is being calculated. At that time, PI control will be used. The mode switch function will be enabled after calculating the moment of inertia.

<Supplementary Information>

Advanced autotuning makes adjustments by referring to the positioning completion width (Pn522). If the SERVOPACK is operated in position control (Pn000.1=1), set the electronic gear ratio (Pn20E/Pn210) and positioning completion width (Pn522). If the SERVOPACK is operated in speed control (Pn000.1=0), use the factory settings.



IMPORTANT

- Unless the positioning completion signal (/COIN) is turned ON within approximately 3 seconds after positioning has been completed, "WAITING" will blink. Furthermore, unless the positioning completion signal (/COIN) is turned ON within approximately 10 seconds, "Error" will blink for 2 seconds and tuning will be aborted.

(4) Automatically Setting the Notch Filter

Usually, set this function to Auto Setting. (The notch filter is factory-set to Auto Setting.)

If this function is set to Auto Setting, vibration will be detected automatically and the notch filter will be set.

Set this function to Not Auto Setting only if you do not change the notch filter setting before executing advanced autotuning.

Parameter		Function	When Enabled	Classification
Pn460	n.□□□0	Does not set the 1st notch filter automatically.	Immediately	Tuning
	n.□□□1	Sets the 1st notch filter automatically. [Factory setting]		
	n.□0□□	Does not set the 2nd notch filter automatically.		
	n.□1□□	Sets the 2nd notch filter automatically. [Factory setting]		

(5) Anti-Resonance Control Adjustment Function

This function reduces vibration of which the notch filter does not effective because of low vibration frequency.

Usually, set this function to Auto Setting. (The anti-resonance control is factory-set to Auto Setting.)

When this function is set to Auto Setting, vibration will be automatically detected during advanced autotuning and anti-resonance control will be automatically adjusted and set.

Set this function to Not Auto Setting only if you do not change the setting for anti-resonance control before executing advanced autotuning.

For details, refer to 6.6 *Anti-Resonance Control Adjustment Function (Fn204)*.

Parameter	Function	When Enabled	Classification
Pn160	n.□□0□	Immediately	Tuning
	n.□□1□ [Factory setting]		

The following parameters related to anti-resonance control are set automatically.

Parameter	Name
Pn161	Anti-Resonance Frequency
Pn163	Anti-Resonance Damping Gain

Note: The following parameters related to anti-resonance control are not set automatically but the respective set values in the parameters will apply.

- Anti-resonance gain compensation (Pn162)
- Anti-resonance filter time constant 1 compensation (Pn164)
- Anti-resonance filter time constant 2 compensation (Pn165)

(6) Model Following Control with Vibration Suppression

The vibration suppression function suppresses transitional vibration at frequency as low as 1 to 100 Hz that is generated mainly when positioning if the machine stand vibrates.

Usually, set this function to Auto Setting. (The vibration suppression function is factory-set to Auto Setting.) When this function is set to Auto Setting, vibration will be automatically detected during advanced autotuning and model following control with vibration suppression will be automatically adjusted and set.

Set this function to Not Auto Setting only if you do not change the setting for model following control with vibration suppression before executing advanced autotuning.

Note: This function uses model following control. Therefore, the function can be executed only if the adjustment level is set to mode 2 or 3.

■ Related Parameters

Parameter	Function	When Enabled	Classification
Pn140	n.□0□□	Immediately	Tuning
	n.□1□□ [Factory setting]		

The following parameters related to model following control with vibration suppression are set automatically.

Parameter	Name
Pn141	Model Following Control Gain
Pn145	Vibration Suppression 1 Frequency A
Pn146	Vibration Suppression 1 Frequency B

Note: The following parameters related to model following control with vibration suppression are not set automatically but the respective set values in the parameters will apply.

- Model following control gain compensation (Pn142)

(7) Friction Compensation

This function compensates for changes in the following conditions.

- Changes in the viscous resistance of the lubricant, such as the grease, on the sliding parts of the machine
- Changes in the load resistance resulting from fluctuations in the machine assembly
- Secular changes in the load resistance

Conditions to which friction compensation is applicable depend on the tuning level. The friction compensation setting in Pn408.3 applies when the mode is 1.

Friction Compensation Setting \ Tuning Level		Mode 1	Mode 2 Mode 3
Pn408	n.0□□□	×	○
	n.1□□□	○	○

○: Adjusted with the friction compensation function.

×: Adjusted without the friction compensation function.

(8) Feedforward

If tuning is performed at mode 2 or mode 3, the feedforward reference (Pn109), speed feedforward (V-REF) input, and torque feedforward (T-REF) input will be ignored because model following control will be enabled.

The following settings are required if model following control is used together with the speed feedforward (V-REF) input and torque feedforward (T-REF) input.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□	Model following control is not used together with external speed/torque feedforward input. [Factory setting]	Immediately	Tuning
	n.1□□□	Model following control is used together with external speed/torque feedforward input.		



IMPORTANT

- Model following control is used to make optimum feedforward settings in the servo. Therefore, model following control is not used together with either the speed feedforward (V-REF) input or torque feedforward (T-REF) input. An improper speed feedforward (V-REF) input or torque feedforward (T-REF) input may result in overshooting.

Refer to 6.8.2 Torque Feedforward and 6.8.3 Speed Feedforward for details.

6.3.2 Advanced Autotuning Procedure

The following procedure is used for advanced autotuning.














Advanced autotuning is performed from the Digital Operator (option) or SigmaWin+.




















Here, the operating procedure from the Digital Operator is described.



Refer to the *Σ-V series SGM□V/SGDV User's Manual, Operation of Digital Operator* (SIEPS80000055) for basic key operations of the Digital Operator.

Note: The function cannot be performed from the Panel Operator.

(1) Operating Procedure

Step	Display after Operation	Keys	Operation
1	<pre> BB — FUNCTION — Fn200: TuneLvl Set Fn201: AAT Fn202: Ref-AAT Fn203: OnePrmTun </pre>	  	Display the main menu of the utility function mode, and select Fn201.
2	<pre> BB Advanced AT Jcalc=ON Mode=2 Type=2 Stroke=+00800000 (0003.0) rev </pre>		Press the  Key to display the initial setting screen for advanced autotuning. Note: If the display does not switch and NO-OP is displayed, refer to (1) Check Points for Settings.
3	<pre> BB Advanced AT Jcalc=ON Mode=2 Type=2 Stroke=+00800000 (0003.0) rev </pre>	  	Press the  ,  or  Key and set the items in steps 3-1 to 3-4.
3-1	<p>■Calculating Load Moment of Inertia</p> <p>Select the mode to be used. Normally, set Jcalc to ON. Jcalc = ON: Load moment of inertia ratio calculated Jcalc = OFF: Load moment of inertia ratio not calculated</p> <p><Supplementary Information></p> <p>If the moment of inertia ratio is already known from the machine specifications, set the value in Pn103 and set Jcalc to OFF.</p>		
3-2	<p>■Tuning Level</p> <p>Select the tuning level. Mode = 1: Makes adjustments considering responsiveness and stability. (Standard level) Mode = 2: Makes adjustments for positioning. Mode = 3: Makes adjustments for positioning, giving priority to overshooting suppression. Set this level if position error overshoots at mode 2.</p> <p>Note: Set the mode to 1 if Fn202 (Advanced Autotuning by Reference) is performed after executing this function.</p>		
3-3	<p>■Filter Type Setting</p> <p>Select the filter type to set a filter according to the machine element to be driven. Set the filter referring to the following functional elements.</p> <p><Supplementary Information></p> <p>If there is noise or the gain does not increase, good results may be obtained by changing the filter type. Type = 1: Selects a filter suitable for belt drive mechanisms. Type = 2: Selects a filter suitable for ball screw drive mechanisms [Factory setting]. Type = 3: Selects a filter suitable for rigid systems, such as a gear.</p>		
3-4	<p>■STROKE (Travel Distance) Setting</p> <p>Specify a travel distance in increments of 1000 references. Travel distance setting range: The travel distance setting range is from -99990000 to +99990000. The negative (-) direction is for reverse rotation, and the positive (+) direction is for forward rotation. Initial value: About 3 rotations</p> <p>Note:</p> <ul style="list-style-type: none"> Move the position using JOG operation to where a suitable movable range is ensured. Set the number of motor rotations to at least 0.5; otherwise, "Error" will be displayed and the travel distance cannot be set. To calculate the load moment of inertia ratio/mass ratio and ensure precise tuning, it is recommended to set the number of motor rotations to around 3. 		
4	<pre> BB ADVANCED AT Pn103=00000 Pn100=0040.0 Pn101=0020.00 Pn102=0040.0 </pre>		Press the  Key. The advanced autotuning execution screen will be displayed.

Step	Display after Operation	Keys	Operation
5	<pre> RUN ADVANCED AT P n 1 0 3 = 0 0 0 0 . 0 P n 1 0 0 = 0 0 4 0 . 0 P n 1 0 1 = 0 0 2 0 . 0 0 P n 1 4 1 = 0 0 5 0 . 0 </pre>		<p>Press the  Key. The servo will be ON and the display will change from "BB" to "RUN."</p> <p>*If the level is set to 3, the "Pn102" display will change to the "Pn141."</p>
6	<pre> RUN ADVANCED AT P n 1 0 3 = 0 0 3 0 . 0 P n 1 0 0 = 0 0 4 0 . 0 P n 1 0 1 = 0 0 2 0 . 0 0 P n 1 4 1 = 0 0 5 0 . 0 </pre>	   	<p>Press the  Key if a positive (+) value is set in STROKE (travel distance), or press the  Key if a negative (-) value is set. Calculation of the moment of inertia ratio/mass ratio will start. While the moment of inertia ratio/mass ratio is being calculated, the set value for Pn103 will blink. When the calculation has been completed, the set value will stop blinking and the calculated load moment of inertia ratio/mass ratio will be displayed. The servo will remain ON, but the auto run operation will enter HOLD status.</p> <p>Note:</p> <ul style="list-style-type: none"> Press the  Key to stop advanced autotuning. The estimated load moment of inertia ratio/mass ratio will be saved in the SERVOPACK. In the case of calculating the moment of inertia only, press the  Key after pressing the  Key to finish Fn201. The wrong key for the set travel direction is pressed, the calculation will not start. If the tuning operation or the calculation of the moment of inertia/mass ratio does not start, "NO-OP" will blink. Refer to (3) <i>Failure in Operation</i>, and take a corrective action to enable operation. If the calculation of the moment of inertia/mass ratio is not completed normally because the required conditions are not met, "Pn103=ERR" will be displayed. Refer to (4) <i>Errors during Calculation of Load Moment of Inertia Ratio/Mass Ratio</i>, press the  Key to cancel the function, modify the settings, and then restart. <p><Supplementary Information> If the moment of inertia/mass ratio is not calculated, the set value for Pn103 will be displayed but not blink.</p>
7	<pre> Adj ADVANCED AT P n 1 0 3 = 0 0 3 0 . 0 P n 1 0 0 = 0 1 0 0 . 0 P n 1 0 1 = 0 0 0 6 . 3 6 P n 1 4 1 = 0 1 5 0 . 0 </pre>	 	<p>When the  or  Key is pressed according to the sign (+ or -) of the value set for STROKE (travel distance), the calculated value of the moment of inertia/mass ratio will be written to the SERVOPACK and the auto run operation will restart. While the servomotor is running, the notch filter, the torque reference filter, and gains will be automatically set. "Adj" will blink during the auto setting operation.</p> <p>Note:</p> <ul style="list-style-type: none"> Precise adjustments cannot be made and "Error" will be displayed as the status if there is vibration when starting adjustments. If that occurs, make adjustments using one-parameter tuning (Fn203).
8	<pre> End ADVANCED AT P n 1 0 3 = 0 0 3 0 . 0 P n 1 0 0 = 0 1 0 0 . 0 P n 1 0 1 = 0 0 0 6 . 3 6 P n 1 4 1 = 0 1 5 0 . 0 </pre>		<p>When the adjustment has been completed normally, the servo will turn OFF, and "End" will blink for two seconds and "Adj" will be displayed on the status display.</p>
9	<pre> Done ADVANCED AT P n 1 0 3 = 0 0 3 0 . 0 P n 1 0 0 = 0 1 0 0 . 0 P n 1 0 1 = 0 0 0 6 . 3 6 P n 1 4 1 = 0 1 5 0 . 0 </pre>		<p>Press the  Key. The values adjusted will be written to the SERVOPACK, "Done" will blink for two seconds, and "Adj" will be displayed again.</p> <p><Supplementary Information> Not to save the values, press the  Key.</p>

Step	Display after Operation	Keys	Operation
10	<pre> BB — FUNCTION — Fn200: TuneLvl Set Fn201: AAT Fn202: Ref-AAT Fn203: OnePrmTun </pre>		Press the  Key to complete the advanced autotuning operation. The screen in step 1 will appear again.

(2) Supplementary Information on Advanced Autotuning

If advanced autotuning is not completed normally, "Error" will blink. Press the MODE/SET Key to end the function, return to the first step, and display the initial setting screen for advanced autotuning.

Set the Positioning Completed Width (Pn522) to a larger value and perform advanced autotuning again.

Example of Display If Advanced Autotuning Is Not Completed Normally

```

Error ADVANCED AT
Pn103: 00123
Pn100: 0063.0
Pn101: 017.00
Pn141: 0063.0


```

(3) Failure in Operation


If "NO-OP" or "Error" blinks during adjustment, the adjustment will be stopped.

■ Probable Causes of "NO-OP" Blinking

- The main circuit power supply is OFF.
- An alarm or warning has occurred.
- An overtravel has occurred.
- A SigmaWin+ communications error has occurred.
- Gain setting 2 is selected by gain switching.
- Jcalc is set to OFF (load moment of inertia ratio/mass ratio not calculated) and the tuning-less function is set to effective.

Press the  Key and stop the adjustment once, and take a corrective action to enable operation.

■ Probable Causes of "Error" Blinking and Remedies

Press the  Key and stop the adjustment once, and take the following remedies to enable operation.

Error	Probable Cause	Corrective Actions
Travel distance setting error	The travel distance is set to approximately 0.5 rotation (0.05 rotation for SGMCS servomotor) or less, which is less than the minimum adjustable travel distance.	Increase the travel distance. It is recommended to set the number of motor rotations to around 3.
An error occurred during the calculation of the load moment of inertia ratio/mass ratio.	Refer to (4) <i>Errors during Calculation of Load Moment of Inertia Ratio/Mass Ratio</i> .	
The positioning completion signal (/COIN) did not turn ON within approximately 10 seconds after positioning adjustment was completed.	The positioning completion width is too small or P control operation (proportional control) is being used.	Increase the set value for Pn522. If the mode switch is used, increase the set value or disable the mode switch.
The gain dropped below the minimum adjustable gain.	Machine vibration is occurring or the positioning completion signal (/COIN) is turning ON and OFF.	Increase the set value for Pn522. If there is machine vibration, suppress the vibration with the anti-resonance control adjustment function and the vibration suppression function.

(4) Errors during Calculation of Load Moment of Inertia Ratio/Mass Ratio

The following table shows the probable causes of errors that may occur during the calculation of the load moment of inertia ratio/mass ratio with the Jcalc set to ON, along with corrective actions for the errors.

Error Display	Error Type	Cause	Corrective Action
Err1	Failure in starting calculation of moment of inertia/mass ratio	The SERVOPACK started calculating the moment of inertia/mass ratio, but the calculation was not completed.	<ul style="list-style-type: none"> • Increase the speed loop gain (Pn100). • Increase the STROKE (travel distance).
Err2	Failure in calculation of moment of inertia/mass ratio	The moment of inertia/mass ratio fluctuated greatly and did not converge within 10 tries.	Set the calculation value based on the machine specifications in Pn103 and execute the calculation with the Jcalc set to OFF.
Err3	Low-frequency vibration error	Low-frequency vibration was detected.	Double the calculation starting level of the moment of inertia/mass ratio (Pn324).
Err4	Torque limit error	The torque limit was reached.	<ul style="list-style-type: none"> • Increase the torque limit value. • Double the calculation starting level of the moment of inertia/mass ratio (Pn324).
Err5	Proportional control error	While calculating the moment of inertia/mass ratio, the speed control was set to proportional control with P-CON input.	Operate the SERVOPACK with PI control while calculating the moment of inertia/mass ratio.

6.3.3 Related Parameters

The following parameters are set automatically by using advanced autotuning function.

Parameter	Name
Pn100	Speed Loop Gain
Pn101	Speed Loop Integral Time Constant
Pn102	Position Loop Gain
Pn121	Friction Compensation Gain
Pn123	Friction Compensation Coefficient
Pn124	Friction Compensation Frequency Correction
Pn125	Friction Compensation Gain Correction
Pn141	Model Following Control Gain
Pn143	Model Following Control Bias (Forward Direction)
Pn144	Model Following Control Bias (Reverse Direction)
Pn145	Vibration Suppression 1 Frequency A
Pn146	Vibration Suppression 1 Frequency B
Pn147	Model Following Control Speed Feedforward Compensation
Pn161	Anti-Resonance Frequency
Pn163	Anti-Resonance Damping Gain
Pn401	Torque Reference Filter Time Constant
Pn408	Notch Filter Selection/Friction Compensation Selection
Pn409	1st Step Notch Filter Frequency
Pn40A	1st Step Notch Filter Q Value
Pn40C	2nd Step Notch Filter Frequency
Pn40D	2nd Step Notch Filter Q Value

6.4 Advanced Autotuning by Reference (Fn202)

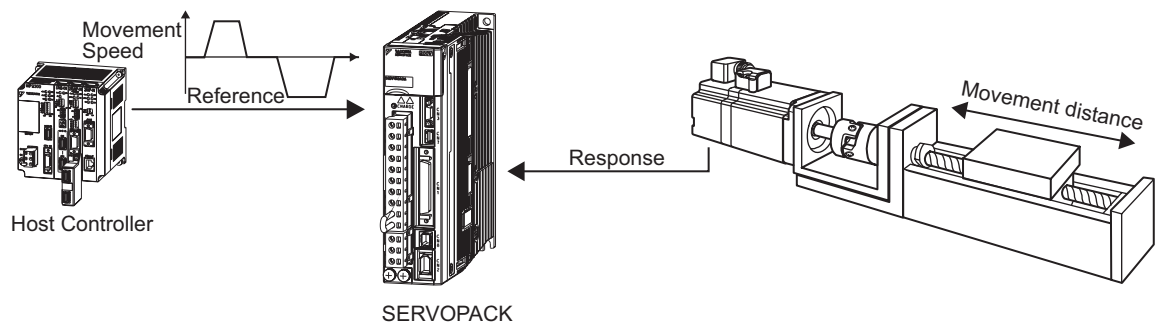
Adjustments with advanced autotuning by reference are described below.

6.4.1 Advanced Autotuning by Reference

Advanced autotuning by reference is used to automatically achieve optimum tuning of the SERVOPACK in response to the user reference inputs from the host.

Advanced autotuning by reference is performed generally to fine-tune the SERVOPACK after advanced autotuning of the SERVOPACK has been performed.

If the load moment of inertia ratio is set correctly is Pn103, advanced autotuning by reference can be performed without performing advanced autotuning.



Advanced autotuning by reference performs the following adjustments.

- Gains (e.g., position loop gain and speed loop gain)
- Filters (torque reference filter and notch filter)
- Friction compensation
- Anti-resonance control
- Vibration suppression

Refer to 6.4.3 *Related Parameters* for parameters used for adjustments.

Tuning level can be set to select an adjustment type.

Tuning Level	Adjustment Type
Mode 1	Standard
Mode 2	Makes adjustments for positioning.
Mode 3	Makes adjustments for positioning, giving priority to overshooting suppression.

A filter type can be set to select a machine resonance reduction filter according to the mechanical element.

Filter Type	Contents
Type = 1	Select a filter suitable for the belt drive mechanism or other mechanism.
Type = 2	Selects a filter suitable for a ball screw drive mechanism.
Type = 3	Selects a filter suitable for a rigid system, such as a gear.

! CAUTION

- Because advanced autotuning by reference adjusts the SERVOPACK during automatic operation, vibration or overshooting may occur. To ensure safety, perform advanced autotuning by reference in a state where the SERVOPACK can come to an emergency stop at any time.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before advanced autotuning by reference is performed. If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.



IMPORTANT

- Advanced autotuning by reference starts adjustments based on the set speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when starting adjustments. In this case, make adjustments after setting a fully stable gain using one-parameter tuning (Fn203).

(1) Check Points for Settings

Check the following settings before performing advanced autotuning by reference, or otherwise "NO-OP" will be displayed during advanced autotuning.

- The main circuit power supply must be ON.
- Forward run prohibited (P-OT) and reverse run prohibited (N-OT) signal must not be in an overtravel state.
- The control must be set to position control.
- Automatic gain switching must be disabled.
- The write prohibited setting (Fn010) must not be set.

(2) Check Points for Operating Conditions

The following conditions are required to perform advanced autotuning by reference. If these conditions are not satisfied, use one-parameter tuning.

- The travel distance in response to references from the host controller must be the same as or larger than the set positioning completion width (Pn522).
- The motor speed in response to references from the host controller must be the same as or larger than the set rotation detection level (Pn502).
- The stopping time, i.e., the period while the positioning completion/COIN signal is OFF, is 10 ms or longer.

(3) Items Influencing Performance

Advanced autotuning by reference may not be performed normally under the following conditions. If the result of autotuning is not satisfactory, perform one-parameter tuning.

Refer to 6.5 *One-parameter Tuning (Fn203)* for details.

- The rigidity of the load is low and vibration occurs when positioning is performed.
- The position integration function is used.
- P control operation (proportional control) is performed.
- The mode switch is used.

<Supplementary Information>

Advanced autotuning by reference is performed by referring to the positioning completion width (Pn522). Set the electronic gear ratio (Pn20E/Pn210) and positioning completion width (Pn522).



IMPORTANT

- Unless the positioning completion signal (/COIN) is turned ON within approximately 3 seconds after positioning has been completed, "WAITING" will blink. Furthermore, unless the positioning completion signal (/COIN) is turned ON within approximately 10 seconds, "Error" will blink for 2 seconds and tuning will be aborted.

(4) Automatically Setting the Notch Filter

Usually, set this function to Auto Setting. (The notch filter is factory-set to Auto Setting.)

If this function is set to Auto Setting, vibration will be detected automatically and the notch filter will be set.

Set this function to Not Auto Setting only if you do not change the notch filter setting before executing advanced autotuning.

Parameter		Function	When Enabled	Classification
Pn460	n.□□□0	Does not set the 1st notch filter automatically.feed-forward	Immediately	Tuning
	n.□□□1	Sets the 1st notch filter automatically. [Factory setting]		
	n.□0□□	Does not set the 2nd notch filter automatically.		
	n.□1□□	Sets the 2nd notch filter automatically. [Factory setting]		

(5) Anti-Resonance Control Adjustment Function

This function reduces vibration of which the notch filter does not effective because of low vibration frequency.

Usually, set this function to Auto Setting. (The anti-resonance control is factory-set to Auto Setting.)

When this function is set to Auto Setting, vibration will be automatically detected during advanced autotuning by reference and anti-resonance control will be automatically adjusted and set.

Set this function to Not Auto Setting only if you do not change the setting for anti-resonance control before executing advanced autotuning by reference.

For details, refer to 6.6 *Anti-Resonance Control Adjustment Function (Fn204)*

Parameter		Function	When Enabled	Classification
Pn160	n.□□0□	Does not use the anti-resonance control automatically.	Immediately	Tuning
	n.□□1□	Uses the anti-resonance control automatically. [Factory setting]		

The following parameters related to anti-resonance control are set automatically.

Parameter	Name
Pn161	Anti-Resonance Frequency
Pn163	Anti-Resonance Damping Gain

Note: The following parameters related to anti-resonance control are not set automatically but the respective set values in the parameters will apply.

Anti-resonance gain compensation (Pn162)
 Anti-resonance filter time constant 1 compensation (Pn164)
 Anti-resonance filter time constant 2 compensation (Pn165)

(6) Model Following Control with Vibration Suppression

The vibration suppression function suppresses transitional vibration at frequency as low as 1 to 100 Hz that is generated mainly when positioning if the machine stand vibrates.

Usually, set this function to Auto Setting. (The vibration suppression function is factory-set to Auto Setting.)

When this function is set to Auto Setting, vibration will be automatically detected during advanced autotuning by reference and model following control with vibration suppression will be automatically adjusted and set.

Set this function to Not Auto Setting only if you do not change the setting for model following control with vibration suppression before executing advanced autotuning by reference.

Note: This function uses model following control. Therefore, the function can be executed only if the adjustment level is set to mode 2 or 3.

■ Related Parameters

Parameter		Function	When Enabled	Classification
Pn140	n.□0□□	Does not use the vibration suppression function automatically.	Immediately	Tuning
	n.□1□□	Uses the vibration suppression function automatically. [Factory setting]		

The following parameters related to model following control with vibration suppression are set automatically.

Parameter	Name
Pn141	Model Following Control Gain
Pn145	Vibration Suppression 1 Frequency A
Pn146	Vibration Suppression 1 Frequency B

Note: The following parameters related to model following control with vibration suppression are not set automatically but the respective set values in the parameters will apply.
Model following control gain compensation (Pn142)

(7) Friction Compensation

This function compensates for changes in the following conditions.

- Changes in the viscous resistance of the lubricant, such as the grease, on the sliding parts of the machine
- Changes in the load resistance resulting from fluctuations in the machine assembly
- Secular changes in the load resistance

Conditions to which friction compensation is applicable depend on the tuning level. The friction compensation setting in Pn408.3 applies when the mode is 1.

Friction Compensation Setting		Tuning Level	Mode 1	Mode 2 Mode 3
Pn408	n.0□□□		×	○
	n.1□□□		○	○

○: Adjusted with the friction compensation function.

×: Adjusted without the friction compensation function.

(8) Feedforward

If tuning is performed at mode 2 or mode 3, the feedforward reference (Pn109), speed feedforward (V-REF) input, and torque feedforward (T-REF) input will be ignored because model following control will be enabled.

The following settings are required if model following control is used together with the speed feedforward (V-REF) input and torque feedforward (T-REF) input.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□	Model following control is not used together with external speed/torque feedforward input. [Factory setting]	Immediately	Tuning
	n.1□□□	Model following control is used together with external speed/torque feedforward input.		



IMPORTANT

- Model following control is used to make optimum feedforward settings in the servo. Therefore, model following control is not used together with either the speed feedforward (V-REF) input or torque feedforward (T-REF) input. An improper speed feedforward (V-REF) input or torque feedforward (T-REF) input may result in overshooting.

Refer to 6.8.2 *Torque Feedforward* and 6.8.3 *Speed Feedforward* for details.

6.4.2 Advanced Autotuning by Reference Procedure

The following procedure is used for advanced autotuning by reference.

Advanced autotuning by reference is performed from the Digital Operator (option) or SigmaWin+.




Here, the operating procedure from the Digital Operator is described.

Refer to the *ΣV series SGM□V/SGDV User's Manual, Operation of Digital Operator* (SIEPS80000055) for basic key operations of the Digital Operator.

Note: The function cannot be performed from the Panel Operator.

(1) Operating Procedure

Step	Display after Operation	Keys	Operation
1	BB — FUNCTION — Fn201: AAT Fn202: Ref-AAT Fn203: OnePrmTun Fn204: A-Vib Sup	MODE/SET ▲ ▼	Display the main menu of the utility function mode, and select Fn202.
2	BB Advanced AT Mode=3 Type=2	DATA	Press the DATA Key to display the initial setting screen for advanced autotuning. Note: If the display does not switch and NO-OP is displayed, refer to (1) Check Points for Settings.
3	BB Advanced AT Mode=3 Type=2	▲ ▼ SCROLL	Press the ▲ ▼ or SCROLL Key and set the items in steps 3-1 and 3-2.
3-1	■Tuning Level Select the tuning level. Mode = 1: Makes adjustments considering responsiveness and stability. (Standard level) Mode = 2: Makes adjustments for positioning. Mode = 3: Makes adjustments for positioning, giving priority to overshooting suppression. Set this level if position error overshoots at mode 2. Note: Set the mode to 1 if Fn202 (Advanced Autotuning by Reference) is performed after executing this function.		
3-2	■Filter Type Setting Select the filter type to set a filter according to the machine element to be driven. Set the filter referring to the following functional elements. <Supplementary Information> If there is noise or the gain does not increase, good results may be obtained by changing the filter type. Type = 1: Selects a filter suitable for belt drive mechanisms. Type = 2: Selects a filter suitable for ball screw drive mechanisms [Factory setting]. Type = 3: Selects a filter suitable for rigid systems, such as a gear.		
4	BB Advanced AT Pn103=0000.0 Pn100=0040.0 Pn101=0020.00 Pn102=0040.0	DATA	Press the DATA Key. The advanced autotuning execution screen will be displayed. *If the level is set to 2 or 3, the "Pn102" display will change to the "Pn141".
5	ADJ Advanced AT Pn103=0030.0 Pn100=0040.0 Pn101=0020.00 Pn141=0050.0		Input an external /S-ON signal, and then input a reference from the host controller.
6	ADJ Advanced AT Pn103=0030.0 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0	▲ ▼	Starts to adjust using ▲ or ▼ Key. "Adj" will blink on the status display. Note: Adjustment cannot be performed during "BB" is shown on the status display.
7	END Advanced AT Pn103=0030.0 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0		When the adjustment has been completed normally, "END" will blink for two seconds on the status display.


Step	Display after Operation	Keys	Operation
8	<div>DONE Advanced AT</div> <div>P n 1 0 3 = 0 0 3 0 0</div> <div>P n 1 0 0 = 0 1 0 0 . 0</div> <div>P n 1 0 1 = 0 0 0 6 . 3 6</div> <div>P n 1 4 1 = 0 1 5 0 . 0</div>	DATA	<p>Press the  Key. The adjusted values will be written to the SERVOPACK, "DONE" will blink for two seconds.</p> <p><Supplementary Information></p> <p>Not to save the values set in step 6, press the  Key.</p>
9	<div>BB — FUNCTION —</div> <div>F n 2 0 1 : AAT</div> <div>F n 2 0 2 : R e f - AAT</div> <div>F n 2 0 3 : O n e P r m T u n</div> <div>F n 2 0 4 : A - V i b S u p</div>	MODE/SET	<p>Press the  Key to complete the advanced autotuning by reference operation. The screen in step 1 will appear again.</p>

(2) Failure in Operation


If "NO-OP" or "Error" blinks for approximately two seconds during adjustment, the adjustment will be stopped. After the adjustment is canceled, "NO-OP" or "Error" will be changed to "RUN" or "BB".

■ Probable Causes of "NO-OP" Blinking

- The main circuit power supply is OFF.
- An alarm or warning has occurred.
- An overtravel has occurred.
- A SigmaWin+ communications error has occurred.
- Gain setting 2 is selected by gain switching.

Press the  Key and stop the adjustment once, and take a corrective action to enable operation.

■ Probable Causes of "Error" Blinking and Remedies

Press the  Key and stop the adjustment once, and take the following remedies to enable operation.

Error	Probable Cause	Corrective Actions
The positioning completion signal (/COIN) did not turn ON within approximately 10 seconds after positioning adjustment was completed.	The positioning completion width is too small or P control operation (proportional control) is being used.	Increase the set value for Pn522. If the P control is set, disable the mode switch.
The gain dropped below the minimum adjustable gain.	Machine vibration is occurring or the positioning completion signal (/COIN) is turning ON and OFF.	Increase the set value for Pn522. If there is machine vibration, suppress the vibration with the anti-resonance control adjustment function, and the vibration suppression function.

6.4.3 Related Parameters

The following parameters are set automatically by using advanced autotuning by reference. Manual adjustments are not required.

Parameter	Name
Pn100	Speed Loop Gain
Pn101	Speed Loop Integral Time Constant
Pn102	Position Loop Gain
Pn121	Friction Compensation Gain
Pn123	Friction Compensation Coefficient
Pn124	Friction Compensation Frequency Correction
Pn125	Friction Compensation Gain Correction
Pn141	Model Following Control Gain
Pn143	Model Following Control Bias (Forward Direction)
Pn144	Model Following Control Bias (Reverse Direction)
Pn145	Vibration Suppression 1 Frequency A
Pn146	Vibration Suppression 1 Frequency B
Pn147	Model Following Control Speed Feedforward Compensation
Pn161	Anti-Resonance Frequency
Pn163	Anti-Resonance Damping Gain
Pn401	Torque Reference Filter Time Constant
Pn408	Notch Filter Selection/Friction Compensation Selection
Pn409	1st Step Notch Filter Frequency
Pn40A	1st Step Notch Filter Q Value
Pn40C	2nd Step Notch Filter Frequency
Pn40D	2nd Step Notch Filter Q Value

6.5 One-parameter Tuning (Fn203)

Adjustments with one-parameter tuning are described below.

6.5.1 One-parameter Tuning

One-parameter tuning is used to manually make tuning level adjustments during operation with a position reference or speed reference input from the host controller.

One-parameter tuning enables automatically setting related servo gain settings to balanced conditions by adjusting one or two autotuning levels.

Tuning level can be set to select an adjustment type.

Tuning Mode	Adjustment Type
Mode 0	Makes adjustments giving priority to stability.
Mode 1	Makes adjustments giving priority to responsiveness.
Mode 2	Makes adjustments for positioning.
Mode 3	Makes adjustments for positioning, giving priority to overshooting suppression.

A filter type can be set to select a machine resonance reduction filter according to the mechanical element.

Filter Type	Contents
Type = 1	Selects a filter suitable for the belt drive mechanism or other mechanism.
Type = 2	Selects a filter suitable for a ball screw drive mechanism.
Type = 3	Selects a filter suitable for a rigid system, such as a gear.

One-parameter tuning performs the following adjustments.

- Gains (e.g., position loop gain and speed loop gain)
- Filters (torque reference filter and notch filter)
- Friction compensation
- Anti-resonance control

Refer to 6.5.4 *Related Parameters* for parameters used for adjustments.

<Supplementary Information>

Perform one-parameter tuning if satisfactory responsiveness is not obtained with advanced autotuning or advanced autotuning by reference.

To fine-tune each servo gain after one-parameter tuning, refer to 6.8 *Servo Gain Adjustment Application Function*.



CAUTION

- Vibration or overshooting may occur during adjustment. To ensure safety, perform one-parameter tuning in a state where the SERVOPACK can come to an emergency stop at any time.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before one-parameter tuning is performed. If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.

(1) Check Points for Settings

Check the following settings before performing one-parameter tuning, or otherwise "NO-OP" will be displayed during one-parameter tuning.

- The write prohibited setting (Fn010) must not be set.

(2) Automatically Setting the Notch Filter

Usually, set this function to Auto Setting. (The notch filter is factory-set to Auto Setting.)

If this function is set to Auto Setting, vibration will be detected automatically and the notch filter will be set.

Set this function to Not Auto Setting only if you do not change the notch filter setting before executing one-parameter tuning.

Parameter		Function	When Enabled	Classification
Pn460	n.□□□0	Does not set the 1st notch filter automatically.	Immediately	Tuning
	n.□□□1	Sets the 1st notch filter automatically. [Factory setting]		
	n.□0□□	Does not set the 2nd notch filter automatically.		
	n.□1□□	Sets the 2nd notch filter automatically. [Factory setting]		

(3) Anti-Resonance Control Adjustment Function

This function reduces vibration of which the notch filter does not effective because of low vibration frequency.

Usually, set this function to Auto Setting. (The anti-resonance control is factory-set to Auto Setting.)

When this function is set to Auto Setting, vibration will be automatically detected during one-parameter tuning and anti-resonance control will be automatically adjusted and set.

Set this function to Not Auto Setting only if you do not change the setting for anti-resonance control before executing one-parameter tuning.

For details, refer to 6.6 Anti-Resonance Control Adjustment Function (Fn204)

Parameter		Function	When Enabled	Classification
Pn160	n.□□0□	Does not use the anti-resonance control automatically.	Immediately	Tuning
	n.□□1□	Uses the anti-resonance control automatically. [Factory setting]		

The following parameters related to anti-resonance control are set automatically.

Parameter	Name
Pn161	Anti-Resonance Frequency
Pn163	Anti-Resonance Damping Gain

Note: The following parameters related to anti-resonance control are not set automatically but the respective set values in the parameters will apply.

Anti-resonance gain compensation (Pn162)

Anti-resonance filter time constant 1 compensation (Pn164)

Anti-resonance filter time constant 2 compensation (Pn165)

"ARES" will blink on the digital operator when anti-resonance control adjustment function is set.

```

RUN      —OnePmTun—
FF LEVEL = 0050
FB LEVEL = 0040

NF1 NF2  ARES

```

(4) Friction Compensation

This function compensates for changes in the following conditions.

- Changes in the viscous resistance of the lubricant, such as the grease, on the sliding parts of the machine
- Changes in the load resistance resulting from fluctuations in the machine assembly
- Secular changes in the load resistance

Conditions to which friction compensation is applicable depend on the tuning level. The friction compensation setting in Pn408.3 applies when the mode is 0 or 1.

Friction Compensation Setting \ Tuning Level		Mode 0	Mode 1	Mode 2	Mode 3
Pn408	n.0□□□	×	×	○	○
	n.1□□□	○	○	○	○

○: Adjusted with the friction compensation function.

×: Adjusted without the friction compensation function.

(5) Feedforward

If tuning is performed at mode 2 or mode 3, the feedforward reference (Pn109), speed feedforward (V-REF) input, and torque feedforward (T-REF) input will be ignored because model following control will be enabled.

The following settings are required if model following control is used together with the speed feedforward (V-REF) input and torque feedforward (T-REF) input.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□	Model following control is not used together with external speed/torque feedforward input. [Factory setting]	Immediately	Tuning
	n.1□□□	Model following control is used together with external speed/torque feedforward input.		



IMPORTANT

- Model following control is used to make optimum feedforward settings in the servo. Therefore, model following control is not used together with either the speed feedforward (V-REF) input or torque feedforward (T-REF) input. An improper speed feedforward (V-REF) input or torque feedforward (T-REF) input may result in overshooting.

Refer to 6.8.2 *Torque Feedforward* and 6.8.3 *Speed Feedforward* for details.

6.5.2 One-parameter Tuning Procedure

The following procedure is used for one-parameter tuning.

One-parameter tuning is performed from the Digital Operator (option) or SigmaWin+.


















Here, the operating procedure from the Digital Operator is described.

Refer to the *Σ-V series SGM□V/SGDV User's Manual, Operation of Digital Operator* (SIEPS80000055) for basic key operations of the Digital Operator.
























Note: Mode 2 and mode 3 cannot be selected from the Panel Operator.

To perform one-parameter tuning with mode 2 or mode 3, operate from the Digital Operator or SigmaWin+.

(1) Operating Procedure 1

Step	Display after Operation	Keys	Operation
1	<pre> RUN —FUNCTION— Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup </pre>	  	Display the main menu of the utility function mode, and select Fn203.
2	<pre> BB —OnePrmTun— Pn103=00300 </pre>		Press the  Key to display the moment of inertia ratio set in Pn103 at present. Select the digit with the  or  Key, change the set value with the  or  Key. Note: If the display does not switch and NO-OP is displayed, refer to (1) Check Points for Settings.
3	<pre> BB —OnePrmTun— Setting Tuning Mode = 2 Type = 2 </pre>		Press the  Key to display the initial setting screen for one-parameter tuning.
4	<pre> BB —OnePrmTun— Setting Tuning Mode = 2 Type = 2 </pre>	  	Press the  ,  or  Key and set the items in steps 4-1 and 4-2.
4-1	■Tuning Mode Select the tuning Mode. Tuning Mode = 0: Makes adjustments giving priority to stability. Tuning Mode = 1: Makes adjustments giving priority to responsiveness. Tuning Mode = 2: Makes adjustments for positioning. Tuning Mode = 3: Make adjustments for positioning, giving priority to overshooting suppression. Set this mode if position error overshoots at Tuning Mode 2. When Tuning Mode is set to 0 or 1, refer to (2) Operating Procedure 2 [Tuning Mode set to 0 or 1]. When Tuning Mode is set to 2 or 3, refer to (3) Operating Procedure 3 [Tuning Mode set to 2 or 3].		
4-2	■Filter Type Setting Select the filter type to set a filter according to the machine element to be driven. Set the filter referring to the following functional elements. <Supplementary Information> If there is noise or the gain does not increase, good results may be obtained by changing the filter type. Type = 1: Selects a filter suitable for belt drive mechanisms. Type = 2: Selects a filter suitable for ball screw drive mechanisms [Factory setting]. Type = 3: Selects a filter suitable for rigid systems, such as a gear.		

(2) Operating Procedure 2 [Tuning Mode set to 0 or 1]
























Step	Display after Operation	Keys	Operation
1			Input an external /S-ON signal. The display will change from "BB" to "RUN." Input a reference from the host controller.
2	<pre> RUN —OnePrmTun— P n 1 0 0 = 0 0 4 0 . 0 P n 1 0 1 = 0 0 2 0 . 0 0 P n 1 4 1 = 0 0 5 0 . 0 </pre>		The set value will be displayed. Press the  Key after checking the value.
3	<pre> RUN —OnePrmTun— LEVEL = 0 0 4 0 NF 1 ARES </pre>	     	<p>Mode 0 and Mode 1 are used to make level adjustments. When the level is increased, the responsiveness will improve. If the value is too large, however, vibration will occur. If that occurs, press the  Key. The SERVOPACK will detect the vibration frequencies automatically and make notch filter or anti-resonance control settings.</p> <p>If the vibration is great, the vibration frequency will be detected even if the  Key is not pressed and a notch filter or anti-resonance control will be set.</p> <p>Select the digit with the  or  Key, adjust the level with  or  Key, and press the  Key. When the notch filter is set, "NF1" or "NF2" will be displayed on the bottom row. "NF1" shows that a one-level notch filter is set.</p> <p>When anti-resonance control is set, "ARES" is displayed.</p>
4	<pre> RUN —OnePrmTun— P n 1 0 0 = 0 0 4 0 . 0 P n 1 0 1 = 0 0 2 0 . 0 0 P n 1 0 2 = 0 0 4 0 . 8 </pre>		A confirmation screen is displayed after level adjustment. Check the value and press the  Key.
5	<pre> DONE —OnePrmTun— P n 1 0 0 = 0 0 4 0 . 0 P n 1 0 1 = 0 0 2 0 . 0 0 P n 1 0 2 = 0 0 4 0 . 8 </pre>		<p>Press the  Key. The adjusted values will be written to the SERVOPACK, "DONE" will blink for two seconds.</p> <p><Supplementary Information></p> <p>Not to save the values set in step 3, press the  Key.</p> <p>The screen in step 3 will appear with the  Key.</p>
6	<pre> RUN —FUNCTION— F n 2 0 2 : R e f - A A T F n 2 0 3 : O n e P r m T u n F n 2 0 4 : A - V i b S u p F n 2 0 5 : V i b S u p </pre>		Press the  Key to complete the one-parameter tuning operation. The screen in step 1 will appear again.

Note: Tuning Mode

0: Makes adjustments giving priority to stability.

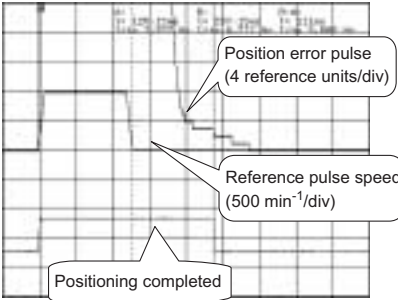
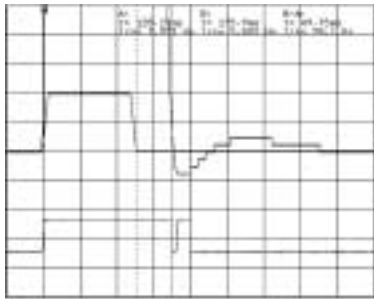
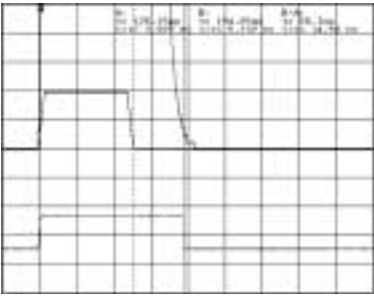
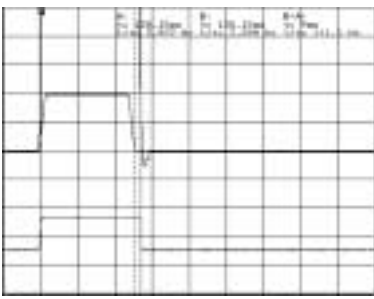

1: Makes adjustments giving priority to responsiveness.

(3) Operating Procedure 3 [Tuning Mode set to 2 or 3]

Step	Display after Operation	Keys	Operation
1			Input an external /S-ON signal. The display will change from "BB" to "RUN." Input a reference from the host controller.
2	<pre> RUN —OnePrmTun— P n 1 0 0 = 0 0 4 0 . 0 P n 1 0 1 = 0 0 2 0 . 0 0 P n 1 4 1 = 0 0 5 0 . 0 </pre>		The set value will be displayed. Press the  Key after checking the value.
3	<pre> RUN —OnePrmTun— FF LEVEL = 0 0 5 0 . 0 FB LEVEL = 0 0 4 0 . 0 NF 1 ARES </pre>	     	<p>Mode 2 or 3 is used to make FF level and FB level adjustments. When the level is increased, the responsiveness will improve. If the value is too large, however, vibration will occur. If that occurs, press the  Key. The SERVOPACK will detect the vibration frequencies automatically and make notch filter or anti-resonance control settings.</p> <p>If the vibration is great, the vibration frequency will be detected even if the  Key is not pressed and a notch filter or anti-resonance control will be set.</p> <p>The positioning time will become shorter if the FF level is increased. If the FF level is too high, overshooting will result. Adjust FF level and FB level with the , ,  or  Keys, and press the  Key.</p> <p>Note:</p> <ul style="list-style-type: none"> A change in the FF level will become effective after the motor stops (i.e., the motor comes to a stop with no reference input), and the response of the motor will change. Wait until the set operation reference stops and check the response before adjusting the FF level. If the FF level is changed greatly while the SERVOPACK is in operation, the response will change radically. This may cause vibration. "FF LEVEL" will blink until the FF level is enabled. If the motor does not stop approximately 10 seconds after the setting is changed, a timeout error will result and the previous setting will be enabled again. The vibration frequencies may not be detected if the amplitude is too small. If that occurs, press the  Key to forcibly detect the vibration frequencies.
4	<pre> RUN —OnePrmTun— P n 1 0 0 = 0 0 4 0 . 0 P n 1 0 1 = 0 0 2 0 . 0 0 P n 1 4 1 = 0 0 5 0 . 0 NF 1 </pre>		A confirmation screen is displayed after adjustment.
5	<pre> DONE —OnePrmTun— P n 1 0 0 = 0 0 4 0 . 0 P n 1 0 1 = 0 0 2 0 . 0 0 P n 1 4 1 = 0 0 5 0 . 0 NF 1 </pre>		<p>Press the  Key. The adjusted values will be written to the SERVOPACK, "DONE" will blink for two seconds.</p> <p><Supplementary Information></p> <p>Not to save the values set in step 3, press the  Key.</p> <p>The screen in step 3 will appear with the  Key.</p>
6	<pre> RUN —FUNCTION— Fn 2 0 2 : Ref-AAT Fn 2 0 3 : OnePrmTun Fn 2 0 4 : A-Vib Sup Fn 2 0 5 : Vib Sup </pre>		Press the  Key to complete the one-parameter tuning operation. The screen in step 1 will appear again.

6.5.3 One-parameter Tuning Example

The following procedure is used for one-parameter tuning on the condition that the tuning mode is set to 2, or 3. This mode is used to reduce positioning time.

Step	Measuring Instrument Display Example	Operation
1		Measure the positioning time after setting the moment of inertia ratio (Pn103) correctly. Tuning will be completed if the specifications are met here. The tuning results will be saved in the SERVOPACK.
2		The positioning time will become shorter if the FF level is increased. The tuning will be completed if the specifications are met. The tuning results will be saved in the SERVOPACK. If overshooting occurs before the specifications are met, go to step 3.
3		Overshooting will be reduced if the LB level is increased. If the overshooting is solved, go to step 4.
4		<p>The graph shows overshooting generated with the FF level increased in step 3. In this state, the overshooting occurs at two references, but the positioning setting time is short. The tuning will be completed if the specifications are met. The adjustment results are saved in the SERVOPACK. If overshooting occurs before the specifications are met, repeat steps 3 and 4.</p> <p>If vibration occurs before the overshooting is eliminated, the vibration will be suppressed by the automatic notch filter.</p> <p>Note:</p> <p>The vibration frequencies may not be detected if the amplitude is too small. If that occurs, press the  Key to forcibly detect the vibration frequencies.</p>
5		The adjustment results are saved in the SERVOPACK.

6.5.4 Related Parameters

The following parameters are set automatically by using one-parameter tuning. Manual adjustments are not required.

Parameter	Name
Pn100	Speed Loop Gain
Pn101	Speed Loop Integral Time Constant
Pn102	Position Loop Gain
Pn121	Friction Compensation Gain
Pn123	Friction Compensation Coefficient
Pn124	Friction Compensation Frequency Correction
Pn125	Friction Compensation Gain Correction
Pn141	Model Following Control Gain
Pn143	Model Following Control Bias (Forward Direction)
Pn144	Model Following Control Bias (Reverse Direction)
Pn147	Model Following Control Speed Feedforward Compensation
Pn161	Anti-Resonance Frequency
Pn163	Anti-Resonance Damping Gain
Pn401	Torque Reference Filter Time Constant
Pn408	Notch Filter Selection/Friction Compensation Selection
Pn409	1st Step Notch Filter Frequency
Pn40A	1st Step Notch Filter Q Value
Pn40C	2nd Step Notch Filter Frequency
Pn40D	2nd Step Notch Filter Q Value

6.6 Anti-Resonance Control Adjustment Function (Fn204)

This section describes the anti-resonance control adjustment function.

6.6.1 Anti-Resonance Control Adjustment Function

An increase in the control gain of the SERVOPACK is effective for high-speed, high-precision driving of a machine. If the gain is excessively high, vibration will occur in the operating section of the machine. The anti-resonance control adjustment function (Fn204) is an effective function that supports anti-resonance control adjustment if the vibration frequencies are from 100 to 1,000 Hz.

The anti-resonance control adjustment function reduces vibration by adjusting the damping gain with vibration frequencies that are automatically detected or manually set.

The automatic detection of vibration frequencies is enabled or disabled using the tuning mode settings.

Tuning Mode	Detection of Vibration Frequencies	Guideline Selection
0	YES	<ul style="list-style-type: none"> The vibration frequencies are unknown. This function is being used for the first time.
1	NO	<ul style="list-style-type: none"> The frequencies are already known. To fine-tune the damping gain when the anti-resonance control adjustment function has already been used.



CAUTION

- If this function is executed, related parameters will be set automatically. Therefore, there will be a large response change after this function is enabled or disabled. Enable the function in a state where the machine can come to an emergency stop at any time to ensure the safety operation of the machine.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before executing the anti-resonance control adjustment function. If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.



IMPORTANT

- This function detects vibration between 100 and 1,000 Hz. Vibration will not be detected for frequencies outside of this range, and instead, "F----" will be displayed. If that occurs, use one-parameter tuning with tuning mode 2 selected to automatically set a notch filter or use the vibration suppression function (Fn205).
- Vibration can be reduced more effectively by increasing the present damping gain (Pn163). The amplitude of vibration may become larger if the damping gain is excessively high. Increase the vibration gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. If the effect of vibration reduction is still insufficient at a gain of 200%, cancel the setting, and lower the control gain using a different method, such as one-parameter tuning.

(1) Check Points for Settings

Check the following settings before performing anti-resonance control adjustment function, or otherwise "NO-OP" will be displayed during anti-resonance control adjustment.

- The control must not be set to torque control.

(2) Items Influencing Performance

Before executing the anti-resonance control adjustment function, check the following precautions and take necessary measures.

- To obtain sufficient vibration reduction, the moment of inertia ratio must be set correctly. Perform advanced autotuning to set the moment of inertia ratio (Pn103).

<Supplementary Information>

Perform one-parameter tuning (Fn203) or use another method to increase the responsiveness after performing this function. If the vibration reduction gain is increased with one-parameter tuning performed, vibration may result again. If that occurs, perform this function again to fine-tune the settings.

6.6.2 Anti-Resonance Control Adjustment Function Operating Procedure

The following procedure is used for anti-resonance control adjustment function.

Anti-resonance control adjustment function is performed from the Digital Operator (option) or SigmaWin+.

Here, the operating procedure from the Digital Operator is described.











Refer to the *Σ-V series SGM□V/SGDV User's Manual, Operation of Digital Operator* (SIEPS80000055) for basic key operations of the Digital Operator.


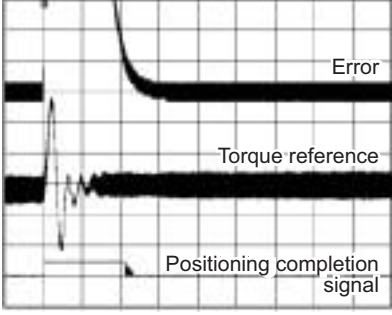









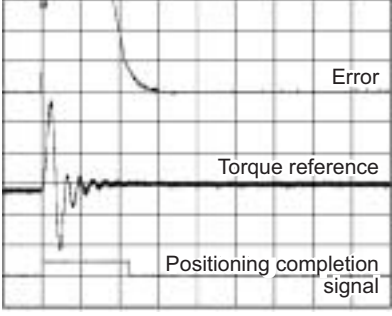











Note: • The function cannot be performed from the Panel Operator.
• Use this function if vibration is generated when a control reference is input.



The following three methods can be used for the anti-resonance control adjustment function. Select and use the best method.

1. Starting Execution with Vibration Suppression When the Anti-resonance Control Adjustment Function Has Not Been Used → See page 6-41.
2. Starting Execution without Vibration Suppression When the Anti-resonance Control Adjustment Function Has Not Been Used → See page 6-43.
3. Starting Execution for Fine-tuning When the Anti-resonance Control Adjustment Function Has Been Used → See page 6-45.













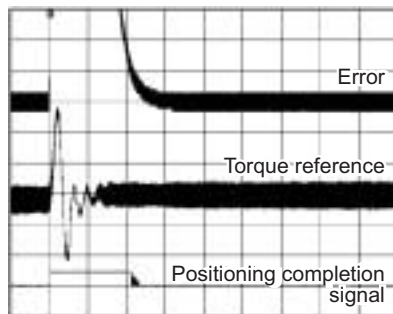










(1) Starting Execution with Vibration Suppression When the Anti-Resonance Control Adjustment Function Has Not Been Used

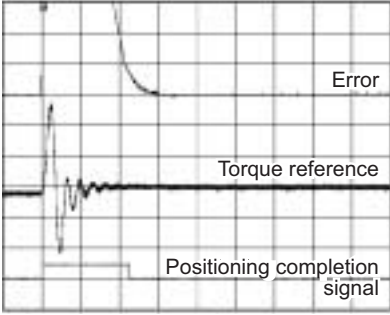



Step	Display after Operation	Keys	Operation
1	<pre> RUN —FUNCTION— Fn203: OnePrmTun Fn204: A-Vib Sup Fn205: Vib Sup Fn206: Easy FFT </pre>	  	Display the main menu of the utility function mode, and select Fn204.
2	<pre> RUN —Vib Sup— Tuning Mode = 0 </pre>		Press the  Key to display the initial setting screen for tuning mode. Note: If the display does not switch and NO-OP is displayed, refer to (1) Check Points for Settings.
3	<pre> RUN —Vib Sup— Tuning Mode = 0 </pre>	  	Press the  or  Key and select the tuning mode "0".

Step	Display after Operation	Keys	Operation
4	<pre> RUN - V i b S u p - f r e q = - - - - H z d a m p = 0 0 0 0 0 </pre>	DATA	<p>Press the  Key while "Tuning Mode = 0" is displayed. The screen shown on the left will appear. The detection of vibration frequencies will start and "freq" will blink.</p> <p>Note: Return to step 3 if vibration is not detected. Lower the vibration detection sensitivity (Pn311). When this parameter is lowered, the detection sensitivity will be increased. Vibration may not be detected accurately if too small value is set.</p>
5	<pre> RUN - V i b S u p - f r e q = 0 4 0 0 H z d a m p = 0 0 0 0 0 </pre>		<p>The vibration frequency will be displayed if vibration is detected.</p> 
6	<pre> RUN - V i b S u p - f r e q = 0 4 0 0 H z d a m p = 0 0 0 2 0 </pre>	DATA	<p>Press the  Key. The cursor will move to "damp," and "freq" will be displayed normally.</p>
7	<pre> RUN - V i b S u p - f r e q = 0 4 0 0 H z d a m p = 0 0 1 2 0 </pre>	   	<p>Select the digit with the  or  Key, and press the  or  Key to adjust the damping gain.</p>  <p>Note: Increase the damping gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. 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 one-parameter tuning.</p>
8	<pre> RUN - V i b S u p - f r e q = 0 4 0 0 H z d a m p = 0 0 1 2 0 </pre>		<p>Press the  Key. The cursor will move from "damp" to "freq".</p>
9	<pre> RUN - V i b S u p - f r e q = 0 4 2 0 H z d a m p = 0 0 1 2 0 </pre>	   	<p>Select the digit with the  or  Key, and press the  or  Key to fine-tune the frequency. Skip this step and go to step 10 if the fine-tuning of the frequency is not necessary.</p>
10	<pre> RUN - V i b S u p - f r e q = 0 4 2 0 H z d a m p = 0 0 1 2 0 </pre>	DATA	<p>Press  Key to save the settings.</p>






























Step	Display after Operation	Keys	Operation
11	<pre> DONE — Vib Sup — freq = 0420 Hz damp = 00120 </pre>		"DONE" will blink for two seconds.
12	<pre> RUN —FUNCTION— Fn203: OnePrmTun Fn204: A-Vib Sup Fn205: Vib Sup Fn206: Easy FFT </pre>		Press the  Key to complete the anti-resonance control adjustment function. The screen in step 1 will appear again.

(2) Starting Execution without Vibration Suppression When the Anti-Resonance Control Adjustment Function Has Not Been Used

Step	Display after Operation	Keys	Operation
1	<pre> RUN —FUNCTION— Fn203: OnePrmTun Fn204: A-Vib Sup Fn205: Vib Sup Fn206: Easy FFT </pre>	  	Display the main menu of the utility function mode, and select Fn204.
2	<pre> RUN — Vib Sup — Tuning Mode = 0 </pre>		Press the  Key to display the initial setting screen for tuning mode.
3	<pre> RUN —FUNCTION— Tuning Mode = 1 </pre>	  	Press the  or  Key and select the tuning mode "1".
4	<pre> RUN — Vib Sup — freq = 0420 Hz damp = 00000 </pre>		<p>Press the  Key while "Tuning Mode = 1" is displayed. The screen shown on the left will appear and "freq" will blink.</p> 
5	<pre> RUN — Vib Sup — freq = 0400 Hz damp = 00000 </pre>	   	Select the digit with the  or  Key, and press the  or  Key to adjust the frequency.
6	<pre> RUN — Vib Sup — freq = 0400 Hz damp = 00000 </pre>		Press the  Key. The cursor will move to "damp".

Step	Display after Operation	Keys	Operation
7	<pre> RUN — Vib Sup — freq = 0400 Hz damp = 000<u>2</u>0 </pre>	<div> <div><</div> <div>></div> <div>▲</div> <div>▼</div> </div>	<p>Select the digit with the < or > Key, and press the ▲ or ▼ Key to adjust the damping gain.</p>  <p>Note: Increase the damping gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. 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 one-parameter tuning.</p>
8	<pre> RUN — Vib Sup — freq = 040<u>0</u> Hz damp = 00120 </pre>	<div> <div>SCROLL</div> <div>▲</div> </div>	<p>Press the  Key. The cursor will move from "damp" to "freq".</p>
9	<pre> RUN — Vib Sup — freq = 04<u>0</u>0 Hz damp = 00120 </pre>	<div> <div><</div> <div>></div> <div>▲</div> <div>▼</div> </div>	<p>Select the digit with the < or > Key, and press the ▲ or ▼ Key to fine-tune the frequency. Skip this step and go to step 10 if the fine-tuning of the frequency is not necessary.</p>
10	<pre> RUN — Vib Sup — freq = 0400 Hz damp = 001<u>2</u>0 </pre>	<div> <div>DATA</div> </div>	<p>Press  Key to save the settings.</p>
11	<pre> DONE — Vib Sup — freq = 0400 Hz damp = 0150 </pre>		<p>"DONE" will blink for two seconds.</p>
12	<pre> RUN —FUNCTION— Fn203: OnePrmTun Fn204: A-Vib Sup Fn205: Vib Sup Fn206: Easy FFT </pre>	<div> <div>MODE/SET</div> <div>↺</div> </div>	<p>Press the  Key to complete the anti-resonance control adjustment function. The screen in step 1 will appear again.</p>

(3) Starting Execution for Fine-tuning When the Anti-Resonance Control Adjustment Function Has Been Used

Step	Display after Operation	Keys	Operation
1	<pre> RUN —FUNCTION— Fn203: OnePrmTun Fn204: A-Vib Sup Fn205: Vib Sup Fn206: Easy FFT </pre>	  	Display the main menu of the utility function mode, and select Fn204.
2	<pre> RUN —FUNCTION— Tuning Mode = 1 </pre>		Press the  Key to display the "Tuning Mode = 1" as shown on the left. Note: If the display does not switch and NO-OP is displayed, refer to (1) Check Points for Settings.
3	<pre> RUN —Vib Sup— freq = 0400 Hz damp = 001<u>2</u>0 </pre>		Press the  Key while "Tuning Mode = 1" is displayed. The screen shown on the left will appear and "damp" will blink.
4	<pre> RUN —Vib Sup— freq = 0400 Hz damp = 001<u>5</u>0 </pre>	   	Select the digit with the  or  Key, and press the  or  Key to adjust the damping gain. Note: Increase the damping gain from about 0% to 200% in 10% increments while checking the effect of vibration reduction. 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 one-parameter tuning.
5	<pre> RUN —Vib Sup— freq = 0400 Hz damp = 015<u>0</u> </pre>		Press the  Key. The cursor will move from "damp" to "freq".
6	<pre> RUN —Vib Sup— freq = 04<u>2</u>0 Hz damp = 0150 </pre>	   	Select the digit with the  or  Key, and press the  or  Key to fine-tune the frequency. Skip this step and go to step 7 if the fine-tuning of the frequency is not necessary.
7	<pre> DONE —Vib Sup— freq = 0420 Hz damp = 015<u>0</u> </pre>		Press  Key to save the settings.
8	<pre> RUN —FUNCTION— Fn203: OnePrmTun Fn204: A-Vib Sup Fn205: Vib Sup Fn206: Easy FFT </pre>		Press the  Key to complete the anti-resonance control adjustment function. The screen in step 1 will appear again.

6.6.3 Related Parameters

Pn160 and Pn161 are set automatically. The other parameters are not set automatically but the respective set values in the parameters will apply.

Parameter	Name
Pn160	Anti-resonance Control Selection
Pn161	Anti-resonance Frequency
Pn162	Anti-resonance Gain Compensation
Pn163	Anti-resonance Damping Gain
Pn164	Anti-resonance Filter Time Constant 1 Compensation
Pn165	Anti-resonance Filter Time Constant 2 Compensation

6.7 Vibration Suppression Function (Fn205)

The vibration suppression function is described in this section.

6.7.1 Vibration Suppression Function

The vibration suppression function suppresses transitional vibration at frequency as low as 1 to 100 Hz that is generated mainly when positioning if the machine stand vibrates.

CAUTION

- If this function is executed, related parameters will be set automatically. Therefore, there will be a large response change after this function is enabled or disabled. Enable the function in a state where the machine can come to an emergency stop at any time to ensure the safety operation of the machine.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before executing this function. If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.



IMPORTANT

- Frequency detection will not be performed if there is no vibration resulting from position errors or the vibration frequencies are outside the range of detectable frequencies. If that occurs, use a device, such as a laser displacement sensor or vibration meter, to measure the vibration.
- If vibration frequencies automatically detected are not suppressed, there may be a difference between the actual frequency and detected frequency. Fine-tune the detected frequency if necessary.

(1) Check Points for Settings

Before performing the vibration suppression function, check the following setting and take necessary measures.

- The control must be set to position control.

(2) Items Influencing Performance

The vibration suppression function cannot suppress vibration effectively under the following condition. If the result is not satisfactory, perform anti-resonance control adjustment function (Fn204) or one-parameter tuning (Fn203).

- Vibration is generated continuously when the motor is not rotating.

<Supplementary Information>

Perform one-parameter tuning (Fn203) to improve responsiveness after vibration suppression is performed.

(3) Detection of Vibration Frequencies

No frequency detection may be possible if the vibration does not appear as a position error or the vibration resulting from the position error is too small.

The detection sensitivity can be adjusted by changing the setting for the remained vibration detection width (Pn560). Perform the detection of vibration frequencies after adjusting the remained vibration detection width (Pn560).

Pn560	Remained Vibration Detection Width Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0.1 to 300%	0.1%	40%	Immediately	Setup

Note: Use a set value of 10% as a guideline. The smaller the set value is, the higher the detection sensitivity will be. If the value is too small, however, the vibration may not be detected accurately.

<Supplementary Information>

Vibration frequencies automatically detected may vary more or less during each positioning operation. Perform positioning several times and make adjustments while checking the effect of vibration suppression.

(4) Feedforward

If this function is performed, the feedforward reference (Pn109), speed feedforward (V-REF) input, and torque feedforward (T-REF) input will be ignored because model following control will be enabled.

The following settings are required if model following control is used together with the speed feedforward (V-REF) input and torque feedforward (T-REF) input.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□	Model following control is not used together with external speed/torque feedforward input. [Factory setting]	Immediately	Tuning
	n.1□□□	Model following control is used together with external speed/torque feedforward input.		



IMPORTANT

- Model following control is used to make optimum feedforward settings in the servo. Therefore, model following control is not used together with either the speed feedforward (V-REF) input or torque feedforward (T-REF) input. An improper speed feedforward (V-REF) input or torque feedforward (T-REF) input may result in overshooting.

Refer to 6.8.2 *Torque Feedforward* and 6.8.3 *Speed Feedforward* for details.

6.7.2 Vibration Suppression Function Operating Procedure

The following procedure is used for vibration suppression function.

Vibration suppression function is performed from the Digital Operator (option) or SigmaWin+.

Here, the operating procedure from the Digital Operator is described.

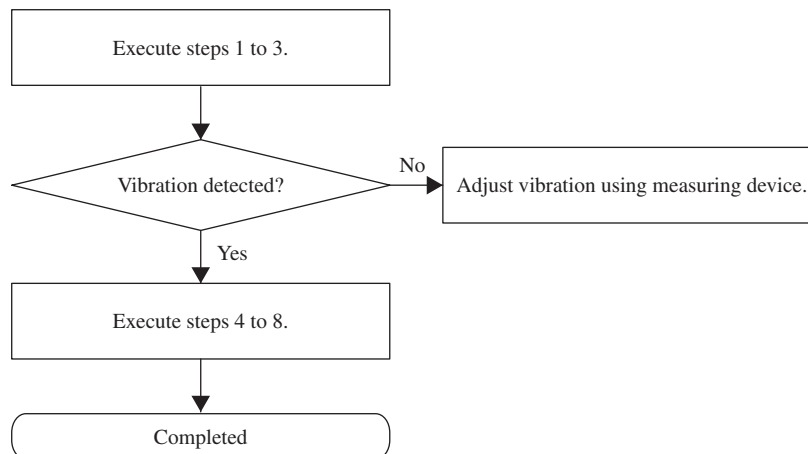
Refer to the *Σ-V series SGM□V/SGDV User's Manual, Operation of Digital Operator* (SIEPS80000055) for basic key operations of the Digital Operator.

Note: • The function cannot be performed from the Panel Operator.








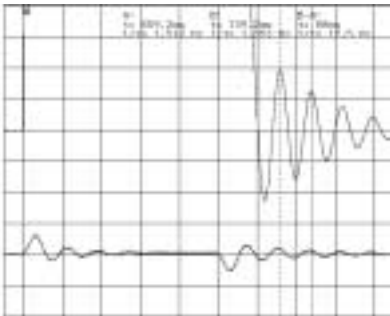








- If this function is aborted by pressing the MODE/SET Key, the SERVOPACK will continue operating until the motor comes to a stop. After the motor stops, the set value will return to the previous value.


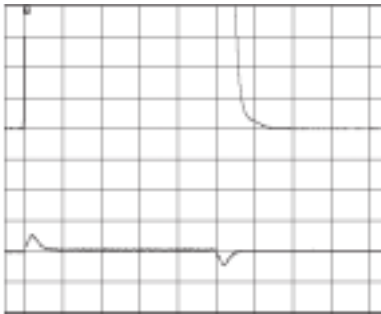



The operating flow of the vibration suppression function is shown below.

(1) Operating Flow



(2) Operating Procedure

Step	Display after Operation	Keys	Operation
1	Input a control reference and take the following steps while repeating positioning.		
2	<pre> RUN —FUNCTION— Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT Fn207:V-Monitor </pre>	  	Display the main menu of the utility function mode, and select Fn205.
3	<pre> RUN —Vib Sup— Measure f=----Hz Setting f=050.0Hz </pre>		<p>Press the  Key. The display shown on the left will appear.</p> <p>Measure f: Measurement frequency Setting f: Setting frequency [Factory-set to the set value for Pn145]</p> <p>Note: If the setting frequency and actual operating frequency are different, "Setting" will blink. The detected vibration frequency will be displayed.</p> <pre> RUN —Vib Sup— Measure f=010.4Hz Setting f=050.0Hz </pre> <p>Frequency detection will not be performed if there is no vibration or the vibration frequency is outside the range of detectable frequencies. The following screen will be displayed if vibration is not detected. If the vibration frequencies are not detected, prepare a means of detecting and measuring the vibration. When the vibration frequencies are measured, go to step 5 and manually set the measured vibration frequency.</p> <pre> RUN —Vib Sup— Measure f=----Hz Setting f=050.0Hz </pre>
4	<pre> RUN —Vib Sup— Measure f=010.4Hz Setting f=010.4Hz </pre>		<p>Press the  Key. The displayed measure f value will be displayed as the setting f value as well.</p>  <p>Error</p> <p>Torque reference</p>
5	<pre> RUN —Vib Sup— Measure f=010.4Hz Setting f=012.4Hz </pre>	   	<p>If the vibration is not completely suppressed, press the  or  Key and move the digit, and press the  or  Key to fine-tune the frequency. Skip this step and go to step 7 if the fine-tuning of the frequency is not necessary.</p> <p>Note: If the setting frequency and actual operating frequency are different, "Setting" will blink.</p>

Step	Display after Operation	Keys	Operation
6	<pre> RUN —Vib Sup— Measure f=010.4Hz Setting f=012.4Hz </pre>	DATA	<p>Press the  Key. The "Setting f" will change to usual display and the frequency currently displayed will be set for the vibration suppression function.</p>  <p>Error</p> <p>Torque reference</p>
7	<pre> DONE —Vib Sup— Measure f=-----Hz Setting f=012.4Hz </pre>	DATA	<p>Press the  Key to save the settings.</p>
8	<pre> RUN —FUNCTION— Fn204 Fn205 Fn206 Fn207 </pre>		<p>Press the  Key to complete the vibration suppression function. The screen in step 1 will appear again.</p>



IMPORTANT

No settings related to the vibration suppression function will be changed during operation.

If the motor does not stop approximately 10 seconds after the setting changes, a timeout error will result and the previous setting will be enabled again.

The vibration suppression function will be enabled when the parameter is set in step 6.

The motor response, however, will change when the motor comes to a stop with no reference input.

6.7.3 Related Parameters

The following parameters are set automatically. Manual adjustments are not required.

Parameter	Name
Pn140	Model Following Control Selection
Pn141	Model Following Control Gain
Pn145	Vibration Suppression 1 Frequency A
Pn146	Vibration Suppression 1 Frequency B

6.8 Servo Gain Adjustment Application Function

The servo gain adjustment application functions are described in this section.

The adjustment application functions are classified roughly into adjustment functions to shorten positioning time and adjustment functions to reduce vibration.

The following table shows a list of adjustment application functions.

(1) Adjustment Functions to Shorten Positioning Time

Adjustment Functions and Related Parameters	Description	Characteristics	Applicable Control Mode	Reference
Feedforward Pn109 Pn10A	Feedforward compensation for the position reference is added to the speed reference.	The system will be unstable if a large value is set, possibly resulting in overshooting or vibration.	Position	6.8.1
Torque Feedforward Pn002 Pn400 Pn415	While in position control or speed control, torque feedforward input is applied into the torque reference input terminal and added to the internal torque reference.		Speed Position	6.8.2
Speed Feedforward Pn207 Pn300 Pn307	While in position control, speed feedforward input is applied into the speed reference input terminal and added to the internal speed reference.		Position	6.8.3
Mode Switch (P/PI control switching) Pn10B Pn10C Pn10D Pn10E Pn10F	Switches from PI control to P control using the value of an internal servo variable in a parameter (torque, speed, acceleration, or position error) as a threshold value.	Enables easily switching PI/P control. Suppresses an overshooting.	Speed Position	6.8.5
Gain Switching Pn100 to Pn106 Pn141 Pn142 Pn148 Pn149 Pn401 Pn412	Manually or automatically change parameters for the position loop gain (Kv), speed loop integral time constant (Ti), position loop gain (Kp), torque reference filter time constant(Tf), model following control gain, and model following control gain compensation.	Enables easily switching gain according to the internal conditions of the SERVO-PACK. The user must select the switching conditions.	Speed Position	6.8.6

(2) Adjustment Functions to Reduce Vibration

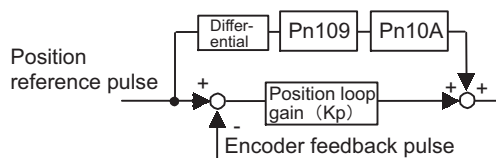
Adjustment Functions and Related Parameters	Description	Characteristics	Applicable Control Mode	Reference
Speed Reference Filter Pn307	A first order lag filter for the speed reference input.	Enables smooth operation. If a large value is set, however, the responsiveness will decrease.	Speed	5.3.4
Torque Reference Filter Pn401	Sets a filter time constant with the first order lag filter and a notch filter arranged in series to the torque reference.	Effective in almost all frequency bands. If a large value (low frequency) is set, the responsiveness will decrease.	Speed Position Torque	6.8.7
Notch Filter Pn408 Pn409 to Pn40E	Sets a Q (notch width) for each of two notch filters arranged in series with the torque reference.	Mainly effective for vibration between 500 and 2,000 Hz. Instability will result if the setting is not correct. As a utility functions for the notch filters settings, the online vibration monitor (Fn207) and EasyFFT (Fn206) functions are available.	Speed Position Torque	6.8.7

(3) Other Adjustment Functions

Adjustment Functions and Related Parameters	Description	Applicable Control Mode	Reference
Proportional Control Operation (Proportional Operation Reference)	When sending references from the host controller to the SERVOPACK, P control mode can be selected from the host controller for particular operating conditions.	Speed Position	6.8.4
Position Integral Time Constant	This function adds an integral control operation to the position loop.	Position	6.8.8
Friction Compensation Pn408	This function rectifies the viscous friction change and regular load change.	Speed Position	6.8.9

6.8.1 Feedforward Reference

Applies feedforward control compensation in position control inside the SERVOPACK. Use this parameter to shorten positioning time.



Pn109	Feedforward Gain Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1%	0	Immediately	Tuning
Pn10A	Feedforward Filter Time Constant Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 6400 (0.00 to 64.00 ms)	0.01 ms	0 (0.00 ms)	Immediately	Tuning

Note: Too high value may cause the machine to vibrate. For ordinary machines, set 80% or less in this parameter.

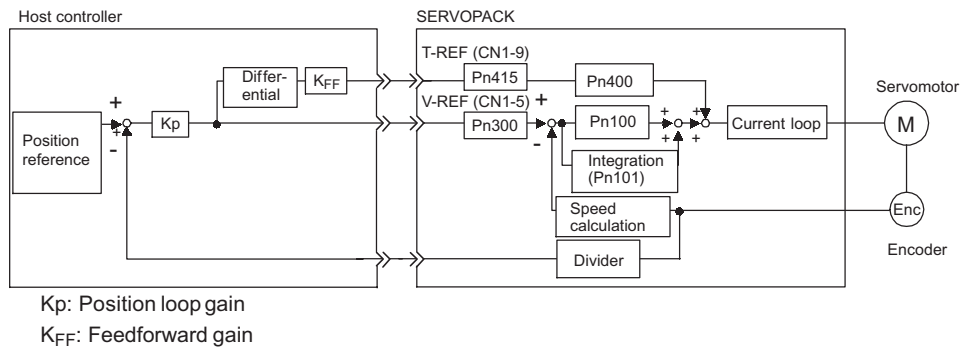
6.8.2 Torque Feedforward

The torque feedforward function is valid only in speed control and position control.

The torque feedforward function shortens positioning time, The host controller differentiates a speed reference to generate a torque feedforward reference, and inputs the torque feedforward reference together with the speed or position reference to the SERVOPACK.

(1) Connection Example

Connect a speed reference signal line to V-REF (CN1-5 and -6) and a torque feedforward reference to T-REF (CN1-9 and -10) from the host controller.



(2) Related Parameters

Torque feedforward is set using the parameters Pn002, Pn400 and Pn415.

The factory setting is Pn400 = 30. If, for example, the torque feedforward value is $\pm 3V$, then, the torque is limited to $\pm 100\%$ of the rated torque.

Parameter		Function	When Enabled	Classification
Pn002	n.□□□0	Disabled	After restart	Setup
	n.□□□2	Uses T-REF terminal for torque feedforward input.		

Pn400	Torque Reference Input Gain				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100 (1.0 to 10.0V/rated torque)	0.1 V/rated torque	30 (3.0 V/rated torque)	Immediately	Setup

- Note 1. Too high a torque feedforward value will result in overshooting or undershooting. To prevent such troubles, set the optimum value while observing the system responsiveness.
2. The torque feedforward function cannot be used with torque limiting by analog voltage reference.

Pn415	Filter Time Constant				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	0	Immediately	Setup

- The following settings are required if model following control is used together with the speed feedforward (V-REF) input and torque feedforward (T-REF) input.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□	Model following control is not used together with external speed/torque feedforward input.	Immediately	Tuning
	n.1□□□	Model following control is used together with external speed/torque feedforward input.		



IMPORTANT

Model following control sets the optimum feed forward value in the servo. Therefore, usually model following control does not use the speed feedforward (V-REF) and the torque feedforward (T-REF) together.
If the speed feedforward (V-REF) value and torque feedforward (T-REF) value are improperly input, overshooting may occur.

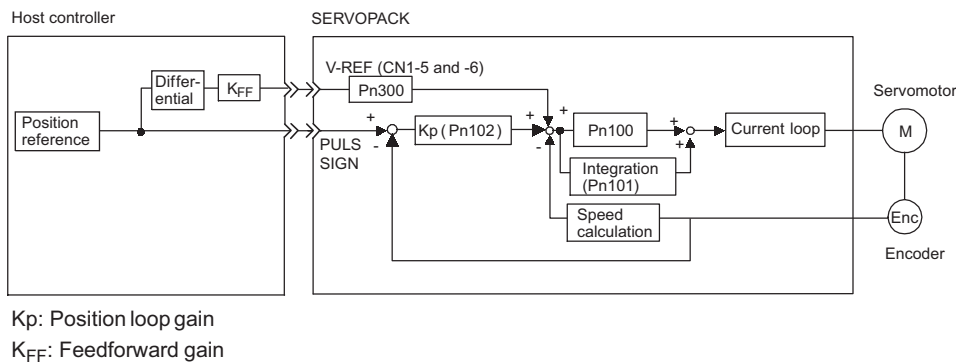
6.8.3 Speed Feedforward

The speed feedforward function is valid only in position control.

The speed feedforward function is used to shorten positioning time. The host controller differentiates the position reference to generate the speed feedforward reference, and inputs the speed feedforward reference together with the position reference to the SERVOPACK.

(1) Connection Example

Connect a position reference signal line to PULS and SIGN (CN1-7, -8, -11, and -12) and a speed feedforward reference signal line to V-REF (CN1-5 and -6) from the host controller.



(2) Related Parameters

Speed feedforward value is set using the parameters Pn207 and Pn300.

The factory setting is Pn300 = 600. If, for example, the speed feedforward value is $\pm 6V$, then the speed is limited to the rated speed.

Parameter		Function	When Enabled	Classification
Pn207	n.□□0□	Disabled	After restart	Setup
	n.□□1□	Uses V-REF terminal for speed feedforward input.		

Pn300	Speed Reference Input Gain				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	150 to 3000 (1.50 to 30.00 V/rated speed)	0.01 V/rated speed	600 (6.00 V/rated torque)	Immediately	Setup

Note: Too high a speed feedforward value will result in overshooting or undershooting. To prevent such troubles, set the optimum value while observing the system responsiveness.

- The following settings are required if model following control is used together with the speed feedforward (V-REF) input and torque feedforward (T-REF) input.

Parameter	Function	When Enabled	Classification
Pn140	n.0□□□ Model following control is not used together with external speed/torque feedforward input. [Factory setting]	Immediately	Tuning
	n.1□□□ Model following control is used together with external speed/torque feedforward input.		

**IMPORTANT**

Model following control sets the optimum feedforward value in the servo. Therefore, usually model following control does not use the speed feedforward (V-REF) and the torque feedforward (T-REF) together.

If the speed feedforward (V-REF) value and torque feedforward (T-REF) value are improperly input, overshooting may occur.

6.8.4 Proportional Control Operation (Proportional Operation Reference)

When sending references from the host controller to the SERVOPACK, proportional control mode can be selected from the host controller for particular operating conditions.

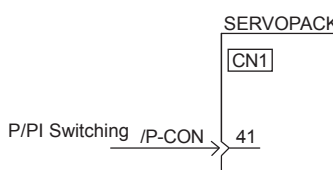
Proportional control operation is set using parameter Pn000 (1st digit) and input signal (/P-CON).

(1) Connection Example

Input signal /P-CON (CN1-41) is used to select PI control or P control.

For the control mode setting, refer to (2) *Related Parameters*.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-41	OFF (High level)	Switches to PI control.
			ON (Low level)	Switches to P control.

Parameter		Control Mode		When Enabled	Classification
Pn000	n.□□0□	Speed Control	<p>Input signal /P-CON (CN1-41) is used to select PI control or P control.</p> <div><p>P/PI Switching /P-CON → 41</p><p>SERVOPACK</p><p>CN1</p></div> <p>CN1-41 is OFF (high level): PI control CN1-41 is ON (low level): P control</p>	After restart	Setup
	n.□□1□	Position Control			

(2) Related Parameters

Proportional control operation is enabled when the control mode is set to speed or position control.

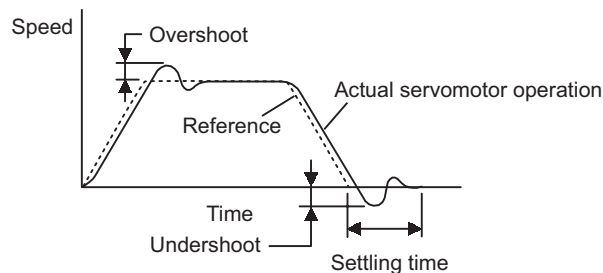
Parameter	Contents	Proportional Control Enabled/ Disabled	/P-CON Signal Allocation	When Enabled	Classification
Pn000	n.□□0□	Speed control (analog reference)	Enabled	Not required	After restart Setup
	n.□□1□	Position control (pulse train reference)	Enabled	Not required	
	n.□□2□	Torque control (analog reference)	Disabled		
	n.□□3□	Internal set speed control (contact reference)	Enabled	Required	
	n.□□4□	Internal set speed control (contact reference)⇔ Speed control (analog reference)	Enabled	Required	
	n.□□5□	Internal set speed control (contact reference)⇔ Position control (pulse train reference)	Enabled	Required	
	n.□□6□	Internal set speed control (contact reference)⇔ Torque control (analog reference)	Enabled	Required	
	n.□□7□	Position control (pulse train reference)⇔ Speed control (analog reference)	Enabled	Required	
	n.□□8□	Position control (pulse train reference)⇔ Torque control (analog reference)	Enabled	Required	
	n.□□9□	Torque control (analog reference)⇔ Speed control (analog reference)	Enabled	Required	
	n.□□A□	Speed control (analog reference)⇔ Zero clamp	Enabled	Required	
	n.□□B□	Position control (pulse train reference)⇔ Position control (inhibit)	Enabled	Required	

6.8.5 Using the Mode Switch (P/PI Switching)

Use the mode switch (P/PI switching) function in the following cases:

P Control: Proportional control
PI Control: Proportional/integral control

- To suppress overshooting during acceleration or deceleration (for speed control)
- To suppress undershooting during positioning and reduce the settling time (for position control)



The mode switch function automatically switches the speed control mode between PI control mode and P control mode based on a comparison between the servo's internal value and a user-set detection level shown in (1) *Related Parameters*.

<Supplementary Information>

- Monitoring the speed response waveform and position error waveform is required for adjustment.
- If I-P control is selected for speed loop control, the mode switching function will be disabled.

(1) Related Parameters

Select the conditions to switch modes (P or PI control switching) by using the following parameters.

Parameter		Mode Switch Selection	Parameter Containing Detection Point Setting	When Enabled	Classification
Pn10B	n.□□□0	Uses a torque reference level for detection point. [Factory setting]	Pn10C	Immediately	Setup
	n.□□□1	Uses a speed reference level for detection point.	Pn10D		
	n.□□□2	Uses an acceleration level for detection point.	Pn10E		
	n.□□□3	Uses an position error pulse level for detection point.	Pn10F		
	n.□□□4	Does not use mode switch function.	—		

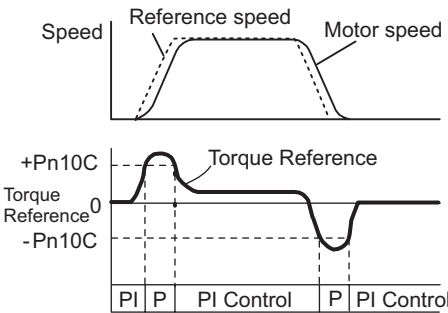
■ Parameters to set the detection point

Pn10C	Mode Switch (Torque Reference) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	200	Immediately	Tuning
Pn10D	Mode Switch (Speed Reference) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min ⁻¹	0	Immediately	Tuning
Pn10E	Mode Switch (Acceleration) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 30000	1 min ⁻¹ /s	0	Immediately	Tuning
Pn10F	Mode Switch (Position Error) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 reference unit	0	Immediately	Tuning

Mode switch functions according to the detection point are as follows.

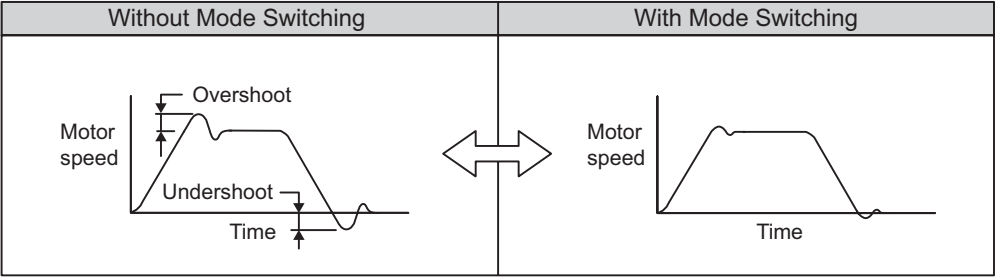
■ Using the Torque Reference Level to Switch Modes (Factory Setting)

With this setting, the speed loop is switched to P control when the value of torque reference input exceeds the torque set in Pn10C. The factory setting for the torque reference detection point is 200% of the rated torque.



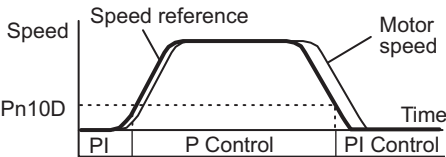
<Example>

If the mode switch function is not being used and the SERVOPACK is always operated with PI control, the speed of the motor may overshoot or undershoot due to torque saturation during acceleration or deceleration. The mode switch function suppresses torque saturation and eliminates the overshooting or undershooting of the motor speed.



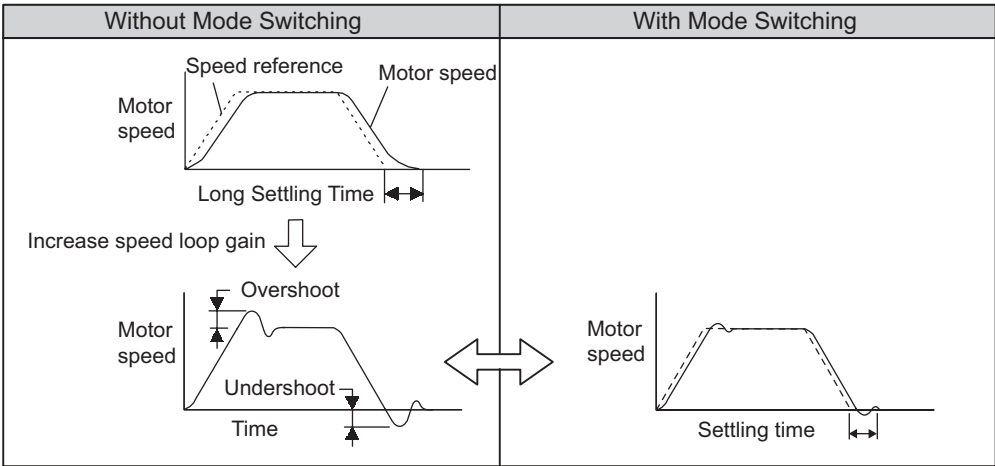
■ Using the Speed Reference Level to Switch Modes

With this setting, the speed loop is switched to P control when the value of speed reference input exceeds the speed set in Pn10D.



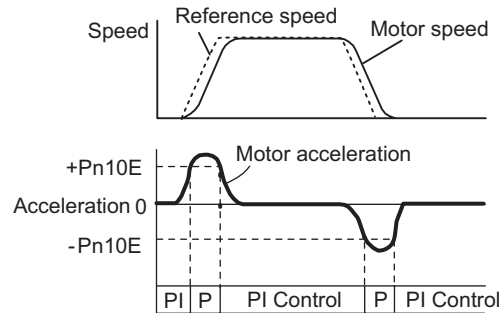
<Example>

In this example, the mode switch is used to reduce the settling time. It is necessary to increase the speed loop gain to reduce the settling time. Using the mode switch suppresses overshooting and undershooting when speed loop gain is increased.



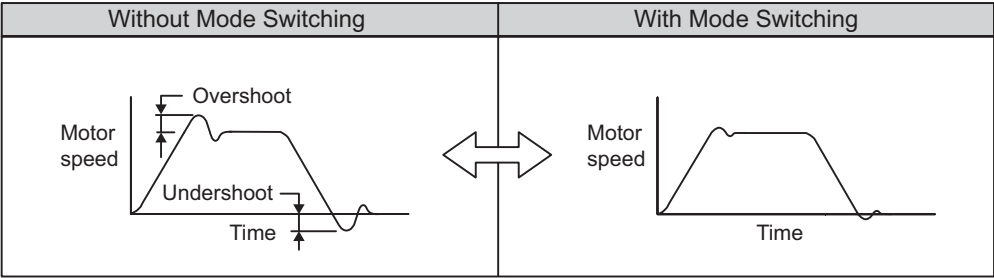
■ Using the Acceleration Level to Switch Modes

With this setting, the speed loop is switched to P control when the speed reference exceeds the acceleration rate set in Pn10E.



<Example>

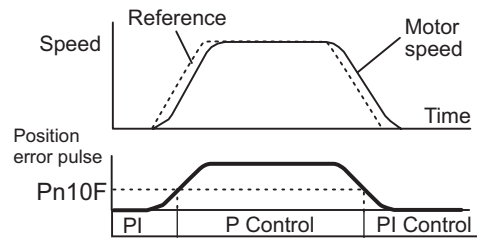
If the mode switch function is not being used and the SERVOPACK is always operated with PI control, the speed of the motor may overshoot or undershoot due to torque saturation during acceleration or deceleration. The mode switch function suppresses torque saturation and eliminates the overshooting or undershooting of the motor speed.



■ Using the Position Error Pulse Level to Switch Modes

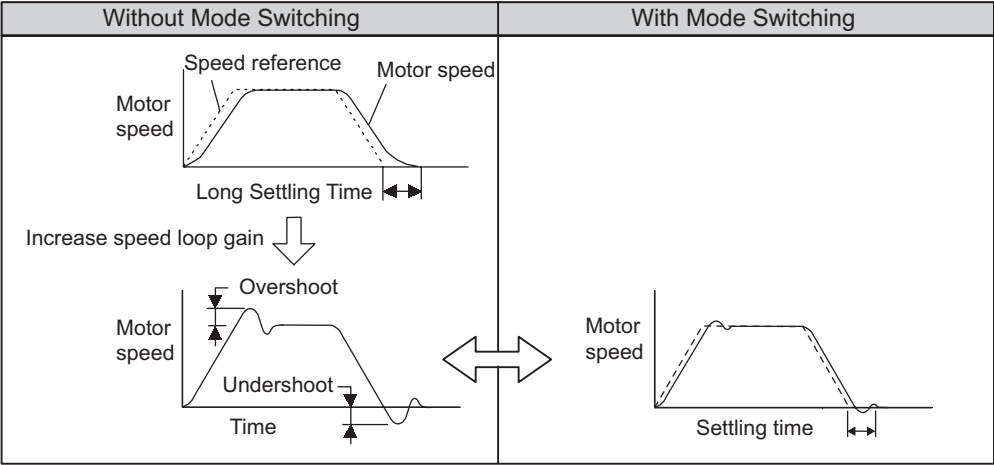
This setting is effective with position control only.

With this setting, the speed loop is switched to P control when the position error pulse exceeds the value set in Pn10F.



<Example>

In this example, the mode switch is used to reduce the settling time. It is necessary to increase the speed loop gain to reduce the settling time. Using the mode switch suppresses overshooting and undershooting when speed loop gain is increased.



6.8.6 Switching Gain Settings

Two gain switching functions are available, manual switching and automatic switching. The manual switching function uses an external input signal to switch gains, and the automatic switching function switches gains automatically.

For the gain combinations for switching, refer to (1) *Gain Combinations for Switching*.

For the manual gain switching, refer to (2) *Manual Gain Switching*.

For the automatic gain switching, refer to (3) *Automatic Gain Switching*.

(1) Gain Combinations for Switching

Setting	Speed Loop Gain	Speed Loop Integral Time Constant	Position Loop Gain	Torque Reference Filter	Model Following Control Gain	Model Following Control Gain Compensation	Friction Compensation Gain
Gain Setting 1	Pn100 Speed Loop Gain	Pn101 Speed Loop Integral Time Constant	Pn102 Position Loop Gain	Pn401 Torque Reference Filter Time Constant	Pn141 Model Following Control Gain	Pn142 Model Following Control Gain Compensation	Pn121 Friction Compensation Gain
Gain Setting 2	Pn104 2nd Speed Loop Gain	Pn105 2nd Speed Loop Integral Time Constant	Pn106 2nd Position Loop Gain	Pn412 2nd Torque Reference Filter Time Constant	Pn148 2nd Model Following Control Gain	Pn149 2nd Model Following Control Gain Compensation	Pn122 2nd Gain for Friction Compensation

Note: The model following control gain and model following control compensation gain can be changed only manually.

(2) Manual Gain Switching

Manual gain switching uses an external input signal (/G-SEL1) to switch gain setting 1 and gain setting 2.

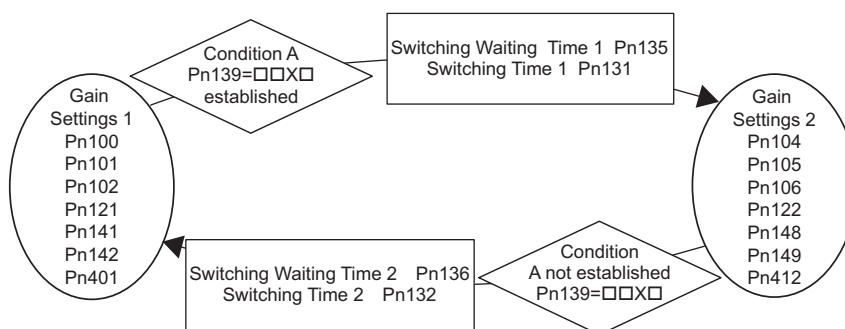
Parameter Setting	Switching Setting	Setting
Pn139=n.□□□0 Manual Gain Switching	OFF (H level)	Gain Setting 1
	ON (L level)	Gain Setting 2

(3) Automatic Gain Switching

Automatic gain switching is performed under the following settings and conditions.

Parameter Setting	Switching Setting	Setting	Switching Wait Time	Switching Time
Pn139=n.□□□2 (Automatic Switching Pattern 1)	Condition A established. Pn139=□□X□	Gain Setting 1 to Gain Setting 2	Gain Switching Waiting Time 1 Pn135	Gain Switching Time 1 Pn131
	Condition A not established. Pn139=□□X□	Gain Setting 2 to Gain Setting 1	Gain Switching Waiting Time 2 Pn136	Gain Switching Time 2 Pn132

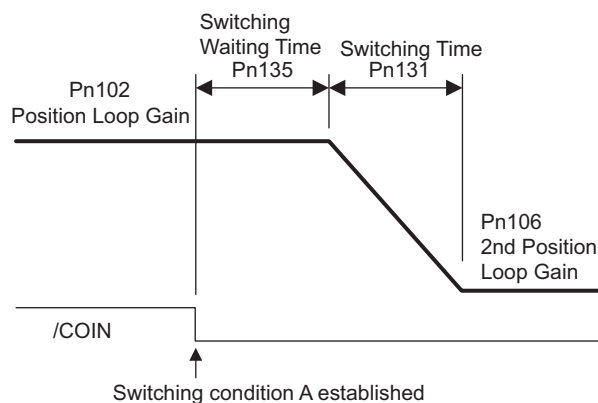
Automatic switching pattern 1 (Pn139.0 = 2)



Note: For the gains if the control is changed from position control to another method using the control switching function, refer to switching condition-A selection described in (5) *Parameters for Automatic Gain Switching*.

■ Relationship between the Gain Switching Waiting Time and the Switching Time Constant

In this example, the "positioning completion signal (/COIN) ON" condition is set as condition A for automatic gain switching pattern 1. The position loop gain is switched from the value in Pn102 (Position Loop Gain) to the value in Pn106 (2nd Position Loop Gain). When the /COIN signal goes ON, the switching operation begins after the waiting time set in Pn135. The switching operation changes the position loop gain linearly from Pn102 to Pn106 over the switching time set in Pn131.



<Supplementary Information>

Automatic gain switching is available in the PI and I-P controls.

(4) Related Parameters

Parameter		Function	When Enabled	Classification
Pn139	n.□□□0	Manual gain switching [Factory setting]	Immediately	Tuning
	n.□□□2	Automatic gain switching pattern 1		

Note: n.□□□1 is reserved. Do not set.

Pn104	2nd Speed Loop Gain Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000 (1.0 to 2000.0 Hz)	0.1 Hz	400 (40.0 Hz)	Immediately	Tuning
Pn105	2nd Speed Loop Integral Time Constant Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	15 to 51200 (0.15 to 512.00 ms)	0.01 ms	2000 (20.00 ms)	Immediately	Tuning
Pn106	2nd Position Loop Gain Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000 (1.0 to 2000.0/s)	0.1/s	400 (40.0/s)	Immediately	Tuning
Pn148	2nd Model Following Control Gain Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1/s	500	Immediately	Tuning
Pn149	2nd Model Following Control Gain Compensation Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	500 to 2000	0.1 %	1000	Immediately	Tuning
Pn412	2nd Torque Reference Filter Time Constant Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535 (0.00 to 655.35 ms)	0.01 ms	100 (1.00 ms)	Immediately	Tuning

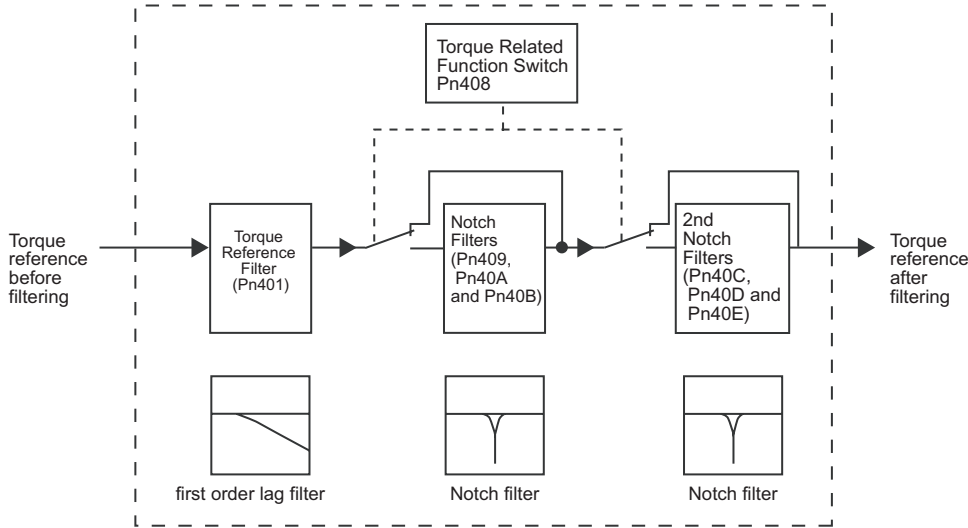
(5) Parameters for Automatic Gain Switching

Pn122	2nd Gain for Friction Compensation Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 1000	1 %	100	Immediately	Tuning
Pn131	Gain Switching Time 1 Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning
Pn132	Gain Switching Time 2 Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning
Pn135	Gain Switching Waiting Time 1 Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning
Pn136	Gain Switching Waiting Time 2 Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning

Parameter		Function			When Enabled	Classification
		Position Control		Other than Position Control		
Pn139	n.□□0□	Switching condition A	Positioning completion signal (/COIN) ON	Fixed in gain setting 1	Immediately	Tuning
	n.□□1□		Positioning completion signal (/COIN) OFF	Fixed in gain setting 2		
	n.□□2□		NEAR signal (/NEAR) ON	Fixed in gain setting 1		
	n.□□3□		NEAR signal (/NEAR) OFF	Fixed in gain setting 2		
	n.□□4□		No output for position reference filter and reference pulse input OFF	Fixed in gain setting 1		
	n.□□5□		Position reference pulse input ON	Fixed in gain setting 2		

6.8.7 Torque Reference Filter

As shown in the following diagram, the torque reference filter contains first order lag filter and notch filters arrayed in series, and each filter operates independently. The notch filters can be enabled and disabled with the Pn408.



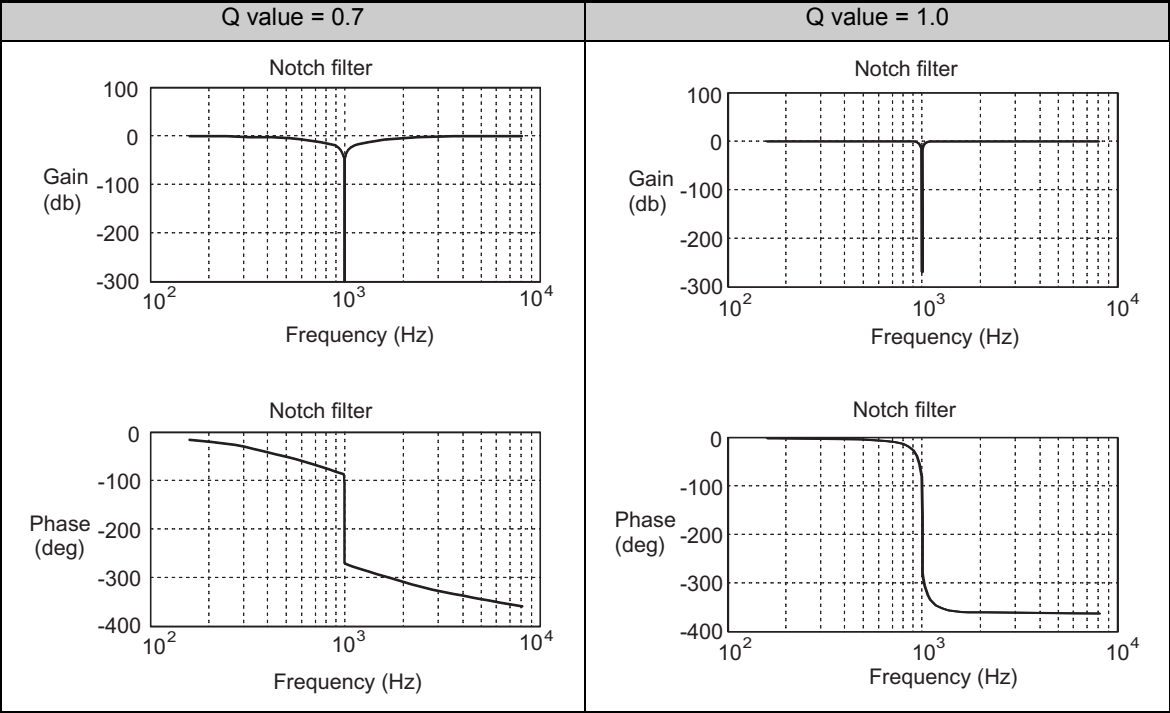
(1) Torque Reference Filter

If you suspect that machine vibration is being caused by the servodrive, try adjusting the filter time constants. This may stop the vibration. The lower the value, the better the speed control response will be, but there is a lower limit that depends on the machine conditions.

Pn401	Torque Reference Filter Time Constant <div><div>Speed</div><div>Position</div><div>Torque</div></div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535 (0.00 to 655.35 ms)	0.01 ms	100 (1.00 ms)	Immediately	Tuning

(2) Notch Filter

The notch filter can eliminate specific frequency vibration generated by sources such as resonances of ball screw axes. The notch filter puts a notch in the gain curve at the specific vibration frequency. The frequency components near the notch frequency can be eliminated with this characteristic. A higher notch filter Q value produces a sharper notch and phase delay.



Set the notch filter enabled/disabled with Pn408.

Parameter		Function	When Enabled	Classification
Pn408	n.□□□0	1st notch filter disabled. [Factory setting]	Immediately	Tuning
	n.□□□1	1st notch filter enabled.		
	n.□0□□	2nd notch filter disabled. [Factory setting]		
	n.□1□□	2nd notch filter enabled.		

Set the machine's vibration frequency in the parameter of a notch filter that is being used.

Pn409	1st Notch Filter Frequency Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning
Pn40A	1st Notch Filter Q Value Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning
Pn40B	1st Notch Filter Depth Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning
Pn40C	2nd Notch Filter Frequency Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning
Pn40D	2nd Notch Filter Q Value Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning
Pn40E	2nd Notch Filter Depth Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning



IMPORTANT

- Sufficient precautions must be taken when setting the notch frequencies. Do not set the notch frequencies (Pn409 or Pn40C) that is close to the speed loop's response frequency. Set the frequencies at least four times higher than the speed loop's response frequency. Setting the notch frequency too close to the response frequency may cause vibration and damage the machine.
- Change the Notch Filter Frequency (Pn409 or Pn40C) only when the motor is stopped. Vibration may occur if the notch filter frequency is changed when the motor is rotating.

6.8.8 Position Integral Time Constant

This function adds an integral control operation to the position loop. It is effective for electronic cam or electronic shaft applications.

Pn11F	Position Integral Time Constant Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 50000 (0.0 to 5000.0 ms)	0.1 ms	0 (0.0 ms)	Immediately	Tuning

6.8.9 Friction Compensation

Friction compensation rectifies the viscous friction change and regular load change.

<Supplementary Information>

The factors causing load changes include grease viscosity resistance changes resulting from temperature changes in addition to viscous friction and regular load changes resulting from equipment variations and secular changes.

Friction compensation is automatically adjusted by the following settings.

1. The friction compensation function and advanced autotuning level are set to tuning level 2 or 3.
2. The one-parameter tuning level is set to 2 or 3.

Refer to the following description and make adjustments only if manual adjustment is required.

(1) Required Parameter Settings


The following parameter settings are required to use friction compensation.

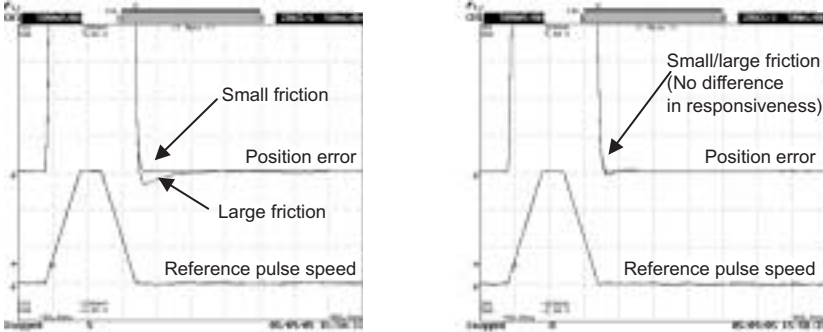
Parameter		Function	When Enabled	Classification
Pn408	n.0□□□	Does not use friction compensation. [Factory setting]	Immediately	Setup
	n.1□□□	Uses friction compensation.		

Pn121	Friction Compensation Gain <div>Speed</div> <div>Position</div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 10000	1 %	100	Immediately	Tuning
Pn123	Friction Compensation Coefficient <div>Speed</div> <div>Position</div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1 %	0	Immediately	Tuning
Pn124	Friction Compensation Frequency Correction <div>Speed</div> <div>Position</div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.1 Hz	0	Immediately	Tuning
Pn121	Friction Compensation Gain Correction <div>Speed</div> <div>Position</div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1000	1 %	100	Immediately	Tuning

(2) Operating Procedure for Friction Compensation

The following procedure is used for friction compensation.

 CAUTION	
Before using friction compensation, set the moment of inertia ratio (Pn103) as correctly as possible. If the wrong moment of inertia ratio is set, vibration may result.	

Step	Operation
1	<p>Set the following parameters for friction compensation to the factory setting as follows.</p> <p>Friction compensation gain (Pn121): 100</p> <p>Friction compensation coefficient (Pn123): 0</p> <p>Friction compensation frequency correction (Pn124): 0</p> <p>Friction compensation gain correction (Pn125): 100</p> <p>Note: Always use the factory-set values for friction compensation frequency correction (Pn124) and friction compensation gain correction (Pn125).</p>
2	<p>To check the effect of friction compensation, increase the friction compensation coefficient (Pn123).</p> <p>Note: The upper limit of the friction compensation coefficient (Pn123) is 95%.</p>
3	<p>If the friction compensation is insufficient in step 2, increase the set value in Pn121 to where the equipment does not vibrate.</p> <p>Note: The SERVOPACK may vibrate if Pn121 is set to a value the same as or higher than the resonance frequency of the equipment.</p> <p>If necessary, adjust Pn121 in increments of 10.0 Hz.</p> <p>Effect of Adjustment</p> <p>The following graph shows the responsiveness with and without proper adjustment.</p> <div></div> <p>Without friction compensation With friction compensation</p> <p>Effect of Adjustment Parameters</p> <p>Pn121: Friction Compensation Gain</p> <p>This parameter sets the responsiveness for external disturbance. The higher the set value is, the better the responsiveness will be. If the equipment has a resonance frequency, however, vibration may result if the set value is the same as or high than the resonance frequency.</p> <p>Pn123: Friction Compensation Coefficient</p> <p>This parameter sets the effect of friction compensation. The higher the set value is, the more effective friction compensation will be. If the set value is excessively high, however, the vibration will occur easily. Usually, set the value to 95% or less.</p>

Utility Functions (Fn□□□)

7.1 List of Utility Functions	7-2
7.2 Alarm History Display (Fn000)	7-4
7.3 JOG Operation (Fn002)	7-5
7.4 Origin Search (Fn003)	7-6
7.5 Program JOG Operation (Fn004)	7-8
7.6 Initializing Parameter Settings (Fn005)	7-13
7.7 Clearing Alarm History (Fn006)	7-14
7.8 Manual Zero-adjustment of Analog Monitor Output (Fn00C)	7-15
7.9 Manual Gain-adjustment of Analog Monitor Output (Fn00D)	7-17
7.10 Automatic Offset-Signal Adjustment of the Motor Current Detection (Fn00E)	7-19
7.11 Manual Offset-Signal Adjustment of the Motor Current Detection (Fn00F)	7-20
7.12 Write Prohibited Setting (Fn010)	7-21
7.13 Servomotor Model Display (Fn011)	7-23
7.14 Software Version Display (Fn012)	7-24
7.15 Resetting Configuration Error of Option Card (Fn014)	7-25
7.16 Vibration Detection Level Initialization (Fn01B)	7-26
7.17 Display of SERVOPACK and Servomotor ID (Fn01E)	7-28
7.18 Display of Servomotor ID in Feedback Option Card (Fn01F)	7-29
7.19 EasyFFT (Fn206)	7-30
7.20 Online Vibration Monitor (Fn207)	7-34
7.21 Origin Setting (Fn020)	7-36
7.22 Software Reset (Fn030)	7-37

7.1 List of Utility Functions

Utility functions are used to execute parameters related to servomotor operation and adjustment.

When a utility function is executed, the Panel Operator displays a corresponding parameter number beginning with Fn.

The following table shows the parameters in the utility mode and reference section.

Function No.	Function	Operation from the Panel Operator	Operation from the Digital Operator or SigmaWin+	Reference Section
Fn000	Alarm traceback data display	○	○	7.2
Fn002	JOG operation	○	○	7.3
Fn003	Origin search	○	○	7.4
Fn004	Program JOG operation	○	○	7.5
Fn005	Initializes parameter settings	○	○	7.6
Fn006	Clears alarm traceback data	○	○	7.7
Fn008	Absolute encoder multi-turn reset and encoder alarm reset	○	○	5.9.5
Fn009	Automatic tuning of analog (speed, torque) reference offset	○	○	5.3.2 5.5.2
Fn00A	Manual servo tuning of speed reference offset	○	○	5.3.2
Fn00B	Manual servo tuning of torque reference offset	○	○	5.5.2
Fn00C	Manual zero-adjustment of analog monitor output	○	○	7.8
Fn00D	Manual gain-adjustment of analog monitor output	○	○	7.9
Fn00E	Automatic offset-adjustment of motor current detection signal	○	○	7.10
Fn00F	Manual offset-adjustment of motor current detection signal	○	○	7.11
Fn010	Write prohibited setting	○	○	7.12
Fn011	Checks servomotor models	○	○	7.13
Fn012	Software version display	○	○	7.14
Fn013	Multi-turn limit value setting change when a Multi-turn Limit Disagreement alarm occurs	○	○	5.9.8
Fn014	Resets configuration error of option card	○	○	7.15
Fn01B	Initializes vibration detection level	○	○	7.16
Fn01E	SERVOPACK and servomotor ID Display	×	○	7.17
Fn01F	Display of servomotor ID for feedback option	×	○	7.18
Fn200	Tuning-less level setting	○	○	6.3.2
Fn201	Advanced autotuning	×	○	6.4.2
Fn202	Advanced autotuning by reference	×	○	6.5.2
Fn203	One-parameter tuning	○*	○	6.6.2
Fn204	Anti-resonance control adjustment function	×	○	6.7.2
Fn205	Vibration suppression function	×	○	6.7.2
Fn206	EasyFFT	○	○	7.19
Fn207	Online vibration monitor	○	○	7.20
Fn020	Origin setting	×	○	7.21
Fn030	Software reset	○	○	7.22

○: Available ×: Not available

* There are functional limitations if the function is executed on the Panel Operator.

- Note 1. If the Panel Operator displays "no_oP" when the above function is executed, the write prohibited setting may be enabled. Refer to *7.12 Write Prohibited Setting (Fn010)* for details.
2. The Panel Operator will display "no_oP" if the user attempts to execute a utility function not supported by the Panel Operator.

7.2 Alarm History Display (Fn000)

This function displays the alarm history to check the ten latest alarms.

The latest ten alarm numbers and time stamps* can be checked.

* Time Stamps

A function that measures the ON times of the control power supply and main circuit power supply in 100-ms units and displays the operating time when an alarm occurs. The time stamp operates around the clock for approximately 13 years.

<Example of Time Stamps>

If 36000 is displayed,

360000 [ms] = 3600 [s]

= 60 [min]

= 1 [h] Therefore, the number of total number of operating hours is 1.

Follow the steps below to confirm the alarm histories.


Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select "Alarm History Display (Fn000)." If a number other than Fn000 is displayed, press the UP Key or DOWN Key to set Fn000.
2			Press the DATA/SHIFT Key for approximately one second. The latest alarm data is displayed.
3	 Alarm Sequence Number The higher the number, the older the alarm date. Alarm Code See the alarm table.		Press the DOWN Key to display one older alarm data. (To display one newer alarm data, press the UP Key.) The higher the leftmost digit, the older the alarm data.
4			Press the DATA/SHIFT Key for less than one second. The lower four digits of Time Stamp are displayed.
5			Press the DATA/SHIFT Key for less than one second. The middle four digits of Time Stamp are displayed.
6			Press the DATA/SHIFT Key for less than one second. The higher two digits of Time Stamp are displayed.
7			Press the DATA/SHIFT Key for less than one second. The alarm number is displayed again.
8			Press the DATA/SHIFT Key for approximately one second. "Fn000" is displayed again.

<Supplementary Information>

- If the same alarm occurs more than one hour later, this alarm is also saved.
- The display "□.---" means no alarm occurs.
- Delete the alarm history using the parameter Fn006. The alarm history is not cleared on alarm reset or when the SERVOPACK power is turned OFF.

7.3 JOG Operation (Fn002)

JOG operation is used to check the operation of the servomotor under speed control without connecting the SERVOPACK to the host.

 **CAUTION**

While the SERVOPACK is in JOG operation, the overtravel function will be disabled. Consider the operating range of the machine when performing JOG operation for the SERVOPACK.

(1) Settings before Operation




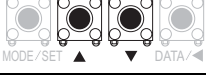


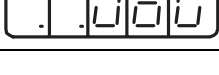





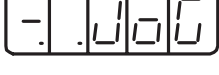



The following settings are required before performing JOG operation.

- If the S-ON input signal is ON, turn OFF the signal.
- If Pn50A.1 is set to 7 (i.e., the servo is always ON), change the value.
- Considering the operating range of the machine, set the JOG operation speed in Pn304.

Pn304	JOG Speed				Classification	
			Speed	Position		Torque
	Setting Range	Setting Unit	Factory Setting	When Enabled		
	0 to 10000	1 min ⁻¹	500	Immediately	Setup	


(2) Operating Procedure

Follow the steps below to set the JOG speed. The following example is given when the rotating direction of servomotor is set as Pn000.0=0(counterclockwise direction is regarded as the forward run).

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn002.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Press the MODE/SET Key. The servo turns ON.
5			The servomotor will rotate at the present speed set in Pn304 while the UP Key (for forward rotation) or DOWN Key (for reverse rotation) is pressed. <div> Forward  Reverse</div>
6			The servo will be turned OFF (i.e., the motor will be turned OFF) when the MODE/SET Key is pressed. <Supplementary Information> The servo can be turned OFF by pressing the DATA/SHIFT Key for approximately one second.
7			Press the DATA/SHIFT Key for approximately one second. "Fn002" is displayed again.

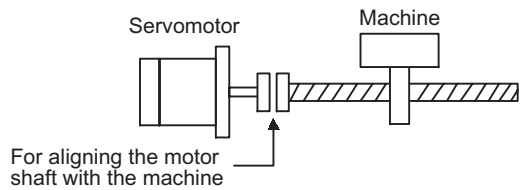
7.4 Origin Search (Fn003)

The origin search is designed to position the origin pulse position of the incremental encoder (phase-C) and to clamp at the position. This mode is used when the motor shaft needs to be aligned to the machine.


CAUTION

- Perform origin searches without connecting the coupling.
The forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are not effective in origin search mode.

Execute the origin search without connecting the couplings.
Motor speed at the time of execution: 60 min⁻¹



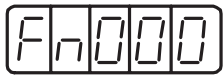

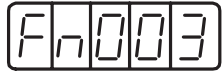
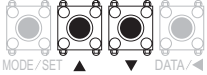





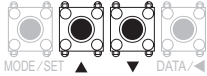
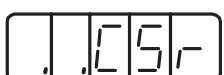
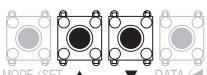
(1) Settings before Operation

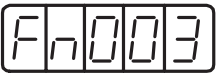

The following settings are required before performing an origin search.

- If the S-ON input signal is ON, turn OFF the signal.
- If Pn50A.1 is set to 7 (i.e., the servo is always ON), change the value.

(2) Operating Procedure

Follow the steps below to execute the origin search.

Step	Display after Operation	Keys	Description											
1			Press the MODE/SET Key to select the utility function mode.											
2			Press the UP or DOWN Key to select the Fn003.											
3			Press the DATA/SHIFT Key for approximately one second, and the display shown on the left appears.											
4			Press the MODE/SET Key. The servomotor is turned to Servo ON.											
5			<div>Pressing the UP Key will rotate the motor in the forward direction. Pressing the DOWN Key will rotate the motor in the reverse direction. The rotation of the servomotor changes according to the setting of Pn000.0.</div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">Parameter</th><th>UP key (Forward)</th><th>DOWN key (Reverse)</th></tr> </thead> <tbody> <tr> <td rowspan="2">Pn000</td><td>n.□□□0</td><td>CCW</td><td>CW</td></tr> <tr> <td>n.□□□1</td><td>CW</td><td>CCW</td></tr> </tbody> </table> <div>Note: Direction when viewed from the load of the servomotor.</div>	Parameter		UP key (Forward)	DOWN key (Reverse)	Pn000	n.□□□0	CCW	CW	n.□□□1	CW	CCW
Parameter		UP key (Forward)	DOWN key (Reverse)											
Pn000	n.□□□0	CCW	CW											
	n.□□□1	CW	CCW											
6	 Display blinks.		Press the UP or DOWN Key. When the servomotor origin search is completed, the display blinks. At this moment, the motor is servo-locked at the origin pulse position.											

Step	Display after Operation	Keys	Description
7			Press the DATA/SHIFT Key for approximately one second. "Fn003" is displayed again.

7.5 Program JOG Operation (Fn004)

The Program JOG Operation is a utility function, that allows continuous automatic operation determined by the preset operation pattern, movement distance, movement speed, acceleration/deceleration time, number of time of repetitive operations.

This function can be used to move the servomotor without it having to be connected to a host controller for the machine as a trial operation in JOG operation mode. Program JOG Operation can be used to confirm the operation and for simple positioning operations.

(1) Settings before Operation

The following settings are required before performing program JOG operation.

- Set correctly the machine operation range and safe operation speed in the parameters such as "program JOG operation movement distance" and "program JOG movement speed."
- The SERVOPACK must be in Servo Ready status to execute this function.
- If the Servo-ON input signal (/S-ON) is ON, turn it OFF.
- Release the Servo-ON signal mask if the parameter Pn 50A.1 is set to 7, and the Servo has been set to always be ON.

(2) Precautions

- Control is position control during program JOG operation. However, the pulse reference input to the SERVOPACK is inhibited (in /INHIBIT status) and no pulse reference input is accepted.

<Supplementary Information>

- The overtravel function is enabled in this function.
- When an absolute encoder is used, input is not necessary since SEN signal is always enabled.
- Other functions that are applicable for position control, such as position reference filter, can be used.

(3) Related Parameters

Pn530	Program JOG Operation Related Switch Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	—	—	0000	Immediately	
Pn531	Program JOG Movement Distance Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	1 to 1073741824(2 ³⁰)	1 Reference unit	32768	Immediately	
Pn533	Program JOG Movement Speed Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	1 to 10000	1 min ⁻¹	500	Immediately	
Pn534	Program JOG Acceleration/Deceleration Time Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	2 to 10000	1 ms	100	Immediately	
Pn535	Program JOG Waiting Time Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	0 to 10000	1 ms	100	Immediately	
Pn536	Number of Times of Program JOG Movement Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	1 to 1000	1 time	1	Immediately	

Parameter		Contents	Factory Setting
Pn530	n.□□□0	(Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536	0
	n.□□□1	(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536	
	n.□□□2	(Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536 (Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536	
	n.□□□3	(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536 (Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536	
	n.□□□4	(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536	
	n.□□□5	(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536	

Note: For details of Pn530, refer to (4) *Setting Infinite Time Operation* and (5) *Program Operation Patterns*.

(4) Setting Infinite Time Operation

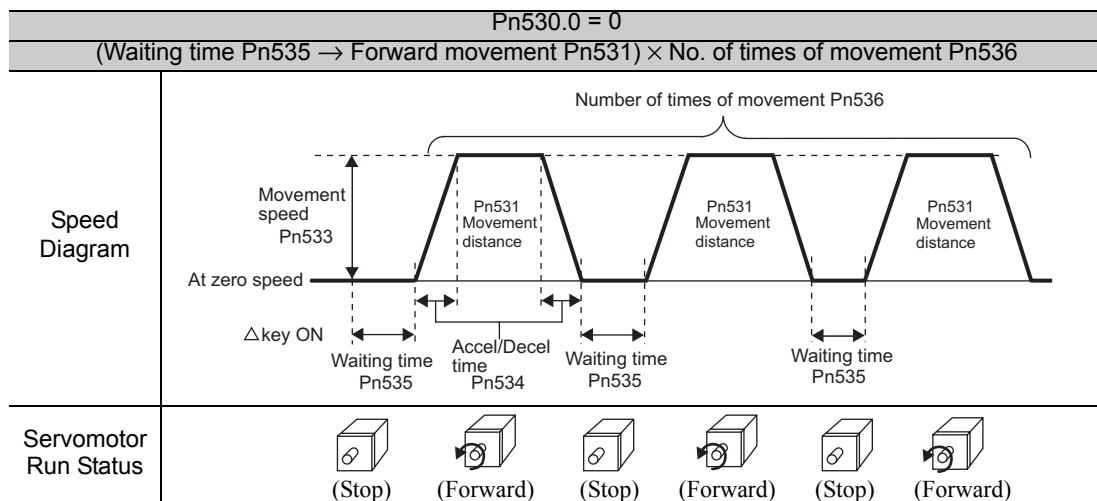
- When 0, 1, 4 or 5 is set to Pn530.0, setting 0 to Pn536 (Number of Times of Program JOG Movement) enables infinite time operation.
- Program JOG operation pattern follows the setting of Pn530.0. Only number of times of program JOG movement is infinite. For details, refer to (5) *Program Operation Patterns*.
- To stop infinite time operation, press the MODE/SET Key (or JOG/SVON Key of digital operator) to servo OFF.

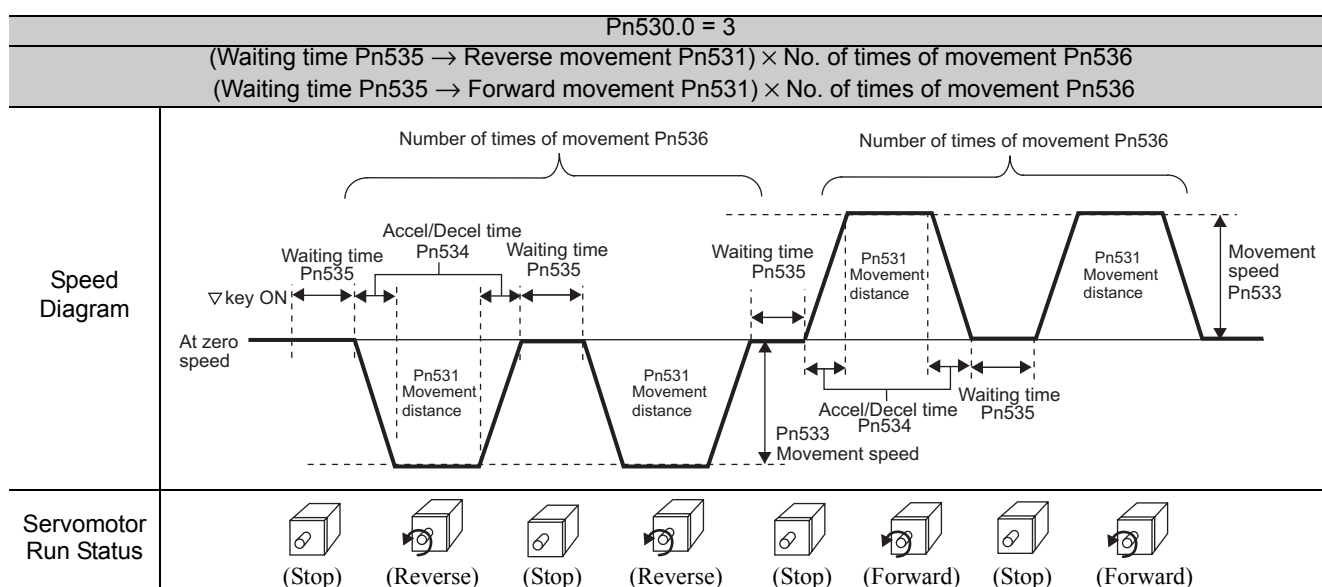
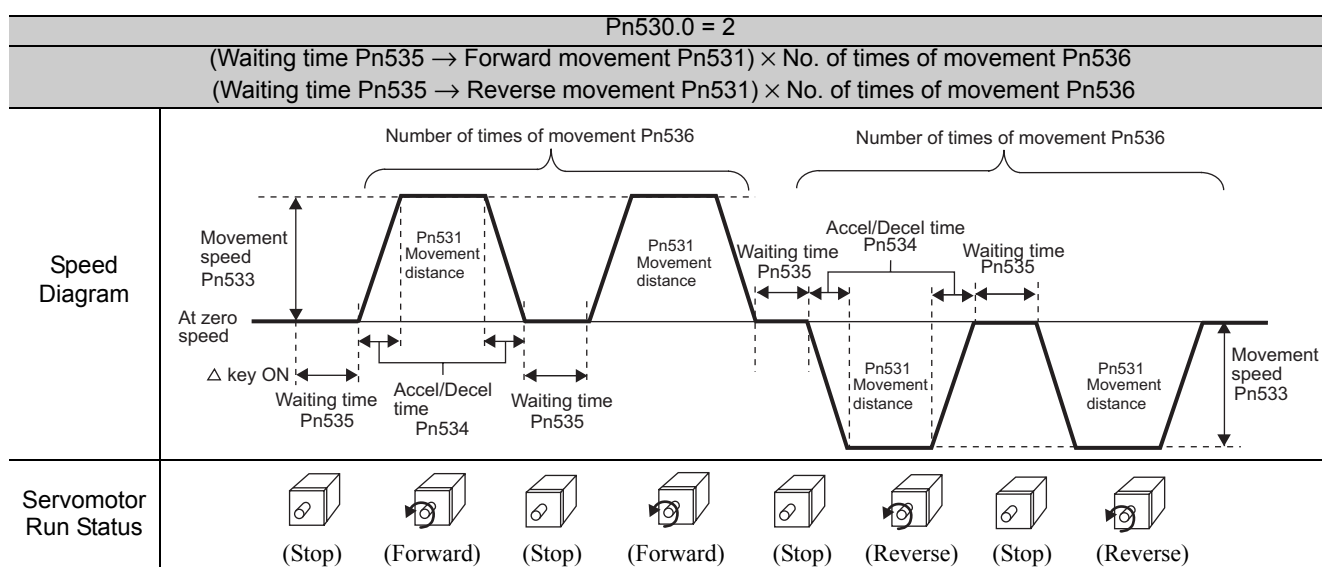
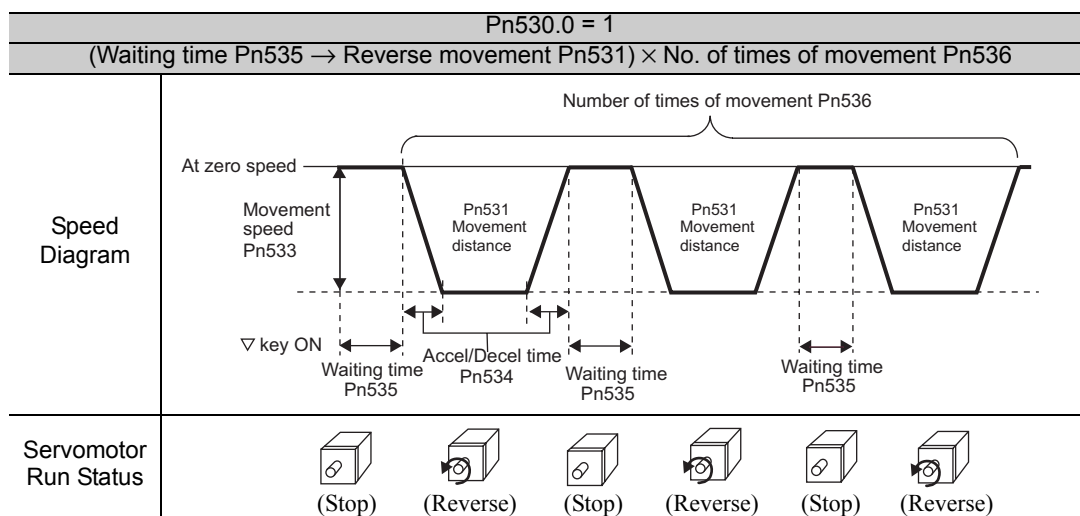
Note: 1, 2 or 3 is set to Pn530.0, infinite time operation is disabled.

2, 0 or 1 is set to Pn530.0, movement is one direction. Take note of movable range.

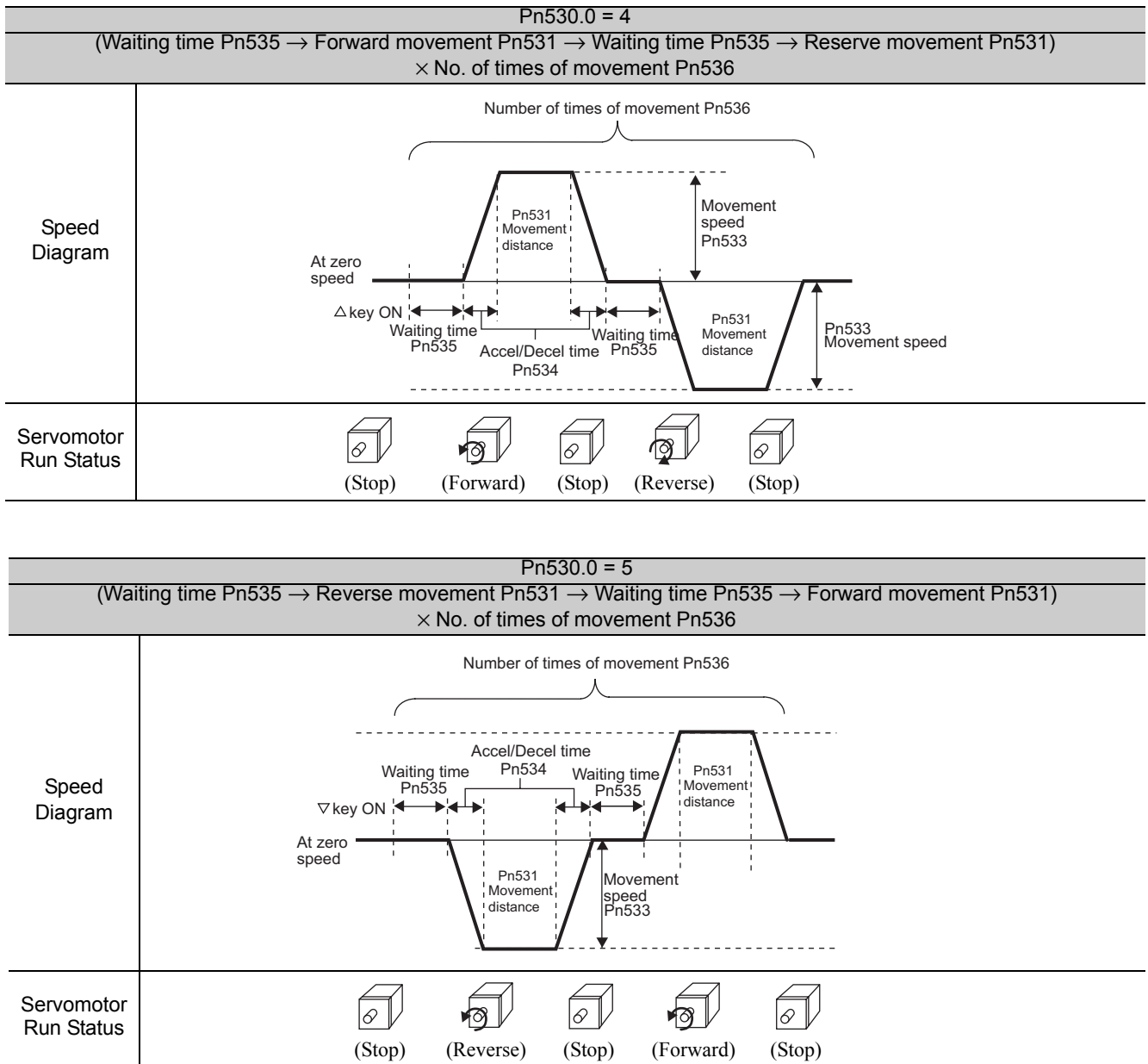
(5) Program Operation Patterns

The following example is given when the rotating direction of the Servomotor is set as Pn000.0 = 1 (counter-clockwise direction is regarded as the forward run).





Note: When 3 is set to Pn530.0, infinite time operation is disabled.



(6) Operating Procedure

Follow the steps below to perform the program JOG operation.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn004.
3			Press the DATA/SHIFT Key for more than one second. The display shown on the left appears.
4			Press the MODE/SET Key. The servo turns ON.

Step	Display after Operation	Keys	Operation
5			<p>Press the UP or DOWN Key according to the first movement direction of the operation pattern. After the preset waiting time, the movement starts.</p> <p><Supplementary Information></p> <ul style="list-style-type: none">• Press the MODE/SET Key again during operation, and the servomotor will be in baseblock status and stop.• Press the DATA/SHIFT Key for more than one second during operation, the servomotor stops and the display of step 2 appears.
6	 (Blinking)		<p>"End" blinks when the program JOG operation movement completes, and the display of step 4 appears.</p> <p><Supplementary Information></p> <ul style="list-style-type: none">• Press the MODE/SET Key, and the servomotor will be in baseblock status and the display of step 3 appears.• Press the DATA/ENTER Key for more than one second, and the display of step 2 appears.

7.6 Initializing Parameter Settings (Fn005)

This function is used when returning to the factory settings after changing parameter settings.



IMPORTANT

- Be sure to initialize the parameter settings with the servo OFF.
- After initialization, turn OFF the power supply and then turn ON again to validate the settings.

Follow the steps below to initialize the parameter setting.


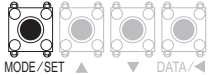

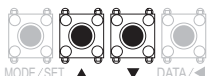
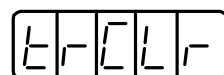



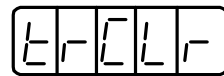
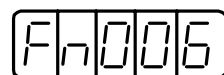

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn005.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	 Display blinks		Press the MODE/SET Key. Then, the parameters will be initialized. During initialization, the display shown on the left blinks.
5	 Display blinks		When the initialization of parameter setting completes, the display shown on the left blinks for about one second.
6			The display changes from "donE" to the display shown on the left.
7			Press the DATA/SHIFT Key for approximately one second. "Fn005" is displayed again.
8	Turn OFF the power and then turn ON again to validate the setting.		

7.7 Clearing Alarm History (Fn006)

The clear alarm history function deletes all of the alarm history recorded in the SERVOPACK.

Note: The alarm history can be deleted only with this function. The alarm history is not deleted when the alarm reset is executed or the main circuit power supply of the SERVOPACK is turned OFF.

Follow the steps below to clear the alarm history.

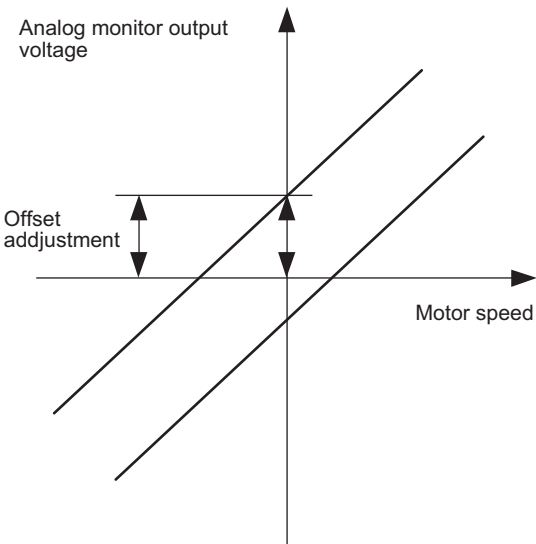
Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn006.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	 Display blinks		Press the MODE/SET Key to clear the alarm history. The display shown on the left blinks for about one second when the data is cleared.
5			The display changes from "donE" to the display shown on the left.
6			Press the DATA/SHIFT Key for approximately one second. "Fn006" is displayed again.

7.8 Manual Zero-adjustment of Analog Monitor Output (Fn00C)

This function is used to manually adjust the offsets for the analog monitor outputs (torque reference monitor output and motor speed monitor output). The offsets for the torque reference monitor output and motor speed monitor output can be adjusted individually. The offset values are factory-set before shipping. Therefore, the user need not usually use this function.

(1) Adjustment Example

An example of offset adjustment to the motor speed monitor is shown below.



Item	Specifications
Zero-adjustment Range	-2 V to + 2 V
Adjustment Unit	18.9 mV/LSB

<Supplementary Information>

- Offset adjustment cannot be made if write protection is set in Fn010.
- The adjustment value will not be initialized when parameter settings are initialized using Fn005.
- Make offset adjustment with a measuring instrument connected, so that the analog monitor output is zero.
An example of settings for a zero analog monitor output is shown below.
 - While the motor is not turned ON, set the monitor signal to the torque reference.
 - In speed control, set the monitor signal to the position error.

(2) Operating Procedure

Follow the steps below to perform the manual zero-adjustment of analog monitor output.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn00C.
3			Press the DATE/SHIFT Key for approximately one second. The display shown on the left appears.
4			Press the MODE/SET Key to select channel-1 or channel-2 monitor output.

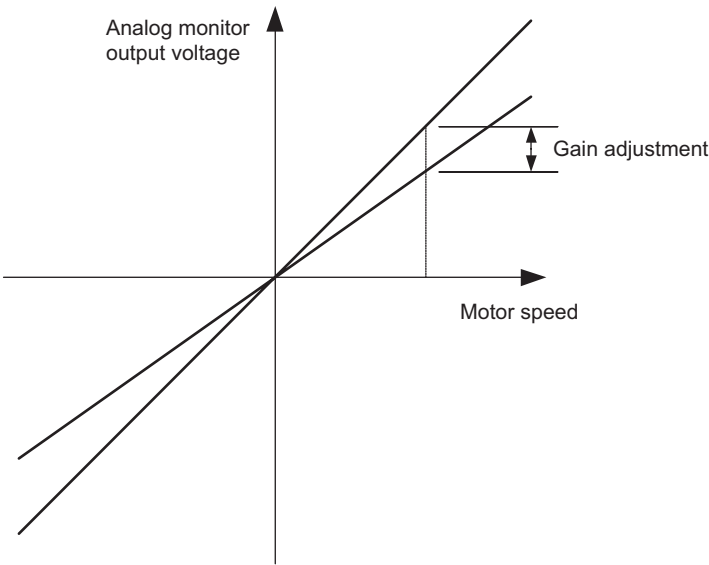
Step	Display after Operation	Keys	Operation
5			Press the DATA/SHIFT Key for less than one second. Zero adjustment data will be displayed as shown on the left.
6			Press the UP or DOWN Key to change the data. This completes zero adjustment of the analog monitor output.
7			Press the DATA/SHIFT Key for less than one second. The zero adjustment data will be displayed as shown on the left. <Supplementary Information> To adjust a different channel, switch the monitor channel using steps 4 through 6.
8			Press the DATA/SHIFT Key for approximately one second. "Fn00C" is displayed again.

7.9 Manual Gain-adjustment of Analog Monitor Output (Fn00D)

This function is used to manually adjust the gains for the analog monitor outputs (torque reference monitor output and motor speed monitor output). The gains for the torque reference monitor output and motor speed monitor output can be adjusted individually. The gain values are factory-set before shipping. Therefore, the user need not usually use this function.

(1) Adjustment Example

An example of gains adjustment to the motor speed monitor is shown below.



The gain adjustment width is made with a 100% output set as a center value (adjustment range: 50% to 150%). A setting example is shown below.

<Setting the Set Value to -125>

$$100\% + (-125 \times 0.4\%) = 50\%$$

Therefore, the monitor output voltage is 0.5 times as high.

<Setting the Set Value to 125>

$$100\% + (125 \times 0.4\%) = 150\%$$

Therefore, the monitor output voltage is 1.5 times as high.

Item	Specifications
Gain-adjustment Range	50% to 150%
Adjustment Unit	0.4%/LSB

<Supplementary Information>

- Gain adjustment cannot be made if write protection is set in Fn010.
- The adjustment value will not be initialized when parameter settings are initialized using Fn005.

(2) Operating Procedure

Follow the steps below to perform the manual gain-adjustment of analog monitor output.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn00D.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Press the MODE/SET Key to select channel-1 or channel-2 monitor output.
5			Press the DATA/SHIFT Key for less than one second. Gain adjustment data will be displayed as shown on the left.
6			Press the UP or DOWN Key to change the data. This completes gain adjustment of the analog monitor output.
7			Press the DATA/SHIFT Key for less than one second. The gain adjustment data will be displayed as shown on the left. <Supplementary Information> To adjust a different channel, switch the monitor channel using steps 4 through 6.
8			Press the DATA/SHIFT Key for approximately one second. "Fn00D" is displayed again.

7.10 Automatic Offset-Signal Adjustment of the Motor Current Detection (Fn00E)

Perform this adjustment only if highly accurate adjustment is required for reducing torque ripple caused by current offset. Basically, the user need not to perform this adjustment.



IMPORTANT

- Be sure to perform this function with the servo OFF.
- Execute the automatic offset adjustment if the torque ripple is too big when compared with that of other SERVOPACKs.

Follow the steps below.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn00E.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	 Display blinks		Press the MODE/SET Key. The offset will be automatically adjusted. When the adjustment completes, the display shown on the left blinks for about one second.
5			The display changes from "donE" to the display shown on the left.
6			Press the DATA/SHIFT Key for approximately one second. "Fn00E" is displayed again.

7.11 Manual Offset-Signal Adjustment of the Motor Current Detection (Fn00F)

Use this function only if the torque ripple is high after the automatic offset adjustment of the motor current detection signal (Fn00E).



IMPORTANT

If this function, particularly manual servo tuning, is executed carelessly, it may worsen the characteristics.

Observe the following precautions when performing manual servo tuning.

- Run the servomotor at a speed of approximately 100 min⁻¹.
- Adjust the operator until the torque reference monitor ripple is minimized by using the analog monitor.
- Adjust the phase-U and phase-V offsets alternately several times until these offsets are well balanced.

Follow the steps below.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn00F.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left (phase U) appears.
4			Press the DATA/SHIFT Key for less than one second to display the phase-U offset amount.
5			Press the UP or DOWN Key to adjust the offset. Carefully adjust the offset while monitoring the torque reference monitor signal. Adjustable range: -512 to +511
6			Press the DATA/SHIFT Key for less than one second. The display shown on the left appears.
7			Press the MODE/SET Key. The display shown on the left appears (phase V).
8			Press the DATA/SHIFT Key for less than one second to display the phase-V offset amount.
9			Press the UP or DOWN Key to adjust the offset. Carefully adjust the offset while monitoring the torque reference monitor signal. Adjustable range: -512 to +511
10			Press the DATA/SHIFT Key for less than one second. The display shown on the left appears.
11			When the offset adjustment completes, press the DATA/SHIFT Key for approximately one second. "Fn00F" is displayed again.

7.12 Write Prohibited Setting (Fn010)

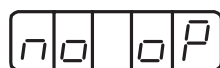
Prohibiting writing prevents writing parameters by mistake.

This function can write-protect all Pn□□□ parameters and the utility functions (Fn□□□) shown in (1) *Utility Functions That Can Be Write-protected*.

(1) Utility Functions That Can Be Write-protected

Parameter No.	Function	Reference Section
Fn002	JOG operation	7.3
Fn003	Origin search	7.4
Fn004	Program JOG operation	7.5
Fn005	Initialize parameter settings	7.6
Fn006	Clear alarm traceback data	7.7
Fn008	Absolute encoder multi-turn reset and encoder alarm reset	5.9.5
Fn009	Automatic tuning of analog (speed, torque) reference offset	5.3.2 5.5.2
Fn00A	Manual servo tuning of speed reference offset	5.3.2
Fn00B	Manual servo tuning of torque reference offset	5.5.2
Fn00C	Manual zero-adjustment of analog monitor output	7.8
Fn00D	Manual gain-adjustment of analog monitor output	7.9
Fn00E	Automatic offset-adjustment of motor current detection signal	7.10
Fn00F	Manual offset-adjustment of motor current detection signal	7.11
Fn013	Multi-turn limit value setting change when a Multi-turn Limit Disagreement alarm occurs	5.9.8
Fn014	Resets configuration error of option card	7.15
Fn01B	Initializes vibration detection level	7.16
Fn200	Tuning-less level setting	6.3.2
Fn201	Advanced autotuning	6.4.2
Fn202	Advanced autotuning by reference	6.5.2
Fn203	One-parameter tuning	6.6.2
Fn204	Anti-resonance control adjustment function	6.7.2
Fn205	Vibration suppression function	6.7.2
Fn206	EasyFFT	7.19
Fn207	Online vibration monitor	7.20

Note: If the write prohibited setting (Fn010) is enabled, the following display will appear on the Panel Operator when the user attempts to execute the above utility functions. To execute these utility functions, set Fn010 to write permitted.



Blinks for second

(2) Operating Procedure

Follow the steps below to set "write prohibited" or "write permitted."

Setting values are as follows:

- "0000": Write permitted (Releases write prohibited mode.)
- "0001": Write prohibited (Parameters become write prohibited from the next power ON.)



Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn010.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Press the UP or DOWN Key to set a value: "0000": Write permitted, "0001": Write prohibited
5	 Display blinks		Press the MODE/SET Key to register the value. The write prohibited settings of parameters are executed. When the value is registered, the display shown on the left blinks for about one second. Note: If a value other than "0000" and "0001" is set, "Error" is displayed.
6			The display changes from "donE" to "P.000□."
7			Press the DATA/SHIFT Key for approximately one second. "Fn010" is displayed again.
8	Turn OFF the power and then turn ON again to validate the setting.		

7.13 Servomotor Model Display (Fn011)

This function is used to check the servomotor model, voltage, capacity, encoder type, and encoder resolution. If the SERVOPACK has been custom-made, you can also check the specification codes of SERVOPACKs.

Follow the steps below.




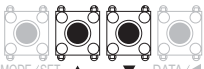



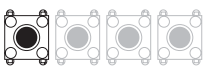


Step	Display after Operation	Keys	Operation																														
1			Press the MODE/SET Key to select the utility function mode.																														
2			Press the UP or DOWN Key to select Fn011.																														
3			<p>Press the DATA/SHIFT Key for approximately one second to display the servomotor model and voltage code.</p> <div><div><table><tr><th colspan="2">Servomotor Voltage</th></tr><tr><th>Data</th><th>Type</th></tr><tr><td>02</td><td>400 VAC</td></tr><tr><td>01</td><td>200 VAC</td></tr></table></div><div><table><tr><th colspan="2">Servomotor Model</th></tr><tr><th>Data</th><th>Model</th></tr><tr><td>60</td><td>SGMAV</td></tr><tr><td>63</td><td>SGMGV</td></tr><tr><td>6D</td><td>SGMJV</td></tr><tr><td>32</td><td>SGMCS-□□C</td></tr><tr><td>33</td><td>SGMCS-□□D</td></tr><tr><td>34</td><td>SGMCS-□□B</td></tr><tr><td>35</td><td>SGMCS-□□E</td></tr><tr><td>36</td><td>SGMCS-□□L</td></tr><tr><td>37</td><td>SGMCS-□□M</td></tr></table></div></div>	Servomotor Voltage		Data	Type	02	400 VAC	01	200 VAC	Servomotor Model		Data	Model	60	SGMAV	63	SGMGV	6D	SGMJV	32	SGMCS-□□C	33	SGMCS-□□D	34	SGMCS-□□B	35	SGMCS-□□E	36	SGMCS-□□L	37	SGMCS-□□M
Servomotor Voltage																																	
Data	Type																																
02	400 VAC																																
01	200 VAC																																
Servomotor Model																																	
Data	Model																																
60	SGMAV																																
63	SGMGV																																
6D	SGMJV																																
32	SGMCS-□□C																																
33	SGMCS-□□D																																
34	SGMCS-□□B																																
35	SGMCS-□□E																																
36	SGMCS-□□L																																
37	SGMCS-□□M																																
4			<p>Press the MODE/SET Key to display the servomotor capacity.</p> <div><p>Servomotor capacity in units of 10 W The above example indicates 100 W</p></div>																														
5			<p>Press the MODE/SET Key, and the encoder type and resolution code will be displayed.</p> <div><div><table><tr><th colspan="2">Encoder Type</th></tr><tr><th>Data</th><th>Type</th></tr><tr><td>00</td><td>Incremental</td></tr><tr><td>01</td><td>Absolute (Multi-turn)</td></tr><tr><td>02</td><td>Absolute (Within one rotation)</td></tr></table></div><div><table><tr><th colspan="2">Encoder Resolution</th></tr><tr><th>Data</th><th>Resolution</th></tr><tr><td>13</td><td>13-bit</td></tr><tr><td>20</td><td>20-bit</td></tr></table></div></div>	Encoder Type		Data	Type	00	Incremental	01	Absolute (Multi-turn)	02	Absolute (Within one rotation)	Encoder Resolution		Data	Resolution	13	13-bit	20	20-bit												
Encoder Type																																	
Data	Type																																
00	Incremental																																
01	Absolute (Multi-turn)																																
02	Absolute (Within one rotation)																																
Encoder Resolution																																	
Data	Resolution																																
13	13-bit																																
20	20-bit																																
6			<p>Press the MODE/SET Key to display the SERVOPACK's code for custom orders.</p> <p>* The display "y.0000" means standard model.</p> <div><p>Code for custom orders</p></div>																														

Step	Display after Operation	Keys	Operation
7			Press the DATA/SHIFT Key for approximately one second. "Fn011" is displayed again.

7.14 Software Version Display (Fn012)

Set Fn012 to select the software-version check mode to check the SERVOPACK and encoder software version numbers.

Follow the steps below.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn012.
3			Press the DATA/SHIFT Key for approximately one second to display the SERVOPACK software version number.
4			Press the MODE/SET Key to display the encoder software version number.
5			Press the DATA/SHIFT Key for approximately one second. "Fn012" is displayed again.

7.15 Resetting Configuration Error of Option Card (Fn014)

The SERVOPACK with option card recognizes installation status and types of option card which is connected to SERVOPACK. If an error is detected, the SERVOPACK issues an alarm.

This function resets these alarms.

For alarm types and corrective actions, refer to *10 Troubleshooting*.

- Note 1. Alarms related to option cards can be cleared only this function. These alarms cannot be cleared by alarm reset or turning OFF the main circuit power supply.
2. Before clearing the alarm, perform corrective action for the alarm.

(1) Operating Procedure

Follow the steps below.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn014.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Press the UP or DOWN Key to select option card to be cleared.
5			Press the MODE/SET Key for approximately one second. The display shown on the left appears.
6	 Display blinks ↓ 		Press the MODE/SET Key again. The display changes shown on the left and the configuration error of option card is cleared.
7			The display changes from "done" to the display shown on the left.
8			Press the DATA/SHIFT Key for approximately one second. "Fn014" is displayed again.
9	Turn OFF the power and then turn ON again to validate the setting.		

7.16 Vibration Detection Level Initialization (Fn01B)

This function detects vibration when servomotor is connected to a machine and automatically adjust the vibration detection level (Pn312) to output more exactly the vibration alarm (A.520) and warning (A.911).

The vibration detection function detects vibration elements according to the motor speed, and if the vibration exceeds the detection level calculated by the following formula, outputs an alarm or warning depending on the setting of vibration detection switch (Pn310).

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

<Remarks>

- Use this function if the vibration alarm (A.529) or warning (A.911) is not output correctly when a vibration above the factory setting vibration detection level (Pn312) is detected. In other cases, it is not necessary to use this function.
- The vibration alarm or warning detection sensibility differs depending on the machine conditions. In this case, a detection sensibility fine adjustment can be set in the detection sensibility Pn311.





- The vibration may not be detected cause of improper servo gains. Also, not all kinds of vibrations can be detected. Use the detection result as a guideline.
- Set the proper moment of inertia ratio (Pn103). Improper setting may result in the vibration alarm, warning misdetection, or non-detection.
- The references that are used to operate your system must be input to execute this function.
- Execute this function under the operation condition for which the vibration detection level should be initialized. A vibration is detected immediately after the servo is turned ON if this function is executed while the servomotor runs at low speed. "Error" is displayed if this function is executed while the servomotor runs at less than 10% of the maximum motor speed.

(1) Operating Procedure

Follow the steps to initialize the parameter Pn312.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn01b.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Press the MODE/SET Key for approximately one second again. The display shown on the left will flash and the vibration level will be detected and refreshed. This will continue until the MODE/SET Key is pressed again. Note: <ul style="list-style-type: none"> • Operate the SERVOPACK with the references that will be used for actual operation. • If the servomotor is rotating at 10% or less of the maximum speed, "Error" will be displayed.
5			Press the MODE/SET Key again at a suitable time to complete frequency detection and refreshing the setting. This will enable the setting. If the setting has been completed normally, "donE" will be displayed. If there was a setting failure, "Error" will be displayed.

Step	Display after Operation	Keys	Operation
6			Press the DATA/SHIFT Key for approximately one second. "Fn016" is displayed again.

(2) Related Parameters

Use the following parameters as required.

Pn311	Vibration Detection Sensibility Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 500	1%	100	Immediately	Setup
Pn312	Vibration Detection Level Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 5000	1 min ⁻¹	50	Immediately	Setup

Note: Pn312 is set by the vibration detection level, so it is not necessary to adjust it.

The vibration detection sensibility can be set at Pn311.

Parameter		Meaning	When Enabled	Classification
Pn310	n.□□□0	Does not detect vibration (Factory setting)	Immediately	Setup
	n.□□□1	Outputs the warning (A.911) when vibration is detected.		
	n.□□□2	Outputs the alarm (A.520) when vibration is detected.		

7.17 Display of SERVOPACK and Servomotor ID (Fn01E)

This function displays ID information for SERVOPACK, servomotor, encoder and option card connected to the SERVOPACK.

To perform this function, the digital operator (JUSP-OP05A-1-E, option) or SigmaWin+ (option) is needed.

This function cannot be performed with the panel operator provided as an accessory.

The following items can be displayed.

ID	Items to be Displayed
SERVOPACK	<ul style="list-style-type: none"> • SERVOPACK model • SERVOPACK serial number • SERVOPACK manufacturing date • SERVOPACK input voltage (V) • Maximum applicable motor capacity (W) • Maximum applicable motor rated current (Arms)
Servomotor	<ul style="list-style-type: none"> • Servomotor model • Servomotor serial number • Servomotor manufacturing date • Servomotor input voltage (V) • Servomotor capacity (W) • Servomotor rated current (Arms)
Encoder	<ul style="list-style-type: none"> • Encoder model • Encoder serial number • Encoder manufacturing date • Encoder type/resolution
Feedback Option Card	<ul style="list-style-type: none"> • Feedback option card model • Feedback option card serial number (Reserved area) • Feedback option card manufacturing date • Feedback option card ID

Note: ID information for fully-closed control I/F card such as model number, serial number and manufacturing date cannot be displayed.

7.18 Display of Servomotor ID in Feedback Option Card (Fn01F)

This function displays ID information for servomotor and encoder in feedback option card connected to the SERVOPACK.

To perform this function, the digital operator (JUSP-OP05A-1-E, option) or SigmaWin+ (option) is needed.

This function cannot be performed with the panel operator provided as an accessory.

The following items can be displayed.

ID	Items to be Displayed
Servomotor	<ul style="list-style-type: none"> • Servomotor model • Servomotor serial number • Servomotor input voltage (V) • Servomotor capacity (W) • Servomotor rated current (Arms) <div>Reserved area</div>
Encoder	<ul style="list-style-type: none"> • Encoder model • Encoder serial number • Encoder type/resolution (bit number display and pulse number/Rev display available)
Parameter file ID	<ul style="list-style-type: none"> • Parameter file source ID (character: 14) • Parameter file version (4 digits hexadecimal display) <div>Reserved area</div>

7.19 EasyFFT (Fn206)



WARNING

- The servomotor rotates at minimal speed when EasyFFT is executed. Do not touch the servomotor or machine during execution of EasyFFT, otherwise injury may result.



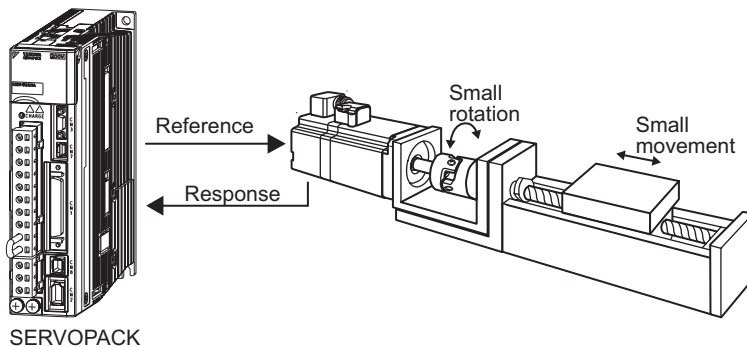
CAUTION

- Use the EasyFFT when the servo gain is low, such as in the initial stage of servo adjustment. If EasyFFT is executed after increasing the gain, the servo system may vibrate depending on the machine characteristics or gain balance.

Machine vibration may be suppressed with a notch filter setting made according to the detected vibration frequency.

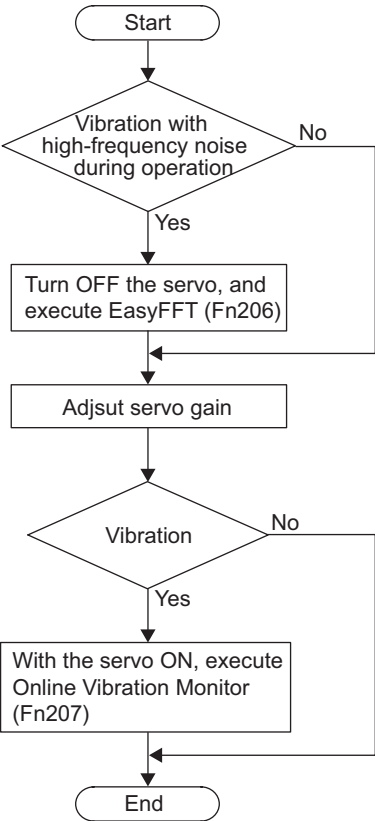
This function detects and sets the frequency as a parameter for the notch filter according to the machine characteristics. This setting function is called EasyFFT.


EasyFFT sends a frequency waveform reference from the SERVOPACK to the servomotor and rotates the servomotor at minimal speed a number of times over a certain period, thus causing machine vibration. The SERVOPACK detects the resonance frequency from the generated vibration and makes notch filter settings according to the resonance frequency detection. The notch filter is effective for the elimination of high-frequency vibration and noise.



In addition to this function, Online Vibration Monitor (Fn207) can be used to detect machine vibration and automatically make notch filter settings. Use the following flowchart to determine which function should be used.

When using mainly for servo gain adjustment, etc.







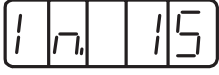



IMPORTANT

- Starts EasyFFT with the servo OFF (the servomotor power OFF).
- Do not input the reference from outside because EasyFFT outputs the special reference from the SERVOPACK.

(1) Operating Procedure

Follow the steps below.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn206.
3	 Setting reference amplitude		Press the DATA/SHIFT for approximately one second. The display shown on the left appears. The panel operator is in Fn206 utility setting execution mode.


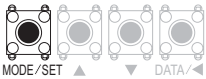

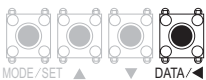
Step	Display after Operation	Keys	Operation
4			Press the UP or DOWN Key to set a reference amplitude. Reference amplitude setting: 1 to 800 Note: <ul style="list-style-type: none"> At the initial execution of Fn206, do not change the reference amplitude setting, but starts from the initial value 15. Though increasing reference amplitude increases the detection accuracy, the vibration and noise occurring on the machine will increase momentarily. Increase an amplitude value little by little, observing the result. The setting value of the reference amplitude setting is stored in Pn456.
5	 Run ready status		Press the DATA/SHIFT Key for approximately one second to enter the run ready status.
6			Press the MODE/SET Key to enter Servo ON status (the motor power ON) <Supplementary Information> Press the MODE/SET Key to turn the servo OFF. "F" is displayed to indicate the run ready status.
7	 Display blinks Servomotor small movement		In the Servo ON status (the servomotor power ON), press the UP Key (forward) or the DOWN Key (reverse). The servomotor performs a few to-and-from movements within 1/4 rotation in automatic operation. The motor performs such movements for approximately 1 to 45 seconds. During this operation, the display shown on the left blinks. Note: <ul style="list-style-type: none"> Do not enter the machine's working area, because the servomotor rotates. Some noise may result. Press the MODE/SET Key to stop the servomotor. No detection is executed. "F." is displayed to indicate the run ready status (step 5).
8	 Detection result example		At normal completion of the detection, "E_FFt" stops blinking and the detected resonant frequency is displayed. When failing to detect, "F----" is displayed.

■ IMPORTANT

If the operation ended normally but it took two second or more, the detection accuracy may not be good. Set the reference amplitude little higher than 15 in step 4 and re-execute the operation. More accurate resonance may be frequency detected.

Though increasing reference amplitude increases the detection accuracy, the vibration and noise occurring in the machine will increase momentarily. Increase an amplitude value little by little, observing the result.

9			To end the vibration monitor, press the DATA/SHIFT Key for less than one second. To set the detected value, proceed to step 11.
10			Press the DATA/SHIFT Key for approximately one second. The servo turns OFF (the servomotor power OFF) and the utility function mode display appears.
11	 Display blinks Pn408=n.□□□1 Pn409=1375 (Hz) ↓ 		After the detection completes normally, press the MODE/SET Key. The optimum notch filter for the detected frequency is automatically set. When the notch filter is set correctly (Pn408, Pn409), the display "done" blinks. When the 1st notch filter frequency was already set (Pn408=n.□□□1), sets 2nd notch filter frequency (Pn40C). When the 2nd notch filter frequency (Pn408=n.□1□□) was also set, the frequency setting of notch filter is unable. If the detected frequency is not used, set the Pn408=n.□□□0

Step	Display after Operation	Keys	Operation
12	 Run ready status		Press the MODE/SET Key to return to the display of run ready status.
13			Press the DATA/SHIFT Key for approximately one second. "Fn206" is displayed again.

(2) Related Parameters

Use the following parameters as required.

Pn40C	2nd Notch Filter Frequency Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning

Pn456	Sweep Torque Reference Amplitude Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 800	1%	15	Immediately	Tuning

Parameter		Meaning	When Enabled	Classification
Pn408	n.□□□0	Disables 1st notch filter. (Factory setting)	Immediately	Setup
	n.□□□1	Uses 1st notch filter.		
	n.□0□□	Disables 2nd notch filter. (Factory setting)		
	n.□1□□	Uses 2nd notch filter.		

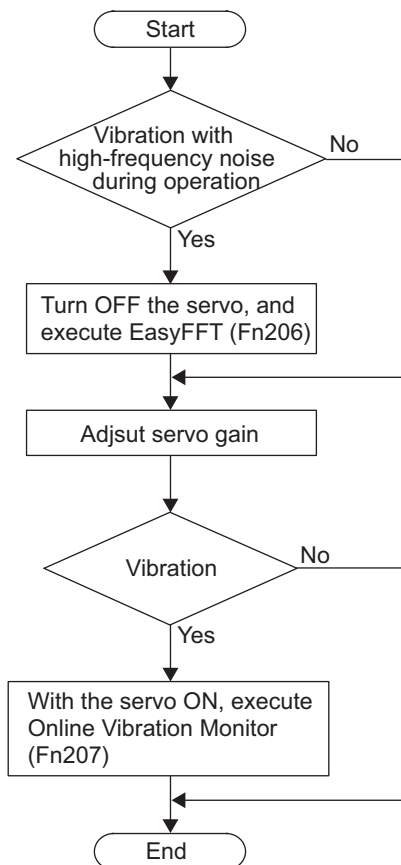
Pn409	1st Notch Filter Frequency Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning

7.20 Online Vibration Monitor (Fn207)

The machine vibration can sometimes be suppressed by setting a notch filter or torque reference filter for the vibration frequencies.

When online, vibration frequencies caused by machine resonance will be detected and the frequency that has the highest peak will be displayed on the Panel Operator. The effective torque reference filter or notch filter frequency for the vibration frequency will be automatically selected. In addition to this function, EasyFFT (Fn206) can be used to detect machine vibration and automatically make notch filter settings. Use the following flowchart to determine which function should be used.

When using mainly for servo gain adjustment, etc.



(1) Operating Procedure

Follow the steps below.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select the Fn207.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Press the MODE/SET Key. "F" will blink, and the detection of frequencies will start automatically.
5			When "F" stops blinking, detection has been completed. If detection has been performed normally, the results of detection will be displayed. The displayed value is the frequency of the highest peak of vibration. Note: <ul style="list-style-type: none"> • If a frequency is not detected, "F----" will be displayed. • If detection processing is not completed normally for some reason, "no_oP" will be displayed.
6			To make only a vibration frequency check without setting the results of detection, press the DATA/SHIFT Key. Proceed to step 7 to set the results of detection.
7			If the MODE/SET Key is pressed, the optimum notch filter frequency or torque reference filter time constant for the frequency value will be set automatically, and "done" will be displayed if the setting is completed normally.
8			Press the DATA/SHIFT Key for approximately one second. "Fn207" is displayed again.

(2) Related Parameters

The following parameters are set automatically by using online vibration monitor.

Parameter	Meaning
Pn401	Torque Reference Filter Time Constant
Pn408	Torque Related Function Switch
Pn409	1st Notch Filter Frequency

7.21 Origin Setting (Fn020)

This function sets current scale position as origin when using the absolute external scale.

Use the following product as an absolute external scale.

Absolute separate linear scale (made by Mitutoyo Corporation)

ABS ST780A series
Model ABS ST78□A

(1) Settings before Operation

The following settings are required before setting origin.

- If the S-ON input signal is ON, turn OFF the signal.
- If Pn50A.1 is set to 7 (i.e., the servo is always ON), change the value.

(2) Operating Procedure

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn020.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Press the UP Key until "0SET5" is displayed. Note: If there is a mistake during key operations. "NO_OP" will be displayed for approximately one second and then "Fn000" will be displayed again.
5			Press the MODE/SET Key to set the origin of the scale. After the setting is completed, "donE" will blink for approximately one second.
6		After one second	After "donE" is displayed, "0SET5" is displayed again.
7			Press the DATA/SHIFT Key for approximately one second. "Fn020" is displayed again.
8	Turn OFF the power and then turn ON again to validate the setting.		

7.22 Software Reset (Fn030)

This function enables resetting the SERVOPACK internally from software. If this function is used when parameter changes have been made that require turning the power OFF and ON, the changes will be reflected without actually turning the power OFF and ON.



IMPORTANT

- Starts software reset operation with the servo OFF.
- This function resets the SERVOPACK independently of host controller. Be sure to confirm that resetting the SERVOPACK has no influence the operation of host controller.

Follow the steps below to reset the SERVOPACK internally.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or DOWN Key to select Fn030.
3			Press the DATE/SHIFT key for approximately one second. The display shown on the left appears.
4	 Display after operation		Press the UP Key until "SrSt5" is displayed. Note: If there is a mistake during key operations, "nO_OP" will be displayed for approximately one second and then "Fn030" will be displayed again.
5			Press the MODE/SET Key. The panel display will disappear. Note: This function cannot be executed while the servo is ON.
6			The status display screen, which is the same as the screen that is displayed immediately after the power turned ON, will appear.

Monitor Modes (Un□□□)

8.1 List of Monitor Modes	8-2
8.2 Operation in Monitor Mode	8-3
8.3 Reading 32-bit Decimal Displays	8-4
8.4 Monitoring Input Signals	8-5
8.4.1 Checking Input Signal Status	8-5
8.4.2 Interpreting Input Signal Display Status	8-5
8.4.3 Input Signal Display Example	8-6
8.5 Monitoring Output Signals	8-7
8.5.1 Checking Output Signal Status	8-7
8.5.2 Interpreting Output Signal Display Status	8-7
8.5.3 Output Signal Display Example	8-7
8.6 Monitor Display at Power ON	8-8
8.7 Monitoring I/O Signals	8-8

8.1 List of Monitor Modes

The monitor mode can be used for monitoring the reference values, I/O signal status, and SERVOPACK internal status.

Refer to the following table.

Parameter No.	Content of Display	Unit
Un000	Motor rotating speed	min ⁻¹
Un001	Speed reference	min ⁻¹
Un002	Internal torque reference (in percentage to the rated torque)	%
Un003 ^{*3}	Rotation angle 1 (32-bit decimal code)	pulse
Un004	Rotation angle 2 (Electric angle from 0 degree of phase-U)	deg
Un005 ^{*1}	Input signal monitor	—
Un006 ^{*2}	Output signal monitor	—
Un007	Input reference pulse speed (valid only in position control)	min ⁻¹
Un008	Error counter (position error amount) (valid only in position control)	reference unit
Un009	Accumulated load ratio (in percentage to the rated torque: effective torque in cycle of 10 seconds)	%
Un00A	Regenerative load ratio (in percentage to the processable regenerative power: regenerative power consumption in cycle of 10 seconds)	%
Un00B	Power consumed by DB resistance (in percentage to the processable power at DB activation: displayed in cycle of 10 seconds)	%
Un00C ^{*3}	Input reference pulse counter (32-bit decimal code)	reference unit
Un00D ^{*3}	Feedback pulse counter (encoder pulses × 4 (multiplier): 32-bit decimal code)	encoder pulse
Un00E ^{*3}	Fully-closed feedback pulse counter (Fully-closed feedback pulse × 4 (multiplier): 32-bit decimal code)	External encoder pulse
Un012	Total operation time	100 ms
Un013 ^{*3}	Feedback pulse counter (32-bit decimal code)	reference unit
Un014	Effective gain monitor	—
Un015	Safety I/O signal monitor	—
Un020	Motor rated speed	min ⁻¹
Un021	Motor maximum speed	min ⁻¹

*1. Refer to 8.4 *Monitoring Input Signals*.

*2. Refer to 8.5 *Monitoring Output Signals*.

*3. Refer to 8.3 *Reading 32-bit Decimal Displays*.

8.2 Operation in Monitor Mode

The example below shows how to display the contents of monitor number Un000 (when the servomotor rotates at 1500 min⁻¹)

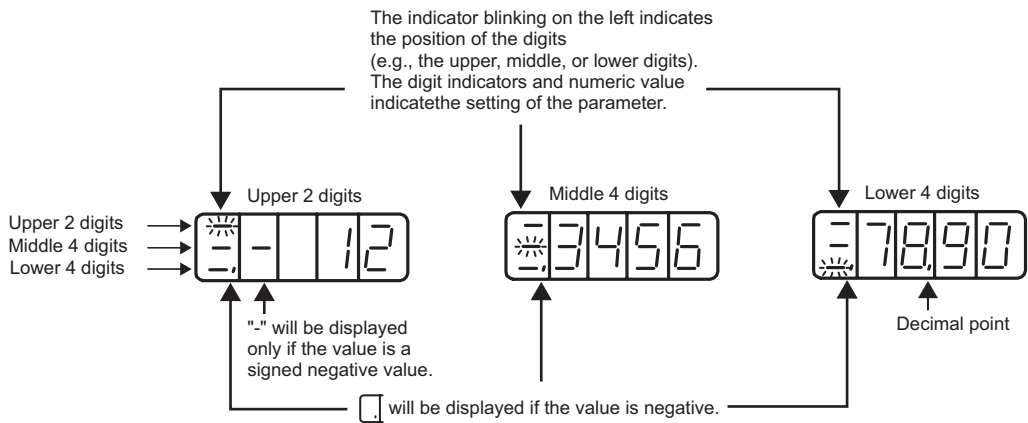
Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the monitor mode.
2			Press the UP or DOWN Key to select the monitor number to be displayed.
3			Press the DATA/SHIFT Key for approximately one second to display the data of Un000 (motor speed).
4			Press the DATA/SHIFT Key for approximately one second to return to the display of step 1.

8.3 Reading 32-bit Decimal Displays

This section describes how to read parameters displayed in 32-bit decimal on the Panel Operator.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the monitor mode.
2			Press the UP or DOWN Key to display the parameter to be displayed in 32-bit decimal.
3	Lower 4 digits 		Press the DATA/SHIFT Key for approximately one second. The lower 4 digits of the setting of the selected parameter are displayed.
4	Middle 4 digits 		After checking the displayed digits, press the DATA/SHIFT Key. The middle 4 digits of the setting of the selected parameter are displayed.
5	Upper 2 digits 		Press the DATA/SHIFT Key again. The upper 2 digits of the setting of the selected parameter are displayed. <Supplementary Information> If the DATA/SHIFT Key is pressed after the upper 2 digits are displayed, the lower 4 digits of the setting will be displayed again.
6			Press the DATA/SHIFT Key for approximately one second to return to the display of step 2.

The method for reading the display is summarized below.



<Supplementary Information>

The number of pulses between -2147483648 (-2^{31}) and 2147483647 (-2^{31}) is displayed continuously. When the number of pulses is outside this range, the display will change as follows:

- The displayed value will change to 2147483647 when the number of pulses decreases by one from -2147483648. Thereafter, the displayed value will decrease according to the number of pulses.
- The displayed value will change to -2147483648 when the number of pulses increases by one from 2147483647. Thereafter, the displayed value will increase according to the number of pulses.

8.4 Monitoring Input Signals

The status of input signals can be checked with the input signal monitor (Un005). The procedure for checking the status, the method of reading the monitor, and a display example are shown below.

8.4.1 Checking Input Signal Status

Use the following steps to check the allocations of input signals using parameter Un005.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the monitor mode.
2			Press the UP or DOWN Key to select Un005.
3	 Input signal display status		The present status can be displayed on the 7-segment display on the Panel Operator by pressing the DATA/SHIFT Key for approximately one second. Refer to 8.4.2 <i>Interpreting Input Signal Display Status</i> .
4			Press the DATA/SHIFT Key for approximately one second to return to the display of step 2.

8.4.2 Interpreting Input Signal Display Status

The status of allocated signals is displayed on the 7-segment display on the Panel Operator.

Input terminals correspond to LED numbers as shown in the following table.



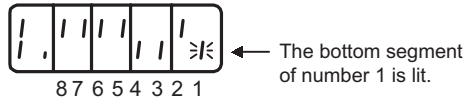
- When the input is in OFF (open) status, the top segment (LED) is lit.
- When the input is in ON (short-circuited) status, the bottom segment (LED) is lit.

Display LED Number	Input Terminal Name	Factory Setting
1	CN1-40	/S-ON
2	CN1-41	/P-CON
3	CN1-42	P-OT
4	CN1-43	N-OT
5	CN1-44	/ALM-RST
6	CN1-45	/P-CL
7	CN1-46	/N-CL
8	CN1-4	SEN

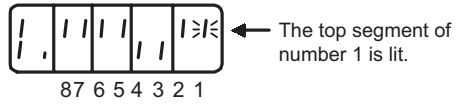
8.4.3 Input Signal Display Example

Input signals are displayed as shown below.

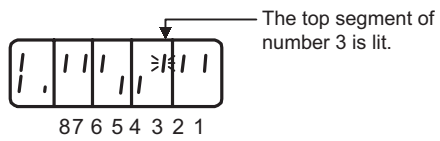
- When /S-ON signal is ON (Servo ON at L level)



- When /S-ON signal is OFF



- When P-OT signal operates (Operates at "H" level)



8.5 Monitoring Output Signals

The status of output signals can be checked with the input signal monitor (Un006). The procedure for checking the status, the method of reading the monitor, and a display example are shown below.

8.5.1 Checking Output Signal Status

Use the following steps to check the allocations of output signals using parameter Un006.

Step	Display after Operation	Keys	Operation
1			Press the MODE/SET Key to select the monitor mode.
2			Press the UP or DOWN Key to select Un006.
3	 Output signal display status		The present status can be displayed on the 7-segment display on the Panel Operator by pressing the DATA/SHIFT Key for approximately one second. Refer to 8.5.2 <i>Interpreting Output Signal Display Status</i> .
4			Press the DATA/SHIFT Key for approximately one second to return to the display of step 2.

8.5.2 Interpreting Output Signal Display Status

The status of allocated signals is displayed on the 7-segment display on the Panel Operator.



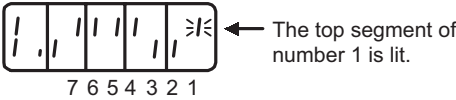
- When the output is in OFF (open) status, the top segment (LED) is lit.
- When the output is in ON (short-circuited) status, the bottom segment (LED) is lit.

Display LED Number	Output Terminal Name	Factory Setting
1	CN1-31, -32	ALM
2	CN1-25, -26	/COIN or /V-CMP
3	CN1-27, -28	/TGON
4	CN1-29, -30	/S-RDY
5	CN1-37	AL01
6	CN1-38	AL02
7	CN1-39	AL03
8	—	Reserved

8.5.3 Output Signal Display Example

Output signals are displayed as shown below.

- When ALM signal operates (alarm at H level)



8.6 Monitor Display at Power ON

When Un number is set using Pn52F, the data of Un□□□ that was specified in the panel operator is displayed when the power is turned ON. When the FFF is set (factory setting), the SERVOPACK becomes the status display mode (bb, run) at power ON.

Pn52F	Monitor Display at Power ON				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to FFF	—	FFF	Immediately	

8.7 Monitoring I/O Signals

The following I/O signals can be monitored.

Un Number	LED Number	Pin Number	Signal Name
Un005 Input Signal Monitor			
	1	CN1-40 (can be allocated)	/S-ON (factory setting)
	2	CN1-41 (can be allocated)	/P-CON (factory setting)
	3	CN1-42 (can be allocated)	P-OT (factory setting)
	4	CN1-43 (can be allocated)	N-OT (factory setting)
	5	CN1-44 (can be allocated)	/ALM-RST (factory setting)
	6	CN1-45 (can be allocated)	/P-CL (factory setting)
	7	CN1-46 (can be allocated)	/N-CL (factory setting)
	8	CN1-4	SEN
Un006 Output Signal Monitor			
	1	CN1-31, 32	ALM
	2	CN1-25, 26 (can be allocated)	/COIN or /V-CMP (factory setting)
	3	CN1-27, 28 (can be allocated)	/TGON (factory setting)
	4	CN1-29, 30 (can be allocated)	/S-RDY (factory setting)
	5	CN1-37	AL01
	6	CN1-38	AL02
	7	CN1-39	AL03
	8	0	Zero fixed
Un015 Safety I/O Signal Monitor			
	1	CN8-4	/HWBB1+
	2	CN8-3	/HWBB1-
	3	CN8-6	/HWBB2+
	4	CN8-5	/HWBB2-
	5	CN8-8	EDM1+
	6	CN8-7	EDM2+
	7	-	Reserved
	8	-	Reserved

■ SigmaWin+ I/O signal monitor function

I/O signals can be checked using the I/O signal monitor function of SigmaWin+.

This function can perform output signal output and output prohibited setting. Therefore, sequence of host controller and wiring between the SERVOPACK and host controller, peripheral devices can be checked.

Fully-closed Loop Control

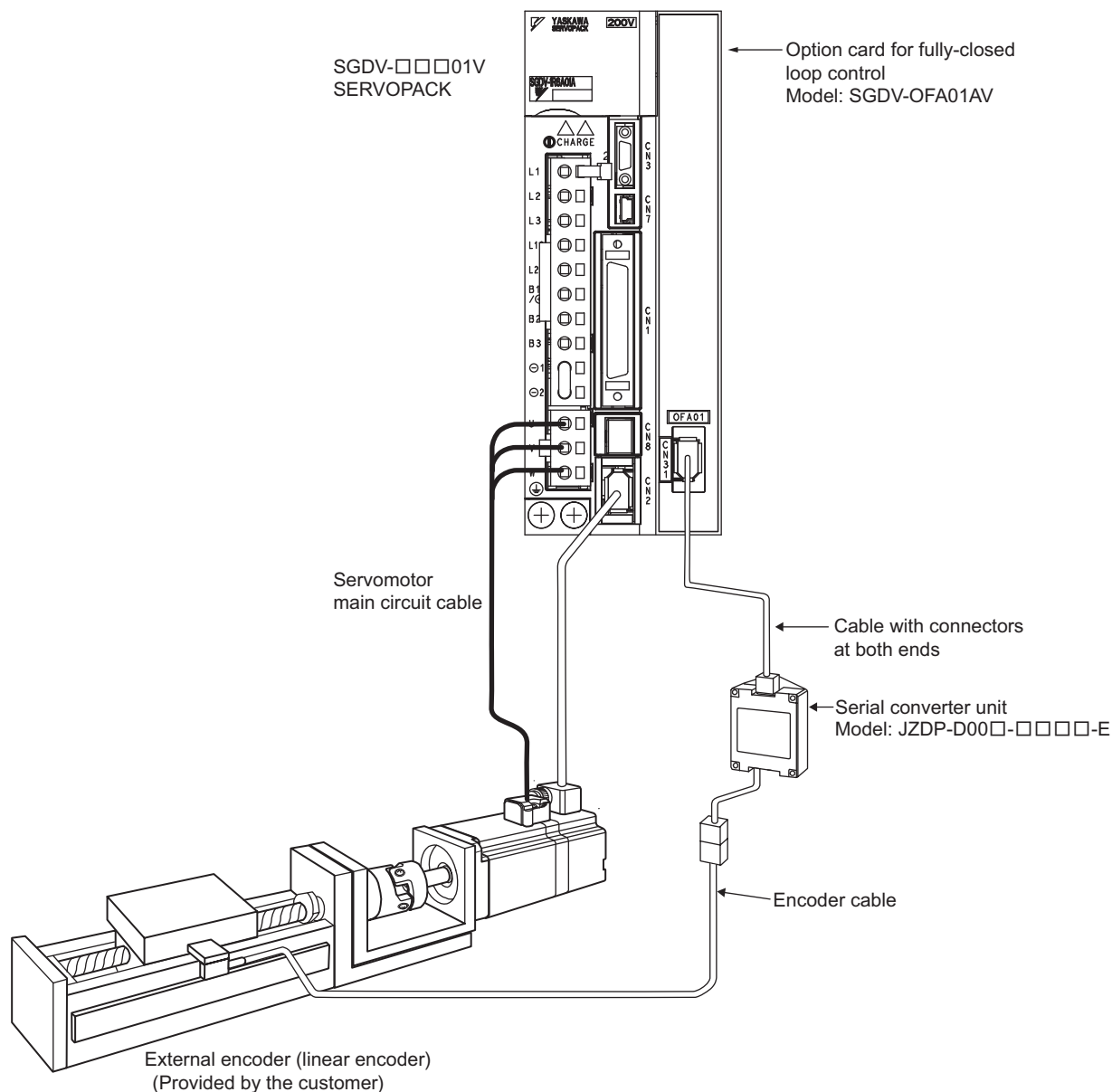
9.1 System Configuration and Connection Example for SERVOPACK with Fully-closed Loop Control	9-2
9.1.1 System Configuration	9-2
9.1.2 Internal Configuration of Fully-closed Loop Control	9-3
9.1.3 Serial Converter Unit	9-4
9.1.4 Analog Signal Input Timing	9-5
9.1.5 Connection Example of External Encoder by Heidenhain	9-6
9.1.6 Connection Example of External Encoder by Mitutoyo	9-7
9.1.7 Connection Example of External Encoder by Renishaw	9-8
9.1.8 Encoder Output Pulse Signals from SERVOPACK with a External Encoder by Renishaw	9-9
9.2 Related Parameters	9-10
9.2.1 Setting Order of Related Parameters	9-10
9.2.2 Speed Feedback Method during Fully-closed Loop Control	9-10
9.2.3 Motor Rotation Direction	9-10
9.2.4 Sine Wave Pitch (Frequency) for an External Encoder	9-12
9.2.5 Number of Encoder Output Pulses (PAO, PBO, and PCO) from the SERVOPACK	9-13
9.2.6 Electronic Gear	9-14
9.2.7 Alarm Detection	9-14
9.2.8 Analog Monitor Signal	9-15

9.1 System Configuration and Connection Example for SERVOPACK with Fully-closed Loop Control

This section describes the system configuration and connection example for the SERVOPACK with fully-closed loop control.

9.1.1 System Configuration

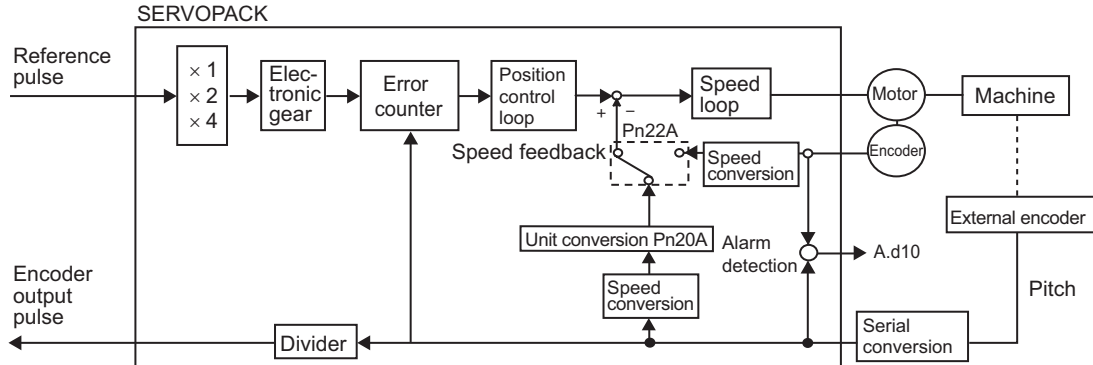
The following figure shows the system configuration for fully-closed loop control.



9.1.2 Internal Configuration of Fully-closed Loop Control

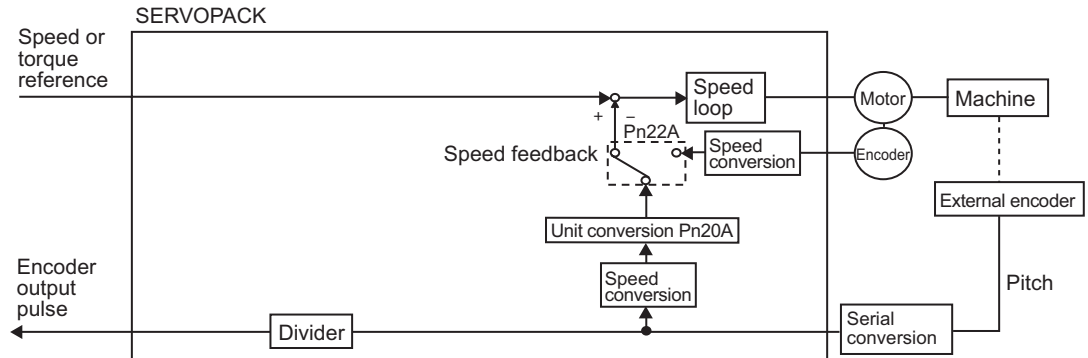
Internal configuration of fully-closed loop control is shown below.

■ With Position Control



Note: Either an incremental or an absolute encoder can be used. When the absolute encoder is used, set 0 to Pn002.2 (use the absolute encoder as an incremental encoder).

■ With Speed Control



9.1.3 Serial Converter Unit

(1) Model: JZDP-D00□-□□□□-E

(2) Characteristics and Specifications

Items		Specifications
Electrical Characteristics	Power Supply Voltage	+5.0V±5%, ripple content 5% max.
	Current Consumption *1	120 mA Typ. 350 mA Max.
	Signal Resolution	Input 2-phase sine wave: 1/256 pitch
	Max. Response Frequency	250 kHz
	Analog Input Signals *2 (cos, sin, Ref)	Differential input amplitude: 0.4 V to 1.2 V Input signal level: 1.5 V to 3.5 V
	Output Signal *3	Position data, alarms
	Output Method	Serial data communications (HDLC (High-level Data Link Control) protocol format with Manchester codes)
	Transmission Cycle	62.5 μs
	Output Circuit	Balanced type transceiver (SN75LBC176 or the equivalent), internal end resistor: 120 Ω
Mechanical Characteristics	Approx. Mass	150 g
	Vibration Resistance	98 m/s ² max. (10 to 2500 Hz) in three directions
	Shock Resistance	980 m/s ² , (11 ms) two times in three directions
Environmental Conditions	Operating Temperature	0 °C to 55 °C
	Storage Temperature	-20 °C to +80 °C
	Humidity	20 % to 90 %RH (without condensation)

* 1. The current consumption of the external encoder is not included in this value.

The current consumption of the external encoder must be taken into consideration for the current capacity of host controller that supplies the power.

* 2. Input a value within the specified range. Otherwise, incorrect position information is output, and the device may be damaged.

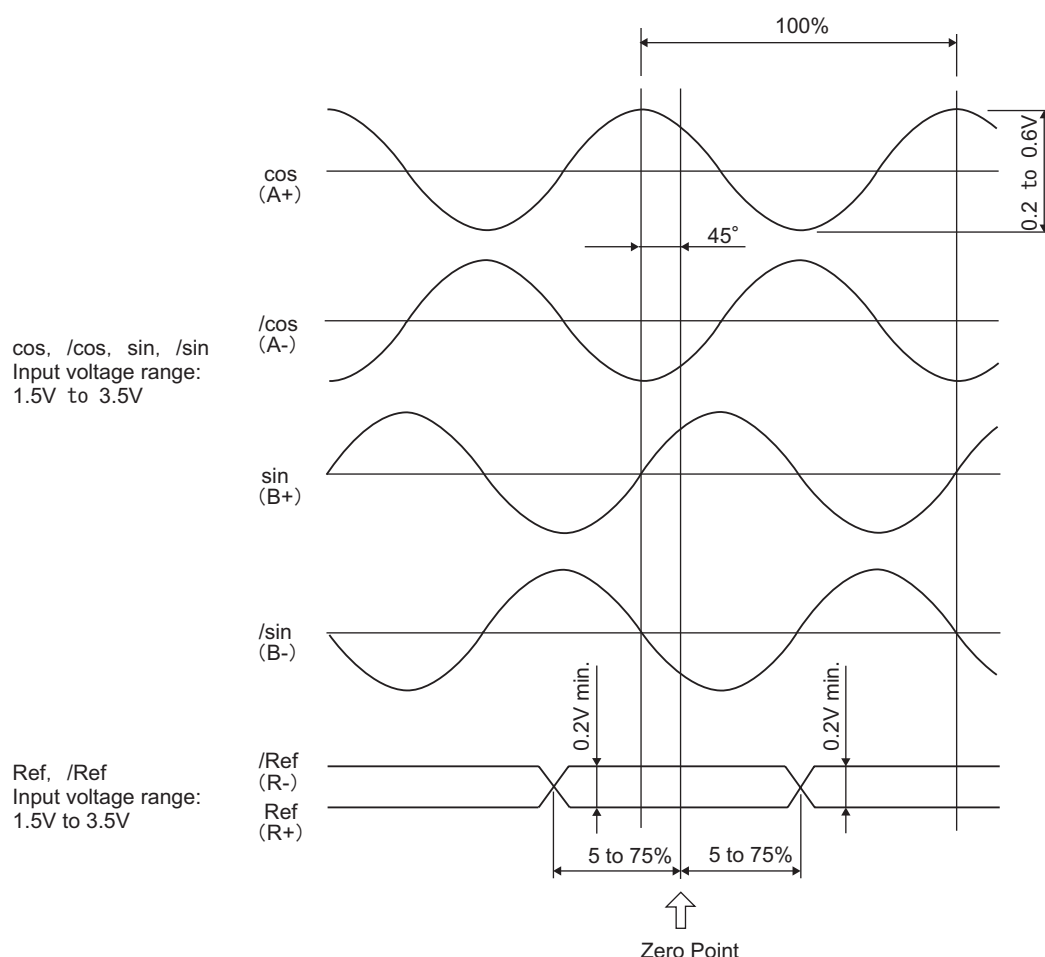
* 3. The transmission is enabled 100 to 300 ms after the power turns ON.

9.1.4 Analog Signal Input Timing

The following figure shows the input timing of the analog signals.

When the cos and sin signals are shifted 180 degrees, the differential signals are the /cos and /sin signals. The specifications of the cos, /cos, sin, and /sin signals are identical except for the phase.

Input the signals Ref and /Ref so that they shall cross each other as shown in the figure because they are input into the converter. When they are crossed, the output data will be counted up.

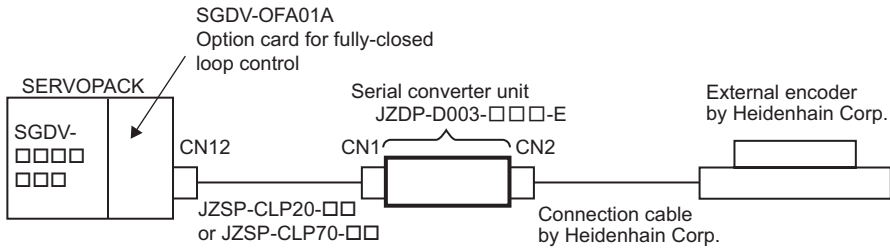


IMPORTANT

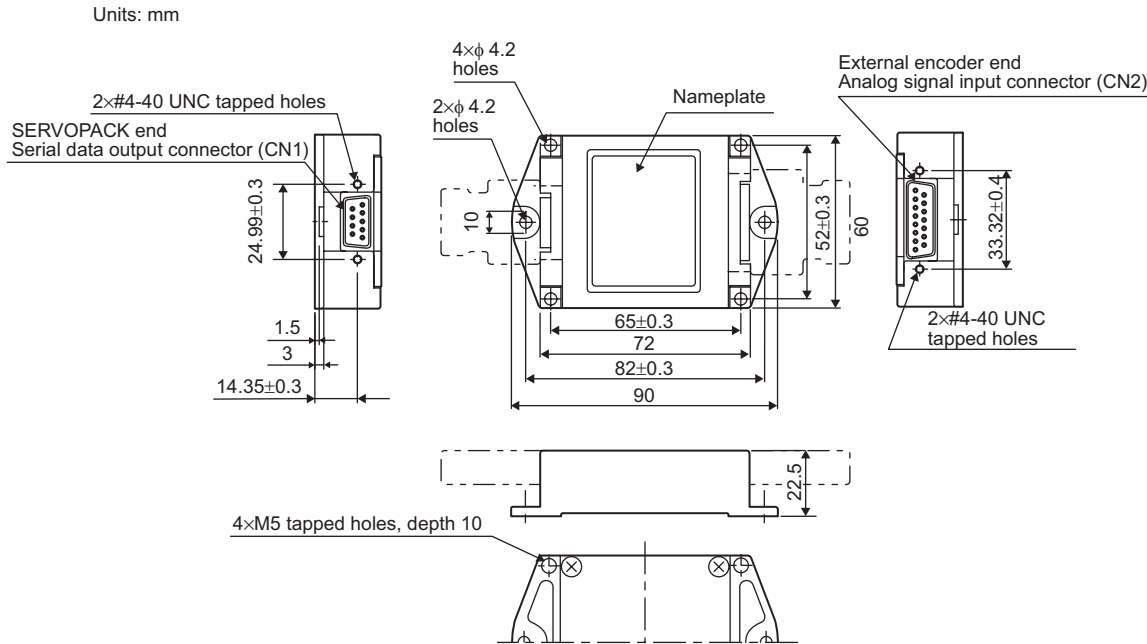
- Never perform insulation resistance and withstand voltage tests.
- When analog signals are input to the serial converter unit, noise influence on the analog signals affects the unit's ability to output correct position information. The analog cable must be as short as possible and shielded.
- Do not connect or disconnect the unit while power is being supplied, or the unit may be damaged.
- When using multiple axes, use a shield cable for each axis. Do not use a shield cable for multiple axes.

9.1.5 Connection Example of External Encoder by Heidenhain

(1) Connection Example



(2) Specifications of Serial Converter Unit (JZDP-D003-□□□□E)



Pin No.	Signal
1	+5V
2	S-phase output
3	Empty
4	Empty
5	0V
6	/S-phase output
7	Empty
8	Empty
9	Empty
Case	Shield

[CN1]
SERVOPACK end
Serial data output

17-series connector
model:
17LE-13090-27
(socket) by DDK Ltd.

Pin No.	Signal
1	cos input (A+)
2	0V
3	sin input (B+)
4	+5V
5	Empty
6	Empty
7	/Ref input (R-)
8	Empty
9	/cos input (A-)
10	0V sensor
11	/sin input (B-)
12	5V sensor
13	Empty
14	Ref input (R+)
15	Empty
Case	Shield

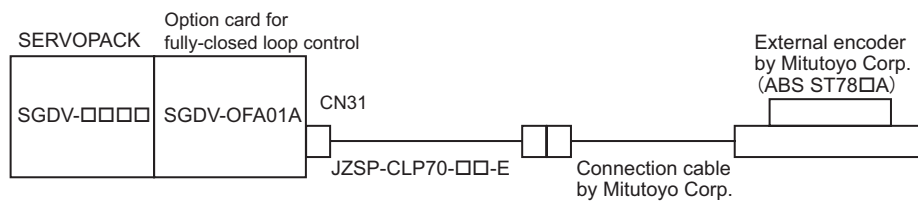
[CN2]
External encoder end
Analog signal input

17-series connector
model:
17LE-13150-27
(socket) by DDK Ltd.

- Note 1. Do not use the empty pins.
2. The external encoder (analog 1V_{p-p} output, D-sub 15-pin) manufactured by Heidenhain Corp. can be directly connected.

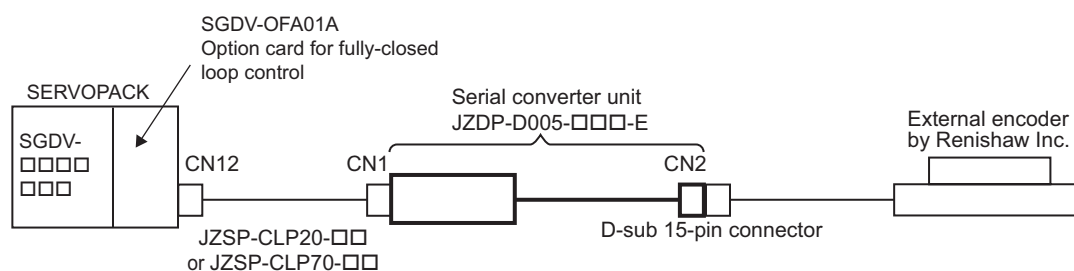
9.1.6 Connection Example of External Encoder by Mitutoyo

The serial converter unit is not needed when using the external encoder made by Mitutoyo Corporation.

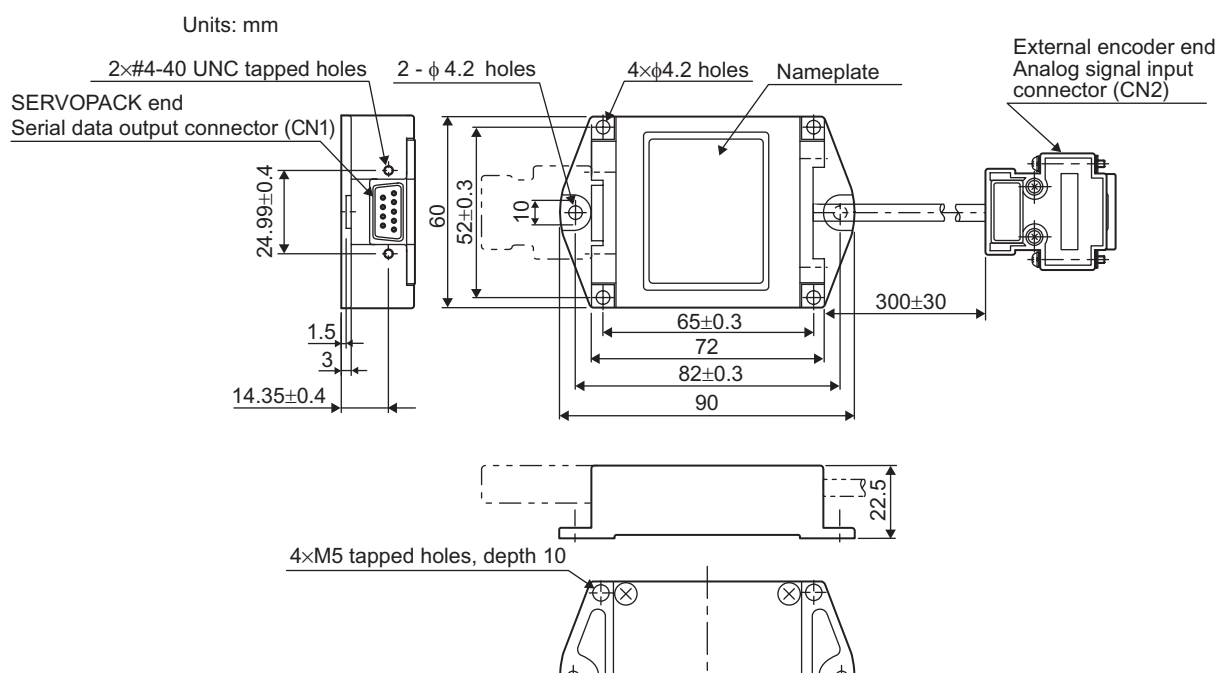


9.1.7 Connection Example of External Encoder by Renishaw

(1) Connection Example



(2) Specifications of Serial Converter Unit (JZDP-D005-□□□E)



Pin No.	Signal
1	+5V
2	S-phase output
3	Empty
4	Empty
5	0V
6	/S-phase output
7	Empty
8	Empty
9	Empty
Case	Shield

SERVOPACK does not have the function to process Vq signals.

Pin No.	Signal
1	+5V
2	S-phase output
3	Empty
4	Empty
5	0V
6	/S-phase output
7	Empty
8	Empty
9	Empty
Case	Shield

17-series connector model:
17LE-13090-27
(socket) by DDK Ltd.

Pin No.	Signal
1	/cos input (V1-)
2	/sin input (V2-)
3	Ref input (V0+)
4	+5V
5	5Vs
6	Empty
7	Empty
8	Empty
9	cos input (V1+)
10	sin input (V2+)
11	/Ref input (V0-)
12	0V
13	0Vs
14	Empty
15	Inner (0V)
Case	Shield

Pin No.	Signal
1	/cos input (V1-)
2	/sin input (V2-)
3	Ref input (V0+)
4	+5V
5	5Vs
6	Empty
7	Empty
8	Empty
9	cos input (V1+)
10	sin input (V2+)
11	/Ref input (V0-)
12	0V
13	0Vs
14	Empty
15	Inner (0V)
Case	Shield

17-series connector model:
17JE-13150-02 (D8C)
(socket) by DDK Ltd.

- Note 1. Do not use empty pins.
2. The external encoder (analog 1Vp-p output, D-sub 15-pin) by Renishaw Inc. can be directly connected. However, the BID and DIR signals are not connected.
3. Use the external encoder end connector to change the home position specifications of the external encoder.

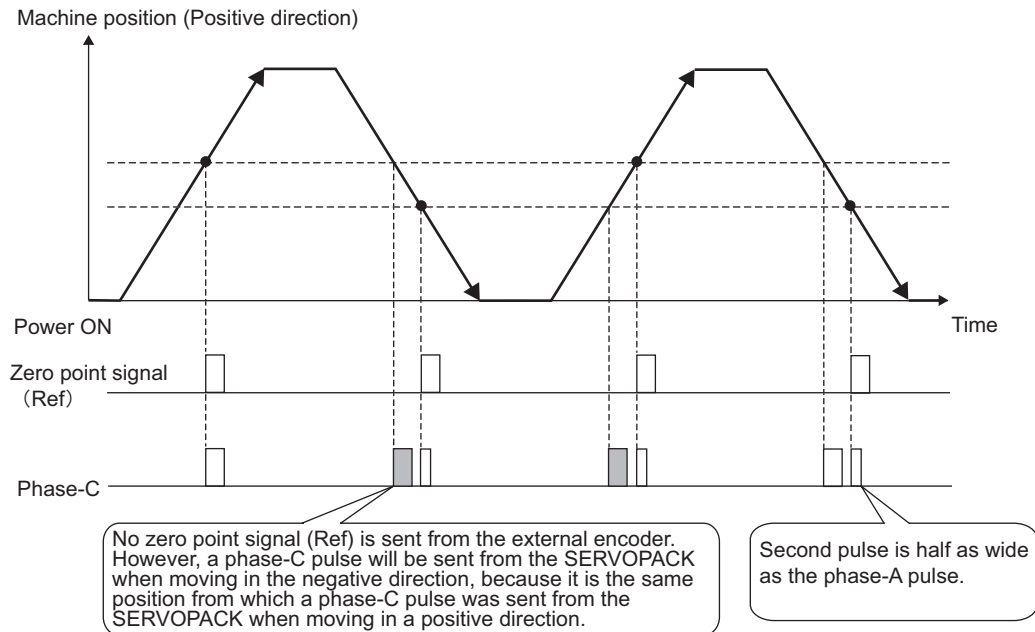
9.1.8 Encoder Output Pulse Signals from SERVOPACK with a External Encoder by Renishaw

The output position of the zero point signal (Ref) may vary in some models of the external encoder made by Renishaw.

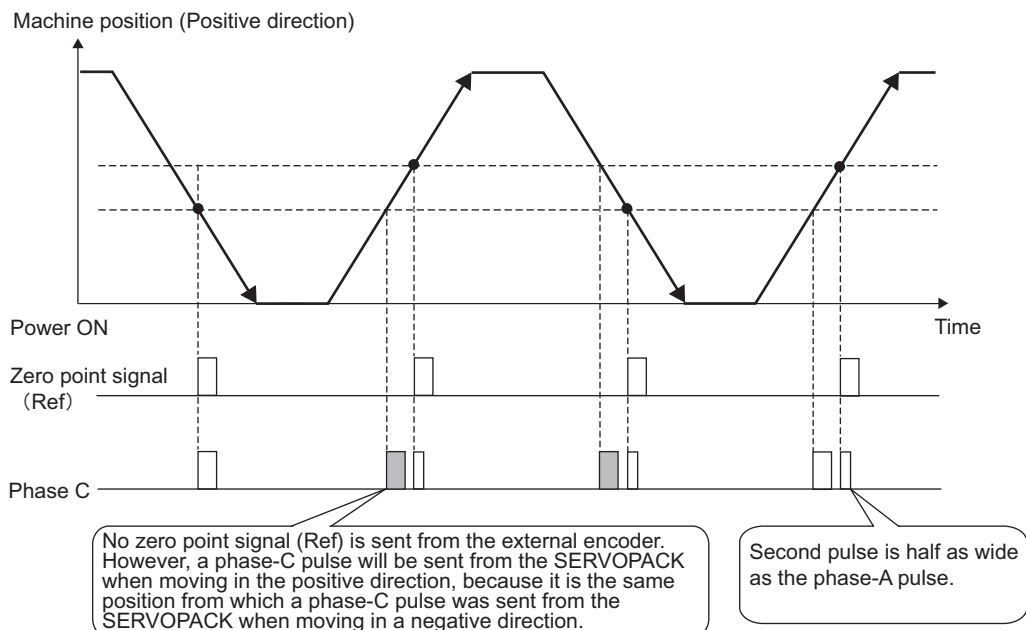
If using a Renishaw model, the phase-C pulses of the SERVOPACK are output at two positions.

For details on the specifications of the zero-point signals for a external encoder, refer to the manual for the Renishaw external encoder.

(1) When Passing the 1st Zero Point Signal (Ref) in Positive Direction after Power ON



(2) When Passing the 1st Zero Point Signal (Ref) in Negative Direction after Power ON



9.2 Related Parameters

This section describes the parameters related to fully-closed loop control.

9.2.1 Setting Order of Related Parameters

The basic setting order of related parameters is shown below.

If the SERVOPACK is in speed control or torque control, perform steps 1 through 4.

If the SERVOPACK is in position control, perform steps 1 through 7.

Step	Setting Contents	Set Parameters	Reference
1	Set the motor rotating direction	Pn000.0/Pn002.3	9.2.3
2	Sets the number of pitches (cycles) of the sine wave for the external scale.	Pn20A	9.2.4
3	Sets the number of output pulses of the PG output signal (PAO, PBO and PCO) from the SERVOPACK to an external device.	Pn281	9.2.5
4	Set the electronic gear.	Pn20E/Pn210	9.2.6
5	Set the alarm detection	Pn51B/Pn52A	9.2.7
6	Set the analog monitor signal.	Pn006/Pn007	9.2.8

9.2.2 Speed Feedback Method during Fully-closed Loop Control

There are two types for speed feedback method during fully-closed loop control.

Uses motor encoder speed:

External encoder speed is used in position control and motor encoder speed is used in speed control. Normally use this setting.

Uses external encoder speed:

External encoder speed is used in both position control and speed control. With this setting, speed ripple can be reduced when the external encoder resolution is higher than the motor encoder resolution. This setting is effective when high-resolution external encoder is connected to direct drive motor.

(1) Related Parameter

Parameter	Meaning	When Enabled	Classification
Pn22A	n.0□□□	After restart	Setup
	n.1□□□		

Note: This parameter is not be used when Pn002.3 is set to 0.

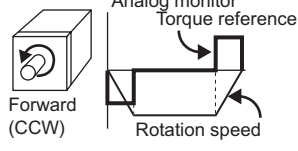


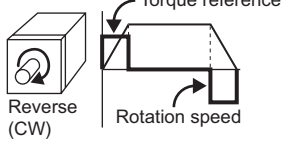


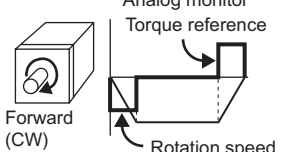


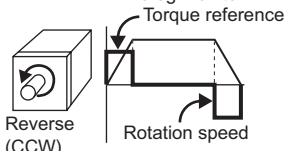
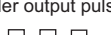

9.2.3 Motor Rotation Direction

The motor rotation direction can be set. To perform fully closed control, it is necessary to set the motor rotation direction with both Pn000.0 (motor rotating direction) and Pn002.3 (external encoder usage method).

 CAUTION
If the setting is wrong, the mechanical system may run out of control.

(1) Parameter Pn000.0

* The standard setting for "forward rotation" is counterclockwise as viewed from the drive end.

Parameter	Meaning
Pn000 n.□□□0 Standard setting (CCW = Forward) (Factory setting)	■ Forward Reference  Analog monitor Torque reference Encoder output pulses PAO  PBO  Phase B lead Rotation speed
Pn000 n.□□□1 Reverse Rotation Mode (CW = Forward)	■ Reverse Reference  Analog monitor Torque reference Encoder output pulses PAO  PBO  Phase A lead Rotation speed
Pn000 n.□□□1 Reverse Rotation Mode (CW = Forward)	■ Forward Reference  Analog monitor Torque reference Encoder output pulses PAO  PBO  Phase B lead Rotation speed
Pn000 n.□□□1 Reverse Rotation Mode (CW = Forward)	■ Reverse Reference  Analog monitor Torque reference Encoder output pulses PAO  PBO  Phase A lead Rotation speed

(2) Parameter Pn002.3

Parameter	Name	Meaning	When Enabled	Classification
Pn002	n.0□□□	Do not use. (Factory setting)* ¹	After restart	Setup
	n.1□□□	Use external encoder in forward rotation direction.* ²		
	n.2□□□	Reserved (Do not set).		
	n.3□□□	Use external encoder in reversed rotation direction.* ³		
	n.4□□□	Reserved (Do not set).		

- Note 1. The mode will be switched to semi-closed position control if Pn002.3 is set to 0.
 2. The direction for which the scale is counted up counter clockwise is defined as forward rotation.
 3. The direction for which the scale is counted up clockwise is defined as forward rotation.

(3) Relation between Motor Rotating Direction and External Encoder Pulse Direction

Refer to the table below.

Parameter			Pn002.3 (Using Method of External Encoder)			
			1		3	
Pn000.0 (Motor rotating direction)	0	Reference direction	Forward run reference	Reverse run reference	Forward run reference	Reverse run reference
		Motor rotating direction	CCW	CW	CCW	CW
		External encoder output	cos lead	sin lead	sin lead	cos lead
		Encoder output pulse	Phase B lead	Phase A lead	Phase A lead	Phase B lead
	1	Reference direction	Forward run reference	Reverse run reference	Forward run reference	Reverse run reference
		Motor rotating direction	CW	CCW	CW	CCW
		External scale output	sin lead	cos lead	cos lead	sin lead
		Encoder output pulse	Phase B lead	Phase A lead	Phase A lead	Phase B lead

- Set Pn002.3 to 1 if the output of the external encoder is cos lead and the motor is turning counterclockwise; set Pn002.3 to 3 if it is sin lead. When Pn000.0 is set to 0 and Pn002.3 to 1, manually turn the motor counterclockwise. If the Fully-closed Feedback Pulse Counter (Un00E) counts up, set Pn002.3 to 1. If the Un00E counts down, set Pn002.3 to 3.
- If Pn002.3 is set to 1, encoder output pulse is phase B lead if the motor runs forward. If Pn002.3 is set to 3, it is phase A lead if the motor turns forward.

9.2.4 Sine Wave Pitch (Frequency) for an External Encoder

Set Pn20A to the number of external encoder pitches per motor rotation.

(1) Setting Example

Specifications External encoder pitch: 20 μ m Ball screw pitch: 30 mm Speed: 1600 mm/s

If the SERVOPACK is connected directly to the motor, the set value will be 1500 (30 mm/0.02 mm = 1500).

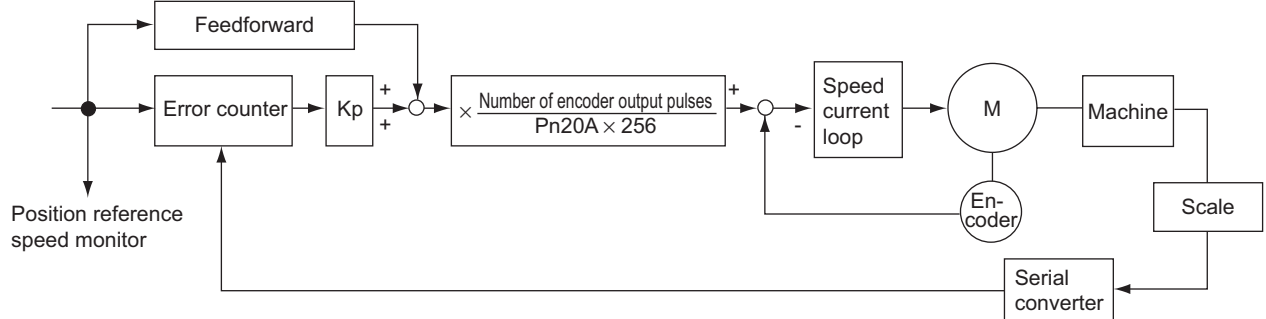
Note: If there is a fraction, round off the digits below the decimal point.

(2) Related Parameter

Pn20A	Number of External Encoder Pitches				Classifica- tion
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	4 to 1048576	1 pitch/Rev	32768	After restart	Setup

(3) Error

The number of speed pitches per motor rotation causes error in the position loop gain (K_p), feedforward, and position reference monitor unless the number of encoder pitches is an integer. This has no influence on the accuracy of positioning, thus does not cause position error.



9.2.5 Number of Encoder Output Pulses (PAO, PBO, and PCO) from the SERVOPACK

Set the position resolution to Pn281. Set the number of phase A and phase B edges.

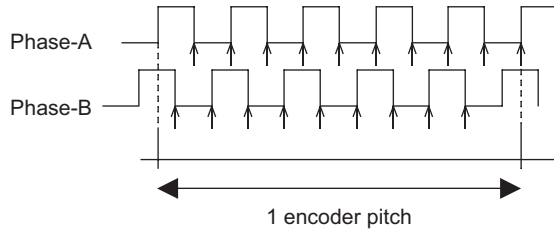
(1) Setting Example

Specifications
 External encoder pitch: 20 μm
 Ball screw pitch: 30 mm
 Speed: 1600 mm/s

If the output of a single pulse (multiplied by 4) is 1 μm , the set value will be 20.

If the output of a single pulse (multiplied by 4) is 0.5 μm , the set value will be 40.

The pulse output will have the following waveform if the set value is 20.



"↑" shows the edge position. In this example, the set value is 20 therefore the number of ↑ is 20.

Note: The upper limit frequency of the encoder signal output (multiplied by 4) is 6.4 Mpps. Do not allow the upper limit frequency to exceed 6.4 Mpps.

Example:

The frequency is as follows if the set value is 20 and the speed is 1600 mm/s:

$$\frac{16000 \text{ mm/sec}}{0.001 \text{ mm}} = 1600000 = 1.6 \text{ Mbps}$$

Because 1.6 Mbps is less than 6.4 Mpps, this value can be used.

(2) Related Parameter

Pn281	Encoder Output Pulses				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 4096	1 P/pitch	20	After restart	Setup

9.2.6 Electronic Gear

For the electronic gear setting, refer to 5.4.3 *Electronic Gear*.

9.2.7 Alarm Detection

The setting of alarm detection (Pn51B/Pn52A) is shown below.

(1) Excessive Error Level between the Motor and Load Positions (Pn51B)

This setting detects the difference between the external encoder position and the encoder position. If the detected difference is above the set level, alarm A.d10 (Motor-load Position Error Pulse Overflow) will be output.

Pn51B	Excessive Error Level Between Servomotor and Load Positions				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1073741824 (2^{30})	1 reference unit	1000	Immediately	Setup

Note: When Pn51B is set to 0, "Motor-load Position Error Pulse Overflow (A.d10)" is not detected.

(2) Multiplier for One Fully-closed Rotation (Pn52A)

The coefficient of the deviation between the external encoder and the motor per rotation can be set. This function can be used to prevent the motor from running out of control due to damage to the external encoder or to detect slippage of the belt.

■ Setting Example

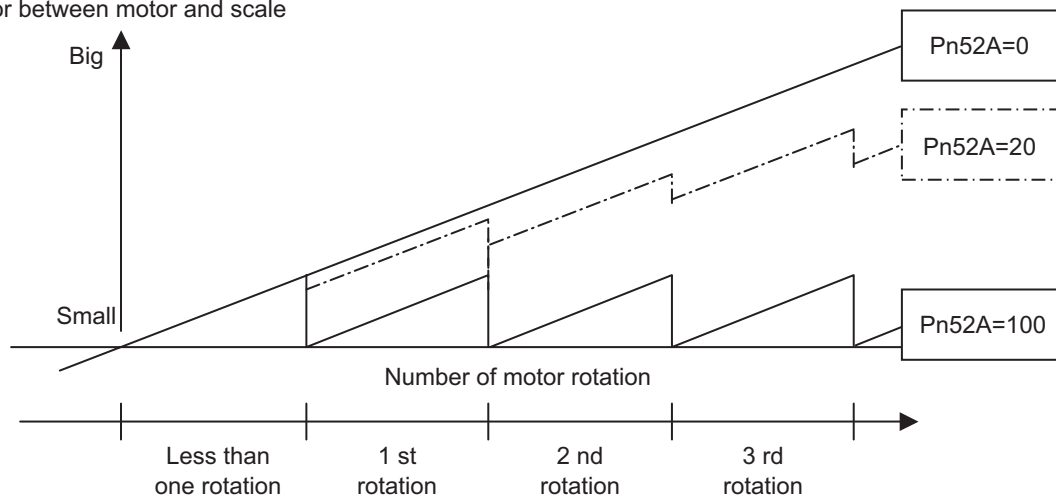
Increase the value if the belt slips or is twisted excessively.

If the set value is 0, the scale value will be read as it is.

The factory setting is 20. In this case, the second rotation will start with the deviation per motor rotation multiplied by 0.8.

(Refer to the following figure.)

Error between motor and scale



■ Related Parameter

Pn52A	Multiplier per One Fully-closed Rotation <div><div>Speed</div><div>Position</div><div>Torque</div></div>				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1070	1%	20	Immediately	Setup

9.2.8 Analog Monitor Signal

Set the following analog monitor signals.

Parameter		Name	Meaning	When Enabled	Classification
Pn006	n.□□07	Analog Monitor 1 Signal Selection	Position error between servomotor and load [0.01 V/1 reference unit] * Factory setting: n.□□02	Immediately	Tuning
		Analog Monitor 2 Signal Selection	Position error between servomotor and load [0.01 V/1 reference unit] * Factory setting: n.□□00		

Troubleshooting

10.1 Troubleshooting	10-2
10.1.1 List of Alarms	10-2
10.1.2 Troubleshooting of Alarms	10-6
10.2 Warning Displays	10-22
10.2.1 List of Warnings	10-22
10.2.2 Troubleshooting of Warnings	10-23
10.3 Troubleshooting Malfunction Based on Operation and Conditions of the Servomotor	10-25

10.1 Troubleshooting

The following sections describe troubleshooting in response to alarm displays.

The alarm name, alarm meaning, alarm stopping method, alarm reset capability and alarm code output are listed in order of the alarm numbers in *10.1.1 List of Alarms*.

The causes of alarms and troubleshooting methods are provided in *10.1.2 Troubleshooting of Alarms*.

10.1.1 List of Alarms

If an alarm occurs, the servomotor can be stopped by doing either of the following operations.

Gr.1: The servomotor is stopped according to the settings in Pn001.0 if an alarm occurs. Pn001.0 is factory-set to stop the servomotor by applying the DB.

Gr.2: The servomotor is stopped according to the setting in Pn00B.1 if an alarm occurs. Pn00B.1 is factory-set to stop the servomotor by setting the speed reference to "0." The servomotor under torque control will always use the Gr.1 method to stop. By setting Pn00B.1 to 1, the servomotor stops using the same method as Gr.1. When coordinating a number of servomotors, use this alarm stop method to prevent machine damage that may result due to differences in the stop method.

Alarm Display	Alarm Name	Meaning	Servo-motor Stop Method	Alarm Reset	Alarm Code Output		
					ALO1	ALO2	ALO3
A.020	Parameter Checksum Error 1	The data of the parameter in the SERVO-PACK is incorrect.	Gr.1	N/A	H	H	H
A.021	Parameter Format Error 1	The data of the parameter in the SERVO-PACK is incorrect.	Gr.1	N/A			
A.022	System Checksum Error 1	The data of the parameter in the SERVO-PACK is incorrect.	Gr.1	N/A			
A.023	Parameter Password Error 1	The data of the parameter in the SERVO-PACK is incorrect.	Gr.1	N/A			
A.030	Main Circuit Detector Error	Detection data for power circuit is incorrect.	Gr.1	Available			
A.040	Parameter Setting Error 1	The parameter setting is outside the allowable setting range.	Gr.1	N/A			
A.041	Encoder Output Pulse Setting Error	The encoder output pulse setting (pulse unit) (Pn212) is outside the allowable setting range or not satisfies the setting conditions.	Gr.1	N/A			
A.042	Parameter Combination Error	Combination of some parameters exceeds the setting range.	Gr.1	N/A			
A.044	Fully-closed Loop Control Parameter Setting Error	The settings of the option card and Pn00B.3, Pn002.3 do not match.	Gr.1	N/A			
A.050	Combination Error	The SERVOPACK and the servomotor capacities do not match each other.	Gr.1	Available			
A.051	Unsupported Device Alarm	The device unit unsupported was connected.	Gr.1	N/A			
A.0b0	Cancelled Servo ON Command Alarm	The Host controller reference was sent to turn the Servo ON after the Servo ON function was used with the utility function.	Gr.1	Available			
A.100	Overcurrent or Heat Sink Overheated	An overcurrent flowed through the IGBT. Heat sink of the SERVOPACK was overheated.	Gr.1	N/A	L	H	H

Alarm Display	Alarm Name	Meaning	Servo-motor Stop Method	Alarm Reset	Alarm Code Output		
					ALO1	ALO2	ALO3
A.300	Regeneration Error	Regenerative circuit or regenerative resistor is faulty.	Gr.1	Available	L	L	H
A.320	Regenerative Overload	Regenerative energy exceeds regenerative resistor capacity.	Gr.2	Available			
A.330	Main Circuit Power Supply Wiring Error	Detected when the power to the main circuit is turned ON.	Gr.1	Available			
A.400	Overvoltage	Main circuit DC voltage is excessively high.	Gr.1	Available	H	H	L
A.410	Undervoltage	Main circuit DC voltage is excessively low.	Gr.2	Available			
A.510	Overspeed	The servomotor speed is excessively high.	Gr.1	Available	L	H	L
A.511	Overspeed of Encoder Output Pulse Rate	The motor speed upper limit of the set encoder output pulse (pulse unit) (Pn212) is exceeded.	Gr.1	Available			
A.520	Vibration Alarm	Vibration at the motor speed was detected.	Gr.1	Available			
A.521	Autotuning Alarm	Vibration was detected while performing tuning-less function.	Gr.1	Available			
A.710	Overload: High Load	The motor was operating for several seconds to several tens of seconds under a torque largely exceeding ratings.	Gr.2	Available	L	L	L
A.720	Overload: Low Load	The motor was operating continuously under a torque largely exceeding ratings.	Gr.1	Available			
A.730 A.731	Dynamic Brake Overload	When the dynamic brake was applied, rotational energy exceeded the capacity of dynamic brake resistor.	Gr.1	Available			
A.740	Overload of Surge Current Limit Resistor	The main circuit power was frequently turned ON and OFF.	Gr.1	Available			
A.7A0	Heat Sink Overheated	The heat sink of the SERVOPACK exceeded 100°C.	Gr.2	Available			
A.7AB	Built-in Fan in SERVOPACK Stopped	The fan inside the SERVOPACK stopped.	Gr.1	Available			
A.810	Encoder Backup Error	All the power supplies for the absolute encoder have failed and position data was cleared.	Gr.1	N/A	H	H	H
A.820	Encoder Checksum Error	The checksum results of encoder memory is incorrect.	Gr.1	N/A			
A.830	Absolute Encoder Battery Error	The battery voltage was lower than the specified value 2 to 4 seconds after the control power supply is turned ON.	Gr.1	Available			
A.840	Encoder Data Error	Data in the encoder is incorrect.	Gr.1	N/A			
A.850	Encoder Overspeed	The encoder was rotating at high speed when the power was turned ON.	Gr.1	N/A			
A.860	Encoder Overheated	The internal temperature of encoder is too high.	Gr.1	N/A			
A.891	Encoder Module Error	Encoder module is faulty.	Gr.1				
A.8A0	External Encoder Error of Scale	External encoder is faulty.	Gr.1	Available			
A.8A1	External Encoder Error of Module	Serial converter unit is faulty.	Gr.1	Available			
A.8A2	External Encoder Error of Sensor	External encoder is faulty.	Gr.1	Available			
A.8A3	External Encoder Error of Position	The position of external encoder is faulty.	Gr.1	Available			

Alarm Display	Alarm Name	Meaning	Servo-motor Stop Method	Alarm Reset	Alarm Code Output		
					ALO1	ALO2	ALO3
A.b10	Speed Reference A/D Error	The A/D converter for speed reference input is faulty.	Gr.2	Available	H	H	H
A.b11	Speed Reference A/D Data Error	A/D conversion data of speed reference is incorrect.	Gr.2	Available			
A.b20	Reference Torque Input Read Error	The A/D converter for torque reference input is faulty.	Gr.2	Available			
A.b31	Current Detection Error1 (Phase-U)	The current detection circuit for phase-U is faulty.	Gr.1	N/A			
A.b32	Current Detection Error 2 (Phase-V)	The current detection circuit for phase-V is faulty.	Gr.1	N/A			
A.b33	Current Detection Error 3 (Current detector)	The detection circuit for the current is faulty.	Gr.1	N/A			
A.bF0	System Alarm 0 (Scan C error)	"Internal program error 0" of the SERVO-PACK occurred.	Gr.1	N/A			
A.bF1	System Alarm 1 (CPU stack memory error)	"Internal program error 1" of the SERVO-PACK occurred.	Gr.1	N/A			
A.bF2	System Alarm 2 (Current control program processing error)	"Internal program error 2" of the SERVO-PACK occurred.	Gr.1	N/A			
A.bF3	System Alarm 3 (Scan A error)	"Internal program error 3" of the SERVO-PACK occurred.	Gr.1	N/A			
A.bF4	System Alarm 4 (CPU watchdog timer error)	"Internal program error 4" of the SERVO-PACK occurred.	Gr.1	N/A			
A.C10	Servo Overrun Detected	The servomotor ran out of control.	Gr.1	Available	L	H	L
A.C20	Phase Detection Error	The detection of the phase is incorrect.	Gr.1	N/A			
A.C21	Hall Sensor Error	The hall sensor is faulty.	Gr.1	N/A			
A.C22	Phase Information Disagreement	The phase information does not match.	Gr.1	N/A			
A.C50	Polarity Detection Error	The polarity detection failed.	Gr.1	N/A			
A.C51	Overtravel Detection at Polarity Detection	The overtravel signal was detected at polarity detection.	Gr.1	N/A			
A.C52	Polarity Detection Uncompleted	The servo was turned ON under the condition of polarity detection uncompleted.	Gr.1	N/A			
A.C53	Out of Range for Polarity Detection	The moving distance exceeded the set value of Pn48E during polarity detection.	Gr.1	N/A			
A.C54	Polarity Detection Error 2	The polarity detection failed.	Gr.1	N/A			
A.C80	Absolute Encoder Clear Error and Multi-turn Limit Setting Error	The multi-turn for the absolute encoder was not properly cleared or set.	Gr.1	N/A			
A.C90	Encoder Communications Error	Communications between the SERVO-PACK and the encoder is not possible.	Gr.1	N/A			
A.C91	Encoder Communications Position Data Error	An encoder position data calculation error occurred.	Gr.1	N/A			
A.C92	Encoder Communications Timer Error	An error occurs in the communications timer between the encoder and the SERVO-PACK.	Gr.1	N/A			
A.CA0	Encoder Parameter Error	Encoder parameters are faulty.	Gr.1	N/A			
A.Cb0	Encoder Echoback Error	Contents of communications with encoder is incorrect.	Gr.1	N/A			
A.CC0	Multi-turn Limit Disagreement	Different multi-turn limits have been set in the encoder and the SERVOPACK.	Gr.1	N/A			

Alarm Display	Alarm Name	Meaning	Servo-motor Stop Method	Alarm Reset	Alarm Code Output		
					ALO1	ALO2	ALO3
A.CF1	Feedback Option Card Communications Error (Reception error) *1	Reception error	Gr.1	N/A	L	H	L
A.CF2	Feedback Option Card Communications Error (Timer stop) *1	Timer stopped	Gr.1	N/A			
A.d00	Position Error Pulse Overflow	Position error pulses exceeded parameter (Pn520).	Gr.1	Available	L	L	H
A.d01	Position Error Pulse Overflow Alarm at Servo ON	Position error pulses accumulated too much.	Gr.1	Available			
A.d02	Position Error Pulse Overflow Alarm by Speed Limit at Servo ON	If the servo turns ON with position error pulses accumulated, the speed is limited by Pn529. In this state, the reference pulse was input without resetting the speed limit, and the position error pulses exceeds the value set for the parameter Pn520.	Gr.2	Available			
A.d10	Motor-load Position Error Pulse Overflow	Position error between motor and load is excessive.	Gr.2	Available			
A.EB0	Safety Function DRV Monitor Circuit Error *2	The safety function DRV monitor circuit is faulty.	Gr.1	N/A	H	L	L
A.EB1	Safety Function Signal Input Timing Error	The safety function signal input timing is faulty.	Gr.1	N/A			
A.EB2	Safety Function DRV Internal Signal Error *2	The safety function DRV internal signal is faulty.	Gr.1	N/A			
A.EB3	Safety Function DRV Communications Error 1 *2	The safety function DRV communications is faulty.	Gr.1	N/A			
A.EB4	Safety Function DRV Communications Error 2 *2	The safety function DRV communications is faulty.	Gr.1	N/A			
A.EB5	Safety Function DRV Communications Error 3 *2	The safety function DRV communications is faulty.	Gr.1	N/A			
A.EB6	Safety Function DRV Communications Data Error *2	The safety function DRV communications data is faulty.	Gr.1	N/A			
A.EC7	Safety Option Card Stop Reference Error *2	The safety option card stop reference is faulty.	Gr.1	N/A			
A.F10	Main Circuit Cable Open Phase	With the main power supply ON, voltage was low for more than 1 second in phase-R, -S or -T.	Gr.2	Available	H	L	H
CPF00	Digital Operator Transmission Error 1	Digital operator (JUSP-OP05A) fails to communicate with the SERVOPACK (e.g., CPU error).	—	N/A	Not decided		
CPF01	Digital Operator Transmission Error 2		—	N/A			
A.— —	Not an error	Normal operation status	—	—	H	H	H

*1. Only when a feedback option card is used.

*2. Only when safety function is used.

10.1.2 Troubleshooting of Alarms

When an error occurs in SERVOPACKs, an alarm display such as A.□□□ and CPF□□ on the panel operator. Refer to the following table to identify the cause of an alarm and the action to be taken.

Contact your Yaskawa representative if the problem cannot be solved by the described corrective action.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.020*1: Parameter Checksum Error 1 (The parameter data in the SERVOPACK is incorrect.)	The power supply voltage suddenly dropped.	Measure the power supply voltage.	Set the power supply voltage within the specified range, and set Fn005 to initialize the parameter.
	The power supply went OFF while changing a parameter setting.	Note the circumstances when the power supply went OFF.	Set Fn005 to initialize the parameter and then set the parameter again.
	The number of times that parameters were written exceeded the limit.	Were the parameters frequently changed through the host controller?	The SERVOPACK may be faulty. Repair or replace the SERVOPACK. Reconsider the method of writing parameters.
	Malfunction caused by noise from the AC power supply or grounding line, static electricity noise, etc.	Turn the power supply ON and OFF several times. If the alarm still occurs, there may be noise interference.	Take countermeasures against noise.
	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. Repair or replace the SERVOPACK.
	A SERVOPACK fault occurred.	Turn the power supply ON and OFF several times. If the alarm still occurs, the SERVOPACK is faulty.	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.021*1: Parameter Format Error 1 (The parameter data in the SERVOPACK is incorrect.)	The software version of SERVOPACK that caused the alarm is older than that of the written parameter.	Check Fn012 to see if the set software version agrees with that of the SERVOPACK. If not, an alarm may occur.	Write the parameter of another SERVOPACK of the same model with the same software version. Then turn the power OFF and then ON again.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.022*1: System Checksum Error 1 (The parameter data in the SERVOPACK is incorrect.)	The power supply voltage suddenly dropped.	Measure the power supply voltage.	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
	The power supply went OFF while setting an utility function.	Note the circumstances when the power supply went OFF.	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
	A SERVOPACK fault occurred.	Turn the power supply ON and OFF several times. If the alarm still occurs, the SERVOPACK is faulty.	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.023*1: Parameter Password Error 1 (The parameter data in the SERVOPACK is incorrect.)	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.030*1: Main Circuit Detector Error	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.040*1: Parameter Setting Error 1 (The parameter setting was out of the allowable setting range.)	The SERVOPACK and servomotor capacities do not match each other.	Check the combination of SERVOPACK and servomotor capacities.	Select the proper combination of SERVOPACK and servomotor capacities.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
	The parameter setting is out of the specified range.	Check the setting ranges of the parameters that have been changed.	Set the parameter Un203 to a value within the specified range.
	The electronics gear ratio is out of the setting range.	Check the electronic gear ratio. The ratio must satisfy: $0.001 < (\text{Pn20E}/\text{Pn210}) < 1000$.	Set the electronic gear ratio in the range: $0.001 < (\text{Pn20E}/\text{Pn210}) < 1000$.
A.041*1: Encoder Output Pulse Setting Error	The encoder output pulse (Pn212) is out of the setting range and does not satisfy the setting conditions.	Check the parameter Pn212.	Set Pn212 to a correct value.
A.042*1: Parameter Combination Error	The speed of program JOG operation (Fn004) is lower than the setting range after having changed the electronic gear ratio (Pn20E/Pn210) or the servomotor.	Check that the detection conditions is satisfied.	Reduce the electronic gear ratio (Pn20E/Pn210).
	The speed of program JOG operation (Fn004) is lower than the setting range after having changed the setting of Pn533 "Program JOG Movement Speed."	Check that the detection conditions is satisfied.	Increase the setting for Pn533 "Program JOG Movement Speed."
	The moving speed of advanced autotuning is lower than the setting range after having changed the electronic gear ratio (Pn20E/Pn210) or the servomotor.	Check that the detection conditions is satisfied.	Reduce the electronic gear ratio (Pn20E/Pn210).
A.044*1: Fully-closed Loop Control Parameter Setting Error	The setting of the option card does not match with those of Pn00B.3 and Pn002.3.	Check the settings of the option card, Pn00B.3, and Pn002.3.	The setting of option card must be compatible with the settings of Pn00B.3 and Pn002.3. Mount an option card or replace the mounted option card with an appropriate model. Or change the parameter setting.
A.04A: Parameter Setting Error 2	For a 4-byte parameter bank, no registration in two consecutive bytes for two bank members.		Change the number of bytes for bank members to an appropriate value.
	The total amount of bank data exceeds 64. ($\text{Pn900} \times \text{Pn901} > 64$)		Reduce the total amount of bank data to 64 or less.
A.050*1: Combination Error (The SERVOPACK and servomotor capacities do not correspond.)	The SERVOPACK and servomotor capacities do not match each other.	Check the capacities to see if they satisfy the following condition: $(\text{Servomotor capacity})/(\text{SERVOPACK capacity}) \leq 1/4$, or $(\text{Servomotor capacity})/(\text{SERVOPACK capacity}) \leq 4$.	Select the proper combination of SERVOPACK and servomotor capacities.
	An encoder fault occurred.	Replace the servomotor and see if the alarm occurs again.	Replace the servomotor (encoder).
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.051*1: Unsupported Device Alarm	An unsupported serial converter unit, serial encoder, or external encoder is connected to the SERVOPACK.	Check the product specifications, and select the correct model.	Select the correct combination of units.
A.0b0*1: Cancelled Servo ON Command Alarm	After executing the utility function to turn ON the power to the motor, the Servo ON command was sent from the host controller.	—	Restart the system including the host controller.
A.100*1: Overcurrent or Heat Sink Overheated (An overcurrent flowed through the IGBT or heat sink of SERVOPACK overheated.)	Incorrect wiring or contact fault of main circuit cable or motor main circuit cable.	Check the wiring. Refer to 3.1 <i>Main Circuit Wiring</i> .	Correct the wiring.
	Short-circuit or ground fault of main circuit cable or motor main circuit cable.	Check for short-circuits across the servomotor terminal phase-U, -V, and -W, or between the grounding and servomotor terminal U, V, or W. Refer to 3.1 <i>Main Circuit Wiring</i> .	Some cables may be damaged. Repair or replace damaged cables.
	Short-circuit or ground fault inside the servomotor.	Check for short-circuits across the servomotor terminal phase-U, -V, and -W, or between the grounding and servomotor terminal U, V, or W. Refer to 3.1 <i>Main Circuit Wiring</i> .	The servomotor may be faulty. Repair or replace the servomotor.
	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 grounding and terminal U, V, or W. Refer to 3.1 <i>Main Circuit Wiring</i> .	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
	Incorrect wiring or contact fault of the regenerative resistor.	Check the wiring. Refer to 3.6 <i>Connecting Regenerative Resistors</i> .	Correct the wiring.
	The dynamic brake (DB: Emergency stop executed from the SERVOPACK) was frequently activated, or the DB overload alarm occurred.	Check the resistor power consumption monitor Un00B to see how many times the DB has been used. Or, check the alarm trace back monitor Fn000 to see if the DB overload alarm A.730 or A.731 was reported.	Change the SERVOPACK model, operation conditions, or the mechanism so that the DB does not need to be used so frequently.
	The generated regenerative energy exceeded the SERVOPACK regenerative energy processing capacity.	Check the regenerative load ratio monitor Un00A to see how many times the regenerative resistor has been used.	Check the operation condition including overload, and reconsider the regenerative resistor value.
	The SERVOPACK regenerative resistance is too small.	Check the regenerative load ratio monitor Un00A to see how many times the regenerative resistor has been used.	Change the regenerative resistance value to a value larger than the SERVOPACK minimum allowable resistance value.
	A heavy load was applied while the servomotor was stopped or running at a low-speed.	Check to see if the operating conditions are outside servodrive specifications.	Reduce the load applied to the servomotor or increase the operation speed.
	Malfunction caused by noise interference.	Improve the wiring or installation environment, such as by reducing noise, and check to see if the alarm recurs.	Take countermeasures for noise, such as correct wiring of the FG. Use an FG wire size equivalent to the SERVOPACK main circuit wire size.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.300*1: Regeneration Error	Regenerative resistor capacity (Pn600) is set to a value other than 0 for a SGDVR70, -R90, -1R6, or -2R8 SERVO-PACK, and an external regenerative resistor is not connected.	Check the external regenerative resistor connection and the value of the Pn600.	Connect the external regenerative resistor, or set Pn600 to 0 if no regenerative resistor is required.
	The jumper between the power supply terminals B2 and B3 is removed.	Confirm that a jumper is mounted between the power supply terminals B2 and B3.	Correctly mount a jumper.
	The external regenerative resistor is incorrectly wired, or is removed or disconnected.	Check the external regenerative resistor connection.	Correctly connect the external regenerative resistor.
	The power supply voltage exceeds the specified limit.	Measure the power supply voltage.	Set the power supply voltage within the specified range.
	The external regenerative resistor capacity or the regenerative resistance is incorrect.	Check the external regenerative resistor to see if the capacity is appropriate.	Change the regenerative resistance to a correct value or use an external regenerative resistor of appropriate capacity.
	Insufficient SERVOPACK capacity or insufficient regenerative resistor capacity caused regenerative power to continuously flow back.	Reconsider the capacity selection.	Reconsider the capacity selection.
	Regenerative power continuously flowed back because negative load was continuously applied.	Check the load to the servomotor during operation.	Reconsider the system including servo, machine, and operation conditions.
	The load moment of inertia exceeds the allowable value.	Check the load moment of inertia.	Reconsider the capacity selection.
	A SERVOPACK fault occurred.	—	While the main circuit power supply is OFF, turn the control power supply OFF and then turn ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVO-PACK.
A.320*1: Regenerative Overload	The power supply voltage exceeds the specified limit.	Measure the power supply voltage.	Set the power supply voltage within the specified range.
	Incorrect external regenerative resistance. Insufficient servo amplifier capacity or regenerative resistor capacity. Or, regenerative power has been continuously flowing back.	Check the operation condition or the capacity using the capacity selection Software SigmaSize+, etc.	Change the regenerative resistance, regenerative resistor capacity, or SERVOPACK capacity. Reconsider the operation conditions using the capacity selection software SigmaSize+, etc.
	Regenerative power continuously flowed back because negative load was continuously applied.	Check the load to the servomotor during operation.	Reconsider the system including servo, machine, and operation conditions.
	The setting of parameter Pn600 is smaller than the external regenerative resistor's capacity.	Check the external regenerative resistor connection and the value of the Pn600.	Set the Pn600 to a correct value.
	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 appropriate capacity.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVO-PACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.330*1: Main Circuit Power Supply Wiring Error (Detected when the power to the main circuit is turned ON.)	The regenerative resistor disconnected when the SERVOPACK power voltage was increased.	Measure the resistance of the regenerative resistor.	When using a regenerative resistor built in the SERVOPACK: Repair or replace the SERVO-PACK. When using an external regenerative resistor: Replace the external regenerative resistor.
	In the AC power input mode, DC power was supplied.	Check the power supply to see if it is a DC power supply.	Correct the settings to match the actual power supply specifications.
	In the DC power input mode, AC power was supplied.	Check the power supply to see if it is a AC power supply.	Correct the settings to match the actual power supply specifications.
	Regenerative resistor capacity (Pn600) is not set to 0 even though the regenerative resistor is disconnected.	Is the regenerative resistor connected? If it is, check the regenerative resistor capacity.	Set Pn600 to 0.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVO-PACK.
A.400*1: Overvoltage (Detected when the SERVOPACK's main circuit DC voltage is one of the values below. 200 VAC SERVOPACKs: 410 VDC or more 400 VAC SERVOPACKs: 820 VDC or more) (Detected when the power to the main circuit is turned ON)	For 200 VAC SERVOPACKs: The AC power supply voltage exceeded 290 V. For 400 VAC SERVOPACKs: The AC power supply voltage exceeded 580 V. For 200 VAC SERVOPACKs with DC power supply input: The power supply voltage exceeded 410 V. For 400 VAC SERVOPACKs with DC power supply input: The power supply voltage exceeded 820 V.	Measure the power supply voltage.	Set AC power supply voltage within the specified range.
	The power supply is unstable, or was influenced by a lightning surge.	Measure the power supply voltage.	Improve the power supply conditions by installing a surge protector, etc. Then, turn the power supply ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVO-PACK.
	For 200 VAC SERVOPACKs: The servomotor accelerated/ decelerated with the AC power voltage between 230 and 270 V. For 400 VAC SERVOPACKs: The servomotor accelerated/ decelerated with the AC power voltage between 480 and 560 V.	Check the power supply voltage and the speed and torque/force during operation.	Set AC power supply voltage within the specified range.
	The external regenerative resistance is too high for the actual operation conditions.	Check the operation conditions and the regenerative resistance.	Select a regenerative resistance value appropriate for the operation conditions and load.
	The load moment of inertia exceeded the allowable value.	Confirm that the load moment of inertia is within the allowable range.	Increase the deceleration time, or reduce the load.
	A SERVOPACK fault occurred.	—	Turn the control power OFF and then ON again while the main circuit power supply is OFF. If the alarm still occurs, the SERVO-PACK may be faulty. Repair or replace the SERVOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.410*1: Undervoltage (Detected when the SERVOPACK's main circuit DC voltage is one of the values below. 200 VAC SERVO- PACKs: 170 VDC or less 400 VAC SERVO- PACKs: 340 VDC or less.) (Detected when the power to the main circuit is turned ON.)	For 200 VAC SERVOPACKs: The power supply is 120 V or less. For 400 VAC SERVOPACKs: The power supply is 240 V or less.	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.
	Occurrence of instantaneous power interruption.	Measure the power supply voltage.	Set the power supply voltage within the specified range. When the instantaneous power cut hold time Pn509 is set, decrease the setting.
	The SERVOPACK fuse is blown out.	—	Repair or replace the SERVO-PACK, connect an AC/DC reactor, and run the SERVOPACK.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVO-PACK.
A.510*1: Overspeed (The servomotor speed exceeds the maximum.)	The order of phases U, V, and W in the servomotor wiring is incorrect.	Check the servomotor wiring.	Confirm that the servomotor is correctly wired.
	A reference value exceeding the overspeed detection level was input.	Check the input value.	Reduce the reference value or adjust the gain.
	The motor speed overshoot occurred.	Check the servomotor speed waveform.	Reduce the reference input gain, adjust the servo gain, or reconsider the operation conditions.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVO-PACK.
A.511*1: Overspeed of Encoder Output Pulse Rate	The encoder output pulse output frequency exceeded the limit.	Check the encoder output pulse output setting.	Decrease the setting of the encoder output pulse (Pn212).
	The encoder output pulse output frequency exceeded the limit because the servomotor speed was too high.	Check the encoder output pulse output setting and servomotor speed.	Decrease the servomotor speed.
A.520*1: Vibration Alarm	Abnormal vibration was detected at the servomotor rotation speed.	Check for abnormal noise from the servomotor, and check the speed and torque/force waveform during operation.	Reduce the servomotor speed or reduce the speed loop gain (Pn100).
	The moment of inertia ratio (Pn103) value is greater than the actual value or is greatly changed.	Check the load moment of inertia.	Set the moment of inertia ratio (Pn103) to an appropriate value.
A.521*1: Autotuning Alarm (Vibration was detected while performing tuning-less function.)	The servomotor vibrated considerably while performing tuning-less function (factory setting).	Check the servomotor speed waveform.	Reduce the load so that the load moment of inertia ratio falls within the allowable value, or reduce the load level or the gain level using the tuning-less function (Fn200).
	The servomotor vibrated considerably during advanced autotuning.	Check the servomotor speed waveform.	Execute advanced autotuning.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.710 ^{*1} : A.720 ^{*1} : Overload A.710: High Load A.720: Low Load	Incorrect wiring or contact fault of servomotor and encoder.	Check the wiring.	Confirm that the servomotor and encoder are correctly wired.
	Operation beyond the overload protection characteristics.	Check the servomotor overload characteristics and executed run command.	Reconsider the load conditions and operation conditions. Or, increase the servomotor capacity.
	Excessive load was applied during operation because the servomotor was not driven due to mechanical problems.	Check the executed run command and servomotor speed.	Remove the mechanical problems.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVO-PACK.
A.730 ^{*1} : A.731 ^{*1} : Dynamic Brake Overload (Detected with SGD-3R8A, -5R5A, -1R9D, -3R5D, -5R4D, -8R4D, -120D, or -170D SERVOPACKs.)	The servomotor rotates because of external force.	Check the operation status.	Take measures to ensure the servomotor will not rotate because of external force.
	The rotating energy at a DB stop exceeds the DB resistance capacity.	Check the DB resistor power consumption monitor (Un00B) to see how many times the DB has been used.	<ul style="list-style-type: none"> • Reduce the servomotor reference speed. • Reduce the load moment of inertia. • Reduce the number of times of the DB stop operation.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVO-PACK.
A.740 ^{*1} : Overload of Surge Current Limit Resistor (The main circuit power is turned ON/OFF too frequently.)	The inrush current limit resistor operation frequency at the main circuit power supply ON/OFF operation exceeds the allowable range.	Check how often the power supply has been turned ON/OFF.	Reduce the frequency of turning the main circuit power supply ON/OFF to less than once per minute.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVO-PACK.
A.7A0 ^{*1} : Heat Sink Overheated (Detected when the heat sink temperature exceeds 100°C.)	The ambient temperature is too high.	Check the ambient temperature using a thermostat.	Decrease the ambient temperature by improving the SERVOPACK installation conditions.
	The overload alarm has been reset by turning OFF the power too many times.	Check the alarm trace back monitor (Fn000) to see if the overload alarm was reported.	Change the method for resetting the alarm.
	Excessive load or operation beyond the regenerative energy processing capacity.	Check the accumulated load ratio monitor Un009 to see the load during operation, and the regenerative load ratio monitor Un00A to see the regenerative energy processing capacity.	Reconsider the load and operation conditions.
	Incorrect SERVOPACK installation orientation or/and insufficient space around the SERVOPACK.	Check the SERVOPACK installation conditions.	Install the SERVOPACK correctly as specified.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVO-PACK.
A.7AB ^{*1} : Built-in Fan in SERVOPACK Stopped	The fan inside the SERVOPACK stopped.	Check for foreign matter or debris inside the SERVOPACK.	Remove foreign matter or debris from the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.810*1: Encoder Backup Error (Detected on the encoder side) (Only when an absolute encoder is connected.)	Alarm occurred when the power to the absolute encoder was initially turned ON.	Check to see if the power was turned ON initially.	Set up the encoder (Fn008).
	The encoder cable disconnected, and connected again.	Check to see if the power was turned ON initially.	Confirm the connection and set up the encoder (Fn008).
	The power from both the control power supply (+5 V) and the battery power supply from the SERVOPACK is not being supplied.	Check the encoder connector battery or the connector contact status.	Replace the battery or take similar measures to supply power to the encoder, and set up the encoder (Fn008).
	An absolute encoder fault occurred.	—	If the alarm cannot be reset by setting up the encoder again, replace the encoder.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.820*1: Encoder Checksum Error (Detected on the encoder side.)	An encoder fault occurred.	—	Set up the encoder again using Fn008. If the alarm still occurs, the servomotor may be faulty. Repair or replace the servomotor.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.830*1: Absolute Encoder Battery Error (Detected when the battery voltage is lower than the specified value 2 to 4 seconds after the control power supply is turned ON.) (Only when an absolute encoder is connected.)	The battery connection is incorrect.	Check the battery connection.	Reconnect the battery.
	The battery voltage is lower than the specified value 2.7 V.	Measure the battery voltage.	Replace the battery and turn the control power supply ON.
	A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.840*1: Encoder Data Error (Detected on the encoder side.)	An encoder fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Repair or replace the servomotor.
	Malfunction of encoder because of noise interference, etc.	—	Correct the wiring around the encoder by separating the encoder cable from the main circuit cable or by checking the grounding and other wiring.
A.850*1: Encoder Overspeed (Detected when the control power supply was turned OFF and then ON again.) (Detected on the encoder side.)	The servomotor was running at 200 min ⁻¹ or higher when the control power supply was turned ON.	Check the speed monitor (Un000) to confirm the servomotor speed when the power is turned ON.	Reduce the servomotor speed to a value less than 200 min ⁻¹ , and turn ON the control power supply.
	An encoder fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Repair or replace the servomotor.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.860* ¹ : Encoder Overheated (Only when an absolute encoder is connected.) (Detected on the encoder side.)	The ambient temperature around the servomotor is too high.	Measure the ambient temperature around the servomotor.	The ambient temperature must be 40°C or less.
	The servomotor load is greater than the rated load.	Check the accumulated load ratio monitor (Un009) to see the load.	The servomotor load must be within the specified range.
	An encoder fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Repair or replace the servomotor.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.891* ¹ : Encoder Module Error	An encoder fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Repair or replace the servomotor.
A.8A0* ² : External Encoder Error of Scale	An external encoder fault occurred.	—	Repair or replace the external encoder.
A.8A1* ² : External Encoder Error of Module	An external encoder fault occurred.	—	Repair or replace the external encoder.
	A serial converter unit fault occurred.	—	Repair or replace the serial converter unit.
A.8A2* ² : External Encoder Error of Sensor (Incremental)	An external encoder fault occurred.	—	Repair or replace the external encoder.
A.8A3* ² : External Encoder Error of Position (Absolute)	An absolute external encoder fault occurred.	—	The absolute external encoder may be faulty. Refer to the encoder manufacturer's instruction manual for corrective actions.
A.b10* ¹ : Speed Reference A/D Error (Detected when the servo is ON.)	A malfunction occurred in the speed reference input section.	—	Clear and reset the alarm and restart the operation.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.b11* ¹ : Speed Reference A/D Data Error	A malfunction occurred in the detection section of the speed reference A/D conversion data. (Not an alarm.)	—	Clear and reset the alarm and restart the operation.
	A malfunction occurred in the speed reference input section.	—	Clear and reset the alarm and restart the operation.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

*2. These errors occur when using a feedback option card.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.b20*1: Reference Torque Input Read Error (Detected when the servo is ON.)	A malfunction occurred in the reading section of the torque ref- erence input.	—	Clear and reset the alarm and restart the operation.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SER- VOPACK.
A.b31*1: Current Detection Error 1 (Phase-U)	The current detection circuit for phase U is faulty.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SER- VOPACK.
A.b32*1: Current Detection Error 2 (Phase-V)	The current detection circuit for phase V is faulty.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SER- VOPACK.
A.b33*1: Current Detection Error 3 (Current detector)	The detection circuit for the cur- rent is faulty.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SER- VOPACK.
	The servomotor main circuit cable is disconnected.	Check for disconnection of the motor main circuit cable.	Correct the servomotor wiring.
A.b6A: MECHATROLINK Communications ASIC Error 1	SERVOPACK MECHA- TROLINK communication sec- tion fault.	—	Replace the SERVOPACK.
A.b6b: MECHATROLINK Communications ASIC Error 2	SERVOPACK MECHA- TROLINK communication sec- tion fault.	—	Replace the SERVOPACK.
A.bF0*1: System Alarm 0 (Scan C error)	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SER- VOPACK.
A.bF1*1: System Alarm 1 (CPU stack memory)	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SER- VOPACK.
A.bF2*1: System Alarm 2 (Current control pro- gram processing error)	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SER- VOPACK.
A.bF3*1: System Alarm 3 (Scan A error)	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SER- VOPACK.
A.bF4*1: System Alarm 4 (CPU watchdog timer error)	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SER- VOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.C10*1: Servo Overrun Detected (Detected when the servo is ON.)	The order of phases U, V, and W in the servomotor wiring is incorrect.	Check the servomotor wiring.	Confirm that the servomotor is correctly wired.
	An encoder fault occurred.	—	If the alarm still occurs after turning the power OFF and then ON again, even though the servomotor is correctly wired, the servomotor may be faulty. Repair or replace the servomotor.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.C80*1: Absolute Encoder Clear Error and Multi- turn Limit Setting Error	An encoder fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Repair or replace the servomotor.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.C90*1: Encoder Communications Error	Contact fault of encoder connector or incorrect encoder wiring.	Check the encoder connector contact status.	Re-insert the encoder connector and confirm that the encoder is correctly wired.
	Encoder cable disconnection or short-circuit. Or, incorrect cable impedance.	Check the encoder cable.	Use the encoder cable with the specified rating.
	Corrosion caused by improper temperature, humidity, or gas Short-circuit caused by intrusion of water drops or cutting oil Connector contact fault caused by vibration.	Check the operating environment.	Improve the operating environmental conditions, and replace the cable. If the alarm still occurs, repair or replace the SERVOPACK.
	Malfunction caused by noise interference.	—	Correct the wiring around the encoder to avoid noise interference (Separate the encoder cable from the main circuit cable, improve grounding, etc.)
	A SERVOPACK fault occurred.	—	Connect the servomotor to another SERVOPACK, and turn ON the control power. If no alarm occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.C91*1: Encoder Communications Position Data Error	The noise interference occurred on the input/output signal line because the encoder cable is bent and the sheath is damaged.	Check the encoder cable and connector.	Confirm that there is no problem with the encoder cable layout.
	The encoder cable is bundled with a high-current line or near a high-current line.	Check the encoder cable layout.	Confirm that there is no surge voltage on the encoder cable.
	The FG potential varies because of influence from machines on the servomotor side, such as the welder.	Check the encoder cable layout.	Properly ground the device to separate from the encoder FG.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.C92*1: Encoder Communications Timer Error	Noise interference occurred on the input/output signal line from the encoder.	—	Take countermeasures against noise.
	Excessive vibration and shocks were applied to the encoder.	Check the operating environment.	Reduce the machine vibration or correctly install the servomotor.
	An encoder fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Repair or replace the servomotor.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.CA0*1: Encoder Parameter Error	An encoder fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Repair or replace the servomotor.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.Cb0*1: Encoder Echoback Error	The encoder wiring and contact are incorrect.	Check the encoder wiring.	Correct the encoder wiring.
	Noise interference occurred due to incorrect encoder cable specifications.	—	Use tinned annealed copper twisted-pair or shielded twisted-pair cable with a core of at least 0.12 mm ² .
	Noise interference occurred because the wiring distance for the encoder cable is too long.	—	The wiring distance must be 20 m max.
	The FG potential varies because of influence from machines on the servomotor side, such as the welder.	Check the encoder cable and connector.	Make the grounding for the machine separately from encoder side FG.
	Excessive vibration and shocks were applied to the encoder.	Check the operating environment.	Reduce the machine vibration or correctly install the servomotor.
	An encoder fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Repair or replace the servomotor.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.CC0*1: Multi-turn Limit Disagreement	When using a direct-drive (DD) servomotor, the multi-turn limit value (Pn205) is different from that of the encoder.	Check the value of the Pn205.	Correct the setting of Pn205 (0 to 65535).
	The multi-turn limit value of the encoder is different from that of the SERVOPACK. Or, the multi-turn limit value of the SERVOPACK has been changed.	Check the value of the Pn205 of the SERVOPACK.	Execute Fn013 at the occurrence of alarm.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.CF1*2: Feedback Option Card Communications Error (Reception error)	Wiring of cable between serial converter unit and SERVOPACK is incorrect or contact is faulty.	Check the external encoder wiring.	Correct the cable wiring.
	The specified cable is not used between serial converter unit and SERVOPACK.	Confirm the external encoder wiring specifications.	Use the specified cable.
	Cable between serial converter unit and SERVOPACK is too long.	Measure the external encoder cable length.	Use 20 m cable max.
	Sheath of cable between serial converter unit and SERVOPACK is broken.	Check the external encoder cable.	Replace the cable.
A.CF2*2: Feedback Option Card Communications Error (Timer stop)	Noise interferes with the cable between serial converter unit and SERVOPACK.	—	Correct the wiring around serial converter unit, e.g., separating input/output signal line from main circuit cable or grounding.
	A serial converter unit fault occurred.	—	Replace the serial converter unit.
	A SERVOPACK fault occurred.	—	Replace the SERVOPACK.
A.d00*1: Position Error Pulse Overflow (Position error exceeded the value set in the excessive position error alarm level (Pn520))	The contact in the servomotor U, V, and W wirings is faulty.	Check the motor main circuit cable connection.	Confirm that there is no contact fault in the motor wiring of encoder wiring.
	The SERVOPACK gain is low.	Check the SERVOPACK gain to see if it is too low.	Increase the servo gain using the parameters such as Pn100 and Pn102.
	The frequency of the position reference pulse is too high.	Reduce the reference pulse frequency, and operate the SERVOPACK.	Reduce the position reference pulse frequency or reference acceleration. Or, reconsider the electronic gear ratio.
	The position reference acceleration is too fast.	Reduce the reference acceleration, and operate the SERVOPACK.	Apply the smoothing function, such as using position reference acceleration/deceleration time constant (Pn216).
	Setting of the Pn520 (Excessive Position Error Alarm Level) is low against the operating condition.	Check the alarm level (Pn520) to see if it is set to an appropriate value.	Set the Pn520 to proper value.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

*2. These errors occur when using a feedback option card.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.d01*1: Position Error Pulse Overflow Alarm at Servo ON	When setting not to clear position error pulses, the servomotor rotated while the servo was OFF, resulting in position error pulse overflow.	Check the error counter (Un008) while servo is OFF.	Set position error pulses to be cleared while in servo OFF status. Or, correct the excessive position error alarm level (Pn520).
A.d02*1: Position Error Pulse Overflow Alarm by Speed Limit at Servo ON	The servo was turned ON while the position error pulses accumulated, and the reference pulse was input while the servomotor was running at the speed limit (Pn529). As a result, the position error count exceeded the excessive position error alarm level (Pn520).	Check the error counter (Un008) while servo is OFF.	Set position error pulses to be cleared while in servo OFF status. Or, correct the excessive position error alarm level (Pn520). Or, adjust the speed limit level (Pn529) when servo turns ON.
A.d10*2: Motor-load Position Error Pulse Overflow	Motor rotation direction and scale installation direction are opposite.	Check the servomotor rotation direction and the scale installation direction.	Install the scale in the opposite direction, or reverse the setting of the external encoder usage method (Pn002.3).
	Mounting of the load (e.g., stage) and scale joint installation are incorrect.	Check the scale mechanical connection.	Check the mechanical joints.
A.E02: COM Alarm 2 (WDC + SyncFlag synchronization error)	A parameter was changed by the digital operator or the personal computer during MECHATROLINK-II communications.	Confirm the way the parameters are edited.	Stop changing parameters using digital operator or personal computer during MECHATROLINK-II communications.
	MECHATROLINK-II transmission cycle fluctuated.	—	Remove the cause of transmission cycle fluctuation at host controller.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.E40: MECHATROLINK-II Transmission Cycle Setting Error	Setting of MECHATROLINK-II transmission cycle is out of specifications range.	Check the MECHATROLINK-II transmission cycle setting.	Set the transmission cycle to the proper value.
A.E50: MECHATROLINK-II Synchronization Error	WDT data of host controller was not updated correctly.	Check the WDT data updating for the host controller.	Update the WDT data at the host controller correctly.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.E51: MECHATROLINK-II Synchronization Failed	WDT data of host controller was not updated correctly at the synchronization communications start, and synchronization communications could not start.	Check the WDT data updating for the host controller.	Update the WDT data at the host controller correctly.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

*2. These errors occur when using a feedback option card.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.E60: MECHATROLINK-II Communications error (Reception error)	MECHATROLINK-II wiring is incorrect.	Check the MECHATROLINK-II wirings.	Correct the MECHATROLINK-II wiring. Connect the terminator correctly.
	MECHATROLINK-II data reception error occurred due to noise interference.	—	Take measures against noise. Check the MECHATROLINK-II communications cable and FG wiring and take measures such as adding ferrite core on the MECHATROLINK-II communications cable.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.E61: MECHATROLINK-II Transmission Cycle Error (Synchronization interval error)	MECHATROLINK-II transmission cycle fluctuated.	Check the MECHATROLINK-II transmission cycle setting.	Remove the cause of transmission cycle fluctuation at host controller.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.EA0: DRV Alarm 0 (SERVOPACK failure)	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.EA1: DRV Alarm 1 (SERVOPACK initial access error)			
A.EA2: DRV Alarm 2 (SERVOPACK WDC error)	A parameter was changed by the digital operator or the personal computer during MECHATROLINK-II communications.	Confirm the way the parameters are edited.	Stop changing parameters using digital operator or personal computer during MECHATROLINK-II communications.
	MECHATROLINK-II transmission cycle fluctuated.	Check the MECHATROLINK-II transmission cycle setting.	Remove the cause of transmission cycle fluctuation at host controller.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.Eb1*1: Safety Function Signal Input Timing Error	The lag between activations of the input signals /HWBB1 and /HWBB2 for the HWBB function is one second or more.	Measure the time lag between the /HWBB1 and /HWBB2 signals.	The output signal circuits or devices for /HWBB1 and /HWBB2 or the SERVOPACK input signal circuits may be faulty. Alternatively, the input signal cables may be disconnected. Repair or replace them.
A.ED0: Internal Command Error	A parameter was changed by the digital operator or the personal computer during MECHATROLINK-II communications.	Confirm the way the parameters are edited.	Stop changing parameters using digital operator or personal computer during MECHATROLINK-II communications.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.ED1: Command Execution Timeout	A timeout error occurred when using an MECHATROLINK command.	Check the motor status when the command is executed.	Execute the SV_ON or SENS_ON command only when the motor is not running.
		Check the external encoder status when the command is executed.	Execute the SENS_ON command only when an external scale is connected.
A.F10*1: Main Circuit Cable Open Phase (With the main power supply ON, voltage was low for more than 1 second in an R, S, or T phase.) (Detected when the main power supply was turned ON.)	The three-phase power supply wiring is incorrect.	Check the power supply wiring.	Confirm that the power supply is correctly wired.
	The three-phase power supply is unbalanced.	Measure the voltage at each phase of the three-phase power supply.	Balance the power supply by changing phases.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
CPF00*1: Digital Operator Transmission Error 1	The contact between the digital operator and the SERVOPACK is faulty.	Check the connector contact.	Insert securely the connector or replace the cable.
	Malfunction caused by noise interference	—	Keep the digital operator or the cable away from noise sources.
CPF01*1: Digital Operator Transmission Error 2	A digital operator fault occurred.	—	Disconnect the digital operator and then re-connect it. If the alarm still occurs, the digital operator may be faulty. Repair or replace the digital operator.
	A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.

*1. These errors occur in SERVOPACKs using analog pulse reference input/MECHATROLINK-II.

10.2 Warning Displays

The following sections describe troubleshooting in response to warning displays.

The warning name, warning meaning, and warning code output are listed in order of the warning numbers in *10.2.1 List of Warnings*.

The causes of alarms and troubleshooting methods are provided in *10.2.2 Troubleshooting of Warnings*.

10.2.1 List of Warnings

The relation between warning displays and warning code outputs are shown below.

Warning Display	Warning Name	Meaning	Warning Code Output		
			ALO1	ALO2	ALO3
A.900	Position Error Pulse Overflow	Position error pulse exceeded the parameter settings (Pn520×Pn51E/100).	H	H	H
A.901	Position Error Pulse Overflow Alarm at Servo ON	When the servo turns ON, the position error pulses exceeded the parameter setting (Pn526×Pn528/100).	H	H	H
A.910	Overload	This warning occurs before the overload alarms (A.710 or A.720) occur. If the warning is ignored and operation continues, an overload alarm may occur.	L	H	H
A.911	Vibration	Abnormal vibration at the motor speed was detected. The detection level is the same as A.520. Set whether to output an alarm or warning by "Vibration Detection Switch" of Pn310.	L	H	H
A.920	Regenerative Overload	This warning occurs before the regenerative overload alarm (A.320) occurs. If the warning is ignored and operation continues, a regenerative overload alarm may occur.	H	L	H
A.921	Dynamic Brake Overload	This warning occurs before Dynamic Brake Overload (A.731) alarm occurs. If the warning is ignored and operation continues, a dynamic brake overload alarm may occur.	H	L	H
A.930	Absolute Encoder Battery Error	This warning occurs when the absolute encoder battery voltage is lowered.	L	L	H
A.941	Change of Parameters Requires Restart	Parameters that require the restart have been changed.	H	H	L
A.971	Undervoltage	This warning occurs before Undervoltage (A.410) alarm occurs. If the warning is ignored and operation continues, an undervoltage alarm may occur.	L	L	L

Note 1. Warning code is not outputted without setting Pn001.3 = 1 (Outputs both Alarm Codes and Warning Codes.)

2. If Pn008.2 = 1 (Do not detect warning) is selected, all warnings will not be detected.

10.2.2 Troubleshooting of Warnings

Refer to the following table to identify the cause of a warning and the action to be taken. Contact your Yaskawa representative if the problem cannot be solved by the described corrective action.

Warning Display	Warning Name	Situation at Warning Occurrence	Cause	Corrective Actions
A.900	Position Error Pulse Overflow	Wiring of the servomotor U, V, or W line is incorrect.	Check the wiring of the cable for motor main circuit.	Check whether there is any loose connection in motor wiring or encoder wiring.
		The SERVOPACK gain is too low.	Check the SERVOPACK gain.	Increase the speed loop gain (Pn100) or position loop gain (Pn102).
		The position reference pulse frequency is too high.	Lower the position reference pulse frequency.	Lower the position reference pulse frequency or the position reference acceleration, or correct the electronic gear ratio.
		The position reference acceleration is too high.	Lower the position reference acceleration.	Apply a smoothing function, such as a position reference acceleration/deceleration time constant (Pn216).
		The excessive position error alarm level (Pn520) is too low for the operating conditions.	Check the excessive position error alarm level (Pn520).	Set an appropriate value for the Pn520.
		A SERVOPACK fault occurred.	—	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.901	Position Error Pulse Overflow Alarm at Servo ON	When the servo was OFF, the servomotor moved without clearing position error pulses and excessive position error pulses accumulated.	Check the error counter (Un008).	Make a setting to clear position error pulses when the servo is OFF or set an appropriate value for the excessive position error alarm level (Pn520).
A.910	Overload: Warning before alarm A710 or A720 occurs In either of the following cases: 1. 20% of the overload detection level of A710 was reached. 2. 20% of the overload detection level of A720 was reached.	The servomotor or encoder wiring is incorrect or the connection is faulty.	Check the wiring.	Correct the servomotor and encoder wiring if they are wrong.
		The servomotor is in excess of the overload protective characteristics.	Check the overload characteristics of the servomotor and reference input.	Reconsider the load and operation conditions. Or, check the servomotor capacity.
		The servomotor is not driven due to a mechanical factor and the operating load has become excessive.	Check the reference input and motor speed.	Improve the mechanical factor.
		A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.911	Vibration	Unusual vibration was detected while the motor was rotating.	Check whether unusual sound is generated from the motor, and check the speed, torque, and thrust waveform of the motor.	Lower the motor rotation speed or the speed loop gain (Pn100).
		The moment of inertia ratio (Pn103) is larger than the actual value or greatly changes.	Check the load moment of inertia.	Set an appropriate value for the load moment of inertia (Pn103).

Warning Display	Warning Name	Situation at Warning Occurrence	Cause	Corrective Actions
A.920	Regenerative Overload: Warning before the alarm A.320 occurs	The power supply voltage is in excess of the specified range.	Measure the power supply voltage.	Set the power supply voltage within the specified range.
		The external regenerative resistance, servo amplifier capacity, or regenerative resistor capacity is insufficient or a continuous regenerative state occurs.	Check the operating conditions or capacity using the capacity selection software SigmaSize+, etc.	Change the regenerative resistance, regenerative resistor capacity, or SERVOPACK capacity. Reconsider the operating conditions using the capacity selection software SigmaSize+, etc.
		Regenerative power continuously flowed back because negative load was continuously applied.	Check the load on the servomotor during operation.	Reconsider the system including the servo, machine, and operation conditions.
A921	Dynamic Brake Overload: Warning before the alarm A.731 occurs	The servomotor is driven by an external force.	Check the operating conditions.	Do not drive the motor with external force.
		The rotating energy at a DB stop exceeds the DB resistance capacity.	Check the operating frequency of the DB with power consumed by DB resistance (Un00B).	<ul style="list-style-type: none"> • Reduce the servomotor reference speed. • Reduce the load moment of inertia. • Reduce the number of times of the DB stop operation.
		A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.930	Absolute Encoder Battery Error (The battery voltage was lowered than the specified value 4 seconds after the control power supply is turned ON.) (Only when an absolute encoder is connected.)	The battery connection is incorrect.	Check the battery connection.	Reconnect the battery.
		The battery voltage is lower than the specified value 2.7 V.	Measure the battery voltage.	Replace the battery and turn the control power supply ON.
		A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.941	Change of Parameters Requires Restart	Parameters that require the restart have been changed.	—	Turn OFF the power and ON again.
A.971	Undervoltage	The power supply voltage for a 200 VAC model is 120 V or below or the power supply for a 400 VAC model is 240 V or below.	Measure the power supply voltage.	Use a power supply voltage within the specified range.
		The power supply voltage dropped during operation.	Measure the power supply voltage.	Increase the power supply capacity.
		An instantaneous power failure occurred.	Measure the power supply voltage.	Set the power supply voltage to the specified range. Lower the instantaneous power cut hold time (Pn509).
		The fuse in the SERVOPACK is burned out.	—	Repair or replace the SERVOPACK and connect an AC/DC reactor to the SERVOPACK.
		A SERVOPACK fault occurred.	—	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.

10.3 Troubleshooting Malfunction Based on Operation and Conditions of the Servomotor

Troubleshooting for the malfunctions based on the operation and conditions of the servomotor is provided in this section.

Be sure to turn OFF the servo system before troubleshooting items shown in bold lines in the table.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Servomotor Does Not Start	The control power supply is not ON.	Check voltage between power supply terminals.	Correct the power circuit.
	The main circuit power supply is not ON.	Check the voltage between power supply terminals.	Correct the power circuit.
	Wiring of I/O signal connector CN1 faulty or disconnected.	Check if the connector CN1 is properly inserted and connected.	Correct the connector CN1 connection.
	Servomotor or encoder wiring disconnected.	Check the wiring.	Correct the wiring.
	Overloaded	Run under no load and check the load status.	Reduce load or replace with larger capacity servomotor.
	Speed/position references not input	Check reference input pins.	Input speed/position references correctly.
	Motion command not input	Check the command sent from the host controller.	Input motion command correctly.
	Setting for Pn50A to Pn50D "Input Signal Selection" is incorrect.	Check settings of parameters Pn50A to Pn50D.	Correct the settings for Pn50A to Pn50D "Input Signal Selection."
	Encoder type differs from parameter setting (Pn002.2).	Check setting of parameter Pn002.2.	Set parameter Pn002.2 to the encoder type being used.
	Servo ON (/S-ON) input signal stays OFF.	Check settings of parameters Pn50A.0 and Pn50A.1.	Set the parameters to turn the Servo ON (/S-ON) input signal ON.
	Servo ON (SV_ON) command is not sent.	Check the command sent from the host controller.	Send the Servo ON (SV_ON) command.
	Sensor ON (SENS_ON) command is not sent.	Check the command sent from the host controller.	Send the command in the correct SERVOPACK sequence.
	/P-CON input function setting is incorrect.	Check parameter Pn000.1.	Set parameters to match the application.
	SEN input is OFF.	Check the ON/OFF status of the SEN input.	If using an absolute encoder, turn the SEN input signal ON.
	Reference pulse mode selection is incorrect.	Check the Pn200.0 setting and the reference pulse status.	Match the Pn200.0 setting and the reference pulse status.
	Speed control: Speed reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input.
	Torque control: Torque reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input.
	Position control: Reference pulse input is incorrect.	Check Pn200.0 reference pulse form or sign + pulse signal.	Correct the control mode selection parameter, or the input.
	Position error pulse clear (CLR) input is turned ON.	Check CLR or /CLR input pins (CN1-14 and -15).	Turn CLR or /CLR input signal OFF.
	The forward run prohibited (P-OT) and reverse run prohibited (N-OT) input signals are turned OFF.	Check P-OT or N-OT input signal.	Turn P-OT or N-OT input signal ON.
	A SERVOPACK fault occurred.		Replace the SERVOPACK.
Servomotor Moves Instantaneously, and then Stops	Servomotor wiring is incorrect.	Check the servomotor wiring.	Correct the wiring.
	Encoder wiring is incorrect.	Check the encoder wiring.	Correct the wiring.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Servomotor Speed Unstable	Wiring connection to servomotor is defective.	Check connections of main circuit cable (phases-U, -V, and -W) and encoder connectors.	Tighten any loose terminals or connectors.
Servomotor Rotates Without Reference Input	Speed control: Speed reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input signal.
	Torque control: Torque reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input signal.
	Speed reference offset is incorrect.	The SERVOPACK offset is adjusted incorrectly.	Adjust the SERVOPACK offset.
	Position control: Reference pulse input is incorrect.	Check Pn200.0 reference pulse form or sign + pulse signal.	Correct the control mode selection parameter, or the input signal.
	A SERVOPACK fault occurred.		Replace the SERVOPACK.
Dynamic Brake Does Not Operate	Improper Pn001 setting	Check the setting of parameter Pn001.0.	Correct the parameter setting.
	DB resistor disconnected	Check if excessive moment of inertia, motor overspeed, or DB frequently activated occurred.	Replace the SERVOPACK, and lighten the load.
	DB drive circuit fault		There is a defective component in the DB circuit. Replace the SERVOPACK.
Abnormal Noise from Servomotor	Mounting is not secured.	Check if there are any loose mounting screws.	Tighten the mounting screws.
		Check if there is misalignment of couplings.	Align the couplings.
		Check if there are unbalanced couplings.	Balance the couplings.
	Bearings are defective.	Check for noise and vibration around the bearings.	If there are any problems, contact your Yaskawa representative.
	Vibration source at the driven machine	Check for any foreign matter, damage, or deformations on the machinery's movable parts.	If there are any problems, contact the machine manufacturer.
	Noise interference due to incorrect input/output signal cable specifications	The input/output signal cables must be tinned annealed copper twisted-pair or shielded twisted-pair cables with a core of 0.12 mm ² min.	Use the specified input signal wires.
	Noise interference due to length of input/output signal cable.	Check the length of the input/output cable.	The input/output cable length must be no more than 3 m, and the impedance a few hundred ohm max.
	Noise interference due to incorrect encoder cable specifications.	The encoder cable must be tinned annealed copper twisted-pair or shielded twisted-pair cables with a core of 0.12 mm ² min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable wiring	Check the length of the encoder cable.	The encoder cable must be no more than 20 m.
	Noise interference due to damaged encoder cable	Check if the encoder cable is damaged or bent.	Replace the encoder cable and modify the encoder cable layout.
	Excessive noise to the encoder cable	Check if the encoder cable is bundled with high-current line or near a high-current line.	Correct the encoder cable layout so that no surge is applied.
	FG potential varies because of influence of machines such as welders at the servomotor.	Check if the machines are correctly grounded.	Ground machines correctly, and prevent diversion to the FG at the PG side.
	SERVOPACK pulse counting error due to noise interference	Check if there is noise interference on the input/output signal line from the encoder.	Take measures against noise in the encoder wiring.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Abnormal Noise from Servomotor (cont'd)	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce vibration from the machine, or secure the servomotor installation.
	An encoder fault occurred.		Replace the servomotor.
Servomotor Vibrates at Frequency of Approx 200 to 400 Hz	Speed loop gain value (Pn100) too high.	Check the speed loop gain value (Pn100). Factory setting: $K_v = 40.0$ Hz	Reduce the speed loop gain (Pn100).
	Position loop gain value (Pn102) too high.	Check the position loop gain value (Pn102). Factory setting: $K_p = 40.0/s$	Reduce the position loop gain (Pn102).
	Incorrect speed loop integral time constant (Pn101) setting	Check the speed loop integral time constant (Pn101). Factory setting: $T_i = 20.0$ ms	Correct the speed loop integral time constant (Pn101) setting.
	Incorrect moment of inertia ratio data (Pn103)	Check the moment of inertia ratio setting (Pn103).	Correct the moment of inertia ratio (Pn103) setting.
High Rotation Speed Overshoot on Starting and Stopping	Speed loop gain value (Pn100) too high	Check the speed loop gain value (Pn100). Factory setting: $K_v = 40.0$ Hz	Reduce the speed loop gain (Pn100).
	Position loop gain value (Pn102) too high	Check the position loop gain value (Pn102). Factory setting: $K_p = 40.0/s$	Reduce the position loop gain (Pn102).
	Incorrect speed loop integral time constant (Pn101) setting	Check the speed loop integral time constant (Pn101). Factory setting: $T_i = 20.0$ ms	Correct the speed loop integral time constant setting (Pn101).
	Incorrect moment of inertia ratio data (Pn103)	Check the moment of inertia ratio setting (Pn103).	Correct the moment of inertia ratio setting (Pn103). Use the mode switch functions (Pn10C to Pn10F).
Absolute Encoder Position Difference Error (The position saved in the host controller when the power was turned OFF is different from the position when the power was next turned ON.)	Noise interference due to improper encoder cable specifications	The encoder cable must be tinned annealed copper twisted-pair or shielded twisted-pair cables with a core of 0.12 mm^2 min.	Use encoder cable with the specified specifications.
	Noise interference due to length of encoder cable.	Check the encoder cable length.	The encoder cable length must be no more than 20 m.
	Noise interference due to damaged encoder cable	Check if the encoder cable is bent or if its sheath is damaged.	Replace the encoder cable and correct the encoder cable layout.
	Excessive noise interference at the encoder cable	Check if the encoder cable is bundled with a high-current line or near high-current line.	Change the encoder cable layout so that no surge is applied.
	FG potential varies because of influence of machines such as welders at the servomotor.	Check if the machines are correctly grounded.	Ground machines correctly, and prevent diversion to the FG at the PG side.
	SERVOPACK pulse counting error due to noise interference	Check if there is noise interference on the input/output signal line from the encoder.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce vibration from the machine, or secure the servomotor installation.
	An encoder fault occurred.		Replace the servomotor.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Absolute Encoder Position Difference Error (The position saved in the host controller when the power was turned OFF is different from the position when the power was next turned ON.) (cont'd)	A SERVOPACK fault occurred. (The pulse count does not change.)		Replace the SERVOPACK.
	Host controller multi-turn data reading error	Check the error detection at the host controller.	Correct the error detection section of the host controller.
		Check if the host controller is executing data parity checks.	Execute a multi-turn data parity check.
		Check noise in the input/output signal line between the SERVOPACK and the host controller.	Take measures against noise, and again execute a multiturn data parity check.
Overtravel (OT) (Movement over the zone specified by the host controller)	Forward or reverse run prohibited signal is input. P-OT (CN1-42 or CN1-7) or N-OT (CN1-43 or CN1-8) is at H level.	Check the external power supply (+24 V) voltage for the input signal.	Correct the external power supply (+24 V) voltage.
		Check if the overtravel limit switch operates properly.	Correct the overtravel limit switch.
		Check if the overtravel limit switch is wired correctly.	Correct the overtravel limit switch wiring.
	Forward or reverse run prohibited signal malfunctioning (P-OT or N-OT signal sometimes changes).	Check the fluctuation of the input signal external power supply (+24 V) voltage.	Stabilize the external power supply (+24 V) voltage.
		Check if the overtravel limit switch operates correctly.	Stabilize the operation of the overtravel limit switch.
		Check if the overtravel limit switch wiring is correct. (check for damaged cables or loose screws.)	Correct the overtravel limit switch wiring.
	Incorrect forward or reverse run prohibited signal (P-OT/N-OT) allocation (parameters Pn50A.3, Pn50B.0)	Check if the P-OT signal is allocated in Pn50A.3.	If another signal is allocated in Pn50A.3, select P-OT.
		Check if the N-OT signal is allocated in Pn50B.0.	If another signal is allocated in Pn50B.0, select N-OT.
	Incorrect servomotor stop method selection	Check Pn001.0 and Pn001.1 when servo is OFF.	Select a servo mode stop method other than "coast to stop."
		Check Pn001.0 and Pn001.1 when in torque control.	Select a servo mode stop method other than "coast to stop."
	Improper overtravel position setting	Check the overtravel (OT) position setting.	If the distance to the OT position is too short compared to the coasting distance, correct the setting.
	Improper overtravel limit switch position setting	Check if the distance to the overtravel limit switch (OTLS) is too short compared to the coasting distance.	Correct the OTLS position.

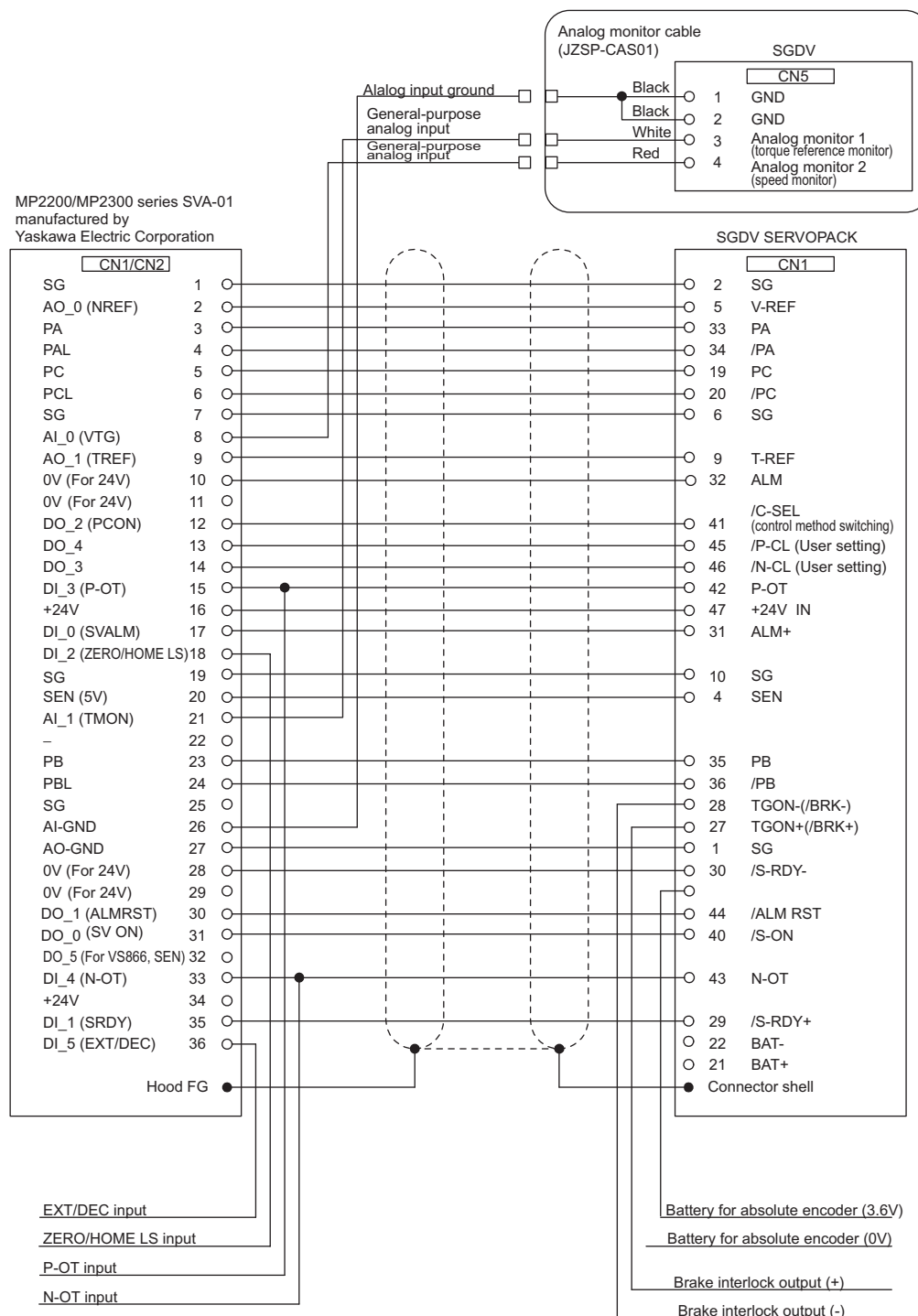
Problem	Probable Cause	Investigative Actions	Corrective Actions
Position Error (Without Alarm)	Noise interference due to improper encoder cable specifications	The encoder cable must be tinned annealed copper twisted-pair or shielded twisted-pair cable with a core of 0.12 mm ² min.	Use encoder cable with the specified specifications.
	Noise interference due to length of encoder cable	Check the encoder cable length.	The encoder cable length must be no more than 20 m.
	Noise influence due to damaged encoder cable	Check if the encoder cable is bent or if its sheath is damaged.	Replace the encoder cable and correct the encoder cable layout.
	Excessive noise interference to encoder cable	Check if the encoder cable is bundled with a high-current line or near a high-current line.	Change the encoder cable layout so that no surge is applied.
	FG potential varies because of influence of machines such as welders at the servomotor.	Check if the machines are correctly grounded.	Ground machines correctly, and prevent diversion to the FG at the PG side.
	SERVOPACK pulse count error due to noise	Check if the input/output signal line from the encoder is influenced by noise.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce the machine vibration or mount the servomotor securely.
	Unsecured coupling between machine and servomotor	Check if a position error occurs at the coupling between machine and servomotor.	Secure the coupling between the machine and servomotor.
	Noise interference due to improper I/O signal cable specifications	The I/O signal cable must be twisted-pair or shielded twisted-pair cable with a core of 0.12 mm ² min. and tinned annealed copper twisted wire.	Use input signal cable with the specified specifications.
	Noise interference due to length of I/O signal cable	Check the I/O signal cable length.	The I/O signal cable length must be no more than 3 m, and the impedance several hundred ohm max.
	An encoder fault occurred. (The pulse count does not change.)		Replace the SERVOPACK.
	A SERVOPACK fault occurred.		Replace the SERVOPACK.
Servomotor Overheated	Ambient temperature too high	Measure the servomotor ambient temperature.	Reduce the ambient temperature to 40°C or less.
	Servomotor surface dirty	Visually check the surface.	Clean dust and oil from the surface.
	Servomotor overloaded	Run under no load and check the load status.	Reduce load or replace with larger capacity servomotor.

11.1	Connection to Host Controller	11-2
11.1.1	Example of Connection to MP2200/MP2300 Motion Module SVA-01	11-2
11.1.2	Example of Connection to MP920 4-axes Analog Module SVA-01	11-3
11.1.3	Example of Connection to OMRON's Motion Control Unit	11-4
11.1.4	Example of Connection to OMRON's Position Control Unit	11-5
11.1.5	Connection to MITSUBISHI's AD72 Positioning Unit (SERVOPACK in Speed Control Mode)	11-6
11.1.6	Connection to MITSUBISHI's AD75 Positioning Unit (SERVOPACK in Position Control Mode)	11-7
11.2	List of Parameters	11-8
11.2.1	Utility Functions	11-8
11.2.2	Parameters	11-9
11.3	Monitor Modes	11-30
11.4	Parameter Recording Table	11-31

11.1 Connection to Host Controller

The following figures show the connection examples to host controllers.

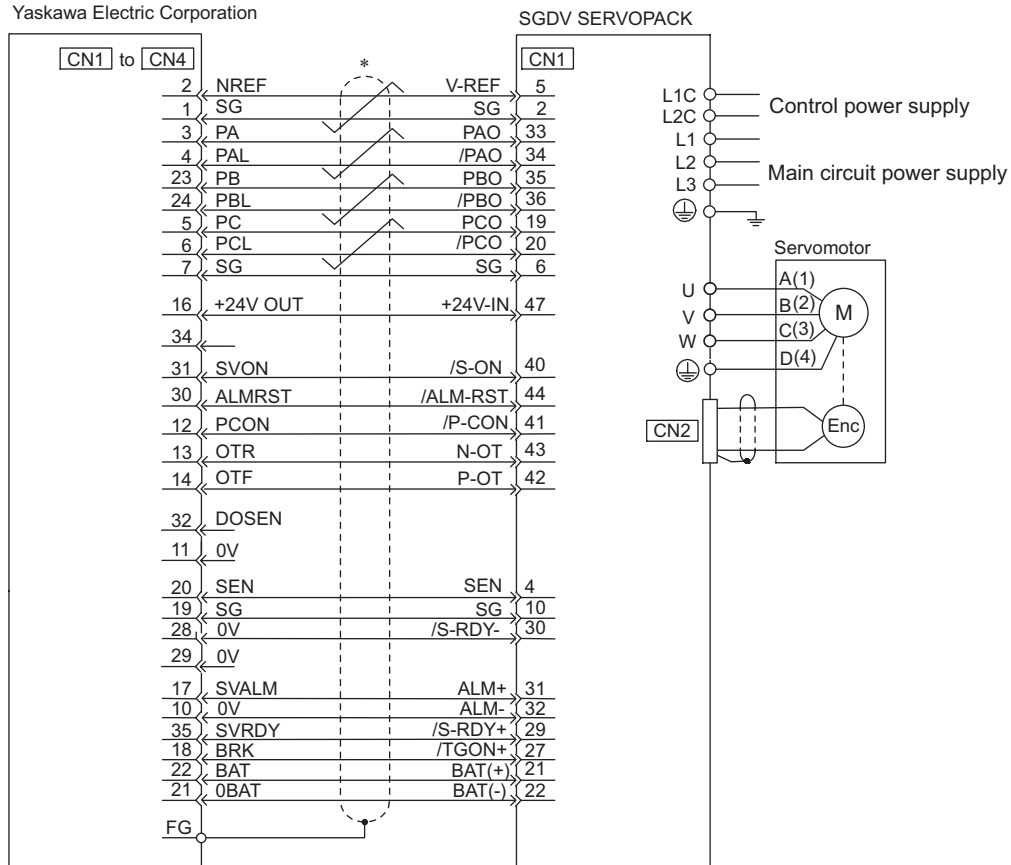
11.1.1 Example of Connection to MP2200/MP2300 Motion Module SVA-01




- Note 1. Connection cables (model: JEPMC-W2040-□□) to connect the SERVOPACK to the MP2200/MP2300 are provided by Yaskawa. For details, refer to *Machine Controller MP2200/2300 Motion Module User's Manual* (SIEPC88070016).
2. The SERVOPACK incorporates a safety function to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation. Necessary circuits and settings are required to use this function. For details, refer to *5.11 Safety Function*.

11.1.2 Example of Connection to MP920 4-axes Analog Module SVA-01

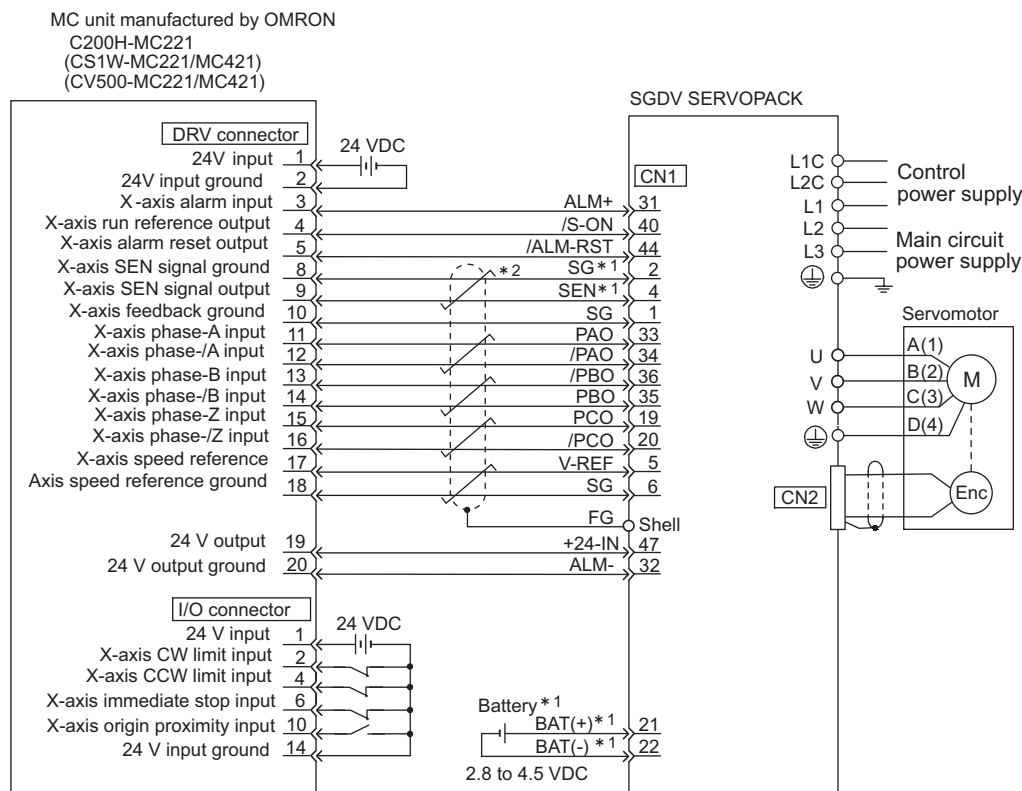
MP920 Series SVA-01
manufactured by
Yaskawa Electric Corporation



*  represents twisted-pair wires.

- Note 1. Connection cables (model: JEPMC-W6050-□□-E) to connect the SERVOPACK to the MP920 are provided by Yaskawa. For details, refer to *Machine Controller MP920 User's Manual design and maintenance* (SIEZ-C887-2.1).
2. The SERVOPACK incorporates a safety function to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation. Necessary circuits and settings are required to use this function. For details, refer to *5.11 Safety Function*.

11.1.3 Example of Connection to OMRON's Motion Control Unit



*1. Connect when an absolute encoder is used.

When the encoder cables with a battery case JUSP-BA01 are used, no battery is required for CN1 (between 21 and 22).

- For CN1: ER6VC3N (3.6 V, 2000 mA)
- Battery case: JUSP-BA01 (3.6 V, 1000 mA)

*2.  represents twisted-pair wires.

Note 1. Only signals applicable to Yaskawa's SGD Servopack and OMRON's MC unit are shown in the diagram.

2. The main circuit power supply is a three-phase 200 VAC SERVOPACK input in the example.

3. Note that incorrect signal connection will cause damage to the MC unit and SERVOPACK.

4. Open the signal lines not to be used.

5. The above connection diagram shows only X-axis connection. When using another axes, make connection to the SERVOPACK in the same way.

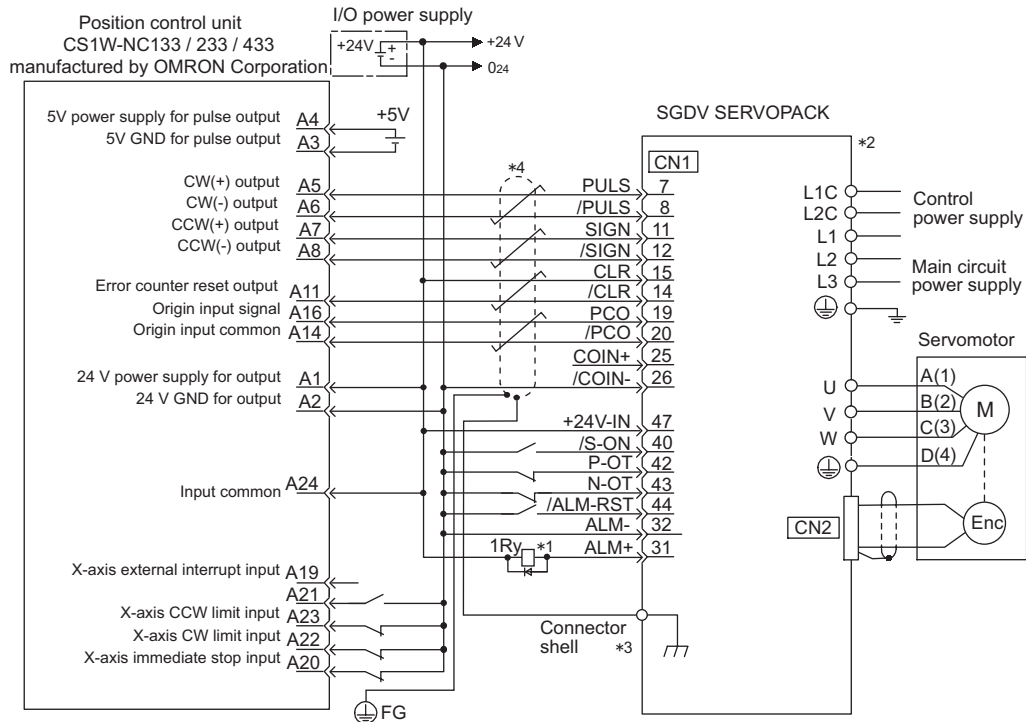
6. The normally closed (N.C.) input terminals not to be used at the motion control unit I/O connector section must be short-circuited at the connector.


7. Make the setting so that the servo can be turned ON/OFF by the Servo ON (/S-ON) signal.

8. The SERVOPACK incorporates a safety function to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation.

Necessary circuits and settings are required to use this function. For details, refer to 5.11 Safety Function.

11.1.4 Example of Connection to OMRON's Position Control Unit

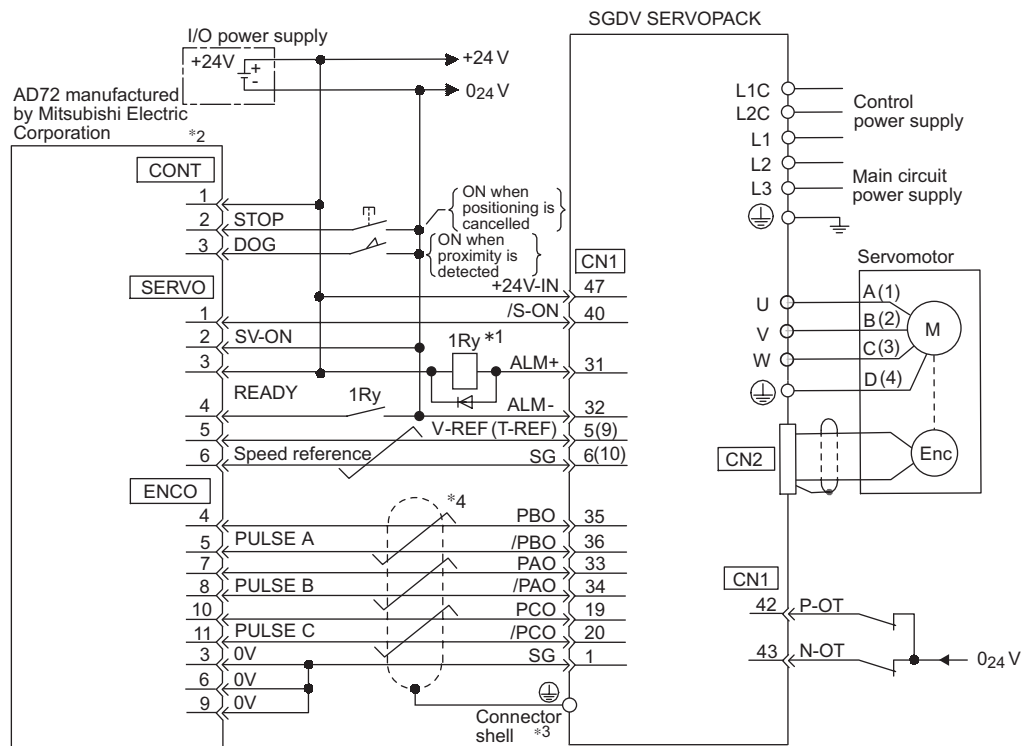



- *1. The ALM signal is output for about five seconds after the control power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK.
- *2. Set parameter Pn200.0 to "1."
- *3. Connect the shield wire to the connector shell.
- *4.  represents twisted-pair wires.

Note 1. Only signals applicable to Yaskawa's SGD Servopack and OMRON's MC unit (positioning unit) are shown in the diagram.

2. The SERVOPACK incorporates a safety function to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation. Necessary circuits and settings are required to use this function. For details, refer to 5.11 Safety Function.

11.1.5 Connection to MITSUBISHI's AD72 Positioning Unit (SERVOPACK in Speed Control Mode)

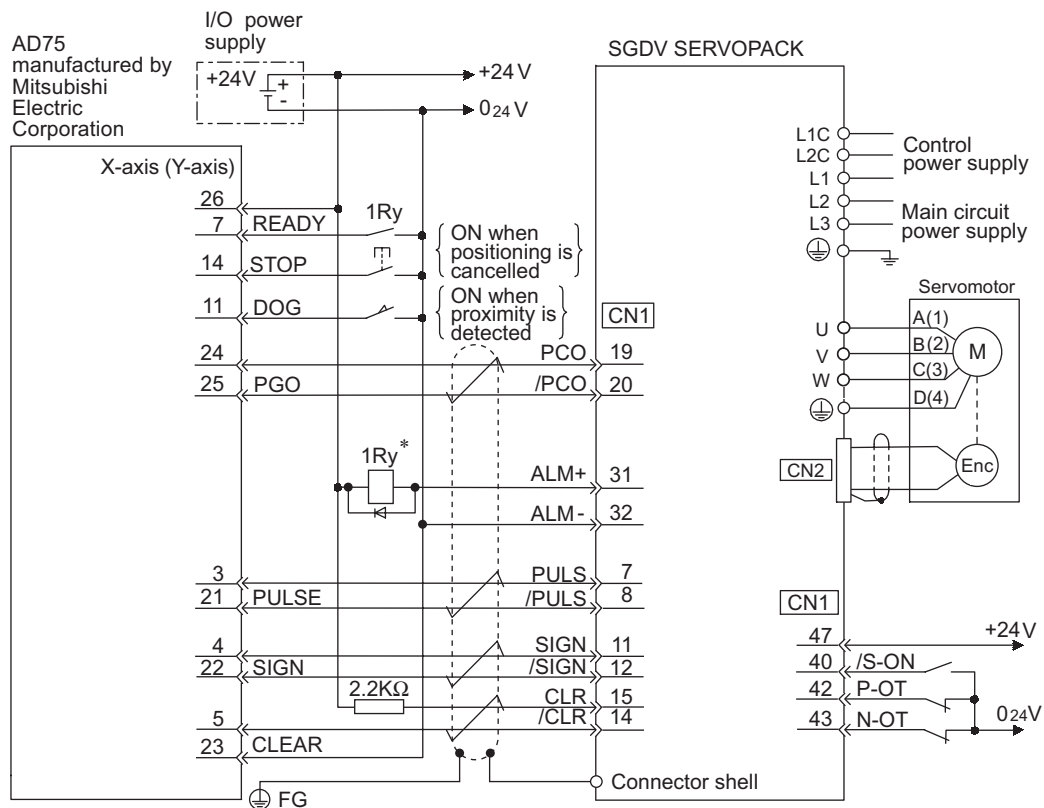


- *1. The ALM signal is output for about five seconds after the control power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK.
- *2. Pin numbers are the same both for X-axis and Y-axis.
- *3. Connect the connector wire to the connector shell.
- *4.  represents twisted-pair wires.

Note 1. Only signals applicable to Yaskawa's SGD Servopack and Mitsubishi's AD72 Positioning Unit are shown in the diagram.

2. The SERVOPACK incorporates a safety function to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation. Necessary circuits and settings are required to use this function. For details, refer to *5.11 Safety Function*.

11.1.6 Connection to MITSUBISHI's AD75 Positioning Unit (SERVOPACK in Position Control Mode)



* The ALM signal is output for about five seconds when the control power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK.

Note 1. Only signals applicable to Yaskawa's SGD Servopack and Mitsubishi's AD75 Positioning Unit are shown in the diagram.

- The SERVOPACK incorporates a safety function to protect people from the hazardous operation of the movable parts of the machines, reduce the risk, and ensure the safety of the machine in operation. Necessary circuits and settings are required to use this function. For details, refer to 5.11 *Safety Function*.

11.2 List of Parameters

11.2.1 Utility Functions

The following list shows the available utility functions.

Parameter No.	Function	Operation from the Panel Operator	Operation from the Digital Operator or SigmaWin+	Reference Section
Fn000	Alarm traceback data display	○	○	7.2
Fn002	JOG mode operation	○	○	7.3
Fn003	Origin search	○	○	7.4
Fn004	Program JOG operation	○	○	7.5
Fn005	Initialize parameter settings	○	○	7.6
Fn006	Clear alarm traceback data	○	○	7.7
Fn008	Absolute encoder multi-turn reset and encoder alarm reset	○	○	5.9.5
Fn009	Automatic tuning of analog (speed, torque) reference offset	○	○	5.3.2 5.5.2
Fn00A	Manual servo tuning of speed reference offset	○	○	5.3.2
Fn00B	Manual servo tuning of torque reference offset	○	○	5.5.2
Fn00C	Manual zero-adjustment of analog monitor output	○	○	7.8
Fn00D	Manual gain-adjustment of analog monitor output	○	○	7.9
Fn00E	Automatic offset-adjustment of motor current detection signal	○	○	7.10
Fn00F	Manual offset-adjustment of motor current detection signal	○	○	7.11
Fn010	Write prohibited setting	○	○	7.12
Fn011	Check servomotor models	○	○	7.13
Fn012	Software version display	○	○	7.14
Fn013	Multi-turn limit value setting change when a Multi-turn Limit Disagreement alarm occurs	○	○	5.9.8
Fn014	Reset configuration error of option card	○	○	7.15
Fn01B	Initialize vibration detection level	○	○	7.16
Fn01E	SERVOPACK and servomotor ID display	×	○	7.17
Fn01F	Display of servomotor ID for feedback option	×	○	7.18
Fn200	Tuning-less level setting	○	○	6.2.2
Fn201	Advanced autotuning	×	○	6.3.2
Fn202	Advanced autotuning by reference	×	○	6.4.2
Fn203	One-parameter tuning	○*	○	6.5.2
Fn204	Anti-resonance control adjustment function	×	○	6.6.2
Fn205	Vibration suppression function	×	○	6.7.2
Fn206	EasyFTT	○	○	7.19
Fn207	Online vibration monitor	○	○	7.20
Fn020	Origin setting	×	○	7.21
Fn030	Software reset	○	○	7.22

○: Available ×: Not available

* The following functional restrictions apply to the Panel Operator.

- Note 1. A setting may be write-prohibited if the Panel Operator displays "no_oP" when any of the above utility function is executed. Refer to *7.12 Write Prohibited Setting (Fn010)*.
2. When utility functions which cannot be operated from the panel operator are executed from the panel operator, "no_oP" is displayed.

11.2.2 Parameters

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn000	Basic Function Select Switch 0	0000 to 00B3	—	0000	After restart	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div>						
	Direction Selection (Refer to 5.2.2)						
	0 Sets CCW as forward direction.						
	1 Sets CW as forward direction (Reverse Rotation Mode)						
	2 to 3 Reserved (Do not use.)						
	Control Method Selection (Refer to 5.7)						
	0 Speed control (analog reference)						
	1 Position control (pulse train reference)						
	2 Torque control (analog reference)						
	3 Internal set speed control (contact reference)						
	4 Internal set speed control (contact reference) ↔ Speed control (analog reference)						
	5 Internal set speed control (contact reference) ↔ Position control (pulse train reference)						
	6 Internal set speed control (contact reference) ↔ Torque control (analog reference)						
	7 Position control (pulse train reference) ↔ Speed control (analog reference)						
	8 Position control (pulse train reference) ↔ Torque control (analog reference)						
	9 Torque control (analog reference) ↔ Speed control (analog reference)						
	A Speed control (analog reference) ↔ Zero clamp						
	B Position control (pulse train reference) ↔ Position control (Inhibit)						
	Reserved (Do not change.)						
	Reserved (Do not change.)						

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn001	Application Function Select Switch 1	0000 to 1122	—	0000	After restart	Setup	—
	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> 4th digit <input type="checkbox"/> </div> <div style="text-align: center;"> 3rd digit <input type="checkbox"/> </div> <div style="text-align: center;"> 2nd digit <input type="checkbox"/> </div> <div style="text-align: center;"> 1st digit <input type="checkbox"/> </div> </div>						
	<div style="display: flex; justify-content: space-between;"> <div style="width: 10%;">n.</div> <div style="width: 80%; border: 1px solid black; padding: 5px;"> <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="width: 100px; border-right: 1px solid black; padding-right: 5px;"></div> <div> <div style="background-color: #f0f0f0; padding: 2px 5px;">Servo OFF or Alarm G1 Stop Mode</div> <div style="padding: 2px 5px;">0 Stops the motor by applying DB (dynamic brake).</div> <div style="padding: 2px 5px;">1 Stops the motor by applying dynamic brake (DB) and then releases DB.</div> <div style="padding: 2px 5px;">2 Makes the motor coast to a stop state without using the dynamic brake (DB).</div> </div> </div> </div> </div>						
	<div style="display: flex; justify-content: space-between;"> <div style="width: 10%;">n.</div> <div style="width: 80%; border: 1px solid black; padding: 5px;"> <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="width: 100px; border-right: 1px solid black; padding-right: 5px;"></div> <div> <div style="background-color: #f0f0f0; padding: 2px 5px;">Overtravel (OT) Stop Mode *</div> <div style="padding: 2px 5px;">0 Same setting as Pn001.0 (Stops the motor by applying DB or by coasting).</div> <div style="padding: 2px 5px;">1 Sets the torque of Pn406 to the maximum value, decelerate the motor to a stop, and then sets it to servolock state.</div> <div style="padding: 2px 5px;">2 Sets the torque of Pn406 to the maximum value, decelerates the motor to a stop, and then sets it to coasting state.</div> </div> </div> </div> </div>						
	<div style="display: flex; justify-content: space-between;"> <div style="width: 10%;">n.</div> <div style="width: 80%; border: 1px solid black; padding: 5px;"> <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="width: 100px; border-right: 1px solid black; padding-right: 5px;"></div> <div> <div style="background-color: #f0f0f0; padding: 2px 5px;">AC/DC Power Input Selection</div> <div style="padding: 2px 5px;">0 Not applicable to DC power input: Input AC power supply through L1, L2 (, and L3) terminals.</div> <div style="padding: 2px 5px;">1 Applicable to DC power input: Input DC power supply between B1/ + and —, or input DC power supply between B1/⊕ and ⊖1.</div> </div> </div> </div> </div>						
	<div style="display: flex; justify-content: space-between;"> <div style="width: 10%;">n.</div> <div style="width: 80%; border: 1px solid black; padding: 5px;"> <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="width: 100px; border-right: 1px solid black; padding-right: 5px;"></div> <div> <div style="background-color: #f0f0f0; padding: 2px 5px;">Warning Code Output Selection</div> <div style="padding: 2px 5px;">0 ALO1, ALO2, and ALO3 output only alarm codes.</div> <div style="padding: 2px 5px;">1 ALO1, ALO2, and ALO3 output both alarm codes and warning codes. While warning codes are output, ALM signal output remains ON (normal state).</div> </div> </div> </div> </div>						
	<div style="text-align: right; padding-top: 10px;"> * The motor is stopped by the dynamic brake or by coasting regardless of the setting in the torque control mode. </div>						

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn002	Application Function Select Switch 2	0000 to 4113	—	0000	After restart	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div>						
	Speed Control Option (T-REF Terminal Allocation)						
	0 N/A						
	1 Uses T-REF as an external torque limit input. (Refer to 5.8.3)						
	2 Uses T-REF as a torque feedforward input. (Refer to 6.8.2)						
	3 Uses T-REF as an external torque limit input when P-CL and N-CL are ON. (Refer to 5.8.4)						
	Torque Control Option (V-REF Terminal Allocation) (Refer to 5.5.3)						
	0 N/A						
	1 Uses V-REF as an external speed limit input.						
	Absolute Encoder Usage (Refer to 5.9.1)						
	0 Uses absolute encoder as an absolute encoder.						
	1 Uses absolute encoder as an incremental encoder.						
	External Encoder Usage (Refer to 9.2)						
	0 Do not use external encoder.						
	1 Uses external encoder in forward rotation direction.						
	2 Reserved (Do not set.)						
	3 Uses external encoder in reversed rotation direction.						
	4 Reserved (Do not set.)						
Pn006	Application Function Select Switch 6	0000 to 005F	—	0002	Immediately	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div>						
	Analog Monitor 1 Signal Selection (Refer to 6.1.3)						
	00 Motor speed (1 V/1000 min ⁻¹)						
	01 Speed reference (1 V/1000 min ⁻¹)						
	02 Torque reference (1 V/100%)						
	03 Position error (0.05 V/1 reference unit)						
	04 Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit)						
	05 Position reference speed (1 V/1000 min ⁻¹)						
	06 Reserved (Do not use.)						
	07 Motor load position error (0.01 V/1 reference unit)						
	08 Positioning completion signal (positioning completed: 5 V, positioning not completed: 0 V)						
	09 Speed feedforward (1 V/1000 min ⁻¹)						
	0A Torque feedforward (1 V/100%)						
	0B Active gain (1st gain: 1 V, 2nd gain: 2 V, 3rd gain: 3 V, 4th gain: 4 V)						
	0C Completion of position reference (completed: 5 V, not completed: 0 V)						
	0D External encoder speed (1 V/1000 min ⁻¹)						
	Reserved (Do not change.)						
	Reserved (Do not change.)						

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn007	Application Function Select Switch 7	0000 to 005F	—	0000	Immediately	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div>						
	Analog Monitor 1 Signal Selection (Refer to 6.1.3)						
	00 Motor speed (1 V/1000 min ⁻¹)						
	01 Speed reference (1 V/1000 min ⁻¹)						
	02 Torque reference (1 V/100%)						
	03 Position error (0.05 V/1 reference unit)						
	04 Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit)						
	05 Position reference speed (1 V/1000 min ⁻¹)						
	06 Reserved (Do not use.)						
	07 Motor load position error (0.01 V/1 reference unit)						
	08 Positioning completion signal (positioning completed: 5 V, positioning not completed: 0 V)						
	09 Speed feedforward (1 V/1000 min ⁻¹)						
	0A Torque feedforward (1 V/100%)						
	0B Active gain (1st gain: 1 V, 2nd gain: 2 V, 3rd gain: 3 V, 4th gain: 4 V)						
	0C Completion of position reference (completed: 5 V not completed: 0 V)						
	0D External encoder speed (1 V/1000 min ⁻¹)						
	Reserved (Do not change.)						
	Reserved (Do not change.)						
Pn008	Application Function Select Switch 8	0000 to 7121	—	0000	After restart	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div>						
	Lowered Battery Voltage Alarm/Warning Selection (Refer to 5.9.4)						
	0 Outputs alarm (A.830) for lowered battery voltage.						
	1 Outputs warning (A.930) for lowered battery voltage.						
	Function Selection at Main Circuit Voltage Drop (Refer to 5.2.7)						
	0 Disables detection of the main circuit voltage drop.						
	1 Enables detection of the main circuit voltage drop.						
	2 Detects warning and limits torque by Pn424 and Pn425.						
	Warning Detection Selection (Refer to 10.2.1)						
	0 Detects warning.						
	1 Does not detect warning.						
	Reserved (Do not change.)						

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn009	Application Function Select Switch 9	0000 to 0111	—	0010	After restart	Tuning	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div>						
	Reserved (Do not change.)						
	Current Control Method Selection						
	0 Current control method 1						
	1 Current control method 2						
	Speed Detection Method Selection						
	0 Speed detection 1						
	1 Speed detection 2						
	Reserved (Do not change.)						
Pn00B	Application Function Select Switch B	0000 to 1111	—	0000	After restart	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div>						
	Parameter Display Selection (Refer to 2.5.3)						
	0 Setup parameters						
	1 All parameters						
	Alarm G2 Stop Method Selection (Refer to 5.2.5)						
	0 Stops the motor by setting the speed reference to "0".						
	1 Same setting as Pn001.0 (Stops the motor by applying DB or by coasting)						
	Power Supply Method for Three-phase SERVOPACK						
	0 Three-phase power supply						
	1 Single-phase power supply						
	Reserved (Do not change.)						

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn00C	Application Function Select Switch C	—	—	0000	After restart	Setup	—
	<div><div><div>4th digit</div><div>3rd digit</div><div>2nd digit</div><div>1st digit</div></div><div>n. <div><div></div><div></div><div></div><div></div></div></div><div><div><div>Selection of Test without Motor</div><div>(Refer to 4.7.4)</div></div><div><div>0</div><div>Test without motor disabled</div></div><div><div>1</div><div>Test without motor enabled</div></div></div><div><div><div>Encoder Resolution for Test without Motor</div><div>(Refer to 4.7.4)</div></div><div><div>0</div><div>13 bits</div></div><div><div>1</div><div>20 bits</div></div></div><div><div><div>Encoder Type for Test without Motor</div><div>(Refer to 4.7.4)</div></div><div><div>00</div><div>Incremental encoder</div></div><div><div>01</div><div>Absolute encoder</div></div></div><div><div>Reserved (Do not change.)</div></div></div>						
	Axis Address Selection (for UART/USB communication)	0000 to 007F	—	0001	After restart	Setup	—
	Speed Loop Gain	10 to 20000	0.1 Hz	400	Immediately	Tuning	—
	Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately	Tuning	—
	Position Loop Gain	10 to 20000	0.1/s	400	Immediately	Tuning	—
	Moment of Inertia Ratio	0 to 20000	1%	100	Immediately	Tuning	—
	2nd Speed Loop Gain	10 to 20000	0.1 Hz	400	Immediately	Tuning	6.8.6
	2nd Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately	Tuning	
	2nd Position Loop Gain	10 to 20000	0.1/s	400	Immediately	Tuning	
	Feedforward Gain	0 to 100	%	0	Immediately	Tuning	6.8.1
	Feedforward Filter Time Constant	0 to 6400	0.01 ms	0	Immediately	Tuning	

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section		
Pn10B	Application Function for Gain Select Switch	—	—	0000	—	Setup	—		
	<div><div><div>4th digit</div><div>3rd digit</div><div>2nd digit</div><div>1st digit</div></div><div>n. <div><div></div><div></div><div></div><div></div></div></div></div>	Mode Switch Selection (Refer to 6.8.5)						When Enabled	
		0	Uses internal torque reference as the condition (Level setting: Pn10C)					Immediately	
		1	Uses speed reference as the condition (Level setting: Pn10D)						
		2	Uses acceleration as the condition (Level setting: Pn10E)						
		3	Uses position error pulse as the condition (Level setting: Pn10F)						
		4	No mode switch function available						
		Speed Loop Control Method (Refer to 6.8.4)						When Enabled	
		0	PI control					After restart	
		1	I-P control						
		2 and 3	Reserved (Do not change.)						
		Reserved (Do not change.)							
		Reserved (Do not change.)							
		Pn10C	Mode Switch (torque reference)	0 to 800	1%	200	Immediately	Tuning	6.8.5
		Pn10D	Mode Switch (speed reference)	0 to 10000	1 min ⁻¹	0	Immediately	Tuning	
Pn10E	Mode Switch (acceleration)	0 to 30000	1 min ⁻¹ /s	0	Immediately	Tuning			
Pn10F	Mode Switch (position error pulse)	0 to 10000	reference unit	0	Immediately	Tuning			
Pn11F	Position Integral Time Constant	0 to 50000	0.1 ms	0	Immediately	Tuning	6.8.8		
Pn121	Friction Compensation Gain	10 to 1000	0.1%	100	Immediately	Tuning	6.8.9		
Pn122	2nd Gain for Friction Compensation	10 to 1000	%	100	Immediately	Tuning			
Pn123	Friction Compensation Coefficient	0 to 100	1%	0	Immediately	Tuning			
Pn124	Friction Compensation Frequency Correction	-1000 to 10000	0.1 Hz	0	Immediately	Tuning			
Pn125	Friction Compensation Gain Correction	1 to 10000	1%	100	Immediately	Tuning	6.8.6		
Pn131	Gain Switching Time 1	0 to 65535	1 ms	0	Immediately	Tuning			
Pn132	Gain Switching Time 2	0 to 65535	1 ms	0	Immediately	Tuning			
Pn135	Gain Switching Waiting Time 1	0 to 65535	1 ms	0	Immediately	Tuning			
Pn136	Gain Switching Waiting Time 2	0 to 65535	1 ms	0	Immediately	Tuning			

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn139	Automatic Gain Changeover Related Switch 1	0000 to 0052	–	0000	After restart	Tuning	–
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div> <div>Gain Switching Selection Switch (Refer to 6.8.6)</div> <div> <div>0</div> <div>Manual gain switching Changes gain manually using external input signals (G-SEL)</div> </div> <div> <div>1</div> <div>Reserved (Do not change.)</div> </div> <div> <div>2</div> <div>Automatic gain switching pattern 1 Changes automatically 1st gain to 2nd gain when the switching condition A is satisfied. Changes automatically 2nd gain to 1st gain when the switching condition A is not satisfied.</div> </div>						
	<div>Gain Switching Condition A (Refer to 6.8.6)</div> <div> <div>0</div> <div>Positioning completion signal (/COIN) ON</div> </div> <div> <div>1</div> <div>Positioning completion signal (/COIN) OFF</div> </div> <div> <div>2</div> <div>NEAR signal (/NEAR) ON</div> </div> <div> <div>3</div> <div>NEAR signal (/NEAR) OFF</div> </div> <div> <div>4</div> <div>Position reference filter output = 0 and reference pulse input OFF</div> </div> <div> <div>5</div> <div>Position reference pulse input ON</div> </div>						
	Reserved (Do not change.)						
	Reserved (Do not change.)						
Pn13D	Current Gain Level	100 to 2000	%	2000	Immediately	Tuning	–
Pn140	Model Following Control Related Switch	0000 to 1121	–	0100	Immediately	Tuning	–
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div> <div>Model Following Control Selection</div> <div> <div>0</div> <div>Does not use model following control.</div> </div> <div> <div>1</div> <div>Uses model following control.</div> </div>						
	<div>Vibration Suppression Selection</div> <div> <div>0</div> <div>Does not perform vibration suppression.</div> </div> <div> <div>1</div> <div>Performs vibration suppression over the specified frequency.</div> </div> <div> <div>2</div> <div>Performs vibration suppression over two different kinds of frequencies.</div> </div>						
	<div>Vibration Suppression Adjustment Selection Refer to 6.5.1, 6.5.1, 6.5.1 and 6.7.1</div> <div> <div>0</div> <div>Does not adjust vibration suppression automatically using utility function.</div> </div> <div> <div>1</div> <div>Adjusts vibration suppression automatically using utility function.</div> </div>						
	<div>Selection of Speed Feedforward (VFF) / Torque Feedforward (TFF) (Refer to 6.3.1, 6.4.1)</div> <div> <div>0</div> <div>Does not use model following control and external speed/torque feedforward together.</div> </div> <div> <div>1</div> <div>Uses model following control and external speed/torque feedforward together.</div> </div>						
Pn141	Model Following Control Gain	10 to 20000	0.1/s	500	Immediately	Tuning	–
Pn142	Model Following Control Gain Compensation	500 to 2000	0.1%	1000	Immediately	Tuning	–

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn143	Model Following Control Bias (Forward Direction)	0 to 10000	0.1%	1000	Immediately	Tuning	—
Pn144	Model Following Control Bias (Reverse Direction)	0 to 10000	0.1%	1000	Immediately	Tuning	—
Pn145	Vibration Suppression 1 Frequency A	10 to 2500	0.1 Hz	500	Immediately	Tuning	—
Pn146	Vibration Suppression 1 Frequency B	10 to 2500	0.1 Hz	700	Immediately	Tuning	—
Pn147	Model Following Control Speed Feedforward Compensation	0 to 10000	0.1%	1000	Immediately	Tuning	—
Pn148	2nd Model Following Control Gain	10 to 20000	0.1/s	500	Immediately	Tuning	—
Pn149	2nd Model Following Control Gain Compensation	500 to 2000	0.1%	1000	Immediately	Tuning	—
Pn14A	Vibration Suppression 2 Frequency	10 to 2000	0.1 Hz	800	Immediately	Tuning	—
Pn14B	Vibration Suppression 2 Compensation	10 to 1000	1%	100	Immediately	Tuning	—
Pn160	Anti-Resonance Control Related Switch	0000 to 0011	—	0010	Immediately	Tuning	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div> <div> <div>Anti-Resonance Control Selection (Refer to 6.3.1, 6.5.1, 6.5.1, 6.7.1)</div> <div>0 Does not use anti-resonance control.</div> <div>1 Uses anti-resonance control.</div> <div>Anti-Resonance Control Adjustment Selection (Refer to 6.5.1, 6.5.1, 6.5.1, 6.5.1)</div> <div>0 Does not use adjust anti-resonance control automatically using utility function.</div> <div>1 Adjusts anti-resonance control automatically using utility function.</div> <div>Reserved (Do not change.)</div> <div>Reserved (Do not change.)</div> </div>						
	Anti-Resonance Frequency	10 to 20000	0.1 Hz	1000	Immediately	Tuning	—
	Anti-Resonance Gain Compensation	1 to 1000	1%	100	Immediately	Tuning	—
	Anti-Resonance Damping Gain	0 to 300	1%	0	Immediately	Tuning	—
	Anti-Resonance Filter Time Constant 1 Compensation	-1000 to 1000	0.01 ms	0	Immediately	Tuning	—
	Anti-Resonance Filter Time Constant 2 Compensation	-1000 to 1000	0.01 ms	0	Immediately	Tuning	—

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section		
Pn170	Tuning-less Function Rated Switch		0000 to 2411	—	1401	—	Setup	6.2	
	n.	4th digit	<input type="checkbox"/>	Tuning-less Function Selection				When Enabled	
		3rd digit	<input type="checkbox"/>					After restart	
		2nd digit	<input type="checkbox"/>						
		1st digit	<input type="checkbox"/>						
								When Enabled	
		0	Tuning-less function disabled			After restart			
		1	Tuning-less function enabled						
								When Enabled	
		0	Uses as speed control.			After restart			
		1	Uses as position control at host controller.						
								When Enabled	
		0 to 4	Sets tuning-less level.			Immediaately			
								When Enabled	
		0 to 2	Sets tuning-less load level.			Immediaately			
Pn200	Position Control Reference Form Selection Switch		0000 to 1236	—	0000	After restart	Setup	—	
	n.	4th digit	<input type="checkbox"/>	Reference Pulse Form				(Refer to 6.5.1)	
		3rd digit	<input type="checkbox"/>						
		2nd digit	<input type="checkbox"/>						
		1st digit	<input type="checkbox"/>						
		0	Sign + Pulse, positive logic						
		1	CW + CCW, positive logic						
		2	Phase A + Phase B (×1), positive logic						
		3	Phase A + Phase B (×2), positive logic						
		4	Phase A + Phase B (×4), positive logic						
		5	Sign + Pulse, negative logic						
		6	CW + CCW, negative logic						
								(Refer to 6.5.1)	
		0	Clears position error pulse when the signal is at H level.						
		1	Clears position error pulse at the rising edge of the signal.						
		2	Clears position error pulse when the signal is at L level.						
		3	Clears position error pulse at the falling edge of the signal.						
								(Refer to 6.5.1)	
		0	Clears position error pulse at the baseblock (Servo OFF or alarm occurred).						
		1	Does not clear position error pulse (possible to clear error counter only with CLR signal)						
		2	Clears position error pulse when an alarm occurs.						
								(Refer to 6.5.1)	
		0	Reference input filter 1 for line driver signal (to 1 Mpps)						
		1	Reference input filter for open collector signal (to 200 kpps)						
		2	Reference input filter 2 for line driver signal (to 4 Mpps)						

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn205	Multiturn Limit Setting *	0 to 65535	1 rev	65535	After restart	Setup	5.9.7
Pn207	Position Control Function Switch	0000 to 2210	—	0010	After restart	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div> <div>Reserved (Do not change.)</div> <div>Position Control Option (Refer to 6.5.1)</div> <div>0 N/A</div> <div>1 Uses V-REF as a speed feedforward input.</div> <div>Reserved (Do not change.)</div> <div>/COIN Output Timing (Refer to 6.5.1)</div> <div>0 Outputs when the position error absolute value is the same or less than the positioning completion width (Pn522).</div> <div>1 Outputs when the position error absolute value is the position completion width (Pn522) or less and the reference after position reference filtering is 0.</div> <div>2 When the absolute value of the position error is below the positioning completed width setting (Pn522), and the position reference input is 0.</div>						
Pn20A	Number of External Scale Pitch	4 to 1048576	1 pitch/rev	32768	After restart	Setup	9.2
Pn20E	Electronic Gear Ratio (Numerator)	1 to 1073741824 (2 ³⁰)	-	4	After restart	Setup	5.4.3
Pn210	Electronic Gear Ratio (Denominator)	1 to 1073741824 (2 ³⁰)	-	1	After restart	Setup	
Pn212	Encoder Output Pulses	16 to 1073741824 (2 ³⁰)	1 P/rev	2048	After restart	Setup	5.3.7
Pn216	Position Reference Acceleration/Deceleration Time Constant	0 to 65535	0.1 ms	0	Immediately	Setup	5.4.4
Pn217	Average Movement Time of Position Reference	0 to 10000	0.1 ms	0	Immediately	Setup	
Pn22A	Fully-closed Control Selection Switch	0000 to 1003	—	0000	—	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div> <div>Reserved (Do not change.)</div> <div>Reserved (Do not change.)</div> <div>Reserved (Do not change.)</div> <div>Speed Feedback Selection at Fully-closed Control (Refer to 6.5.1)</div> <div>0 Uses motor encoder speed.</div> <div>1 Uses external encoder speed.</div>						

* The multiturn limit must be changed only for special applications. Changing this limit inappropriately or unintentionally can be dangerous.

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn281	Encoder Output Resolution	1 to 4096	1 P/pitch	20	After restart	Setup	9.2
Pn300	Speed Reference Input Gain	150 to 3000	0.01V / rated speed	600	Immediately	Setup	5.3.1 5.5.3 6.8.3
Pn301	Internal Set Speed 1	0 to 10000	1 min ⁻¹	100	Immediately	Setup	5.6.1
Pn302	Internal Set Speed 2	0 to 10000	1 min ⁻¹	200	Immediately	Setup	
Pn303	Internal Set Speed 3	0 to 10000	1 min ⁻¹	300	Immediately	Setup	
Pn304	JOG Speed	0 to 10000	1 min ⁻¹	500	Immediately	Setup	7.3
Pn305	Soft Start Acceleration Time	0 to 10000	1 ms	0	Immediately	Setup	5.3.3
Pn306	Soft Start Deceleration Time	0 to 10000	1 ms	0	Immediately	Setup	
Pn307	Speed Reference Filter Time Constant	0 to 65535	0.01 ms	40	Immediately	Setup	5.3.4
Pn310	Vibration Detection Switch	0000 to 0002	—	0000	Immediately	Setup	—
	<div><div>4th digit 3rd digit 2nd digit 1st digit</div><div>n. <div><div></div><div></div><div></div><div></div></div></div><div><div><div>Vibration Detection Selection</div><div>(Refer to 7.16)</div></div><div><div>0</div><div>No detection.</div></div><div><div>1</div><div>Outputs warning (A.911) when vibration is detected.</div></div><div><div>2</div><div>Outputs alarm (A.520) when vibration is detected.</div></div></div><div><div>Reserved (Do not change.)</div></div><div><div>Reserved (Do not change.)</div></div><div><div>Reserved (Do not change.)</div></div></div>						
Pn311	Vibration Detection Sensibility	50 to 500	1%	100	Immediately	Tuning	7.16
Pn312	Vibration Detection Level	0 to 5000	1 min ⁻¹	50	Immediately	Tuning	
Pn324	Moment of Inertia Setting Start Level	0 to 20000	1%	300	Immediately	Setup	—
Pn400	Torque Reference Input Gain	10 to100	0.1 V/ rated torque	30	Immediately	Setup	5.5.1 6.8.2
Pn401	Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	Tuning	6.8.7
Pn402	Forward Torque Limit	0 to 800	1%	800	Immediately	Setup	5.8.1
Pn403	Reverse Torque Limit	0 to 800	1%	800	Immediately	Setup	
Pn404	Forward External Torque Limit	0 to 800	1%	100	Immediately	Setup	5.8.2
Pn405	Reverse External Torque Limit	0 to 800	1%	100	Immediately	Setup	5.8.4
Pn406	Emergency Stop Torque	0 to 800	1%	800	Immediately	Setup	5.2.3
Pn407	Speed Limit during Torque Control	0 to 10000	1 min ⁻¹	10000	Immediately	Setup	5.5.3

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn408	Torque Related Function Switch	0000 to 1111	—	0000	—	Setup	—
	<div style="display: flex; align-items: center;"> <div style="margin-right: 10px;"> 4th digit n. <input type="checkbox"/> 3rd digit <input type="checkbox"/> 2nd digit <input type="checkbox"/> 1st digit <input type="checkbox"/> </div> <div> <div>1st Step Notch Filter Selection (Refer to 6.8.7)</div> <div>When Enabled</div> <div>0 N/A</div> <div>1 Uses 1st step notch filter for torque reference.</div> <div>Immediately</div> </div> </div>						
	<div style="display: flex; align-items: center;"> <div style="margin-right: 10px;"> 4th digit n. <input type="checkbox"/> 3rd digit <input type="checkbox"/> 2nd digit <input type="checkbox"/> 1st digit <input type="checkbox"/> </div> <div> <div>Speed Limit Selection (Refer to 5.5.3)</div> <div>When Enabled</div> <div>0 Uses the smaller value between motor max. speed and parameter Pn407 as speed limit value.</div> <div>1 Uses the smaller value between overspeed detection speed and parameter Pn407 as speed limit value.</div> <div>After restart</div> </div> </div>						
	<div style="display: flex; align-items: center;"> <div style="margin-right: 10px;"> 4th digit n. <input type="checkbox"/> 3rd digit <input type="checkbox"/> 2nd digit <input type="checkbox"/> 1st digit <input type="checkbox"/> </div> <div> <div>2nd Step Notch Filter Selection (Refer to 6.8.7)</div> <div>When Enabled</div> <div>0 N/A</div> <div>1 Uses 2nd step notch filter for torque reference.</div> <div>Immediately</div> </div> </div>						
	<div style="display: flex; align-items: center;"> <div style="margin-right: 10px;"> 4th digit n. <input type="checkbox"/> 3rd digit <input type="checkbox"/> 2nd digit <input type="checkbox"/> 1st digit <input type="checkbox"/> </div> <div> <div>Friction Compensation Function Selection (Refer to 6.8.9)</div> <div>When Enabled</div> <div>0 Disables use friction compensation function.</div> <div>1 Enables friction compensation function.</div> <div>Immediately</div> </div> </div>						
	Pn409	1st Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning
	Pn40A	1st Notch Filter Q Value	50 to 1000	0.01	70	Immediately	Tuning
	Pn40B	1st Notch Filter Depth	0 to 1000	0.001	0	Immediately	Tuning
	Pn40C	2nd Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning
	Pn40D	2nd Notch Filter Q Value	50 to 1000	0.01	70	Immediately	Tuning
	Pn40E	2nd Notch Filter Depth	0 to 1000	0.001	0	Immediately	Tuning
	Pn40F	2nd Step 2nd Torque Reference Filter Frequency	100 to 5000	Hz	5000	Immediately	Tuning
	Pn410	2nd Step 2nd Torque Reference Filter Q Value	50 to 100	0.01	50	Immediately	Tuning
	Pn412	1st Step 2nd Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	Tuning
	Pn415	T-REF Filter Time Constant	0.00 to 655.35	0.01 ms	0	Immediately	Setup
Pn424	Torque Limit at Main Circuit Voltage Drop	0 to 100	%	50	Immediately	Setup	5.2.7
Pn425	Release Time for Torque Limit at Main Circuit Voltage Drop	0 to 1000	ms	100	Immediately	Setup	
Pn456	Sweep Torque Reference Amplitude	1 to 800	1%	15	Immediately	Tuning	7.15

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section	
Pn460	Notch Filter Adjustment Switch	0000 to 0101	–	0101	Immediately	Tuning	6.3.1 6.4.1 6.5.1	
	<div><div><div>4th digit</div><div>3rd digit</div><div>2nd digit</div><div>1st digit</div></div><div>n. <div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div></div></div><div><div>Notch Filter Adjustment Selection 1</div><div><div>0</div><div>1st step notch filter is not adjusted automatically with utility function.</div></div><div><div>1</div><div>1st step notch filter is adjusted automatically with utility function.</div></div><div>Reserved (Do not change.)</div><div>Notch Filter Adjustment Selection 2</div><div><div>0</div><div>2nd step notch filter is not adjusted automatically with utility function.</div></div><div><div>1</div><div>2nd step notch filter is adjusted automatically with utility function.</div></div><div>Reserved (Do not change.)</div></div></div>							
	Pn481	Polarity Detection Speed Loop Gain	1.0 to 2000.0	0.1 Hz	40.0	Immediately	Tuning	–
	Pn482	Polarity Detection Speed Loop Integral Time Constant	0.15 to 512.00	0.01 ms	30.00	Immediately	Tuning	–
	Pn486	Polarity Detection Reference Accel/Decel Time	0 to 100	ms	25	Immediately	Tuning	–
	Pn487	Polarity Detection Constant Speed Time	0 to 300	ms	0	Immediately	Tuning	–
	Pn488	Polarity Detection Reference Waiting Time	50 to 500	ms	100	Immediately	Tuning	–
	Pn490	Polarity Detection Load Level	0 to 20000	%	100	Immediately	Tuning	–
	Pn493	Polarity Detection Reference Speed	0 to 1000	min ⁻¹	50	Immediately	Tuning	–
	Pn494	Polarity Detection Range	0.001 to 65.535	0.001 rev	0.250	Immediately	Tuning	–
	Pn495	Polarity Detection Confirmation Torque Reference	0 to 200	%	100	Immediately	Tuning	–
	Pn498	Polarity Detection Allowable Error Range	0 to 30	deg	10	Immediately	Tuning	–
Pn501	Zero Clamp Level	0 to 10000	1 min ⁻¹	10	Immediately	Setup	5.3.5	
Pn502	Rotation Detection Level	1 to 10000	1 min ⁻¹	20	Immediately	Setup	5.10.3	
Pn503	Speed Coincidence Signal Output Width	0 to 100	1 min ⁻¹	10	Immediately	Setup	5.3.8	
Pn506	Brake Reference - Servo OFF Delay Time	0 to 50	10 ms	0	Immediately	Setup	5.2.4	
Pn507	Brake Reference Output Speed Level	0 to 10000	1 min ⁻¹	100	Immediately	Setup		
Pn508	Waiting Time for Brake Signal When Motor Running	10 to 100	10 ms	50	Immediately	Setup		
Pn509	Instantaneous Power Cut Hold time	20 to 1000	1 ms	20	Immediately	Setup	5.2.6	

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50A	Input Signal Selection 1	0000 to FFF1	—	2100	After restart	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div>						
	Input Signal Allocation Mode (Refer to 3.3.1)						
	0 Uses the sequence input signal terminals with standard allocation.						
	1 Changes the sequence input signal allocation for each signal.						
	/S-ON Signal Mapping (Refer to 5.2.1)						
	Signal Polarity: Normal; Servo ON when ON (L-level)						
	Signal Polarity: Reverse; Servo ON when OFF (H-level)						
	0 ON when CN1-40 input signal is ON (L-level)						
	1 ON when CN1-41 input signal is ON (L-level)						
	2 ON when CN1-42 input signal is ON (L-level)						
	3 ON when CN1-43 input signal is ON (L-level)						
	4 ON when CN1-44 input signal is ON (L-level)						
	5 ON when CN1-45 input signal is ON (L-level)						
	6 ON when CN1-46 input signal is ON (L-level)						
	7 Sets signal ON.						
	8 Sets signal OFF.						
	9 OFF when CN1-40 input signal is OFF (H-level)						
	A OFF when CN1-41 input signal is OFF (H-level)						
	B OFF when CN1-42 input signal is OFF (H-level)						
	C OFF when CN1-43 input signal is OFF (H-level)						
	D OFF when CN1-44 input signal is OFF (H-level)						
	E OFF when CN1-45 input signal is OFF (H-level)						
	F OFF when CN1-46 input signal is OFF (H-level)						
	/P-CON Signal Mapping (P control when ON (L-level)) (Refer to 6.8.4)						
	0 to F Same as /S-ON						
	P-OT Signal Mapping (Overtravel when OFF (H-level)) (Refer to 5.2.3)						
	0 Forward run allowed when CN1-40 input signal is ON (L-level)						
	1 Forward run allowed when CN1-41 input signal is ON (L-level)						
	2 Forward run allowed when CN1-42 input signal is ON (L-level)						
	3 Forward run allowed when CN1-43 input signal is ON (L-level)						
	4 Forward run allowed when CN1-44 input signal is ON (L-level)						
	5 Forward run allowed when CN1-45 input signal is ON (L-level)						
	6 Forward run allowed when CN1-46 input signal is ON (L-level)						
	7 Forward run prohibited						
	8 Forward run allowed						
	9 Forward run allowed when CN1-40 input signal is OFF (H-level)						
	A Forward run allowed when CN1-41 input signal is OFF (H-level)						
	B Forward run allowed when CN1-42 input signal is OFF (H-level)						
	C Forward run allowed when CN1-43 input signal is OFF (H-level)						
	D Forward run allowed when CN1-44 input signal is OFF (H-level)						
	E Forward run allowed when CN1-45 input signal is OFF (H-level)						
	F Forward run allowed when CN1-46 input signal is OFF (H-level)						

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50B	Input Signal Selection 2	0000 to FFFF	—	6543	After restart	Setup	
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div>						
	N-OT Signal Mapping (Overtravel when OFF (H-level)) (Refer to 5.2.3)						
	0 Reverse run allowed when CN1-40 input signal is ON (L-level).						
	1 Reverse run allowed when CN1-41 input signal is ON (L-level).						
	2 Reverse run allowed when CN1-42 input signal is ON (L-level).						
	3 Reverse run allowed when CN1-43 input signal is ON (L-level) .						
	4 Reverse run allowed when CN1-44 input signal is ON (L-level).						
	5 Reverse run allowed when CN1-45 input signal is ON (L-level).						
	6 Reverse run allowed when CN1-46 input signal is ON (L-level).						
	7 Reverse run prohibited.						
	8 Reverse run allowed.						
	9 Reverse run allowed when CN1-40 input signal is OFF (H-level).						
	A Reverse run allowed when CN1-41 input signal is OFF (H-level).						
	B Reverse run allowed when CN1-42 input signal is OFF (H-level).						
	C Reverse run allowed when CN1-43 input signal is OFF (H-level).						
	D Reverse run allowed when CN1-44 input signal is OFF (H-level).						
	E Reverse run allowed when CN1-45 input signal is OFF (H-level).						
	F Reverse run allowed when CN1-46 input signal is OFF (H-level).						
	/ALM-RST Signal Mapping (Alarm reset when OFF (H-level) to ON (L-level)) (Refer to 5.10.1)						
	0 Active on the falling edge of CN1-40 input signal.						
	1 Active on the falling edge of CN1-41 input signal.						
	2 Active on the falling edge of CN1-42 input signal.						
	3 Active on the falling edge of CN1-43 input signal.						
	4 Active on the falling edge of CN1-44 input signal.						
	5 Active on the falling edge of CN1-45 input signal.						
	6 Active on the falling edge of CN1-46 input signal.						
	7 Reserved (Do not change.)						
	8 Sets signal OFF.						
	9 Active on the rising edge of CN1-40 input signal.						
	A Active on the rising edge of CN1-41 input signal.						
	B Active on the rising edge of CN1-42 input signal.						
	C Active on the rising edge of CN1-43 input signal.						
	D Active on the rising edge of CN1-44 input signal.						
	E Active on the rising edge of CN1-45 input signal.						
	F Active on the rising edge of CN1-46 input signal.						
	/P-CL Signal Mapping (Torque Limit when ON (L-level)) (Refer to 5.8.2)						
	0 to F Same as /S-ON, the setting of 2nd digit of Pn50A						
	/N-CL Signal Mapping (Torque Limit when ON (L-level)) (Refer to 5.8.2)						
	0 to F Same as /S-ON, the setting of 2nd digit of Pn50A						

■ Input signal polarities

Signal	Level	Voltage level	Contact
ON	Low (L) level	0 V	Close
OFF	High (H) level	24 V	Open

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50C	Input Signal Selection 3	0000 to FFFF	–	8888	After restart	Setup	–
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div>						
	/SPD-D Signal Mapping (See the internal set speed control function.) (Refer to 5.6.1)						
	0 ON when CN1-40 input signal is ON (L-level).						
	1 ON when CN1-41 input signal is ON (L-level).						
	2 ON when CN1-42 input signal is ON (L-level).						
	3 ON when CN1-43 input signal is ON (L-level).						
	4 ON when CN1-44 input signal is ON (L-level).						
	5 ON when CN1-45 input signal is ON (L-level).						
	6 ON when CN1-46 input signal is ON (L-level).						
	7 Sets signal ON.						
	8 Sets signal OFF.						
	9 ON when CN1-40 input signal is OFF (H-level).						
	A ON when CN1-41 input signal is OFF (H-level).						
	B ON when CN1-42 input signal is OFF (H-level).						
	C ON when CN1-43 input signal is OFF (H-level).						
	D ON when CN1-44 input signal is OFF (H-level).						
	E ON when CN1-45 input signal is OFF (H-level).						
	F ON when CN1-46 input signal is OFF (H-level).						
	/SPD-A Signal Mapping (Refer to 5.6.1)						
	0 to F Same as /SPD-D						
	/SPD-B Signal Mapping (Refer to 5.6.1)						
	0 to F Same as /SPD-D						
	/C-SEL Signal Mapping (Control mode change when ON (L-level)) (Refer to 5.7.2)						
	0 to F Same as /SPD-D						

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50D	Input Signal Selection 4	0000 to FFFF	—	8888	After restart	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div>						
	<div> <div> <div>0</div> <div>ON when CN1-40 input signal is ON (L-level).</div> </div> <div> <div>1</div> <div>ON when CN1-41 input signal is ON (L-level).</div> </div> <div> <div>2</div> <div>ON when CN1-42 input signal is ON (L-level).</div> </div> <div> <div>3</div> <div>ON when CN1-43 input signal is ON (L-level).</div> </div> <div> <div>4</div> <div>ON when CN1-44 input signal is ON (L-level).</div> </div> <div> <div>5</div> <div>ON when CN1-45 input signal is ON (L-level).</div> </div> <div> <div>6</div> <div>ON when CN1-46 input signal is ON (L-level).</div> </div> <div> <div>7</div> <div>Sets signal ON.</div> </div> <div> <div>8</div> <div>Sets signal OFF.</div> </div> <div> <div>9</div> <div>ON when CN1-40 input signal is OFF (H-level).</div> </div> <div> <div>A</div> <div>ON when CN1-41 input signal is OFF (H-level).</div> </div> <div> <div>B</div> <div>ON when CN1-42 input signal is OFF (H-level).</div> </div> <div> <div>C</div> <div>ON when CN1-43 input signal is OFF (H-level).</div> </div> <div> <div>D</div> <div>ON when CN1-44 input signal is OFF (H-level).</div> </div> <div> <div>E</div> <div>ON when CN1-45 input signal is OFF (H-level).</div> </div> <div> <div>F</div> <div>ON when CN1-46 input signal is OFF (H-level).</div> </div> </div>						
	<div> <div> <div>0 to F</div> <div>Same as /ZCLAMP</div> </div> </div>						
	<div> <div> <div>0 to F</div> <div>Same as /ZCLAMP</div> </div> </div>						
	Reserved (Do not change.)						
	Output Signal Selection 1	0000 to 3333	—	3211	After restart	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div>						
	<div> <div> <div>0</div> <div>Disabled (the above signal is not used.)</div> </div> <div> <div>1</div> <div>Outputs the signal from CN1-25, 26 output terminal.</div> </div> <div> <div>2</div> <div>Outputs the signal from CN1-27, 28 output terminal.</div> </div> <div> <div>3</div> <div>Outputs the signal from CN1-29, 30 output terminal.</div> </div> </div>						
	<div> <div> <div>0 to 3</div> <div>Same as /COIN</div> </div> </div>						
	<div> <div> <div>0 to 3</div> <div>Same as /COIN</div> </div> </div>						
	<div> <div> <div>0 to 3</div> <div>Same as /COIN</div> </div> </div>						

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50F	Output Signal Selection 2	0000 to 3333	—	0000	After restart	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div> <div> <div>Torque Limit Detection Signal Mapping (/CLT) (Refer to 5.8.5)</div> <div>0 Disabled (the above signal is not used.)</div> <div>1 Outputs the signal from CN1-25, -26 output terminal.</div> <div>2 Outputs the signal from CN1-27, -28 output terminal.</div> <div>3 Outputs the signal from CN1-29, -30 output terminal.</div> <div>Speed Limit Detection Signal Mapping (/VLT) (Refer to 5.5.3)</div> <div>0 to 3 Same as /CLT</div> <div>Brake Signal Mapping (/BK) (Refer to 5.2.4)</div> <div>0 to 3 Same as /CLT</div> <div>Warning Signal Mapping (/WARN) (Refer to 5.10.2)</div> <div>0 to 3 Same as /CLT</div> </div>						
	Output Signal Selection 3	0000 to 0033	—	0000	After restart	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div> <div> <div>Near Signal Mapping (/NEAR) (Refer to 5.4.6)</div> <div>0 Disabled (the above signal is not used.)</div> <div>1 Outputs the signal from CN1-25, -26 terminal.</div> <div>2 Outputs the signal from CN1-27, -28 terminal.</div> <div>3 Outputs the signal from CN1-29, -30 terminal.</div> <div>Reserved (Do not change.)</div> <div>Reserved (Do not change.)</div> <div>Reserved (Do not change.)</div> </div>						
	Input Signal Selection	0000 to 0111	—	8888	After restart	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div> <div> <div>Reserved (Do not change.)</div> <div>Reserved (Do not change.)</div> <div>Reserved (Do not change.)</div> <div>Reserved (Do not change.)</div> </div>						

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn512	Output Signal Inverse Setting	0000 to 0111	—	0000	After restart	Setup	3.3.3
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div> <div> <div>Output Signal Inverse for CN1-25 or -26 Terminals</div> <div>0 Does not inverse outputs.</div> <div>1 Inverses outputs.</div> <div>Output Signal Inverse for CN1-27 or -28 Terminals</div> <div>0 Does not inverse outputs.</div> <div>1 Inverses outputs.</div> <div>Output Signal Inverse for CN1-29 or -30 Terminals</div> <div>0 Does not inverse outputs.</div> <div>1 Inverses outputs.</div> <div>Reserved (Do not change.)</div> </div>						
	Output Signal Selection 4	0000 to 0333	—	8888	After restart	Setup	—
	<div> <div>4th digit</div> <div>3rd digit</div> <div>2nd digit</div> <div>1st digit</div> </div> <div>n. <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></div> <div> <div>Reserved (Do not change.)</div> <div>Reserved (Do not change.)</div> <div>Reserved (Do not change.)</div> <div>Reserved (Do not change.)</div> </div>						
	Excessive Error Level Between Servomotor and Load Positions	1 to 1073741824 (2^{30})	reference unit	1000	Immediately	Setup	9.2.7
	Excessive Position Error Warning Level	10 to 100	1%	100	Immediately	Setup	10.2.1
	Excessive Position Error Alarm Level	1 to 1073741823 ($2^{30}-1$)	reference unit	5242880	Immediately	Setup	6.1.4 10.1.1
	Positioning Completed Width	0 to 1073741824 (2^{30})	reference unit	7	Immediately	Setup	5.4.5
	NEAR Signal Width	1 to 1073741824 (2^{30})	reference unit	1073741824	Immediately	Setup	5.4.6
	Excessive Position Error Alarm Level at Servo ON	1 to 1073741823 ($2^{30}-1$)	reference unit	5242880	Immediately	Setup	10.1.1
Pn528	Excessive Position Error Warning Level at Servo ON	10 to 100	1%	100	Immediately	Setup	10.2.1
Pn529	Speed Limit Level at Servo ON	0 to 10000	1 min ⁻¹	10000	Immediately	Setup	10.1.1
Pn52A	Multiplier per One Fully-closed Rotation	0 to 100	1%	20	Immediately	Tuning	9.2.7

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn52B	Overload Warning Level	1 to 100	%	20	Immediately	Setup	–
Pn52C	Derating of Base Current at Detecting Overload of Motor	10 to 100	%	100	After restart	Setup	–
Pn52F	Monitor Display at Power ON	0000 to 0FFF	–	0FFF	Immediately	Setup	8.6
Pn530	Program JOG Operation Related Switch	0000 to 0005	–	0000	Immediately	Setup	7.5
	<div><div><div>4th digit</div><div>3rd digit</div><div>2nd digit</div><div>1st digit</div></div><div>n. <div><div><div></div></div><div><div></div></div><div><div></div></div><div><div></div></div></div></div><div><div><div>Program JOG Operation Related Switch</div><div><div>0</div><div>(Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536</div></div><div><div>1</div><div>(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536</div></div><div><div>2</div><div>(Waiting time Pn535 → Forward movement Pn531) × Number of times of movements Pn536 (Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536</div></div><div><div>3</div><div>(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536 (Waiting time Pn535 → Forward movement Pn531) × Number of times of movements Pn536</div></div><div><div>4</div><div>(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536</div></div><div><div>5</div><div>(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536</div></div></div><div><div>Reserved (Do not change.)</div><div>Reserved (Do not change.)</div><div>Reserved (Do not change.)</div></div></div></div>						
Pn531	Program JOG Movement Distance	1 to 1073741824 (2 ³⁰)	reference unit	32768	Immediately	Setup	7.5
Pn533	Program JOG Movement Speed	1 to 10000	1 min ⁻¹	500	Immediately	Setup	
Pn534	Program JOG Acceleration/Deceleration Time	2 to 10000	1 ms	100	Immediately	Setup	
Pn535	Program JOG Waiting Time	0 to 10000	1 ms	100	Immediately	Setup	
Pn536	Number of Times of Program JOG Movement	0 to 1000	1 time	1	Immediately	Setup	
Pn550	Analog Monitor 1 Offset Voltage	-1000.0 to 1000.0	0.1 V	0	Immediately	Setup	6.1.3
Pn551	Analog Monitor 2 Offset Voltage	-1000.0 to 1000.0	0.1 V	0	Immediately	Setup	
Pn552	Analog Monitor Magnification (×1)	-100.00 to 100.00	×0.01	1.00	Immediately	Setup	
Pn553	Analog Monitor Magnification (×2)	-100.00 to 100.00	×0.01	1.00	Immediately	Setup	
Pn560	Remained Vibration Detection Width	0.1 to 300.0	0.1%	40.0	Immediately	Setup	6.7.1
Pn561	Overshoot Detection Level	0 to 100	%	100	Immediately	Setup	–
Pn600	Regenerative Resistor Capacity *1	Depends on SERVOPACK Capacity *2	10 W	0	Immediately	Setup	3.6.2

*1. Normally set to "0." When using an external regenerative resistor, set the capacity (W) of the regenerative resistor.

*2. The upper limit is the maximum output capacity (W) of the SERVOPACK.

11.3 Monitor Modes

The following list shows monitor modes available.

Un Number	Content of Display	Unit
Un000	Motor rotating speed	min ⁻¹
Un001	Speed reference	min ⁻¹
Un002	Internal torque reference (in percentage to the rated torque)	%
Un003 ^{*3}	Rotation angle 1 (32-bit decimal code)	pulse to the zero-point
Un004	Rotation angle 2 (Angle to the zero-point (electrical angle))	deg
Un005 ^{*1}	Input signal monitor	—
Un006 ^{*2}	Output signal monitor	—
Un007	Input reference pulse speed (displayed only in position control)	min ⁻¹
Un008	Error counter (position error amount) (displayed only in position control)	pulse
Un009	Accumulated load ratio (in percentage to the rated torque: effective torque in cycle of 10 seconds)	%
Un00A	Regenerative load ratio (in percentage to the processable regenerative power: regenerative power consumption in cycle of 10 seconds)	%
Un00B	Power consumed by DB resistance (in percentage to the processable power at DB activation: display in cycle of 10 seconds)	%
Un00C ^{*3}	Input reference pulse counter (32-bit decimal code)	reference unit
Un00D ^{*3}	Feedback pulse counter (number of encoder pulses × 4: 32-bit decimal code)	encoder pulse
Un00E ^{*3}	Fully-closed feedback pulse counter (number of fully-closed feedback pulses × 4: 32-bit decimal code)	Fully-closed encoder pulse
Un012	Total operation time	100 ms
Un013 ^{*3}	Feedback pulse counter (32-bit decimal code)	reference unit
Un014	Effective gain monitor	—
Un015	Safety I/O signal monitor	—
Un020	Motor rated speed	min ⁻¹
Un021	Motor maximum speed	min ⁻¹

*1. Refer to 8.4.

*2. Refer to 8.5.

*3. Refer to 8.3.

11.4 Parameter Recording Table

Use the following table for recording parameters.

Note: Pn10B, Pn170 and Pn408 have two kinds of digits: the digit which does not need the restart after changing the settings and the digit which needs the restart. The underlined digits of the factory setting in the following table show the digit which needs the restart.

Parameter	Factory Setting						Name	When Enabled
Pn000	0000						Basic Function Select Switch 0	After restart
Pn001	0000						Application Function Select Switch 1	After restart
Pn002	0000						Application Function Select Switch 2	After restart
Pn006	0002						Application Function Select Switch 6	Immediately
Pn007	0000						Application Function Select Switch 7	Immediately
Pn008	0000						Application Function Select Switch 8	After restart
Pn009	0010						Application Function Select Switch 9	After restart
Pn00B	0000						Application Function Select Switch B	After restart
Pn00C	0000						Application Function Select Switch C	After restart
Pn010	0001						Axis Address Selection (for UART/USB communication)	After restart
Pn100	40.0 Hz						Speed Loop Gain	Immediately
Pn101	20.00 ms						Speed Loop Integral Time Constant	Immediately
Pn102	40.0/s						Position Loop Gain	Immediately
Pn103	100 %						Moment of Inertia Ratio	Immediately
Pn104	40.0 Hz						2nd Speed Loop Gain	Immediately
Pn105	20.00 ms						2nd Speed Loop Integral Time Constant	Immediately
Pn106	40.0/s						2nd Position Loop Gain	Immediately
Pn109	0 %						Feedforward Gain	Immediately
Pn10A	0 ms						Feedforward Filter Time Constant	Immediately
Pn10B	<u>0000</u>						Application Function for Gain Select Switch	—
Pn10C	200 %						Mode Switch (torque reference)	Immediately
Pn10D	0 min ⁻¹						Mode Switch (speed reference)	Immediately
Pn10E	0 min ⁻¹ /s						Mode Switch (acceleration)	Immediately
Pn10F	0 reference unit						Mode Switch (position error pulse)	Immediately
Pn11F	0.0 ms						Position Integral Time Constant	Immediately
Pn121	100%						Friction Compensation Gain	Immediately
Pn122	100%						2nd Gain for Friction Compensation	Immediately
Pn123	0%						Friction Compensation Coefficient	Immediately
Pn124	0 Hz						Friction Compensation Frequency Correction	Immediately
Pn125	100%						Friction Compensation Gain Correction	Immediately
Pn131	0 ms						Gain Switching Time 1	Immediately
Pn132	0 ms						Gain Switching Time 2	Immediately
Pn135	0 ms						Gain Switching Waiting Time 1	Immediately
Pn136	0 ms						Gain Switching Waiting Time 2	Immediately
Pn139	0000						Automatic Gain Changeover Related Switch 1	After restart

Parameter	Factory Setting						Name	When Enabled
Pn13D	500%						Current Gain Level	Immediately
Pn140	0100						Model Following Control Related Switch	Immediately
Pn141	50/s						Model Following Control Gain	Immediately
Pn142	100%						Model Following Control Gain Compensation	Immediately
Pn143	100%						Model Following Control Bias (Forward Direction)	Immediately
Pn144	100%						Model Following Control Bias (Reverse Direction)	Immediately
Pn145	50 Hz						Vibration Suppression 1 Frequency A	Immediately
Pn146	70 Hz						Vibration Suppression 1 Frequency B	Immediately
Pn147	100%						Model Following Control Speed Feedforward Compensation	Immediately
Pn148	50/s						2nd Model Following Control Gain	Immediately
Pn149	100%						2nd Model Following Control Gain Compensation	Immediately
Pn14A	80 Hz						Vibration Suppression 2 Frequency	Immediately
Pn14B	100%						Vibration Suppression 2 Compensation	Immediately
Pn160	0010						Anti-Resonance Control Related Switch	Immediately
Pn161	100 Hz						Anti-Resonance Frequency	Immediately
Pn162	100%						Anti-Resonance Gain Compensation	Immediately
Pn163	0%						Anti-Resonance Damping Gain	Immediately
Pn164	0 ms						Anti-Resonance Filter Time Constant 1 Compensation	Immediately
Pn165	0 ms						Anti-Resonance Filter Time Constant 2 Compensation	Immediately
Pn170	1401						Tuning-less Function Related Switch	—
Pn200	0000						Position Control Reference Form Selection Switch	After restart
Pn205	65535 Rev						Multiturn Limit Setting	After restart
Pn207	0010						Position Control Function Switch	After restart
Pn20A	32768 Pitch/Rev						Number of External Scale Pitch	After restart
Pn20E	4						Electronic Gear Ratio (Numerator)	After restart
Pn210	1						Electronic Gear Ratio (Denominator)	After restart
Pn212	2048 P/Rev						Encoder Output Pulses	After restart
Pn216	0.0 ms						Position Reference Acceleration/Deceleration Time Constant	Immediately
Pn217	0.0 ms						Average Movement Time of Position Reference	Immediately
Pn22A	0000						Fully-closed Control Selection Switch	After restart
Pn281	20 P/Pitch						Encoder Output Resolution	After restart
Pn300	6.00 V/ Rated speed						Speed Reference Input Gain	Immediately
Pn301	100 min ⁻¹						Internal Set Speed 1	Immediately
Pn302	200 min ⁻¹						Internal Set Speed 2	Immediately

Parameter	Factory Setting						Name	When Enabled
Pn303	300 min ⁻¹						Internal Set Speed 3	Immediately
Pn304	500 min ⁻¹						JOG Speed	Immediately
Pn305	0 ms						Soft Start Acceleration Time	Immediately
Pn306	0 ms						Soft Start Deceleration Time	Immediately
Pn307	0.40 ms						Speed Reference Filter Time Constant	Immediately
Pn310	0000						Vibration Detection Switch	Immediately
Pn311	100 %						Vibration Detection Sensibility	Immediately
Pn312	50 min ⁻¹						Vibration Detection Level	Immediately
Pn324	300%						Moment of Inertia Setting Start Level	Immediately
Pn400	3.0 V/Rated torque						Torque Reference Input Gain	Immediately
Pn401	1.00 ms						Torque Reference Filter Time Constant	Immediately
Pn402	800 %						Forward Torque Limit	Immediately
Pn403	800 %						Reverse Torque Limit	Immediately
Pn404	100 %						Forward External Torque Limit	Immediately
Pn405	100 %						Reverse External Torque Limit	Immediately
Pn406	800 %						Emergency Stop Torque	Immediately
Pn407	10000 min ⁻¹						Speed Limit during Torque Control	Immediately
Pn408	0000						Torque Related Function Switch	—
Pn409	5000 Hz						1st Notch Filter Frequency	Immediately
Pn40A	0.70						1st Notch Filter Q Value	Immediately
Pn40B	0						1st Notch Filter Depth	Immediately
Pn40C	5000 Hz						2nd Notch Filter Frequency	Immediately
Pn40D	0.70						2nd Notch Filter Q Value	Immediately
Pn40E	0						2nd Notch Filter Depth	Immediately
Pn40F	5000 Hz						2nd Step 2nd Torque Reference Filter Frequency	Immediately
Pn410	0.50						2nd Step 2nd Torque Reference Filter Q Value	Immediately
Pn412	1.00 ms						1st Step 2nd Torque Reference Filter Time Constant	Immediately
Pn415	0						T-REF Filter Time Constant	Immediately
Pn424	50%						Torque Limit at Main Circuit Voltage Drop	Immediately
Pn425	100 ms						Release Time for Torque Limit at Main Circuit Voltage Drop	Immediately
Pn456	15 %						Sweep Torque Reference Amplitude	Immediately
Pn460	0101						Notch Filter Adjustment Switch	Immediately
Pn481	4.00 Hz						Polarity Detection Speed Loop Gain	Immediately
Pn482	0.30 ms						Polarity Detection Speed Loop Integral Time Constant	Immediately
Pn486	25 ms						Polarity Detection Reference Accel/Decel Time	Immediately
Pn487	0 ms						Polarity Detection Constant Speed Time	Immediately
Pn488	100 ms						Polarity Detection Reference Waiting Time	Immediately

Parameter	Factory Setting						Name	When Enabled
Pn490	100%						Polarity Detection Load Level	Immediately
Pn493	50 min ⁻¹						Polarity Detection Reference Speed	Immediately
Pn494	0.0025 rev						Polarity Detection Range	Immediately
Pn495	100%						Polarity Detection Confirmation Torque Reference	Immediately
Pn498	10 deg						Polarity Detection Allowable Error Range	Immediately
Pn501	10 min ⁻¹						Zero Clamp Level	Immediately
Pn502	20 min ⁻¹						Rotation Detection Level	Immediately
Pn503	10 min ⁻¹						Speed Coincidence Signal Output Width	Immediately
Pn506	0 ms						Brake Reference - Servo OFF Delay Time	Immediately
Pn507	100 min ⁻¹						Brake Reference Output Speed Level	Immediately
Pn508	500 ms						Waiting Time for Brake Signal When Motor Running	Immediately
Pn509	20 ms						Instantaneous Power Cut Hold time	Immediately
Pn50A	2100						Input Signal Selection 1	After restart
Pn50B	6543						Input Signal Selection 2	After restart
Pn50C	8888						Input Signal Selection 3	After restart
Pn50D	8888						Input Signal Selection 4	After restart
Pn50E	3211						Output Signal Selection 1	After restart
Pn50F	0000						Output Signal Selection 2	After restart
Pn510	0000						Output Signal Selection 3	After restart
Pn511	8888						Input Signal Selection 5	After restart
Pn512	0000						Output Signal Reversal Setting	After restart
Pn513	0000						Output Signal Selection 4	After restart
Pn51B	1000 reference unit						Excessive Error Level Between Servomotor and Load Positions	Immediately
Pn51E	100%						Excessive Position Error Warning Level	Immediately
Pn520	524880 reference unit						Excessive Position Error Alarm Level	Immediately
Pn522	7 reference unit						Positioning Completed Width	Immediately
Pn524	1073741824 reference unit						NEAR Signal Width	Immediately
Pn526	524880 reference unit						Excessive Position Error Alarm Level at Servo ON	Immediately
Pn528	100 %						Excessive Position Error Warning Level at Servo ON	Immediately
Pn529	10000 min ⁻¹						Speed Limit Level at Servo ON	Immediately
Pn52A	20 %						Multiplier per One Fully-closed Rotation	Immediately
Pn52B	20%						Overload Warning Level	Immediately

[illegible]

Revision History

The revision dates and numbers of the revised manuals are given on the bottom of the back cover.

MANUAL NO. SIEP S800000 45A

© Printed in Japan June 2007 07-06
└─ Date of printing └─ Date of original publication

Date of Printing	Rev. No.	Section	Revised Content
June 2007	—		First edition

AC Servodrive

Σ -V Series

USER'S MANUAL

Design and Maintenance

Rotational Motor

Analog Voltage and Pulse Train Reference

IRUMA BUSINESS CENTER (SOLUTION CENTER)

480, Kamifujisawa, Iruma, Saitama 358-8555, Japan
Phone 81-4-2962-5696 Fax 81-4-2962-6138

YASKAWA ELECTRIC AMERICA, INC.

2121 Norman Drive South, Waukegan, IL 60085, U.S.A.
Phone 1-847-887-7000 Fax 1-847-887-7370

YASKAWA ELÉTRICO DO BRASIL COMÉRCIO LTD.A.

Avenida Fagundes Filho, 620 Bairro Saude-Sao Paulo-SP, Brazil CEP: 04304-000
Phone 55-11-5071-2552 Fax 55-11-5581-8795

YASKAWA ELECTRIC EUROPE GmbH

Am Kronberger Hang 2, 65824 Schwalbach, Germany
Phone 49-6196-569-300 Fax 49-6196-569-312

YASKAWA ELECTRIC UK LTD.

1 Hunt Hill Orchardton Woods Cumbernauld, G68 9LF, United Kingdom
Phone 44-1236-735000 Fax 44-1236-458182

YASKAWA ELECTRIC KOREA CORPORATION

7F, Doore Bldg. 24, Yeoido-dong, Youngdungpo-Ku, Seoul 150-877, Korea
Phone 82-2-784-7844 Fax 82-2-784-8495

YASKAWA ELECTRIC (SINGAPORE) PTE. LTD.

151 Lorong Chuan, #04-01, New Tech Park 556741, Singapore
Phone 65-6282-3003 Fax 65-6289-3003

YASKAWA ELECTRIC (SHANGHAI) CO., LTD.

No.18 Xizang Zhong Road. Room 1702-1707, Harbour Ring Plaza Shanghai 200001, China
Phone 86-21-5385-2200 Fax 86-21-5385-3299

YASKAWA ELECTRIC (SHANGHAI) CO., LTD. BEIJING OFFICE

Room 1011A, 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

9F, 16, Nanking E. Rd., Sec. 3, Taipei, Taiwan
Phone 886-2-2502-5003 Fax 886-2-2505-1280



YASKAWA

YASKAWA ELECTRIC CORPORATION

In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice for ongoing product modifications and improvements.

© 2007 YASKAWA ELECTRIC CORPORATION. All rights reserved.

MANUAL NO. SIEP S800000 45A

Printed in Japan June 2007 07-6

07-4