YASKAWA

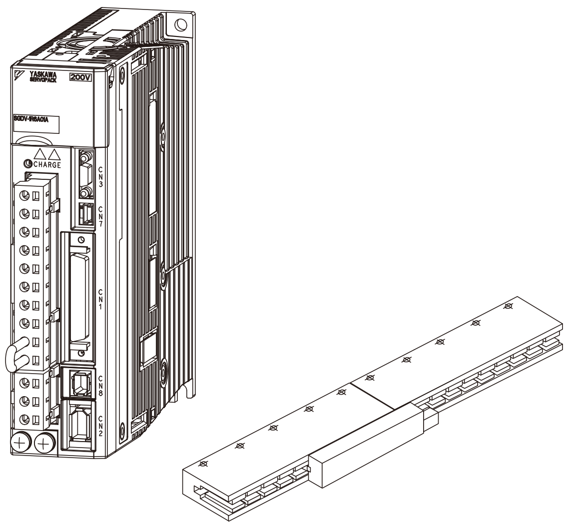
AC Servo Drives

Σ-V Series

USER'S MANUAL
Design and Maintenance

Linear Motor
Analog Voltage and Pulse Train Reference

SGDV SERVOPACK
SGLGW/SGLFW/SGLTW/SGLCW/SGT Linear Servomotors



MANUAL NO. SIEP S800000 47C

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
Linear Servomotor	Σ-V Series SGLGW, SGLFW, SGLTW, SGLCW or SGT linear servomotor
SERVOPACK	Σ-V Series SGDV SERVOPACK
Servo Drive	A set including a servomotor and SERVOPACK (i.e., a servo amplifier)
Servo System	A servo control system that includes the combination of a servo drive with a host controller and peripheral devices
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 User's Manual Setup Linear Motor (SIEP S800000 44)				✓	✓		
Σ-V Series Product Catalog (KAEP S800000 42)	✓	✓					
Σ-V Series User’s Manual Operation of Digital Operator (SIEP S800000 55)					✓	✓	✓
Σ-V Series AC SERVOPACK SGDV Safety Precautions (TOBP C710800 10)	✓			✓			✓
Σ Series Digital Operator Safety Precautions (TOBP C730800 00)							✓
AC SERVOMOTOR Safety Precautions (TOBP C230200 00)				✓			✓

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.

⚠ WARNING	Indicates precautions that, if not heeded, could possibly result in loss of life or serious injury.
⚠ CAUTION	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 serious consequences if not heeded.
⃠ PROHIBITED	Indicates prohibited actions that must not be performed. For example, this symbol would be used to indicate that fire is prohibited as follows: 
❗ MANDATORY	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

- If you have a pacemaker or any other electronic medical device, do not go near the magnetic way of the linear servomotor.
  Failure to observe this warning may result in the malfunction of the medical device.
- Be sure to use nonmagnetic tools when installing or working close to the linear servomotor.
  (Example: a beryllium-copper alloy hexagonal wrench set, made by NGK Insulators, Ltd.)
- 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 linear servomotor or machinery during operation.
  Failure to observe this warning may result in injury.
- Before wiring, install the SERVOPACK and the linear servomotor.
  Failure to observe this warning may result in electric shock.
- 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.
- After the power is turned OFF or after a voltage resistance test, do not touch terminals while the charge indicator is ON.
  Residual voltage may cause electric shock.
- Follow the procedures and instructions provided in the user's manual of the product for trial operation.
  Failure to do so may result not only in faulty operation and damage to equipment, but also in personal injury.
- 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.
- Do not modify the product.
  Failure to observe this warning may result in injury, fire, or damage to the product.
- Provide an appropriate stopping device on the machine side to ensure safety. A holding brake for a linear servomotor with brake is not a stopping device for ensuring safety.
  Failure to observe this warning may result in injury.
- Do not come close to the machine immediately after resetting momentary power loss to avoid an unexpected restart. 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.
- 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.

■ Storage and Transportation

⚠ CAUTION

- Be sure to store the magnetic way in the package that was used for delivery.
- 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 carry the linear servomotor by its cables.

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

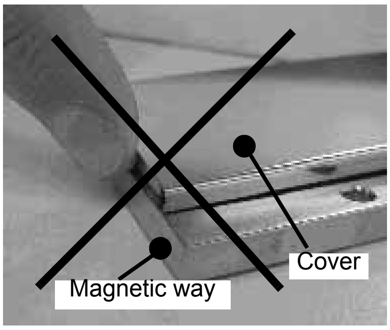
  Example: Heat treatment, where materials are kiln-dried to a core temperature of 56°C for 30 minutes or more.

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

■ Installation

⚠ CAUTION

- When unpacking and installing magnetic way, check that no metal fragments or magnetized objects near the magnetic because they may be affected by the magnetic attraction of the magnetic way.
  Failure to observe this caution may result in injury or damage to the magnetic way's magnets.
- Do not use the magnetic way near metal or other magnetized objects.
  Failure to observe this caution may result in injury.
- Do not place clocks, magnetic cards, floppy disks, or measuring instruments close to the magnetic way.
  Failure to observe this caution may result in malfunction or damage to these items by the magnetic force.
- Securely mount the linear servomotor onto the machine.
  If the linear servomotor is not mounted securely, it may loosen during operation.
- Do not carry the magnetic way by its magnet protection cover.
  Failure to observe this caution may result in injury by the cover’s edge or the shape of the cover may become distorted.



- When removing the dummy plate for reducing magnetic force used for the SGLFM magnetic way, pay attention to the magnetic attraction of the magnetic way. Do not place the removed plate close to the magnetic way.
  Failure to observe this caution may result in injury or damage to the magnetic way’s magnets or the magnet protection cover.
- Install SERVOPACKs, linear servomotors, and regenerative resistors on nonflammable objects.
  Installation directly onto or near flammable objects may result in fire.
- 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

- Securely tighten the cable connector screws and securing mechanism.
  If the connector screws and securing mechanism are not secure, they may loosen during operation.
- Use cables with a radius, heat resistance, and flexibility suitable for the system.
- If the SERVOPACK malfunctions, turn OFF the main circuit's power supply of the SERVOPACK.
  The continuous flow of a large current may cause fire.
- Use a noise filter to minimize the effects of electromagnetic damage.
  Failure to observe this caution may result in electromagnetic damage to electronic devices used near the SERVOPACK.
- 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 I/O signal cables or the serial converter unit connection cable 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 I/O signal cables and the serial converter unit connection cable.
- I/O signal cables must be no longer than 3 m, serial converter unit connection cable must be no longer than 20 m.
- Do not touch the power terminals while the charge indicator is ON after turning power OFF because high voltage may still remain in the SERVOPACK.
  Make sure the charge indicator is off first before starting an inspection.
- Observe the following precautions when wiring main circuit terminals.
  - Remove main circuit terminals from the SERVOPACK prior to wiring.
  - Insert only one main 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.
- Do not turn ON the power to the SERVOPACK until all wiring has been completed, including the main circuit terminals.
- Do not connect the SERVOPACK for 200 V directly to a voltage of 400 V.
  The SERVOPACK will be destroyed.
- 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 burning.
- Make sure that the polarity is correct.
  Incorrect polarity may cause ruptures or damage.
- 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.
  Failure to observe this caution may result in damage to the product.
  - 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
- Wiring or inspection must be performed by a technical expert.
- Use a 24 VDC power supply with double insulation or reinforced insulation.

■ Operation

⚠ CAUTION

- Always use the linear servomotor and SERVOPACK in one of the specified combinations.
  Failure to observe this caution may result in fire or malfunction.
- Do not stand within the machine's range of motion during operation.
  Failure to observe this caution may result in injury.
- Before operation, install a limit switch or stopper on the end of the slider to prevent unexpected movement.
  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 (charging time 0.2 ms) 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.
- When using JOG operations (Fn002), search operations (Fn003), or EasyFFT operations (Fn206), the dynamic brake function does not work for reverse overtravel or forward overtravel. Take necessary precautions.
  Failure to observe this caution may result in damage to the product.
- When using the linear servomotor on a vertical axis, install a safety device such as a counterbalance so that the workpiece does not fall if an alarm or overtravel occurs.
  The workpiece may fall during overtraveling.
- When not using turning-less function, set to the correct mass ratio (Pn103).
  Setting an incorrect mass 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.
- If an alarm occurs, shut down the main circuit power supply.
  Failure to observe this caution may result in fire due to regenerative resistor overheating caused by regenerative transistor failure.
- 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.
- An alarm or warning may be generated if communications are executed with the host controller during operation using SigmaWin+ or the digital operator.
  If an alarm or warning is generated, the process currently being executed may be aborted and the system may stop.

■ Maintenance and Inspection

⚠ CAUTION

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

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	• SGDV	UL508C (E147823)

* Underwriters Laboratories Inc.

■ European Standards

	Model	Low Voltage Directive	EMC Directive		Safety Standards
			EMI	EMS	
SERVOPACK	• SGDV	EN50178 EN61800-5-1	EN55011/A2 group 1 class A EN61800-3	EN61800-3 EN61000-6-2	EN954-1 IEC61508-1 to 4

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

Contents

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Outline

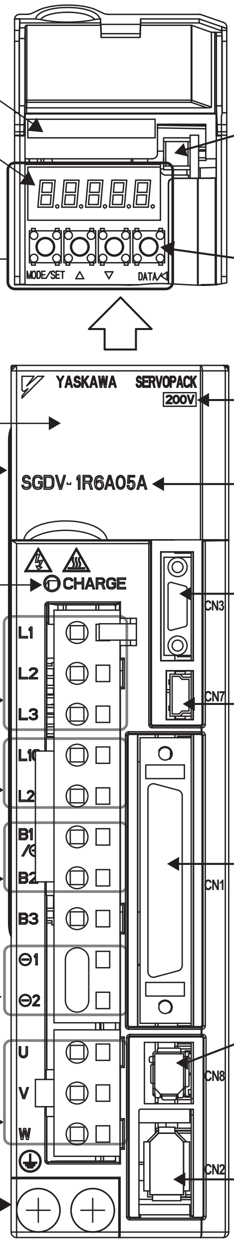
1.1 Σ-V Series SERVOPACKs

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 SGDV type SERVOPACK for analog voltage and pulse train reference.

With front cover open



Serial number

Panel display
Used to display SERVOPACK status, alarm status, and other values when parameters are input.
Refer to *2.1 Panel Operator*.

Panel operator

Front cover

Nameplate (side view)
Indicates the SERVOPACK model and ratings.

Charge indicator
Lights when the main circuit power supply is ON and stays lit as long as the internal capacitor remains charged. Therefore, do not touch the SERVOPACK even after the power supply is turned OFF if the indicator is lit.
It may result in electric shock.

Main circuit power supply terminals
Used for main circuit power supply input.
Refer to *3.1 Main Circuit Wiring*.

Control power supply Terminals
Used for control power supply input.
Refer to *3.1 Main Circuit Wiring*.

Regenerative resistor connecting terminals
Connects external regenerative resistors.
Refer to *3.6 Connecting Regenerative Resistors*..

DC reactor terminals for harmonic suppression
Connects DC reactor for harmonic suppression.
Refer to *3.7.3 Connecting DC Reactor for Harmonic Suppression*.

Servomotor terminals
Connects the main circuit cable for servomotor.
Refer to *3.1 Main Circuit Wiring*.

Ground terminal
Be sure to connect to protect against electrical shock.
Refer to *3.1 Main Circuit Wiring*.

CN5 Analog monitor connector
Used to monitor motor speed, torque reference, and other values through a special cable (option).
Refer to *6.1.3 Monitoring Analog Signals*.

Panel operator keys
Used to set parameters.
Refer to *2.1 Panel Operator*.

Input voltage

SERVOPACK model
Refer to *1.6 SERVOPACK Model Designation*.

CN3 Connector for digital operator
Connects a digital operator (option, JUSP-OP05A-1-E) or a personal computer (RS422).
Refer to *Σ-V series Product Catalog* (KAEPS80000042) and *Σ-V series User's Manual*, *Operation of Digital Operator* (SIEPS80000055).

CN7 Connector for personal computer
Communicates with a personal computer.
Use the connection cable (JZSP-CVS06-02-E).

CN1 I/O signal connector
Used for reference input signals and sequence I/O signals.
Refer to *3.2 I/O Signal Connections*.

CN8 Connector for safety function devices
Connects a safety function device.
Note: When not using the safety function, use the SERVOPACK with the safety function jumper connector (JZSP-CVH05-E, provided as an accessory) inserted.
For the connecting method, refer to *3.2.3 Safety Function Signal (CN8) Names and Functions*.
refer to *5.11 Safety Function*.

CN2 Encoder connector
Connects a serial converter unit or a linear scale.
Refer to *3.5 Examples of Linear Scale Connection*.

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) 100 VAC Rating

SGDV (100 VAC)	R70	R90	2R1	2R8
Continuous Output Current [Arms]	0.66	0.91	2.1	2.8
Max. Output Current [Arms]	2.1	2.9	6.5	9.3
Main Circuit Power Supply	Single-phase, 100 to 115 VAC $^{+10\%}_{-15\%}$, 50/60 Hz			
Control Power	Single-phase, 100 to 115 VAC $^{+10\%}_{-15\%}$, 50/60 Hz			
Overvoltage Category	III			

(2) 200 VAC Rating

SGDV (200 VAC)	R70	R90	1R6	2R8	3R8	5R5	7R6	120	180	200	330	470	550	590	780
Continuous Output Current [Arms]	0.66	0.91	1.6	2.8	3.8	5.5	7.6	11.6	18.5	19.6	32.9	46.9	54.7	58.6	78.0
Max. Output Current [Arms]	2.1	2.9	5.8	9.3	11.0	16.9	17	28	42	56	84	110	130	140	170
Main Circuit Power Supply	Three-phase, 200 to 230 VAC $^{+10\%}_{-15\%}$, 50/60 Hz														
Control Power	Single-phase, 200 to 230 VAC $^{+10\%}_{-15\%}$, 50/60 Hz														
Overvoltage Category	III														

(3) 400 VAC Rating

SGDV (400 VAC)	1R9	3R5	5R4	8R4	120	170	210	260	280	370
Continuos Output Current [Arms]	1.9	3.5	5.4	8.4	11.9	16.5	20.8	25.7	28.1	37.2
Max. Output Current [Arms]	5.5	8.5	14	20	28	42	55	65	70	85
Main Circuit Power Supply	Three-phase, 380 to 480 VAC $^{+10\%}_{-15\%}$, 50/60 Hz									
Control Power	24 VDC ±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				1/256 data of serial converter unit sine wave pitch (incremental)
Operating Conditions	Surrounding Air/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 / 19.6 m/s^2
	Protection Class/ Pollution Degree			Protection class: IP10, Pollution degree: 2 An environment that satisfies the following conditions. • 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/A2 group1 classA, EN61000-6-2, EN61800-3, EN61800-5-1, EN954-1, IEC61508-1 to 4
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)
	Force 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	Fixed Input		SEN signal
		Input Signals which can be allocated	Number of Channels	7 ch
			Functions	The signal allocation and positive/negative logic can be modified. Servo ON (/S-ON), proportional control (/P-CON), alarm reset (/ALM-RST), forward run prohibited (P-OT), reverse run prohibited (N-OT), forward external force limit (/P-CL), reverse external force 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), polarity detection (P-DET)
	Sequence Output	Fixed Output		Servo alarm (ALM), alarm code (ALO1, ALO2, ALO3) outputs
		Output Signals which can be allocated	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 movement detection (/TGON), servo ready (/S-RDY), force limit detection (/CLT), speed limit detection (/VLT), brake (/BK), warning (/WARN), near (/NEAR)

Communi-cations Function	RS422A Communi-cations (CN3)	Interface	Digital operator (JUSP-OP05A-1-E), personal computer (can be connected with SigmaWin+), etc.
		1:N Communica-tions	N = Up to 15 stations possible at RS422A
		Axis Address Setting	Set by parameter
	USB Communi-cations (CN7)	Interface	Personal computer (can be connected with SigmaWin+.)
		Communica-tions Stan-dard	Complies with standard USB1.1. (12 Mbps)
LED Display			Panel display (five 7 segment) and CHARGE indicator
Analog Monitor (CN5)			Number of points: 2 Output voltage: ± 10V DC (linearity effective range ± 8V) Resolution: 16 bit Accuracy: ± 20 mV (Typ) Max. output current: ± 10 mA Settling time (± 1%): 1.2 ms (Typ)
Dynamic Brake (DB)			Operated at main circuit power supply OFF, servo alarm, servo OFF or over-travel
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, regeneration 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 Module			Fully-closed option module

∗1. Rack mounting and duct-ventilated type available as an option.
∗2. Speed regulation by load regulation is defined as follows:

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

Outline

1

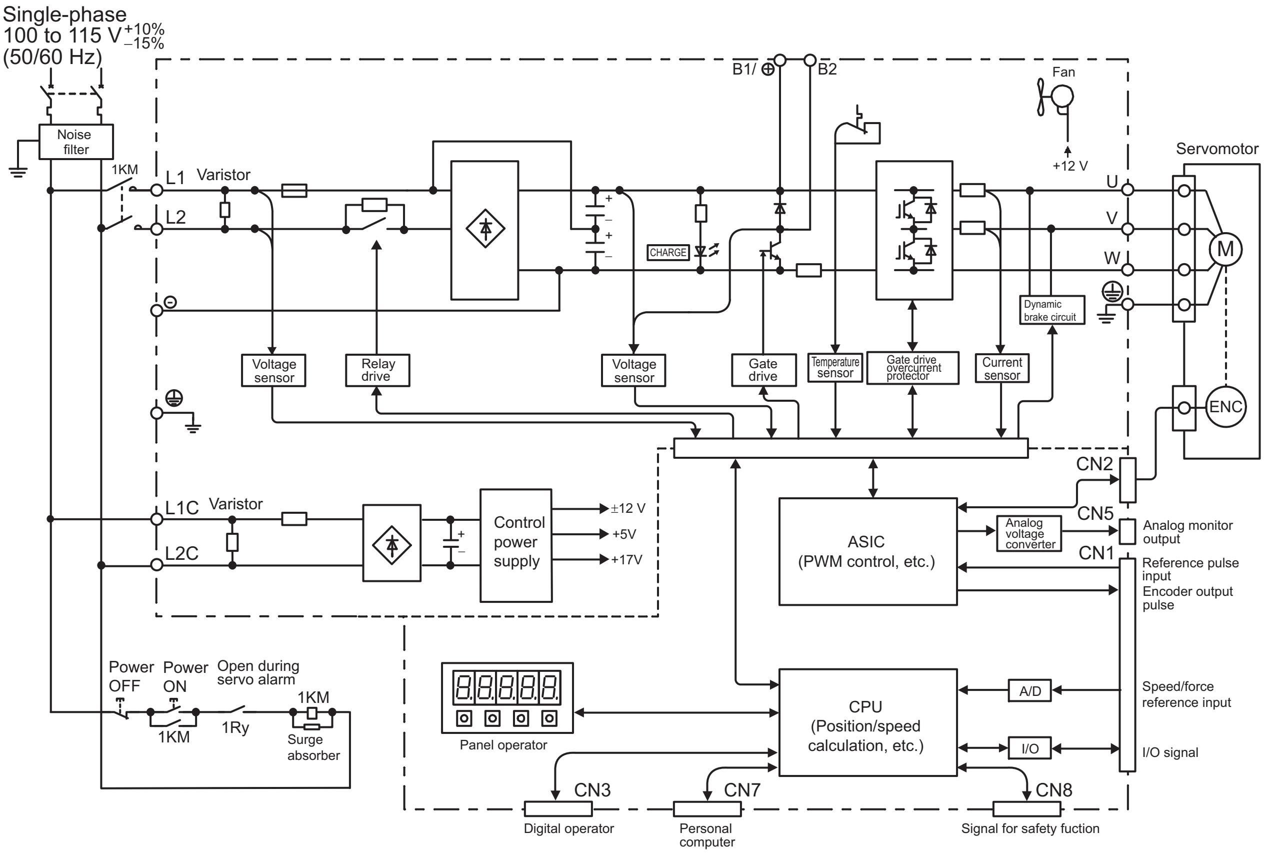
1.3.3 Speed/Position/Force Control Modes

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

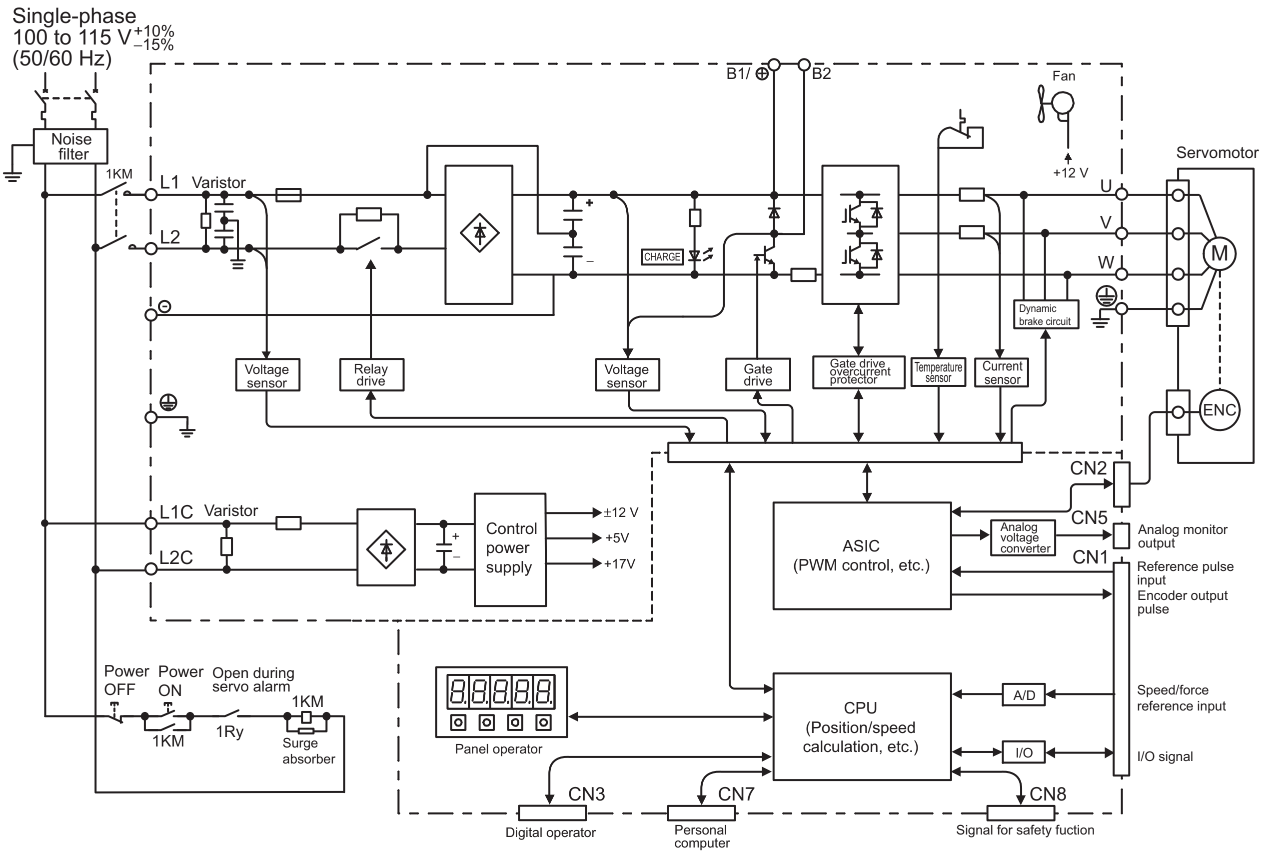
<table>
<tr><th colspan="2">Control Mode</th><th colspan="3">Specifications</th></tr>
<tr><td rowspan="7">Speed Control</td><td>Performance</td><td colspan="2">Soft Start Time Setting</td><td>0 to 10 s (Can be set individually for acceleration and deceleration.)</td></tr>
<tr><td rowspan="3">Input Signals</td><td colspan="2">Reference Voltage</td><td>• Max. input voltage: ±12 V
(forward speed reference with positive reference)
• Factory setting: 6 VDC at rated speed
Input gain setting can be varied.</td></tr>
<tr><td colspan="2">Input Impedance</td><td>About 14 kΩ minimum</td></tr>
<tr><td colspan="2">Circuit Time Constant</td><td>30 μs</td></tr>
<tr><td rowspan="2">Internal Set Speed Control</td><td colspan="2">Movement Direction Selection</td><td>With P control signal</td></tr>
<tr><td colspan="2">Speed Selection</td><td>With forward/reverse current limit signal (speed 1 to 3 selection), servomotor stops or another control method is used when both are OFF.</td></tr>
<tr><td rowspan="6">Position Control</td><td rowspan="2">Performance</td><td colspan="2">Feedforward Compensation</td><td>0 to 100% (setting resolution: 1%)</td></tr>
<tr><td colspan="2">Positioning Completed Width Setting</td><td>0 to 1073741824 reference units (setting resolution: 1 reference unit)</td></tr>
<tr><td rowspan="4">Input Signals</td><td rowspan="3">Reference Pulse</td><td>Type</td><td>Sign + pulse train, 90° phase difference 2-phase pulse (phase A + phase B), or CW + CCW pulse train</td></tr>
<tr><td>Form</td><td>For line driver, open collector</td></tr>
<tr><td>Max. Input Pulse Frequency</td><td>Line driver
Sign + pulse train, CW + CCW phase train: 4 Mpps
90° phase difference 2-phase pulse: 1 Mpps
Open Collector
Sign + pulse train, CW + CCW phase train: 200 kpps
90° phase difference 2-phase pulse: 200 kpps</td></tr>
<tr><td colspan="2">Clear Signal</td><td>Error pulse clear.
For line driver, open collector</td></tr>
<tr><td rowspan="3">Force Control</td><td rowspan="3">Input Signals</td><td colspan="2">Reference Voltage</td><td>• Max. input voltage: ±12 V
(forward force reference with positive reference)
• Factory setting: 3 VDC at rated force
Input gain setting can be varied.</td></tr>
<tr><td colspan="2">Input Impedance</td><td>About 14 kΩ minimum</td></tr>
<tr><td colspan="2">Circuit Time Constant</td><td>16 μs</td></tr>
</table>

1.4 SERVOPACK Internal Block Diagrams

1.4.1 Single-phase 100 V, SGDV-R70F05A, -R90F05A, -2R1F05A Models



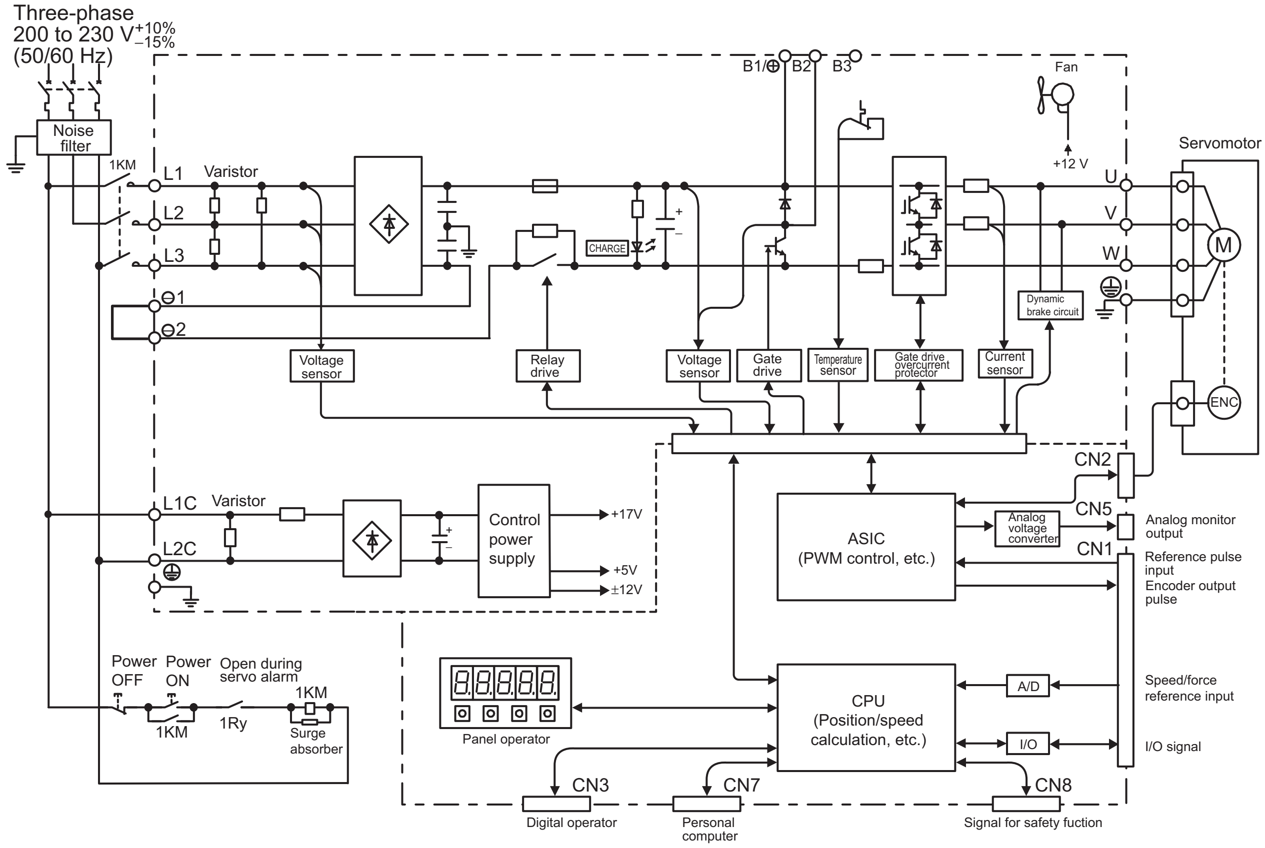
1.4.2 Single-phase 100 V, SGDV-2R8F05A Model



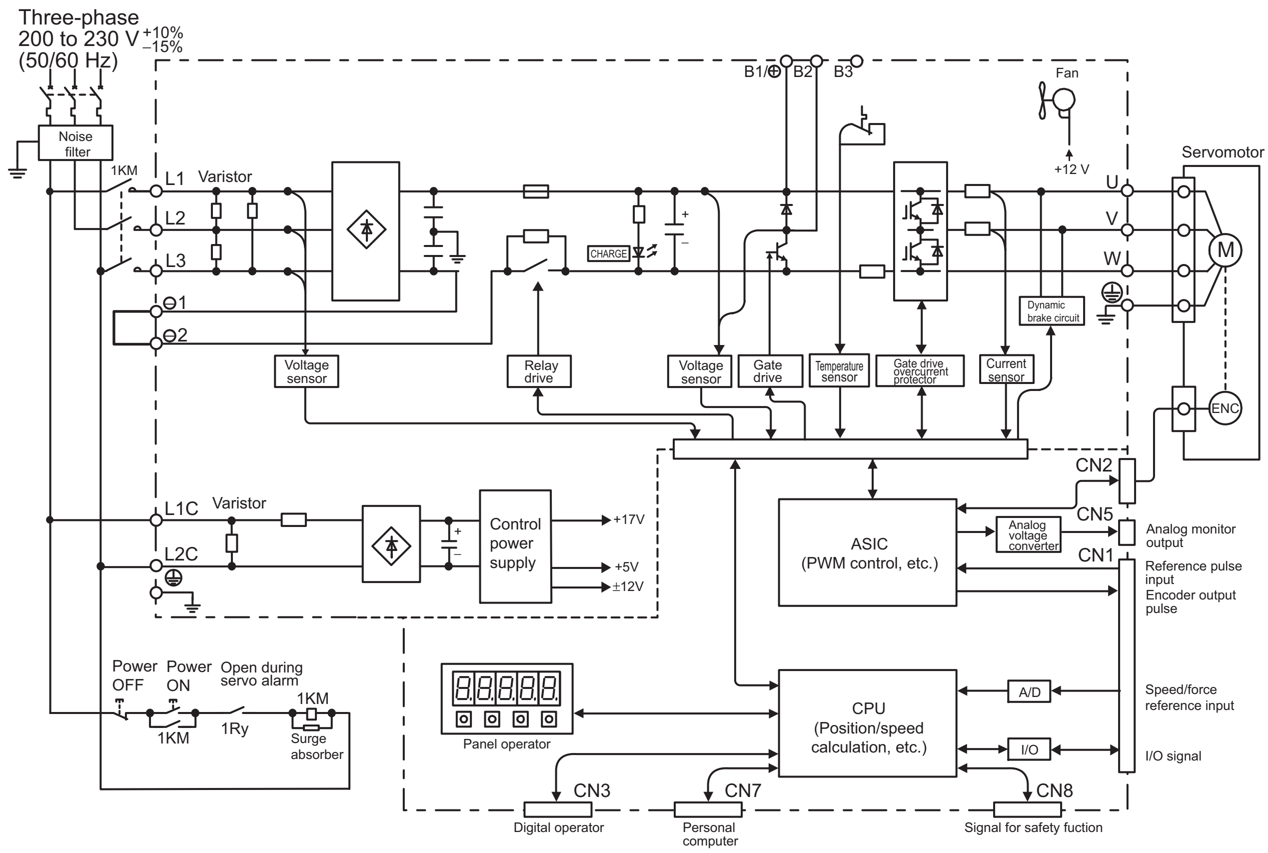
Outline

1

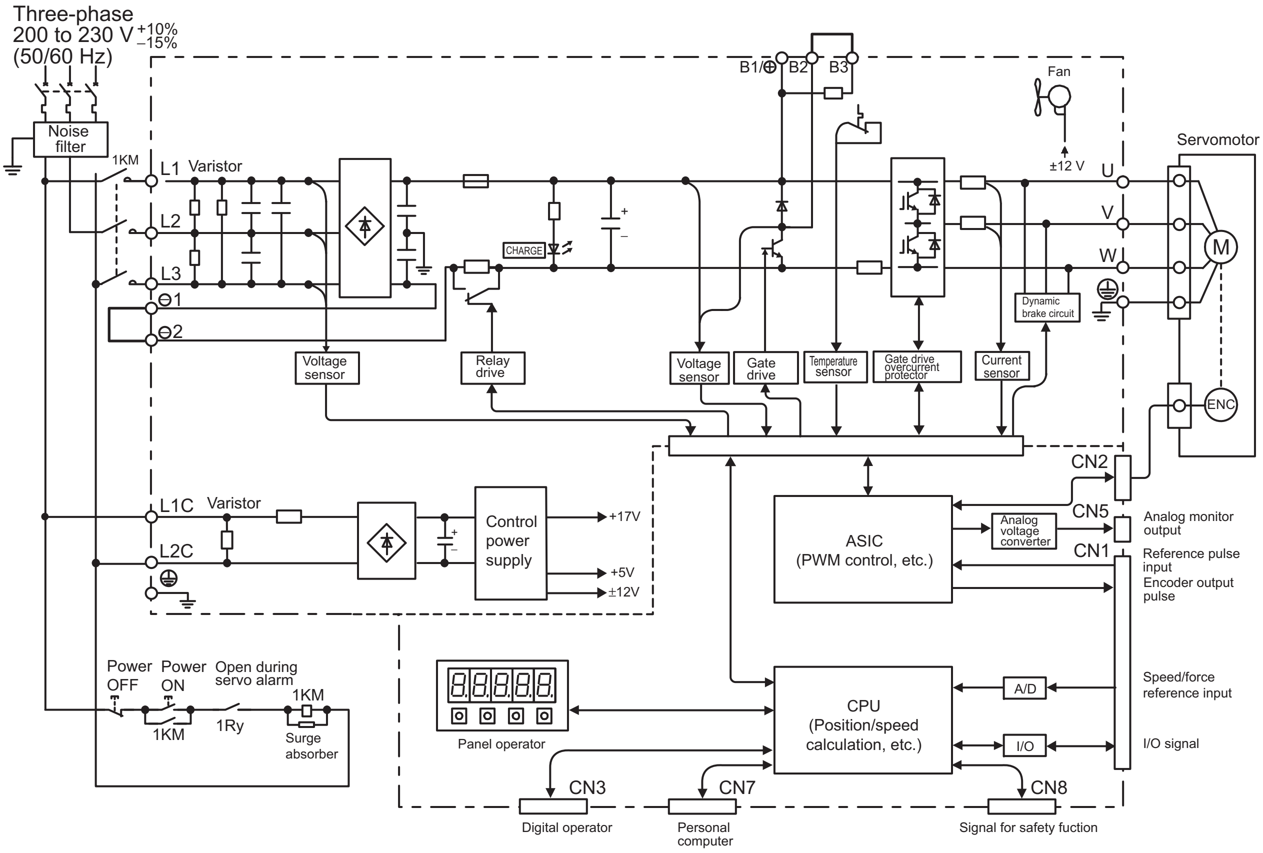
1.4.3 Three-phase 200 V, SGDV-R70A05A, -R90A05A, -1R6A05A Models



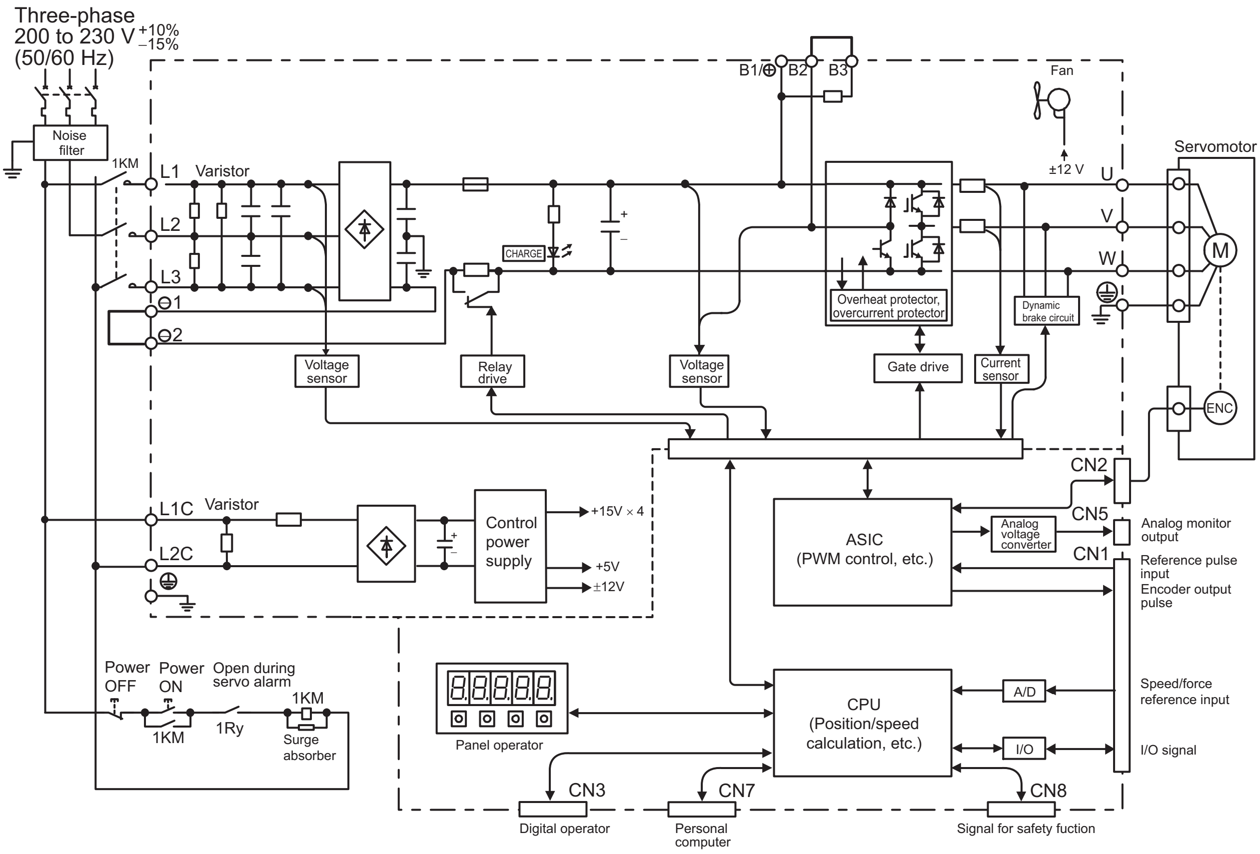
1.4.4 Three-phase 200 V, SGDV-2R8A05A Model



1.4.5 Three-phase 200 V, SGDV-3R8A05A, -5R5A05A, -7R6A05A Models



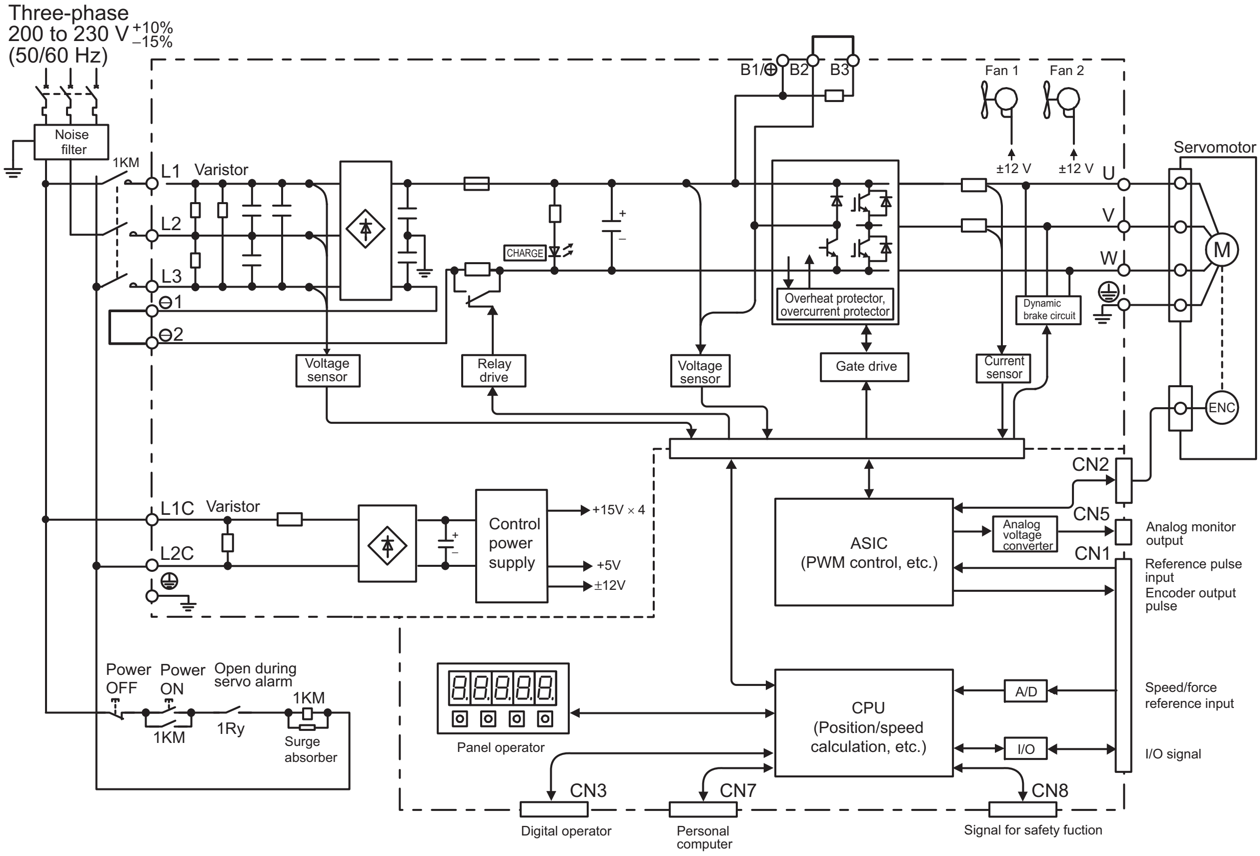
1.4.6 Three-phase 200 V, SGDV-120A05A Model



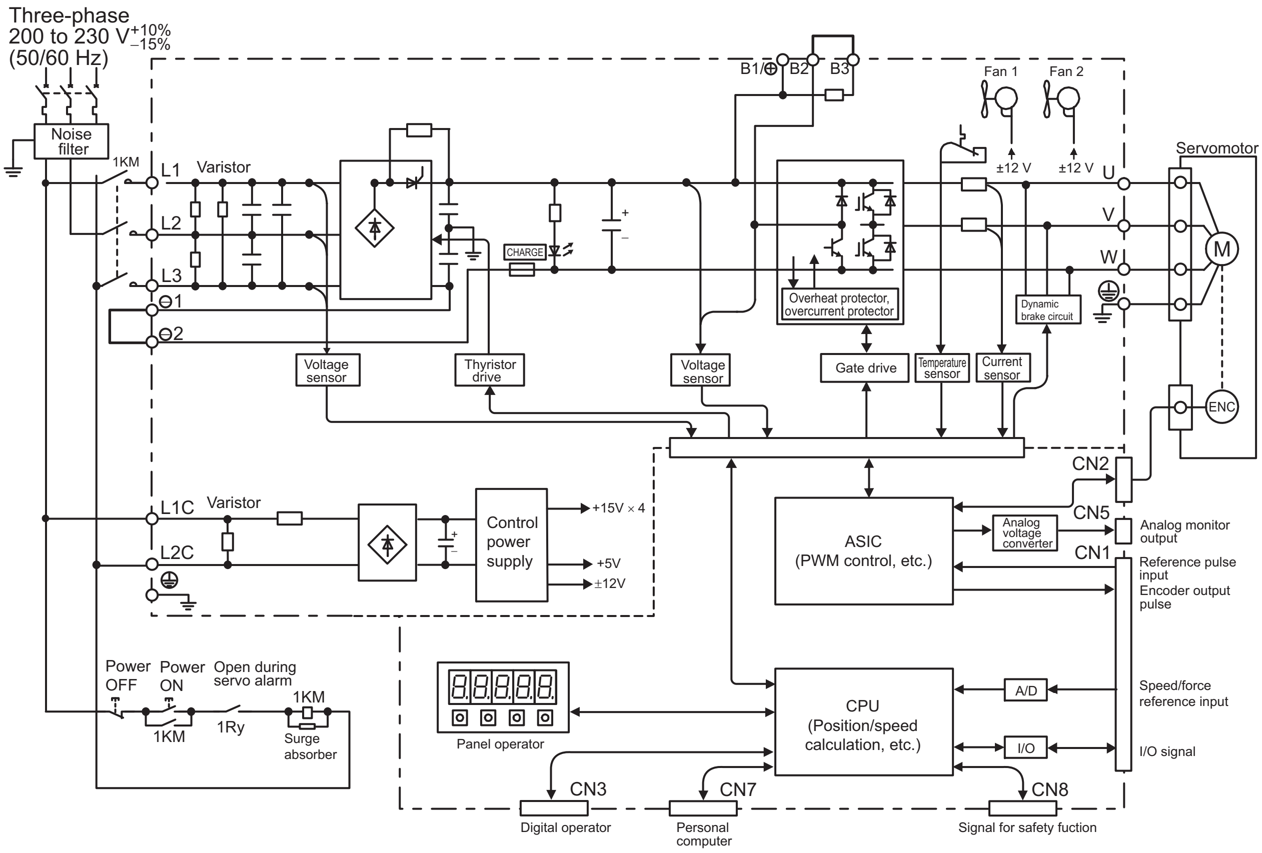
Outline

1

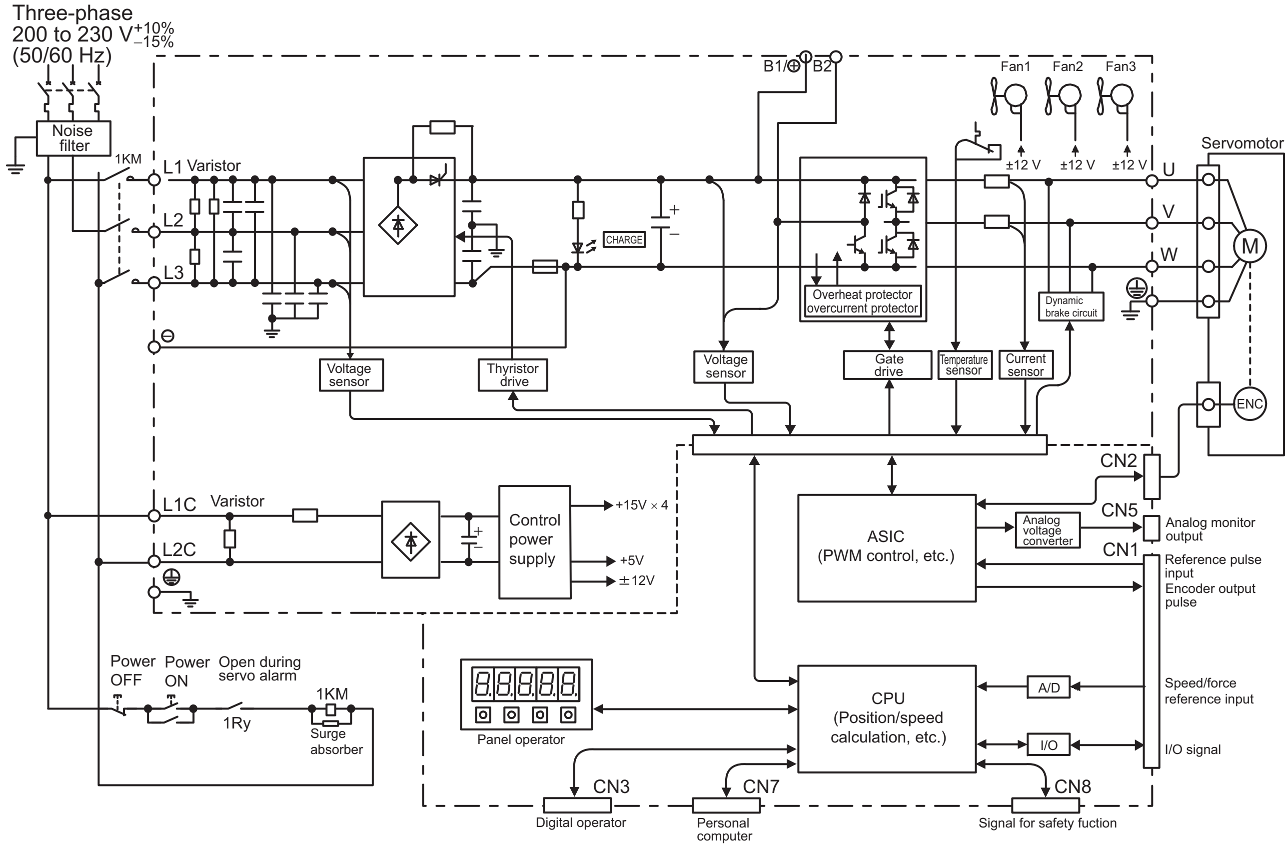
1.4.7 Three-phase 200 V, SGDV-180A05A, -200A05A Models



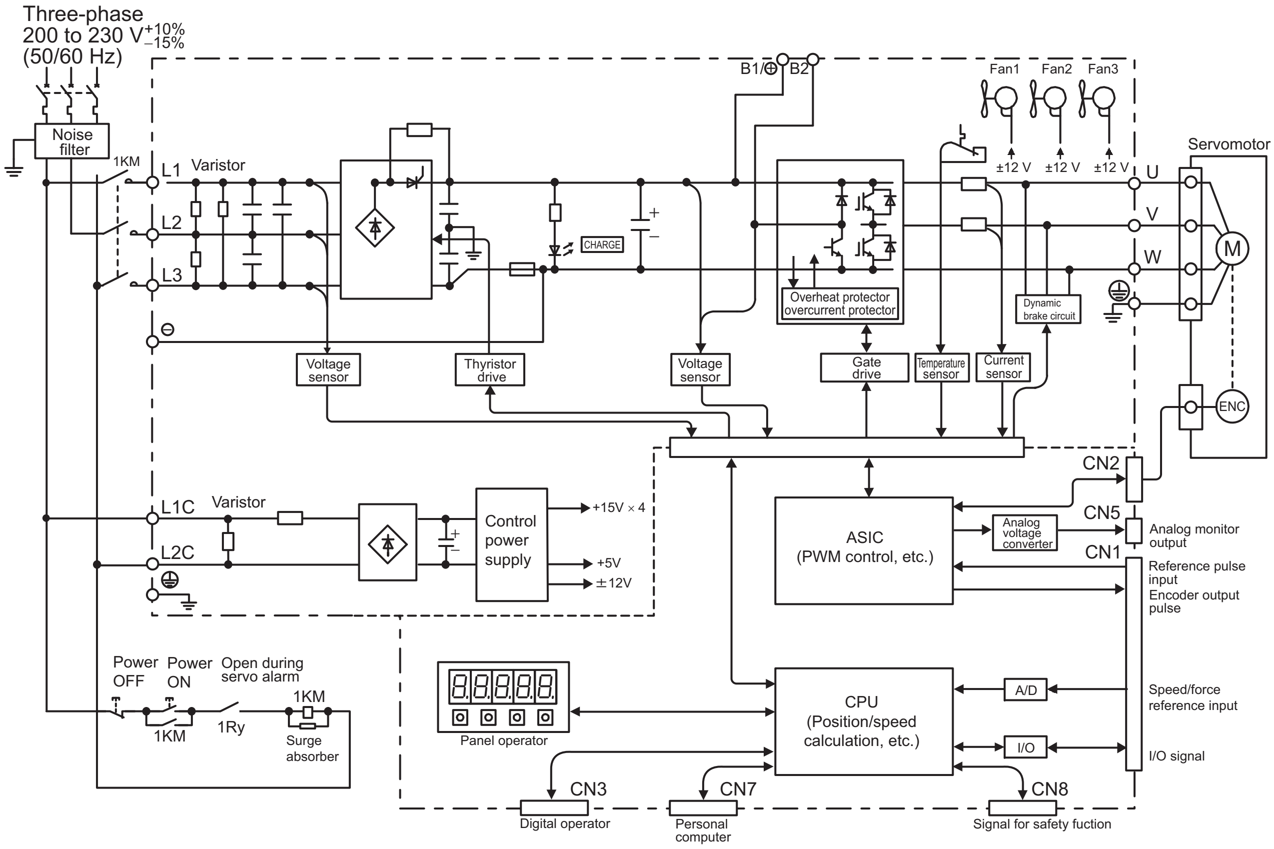
1.4.8 Three-phase 200 V, SGDV-330A05A Model



1.4.9 Three-phase 200 V, SGDV-470A05A, -550A05A Models



1.4.10 Three-phase 200 V SGDV-590A05A, -780A05A Models



Outline

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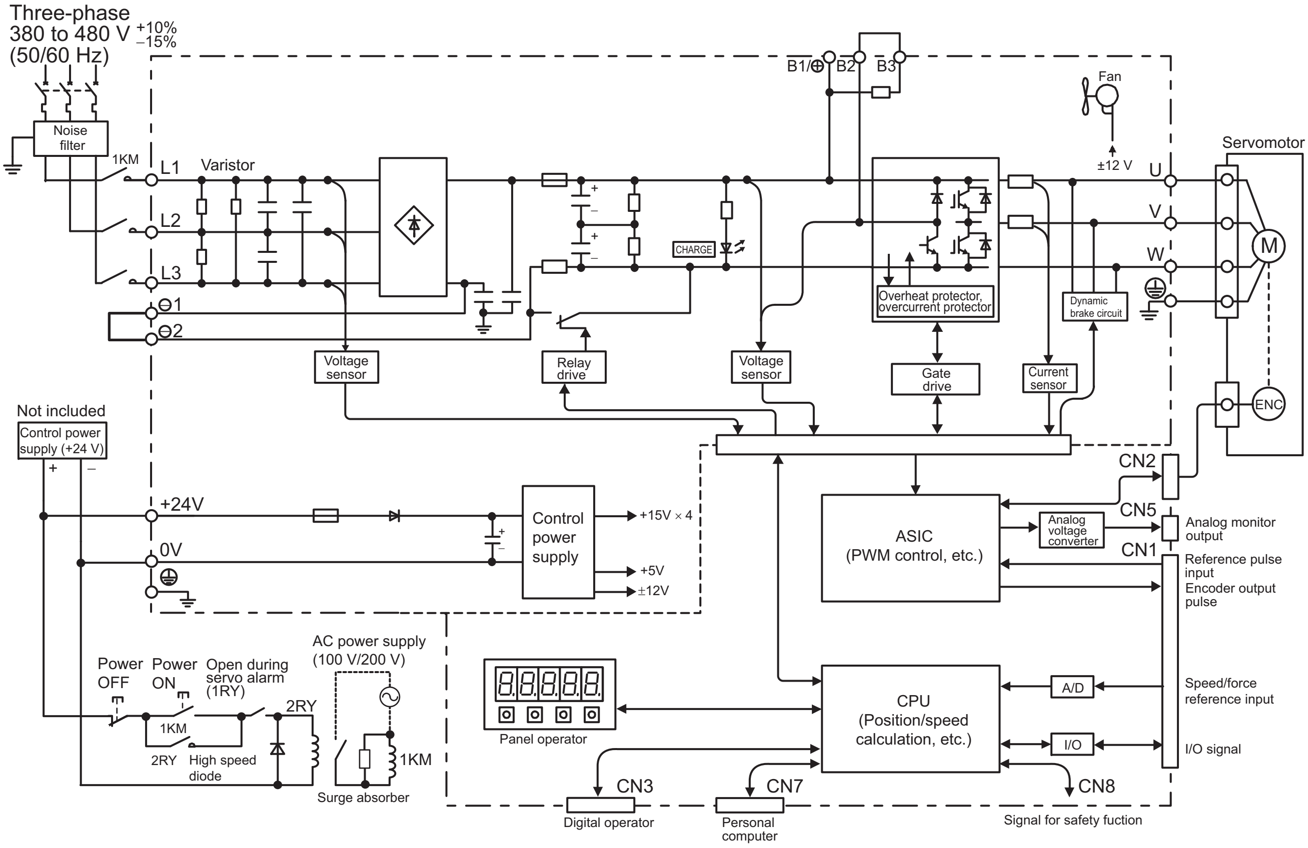
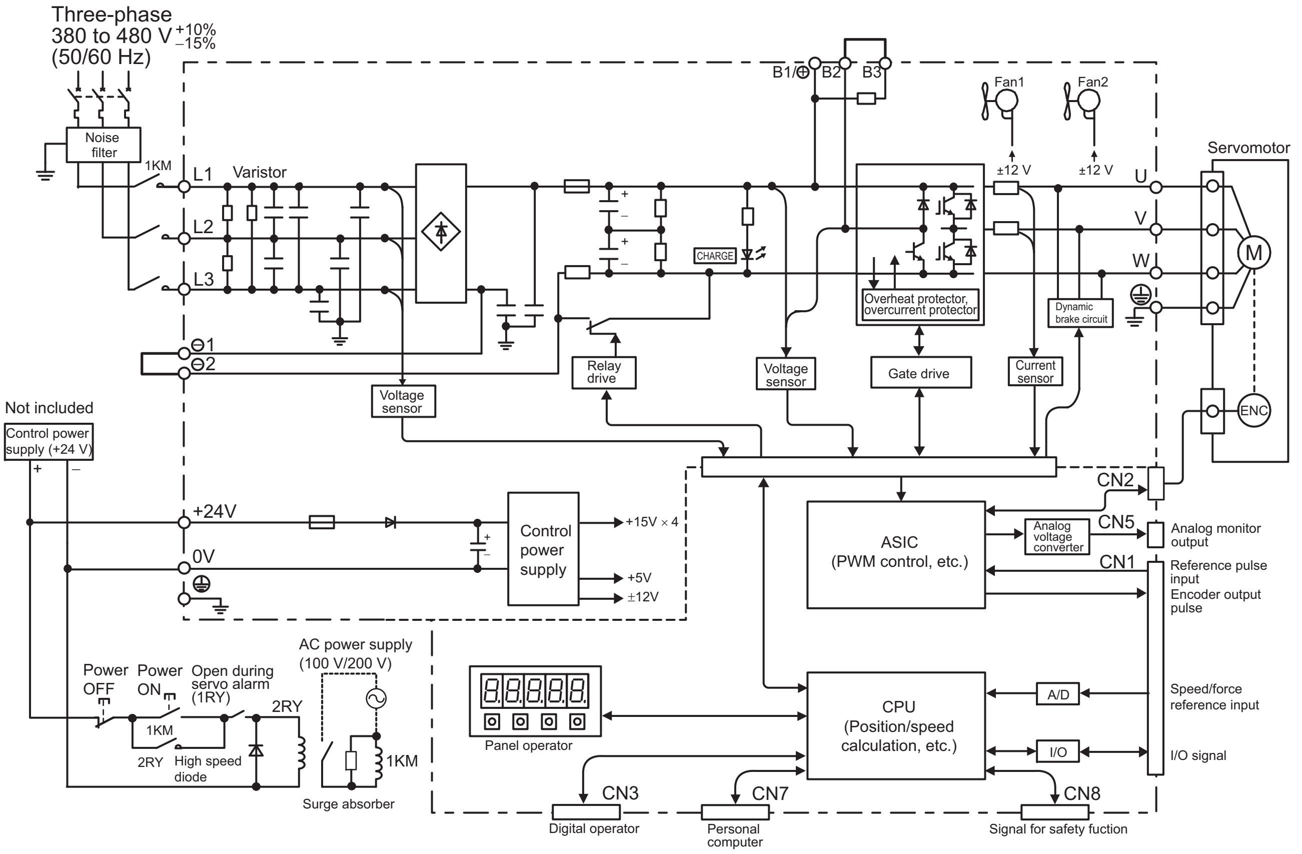
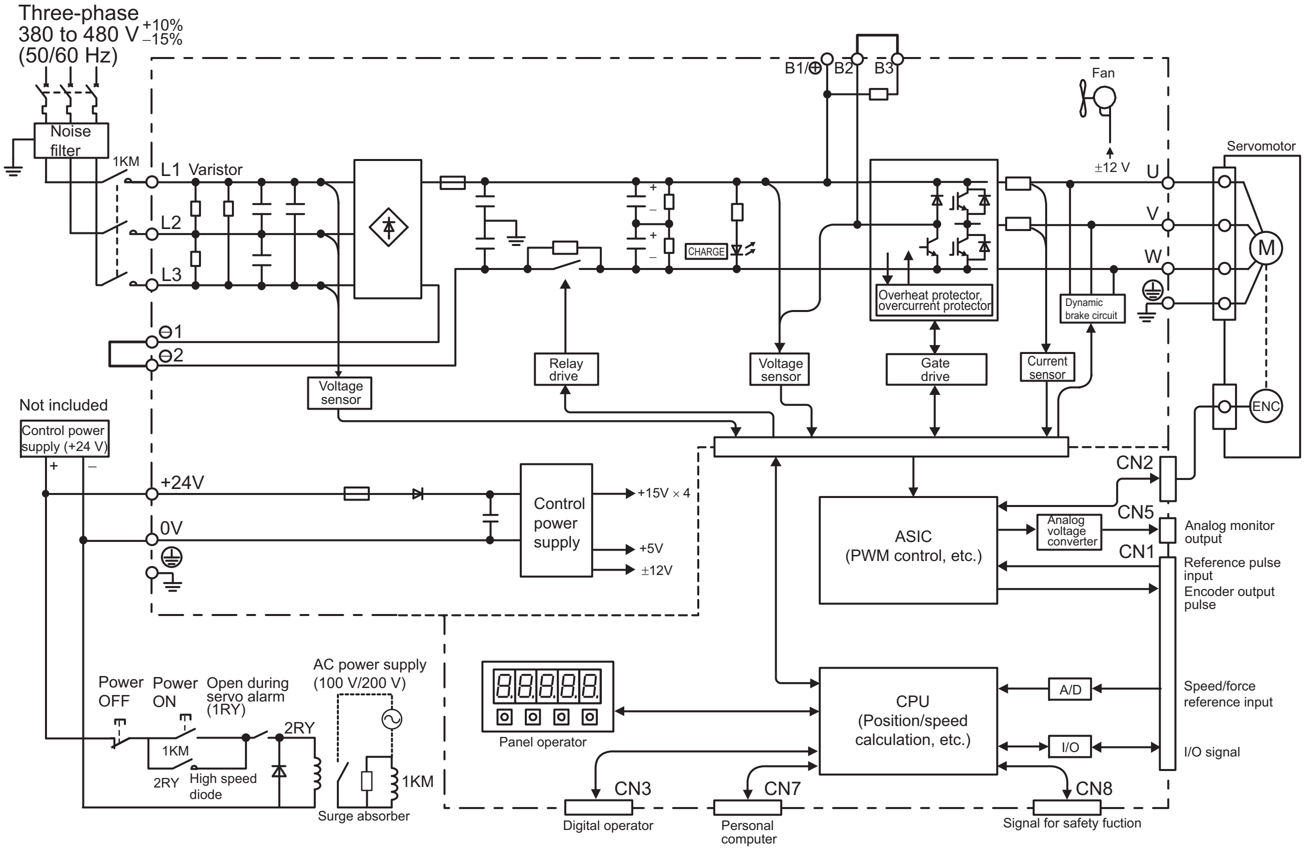
1.4.11 Three-phase 400 V, SGDV-1R9D05A, -3R5D05A, -5R4D05A Models



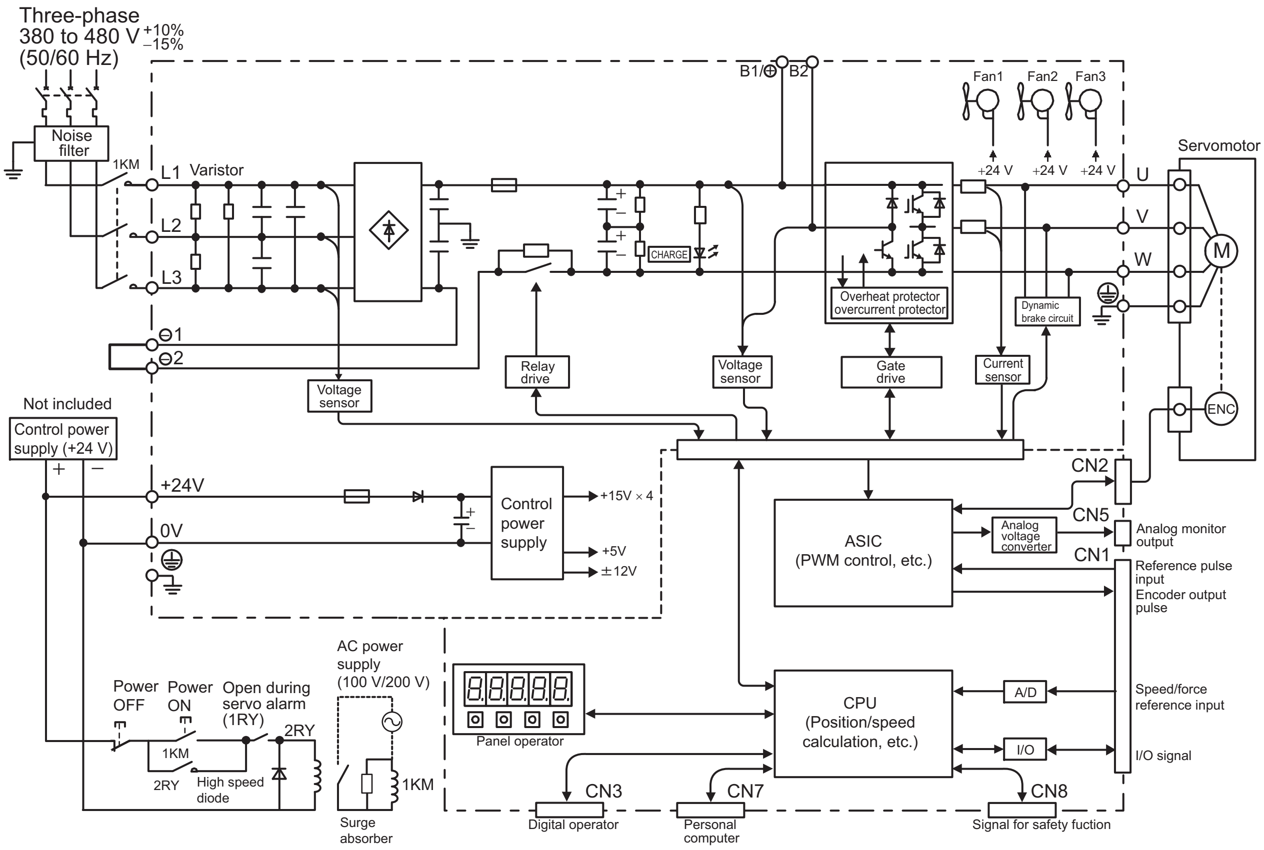
1.4.12 Three-phase 400 V, SGDV-8R4D05A, -120D05A Models



1.4.13 Three-phase 400 V, SGDV-170D05A Model



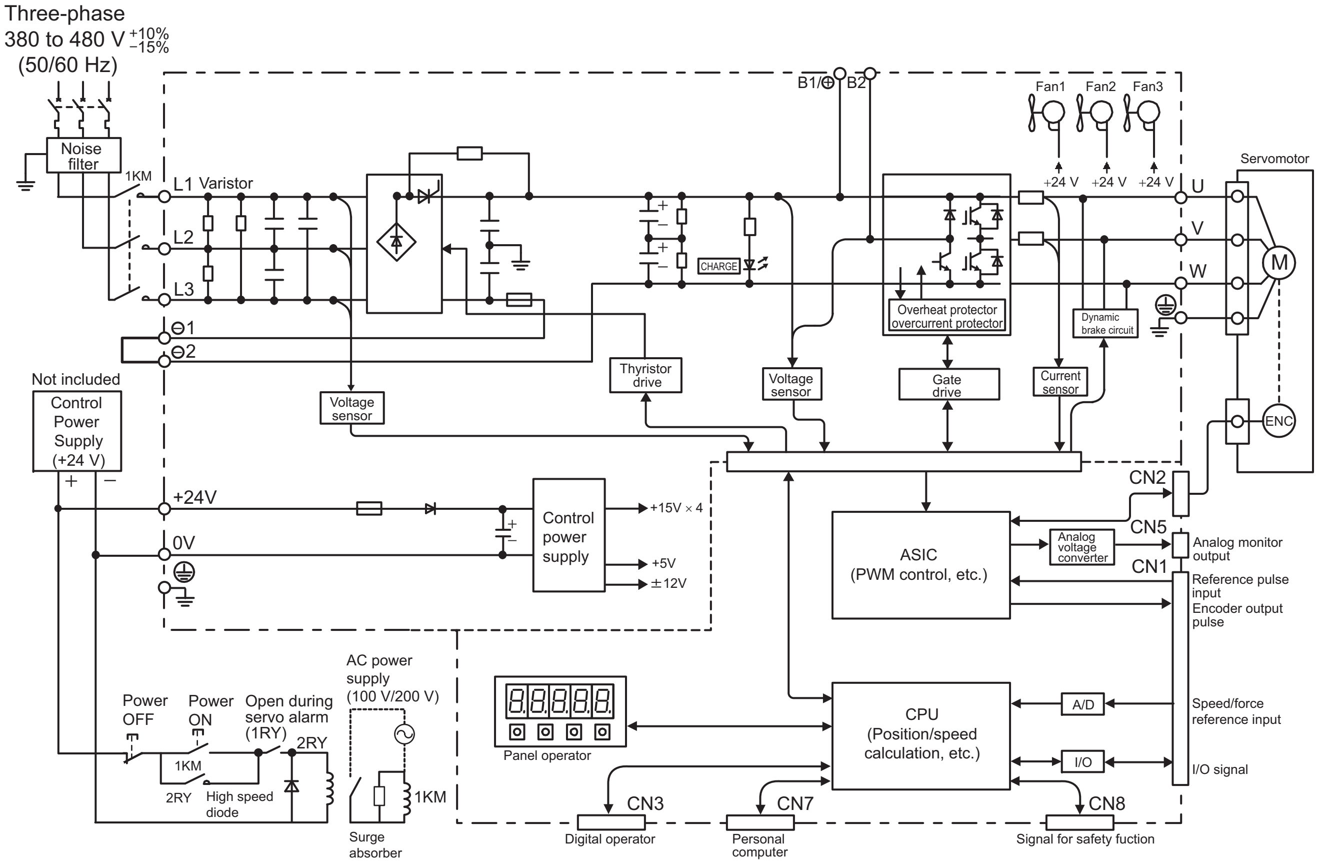
1.4.14 Three-phase 400 V, SGDV-210D05A, -260D05A Models



Outline

1

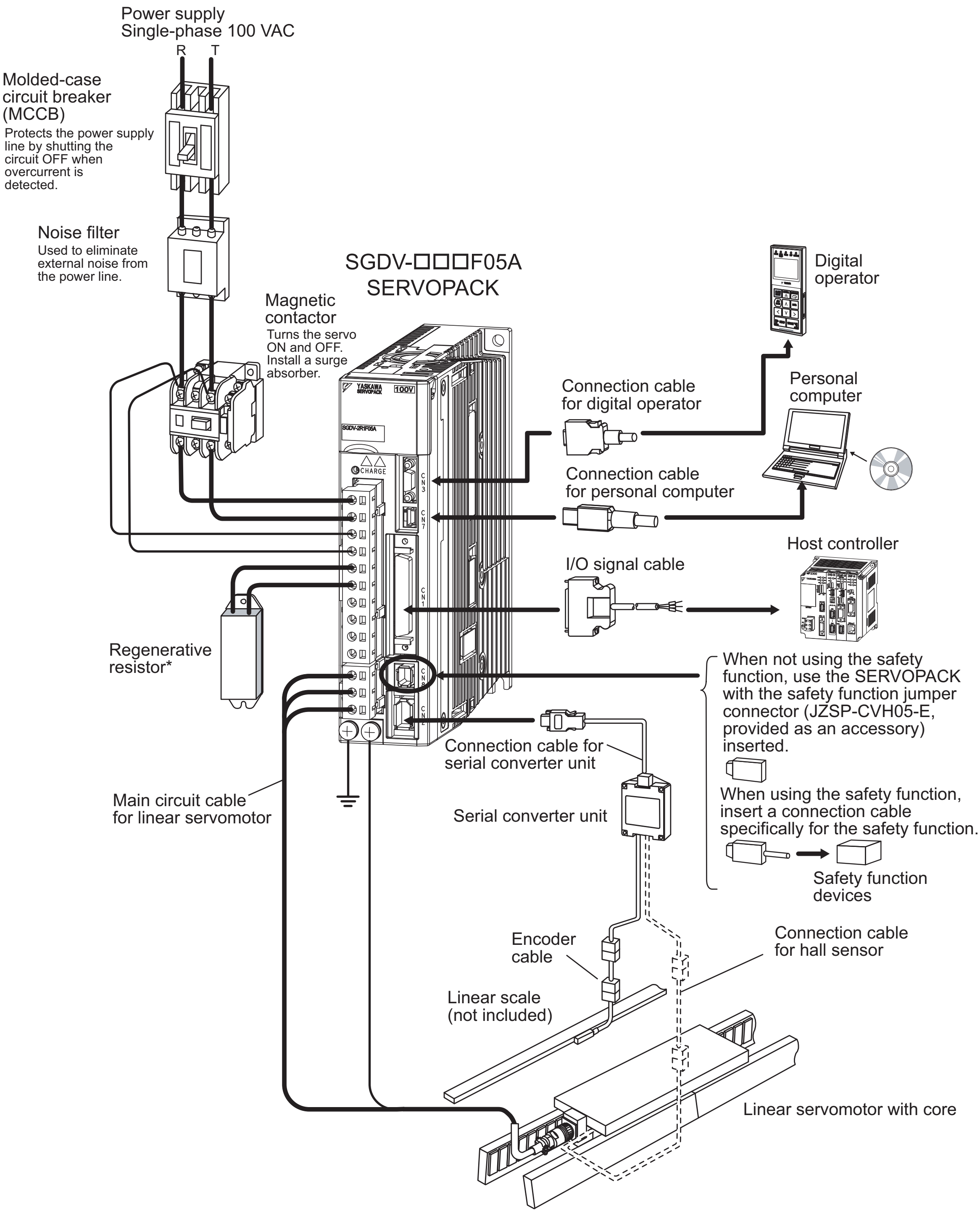
1.4.15 Three-phase 400 V SGDV-280D05A, -370D05A Models



1.5 Examples of Servo System Configurations

This section describes examples of basic servo system configuration.

1.5.1 Connecting to SGDV-□□□F05A SERVOPACK

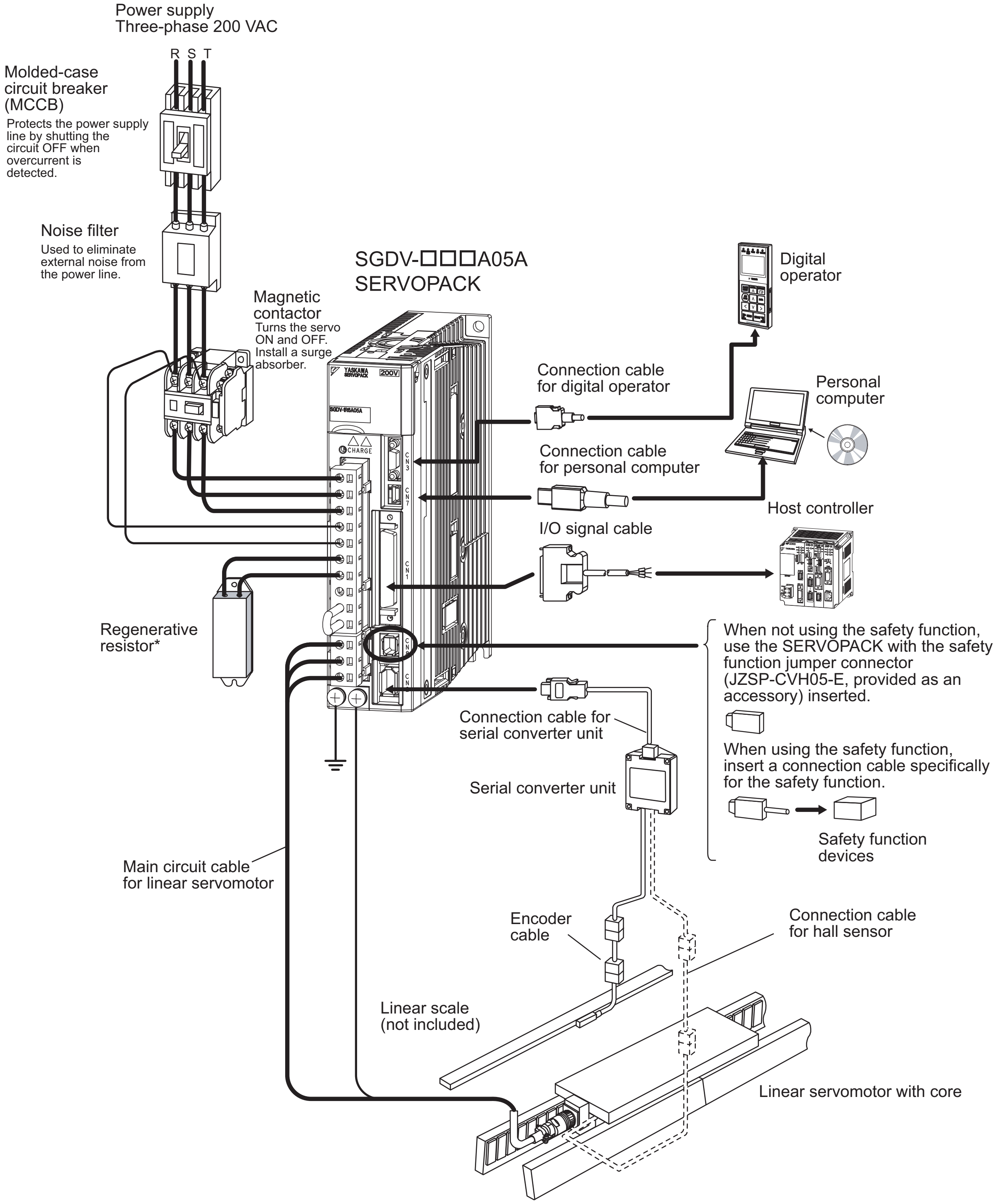


* Before connecting an external regenerative resistor to the SERVOPACK, refer to *3.6 Connecting Regenerative Resistors*.

Outline

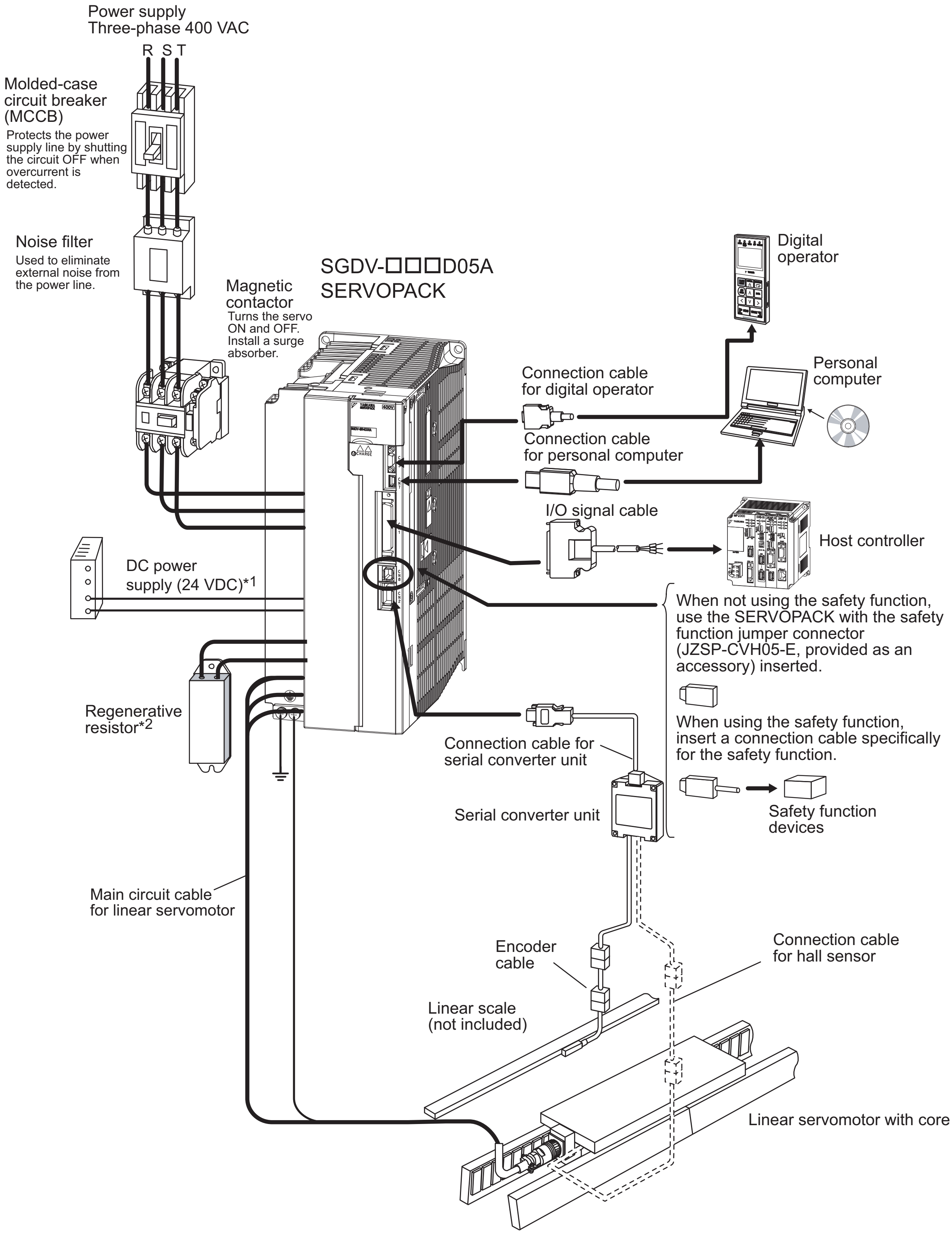
1

1.5.2 Connecting to SGDV-□□□A05A SERVOPACK



* Before connecting an external regenerative resistor to the SERVOPACK, refer to *3.6 Connecting Regenerative Resistors*.

1.5.3 Connecting to SGDV-☐☐☐D05A SERVOPACK



∗1. Use a 24 VDC power supply with double insulation or reinforced insulation. (The power supply is not included)

∗2. Before connecting an external regenerative resistor to the SERVOPACK, refer to *3.6 Connecting Regenerative Resistors*.

Outline

1

1.6 SERVOPACK Model Designation

Select the SERVOPACK according to the applied servomotor.

SGDV – 2R8 A 05 A [8th to 13th digits]

- 1st + 2nd + 3rd digits: 2R8
- 4th digit: A
- 5th + 6th digits: 05
- 7th digit: A
- 8th to13th digits

Series	
SGDV	Σ-V Series

7th digit: Design Revision Order

8th to 13th digits: Option	
Blank	Base-mounted type (standard)
001000	Rack-mounted type or duct-ventilated type (option)

1st + 2nd + 3rd digits: Current		
Voltage	Code	Max. Allowable Motor Capacity (kW)
100 V	R70	0.05
	R90	0.1
	2R1	0.2
	2R8	0.4
200 V	R70	0.05
	R90	0.1
	1R6	0.2
	2R8	0.4
	3R8	0.5
	5R5	0.75
	7R6	1
	120	1.5
	180	2
	200	3
	330	5
	470	6
	550	7.5
	590	11
	780	15
400 V	1R9	0.5
	3R5	1
	5R4	1.5
	8R4	2
	120	3
	170	5
	210	6
	260	7.5
	280	11
	370	15

4th digit: Voltage	
Code	Voltage
F	100 V
A	200 V
D	400 V

5th + 6th digits: Interface Specifications	
Code	Interface
01	Analog voltage and pulse train reference, rotational servomotor
11	MECHATROLINK-II communications reference, rotational servomotor
05	Analog voltage and pulse train reference, linear servomotor
15	MECHATROLINK-II communications reference, linear servomotor

1.7 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

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.

Part	Standard Replacement Period	Operating Conditions
Cooling Fan	4 to 5 years	• Surrounding Air Temperature: Annual average of 30°C • Load Factor: 80% max. • Operation Rate: 20 hours/day max.
Smoothing Capacitor	7 to 8 years	
Other Aluminum Electrolytic Capacitor	5 years	
Relays	-	
Fuses	10 years	

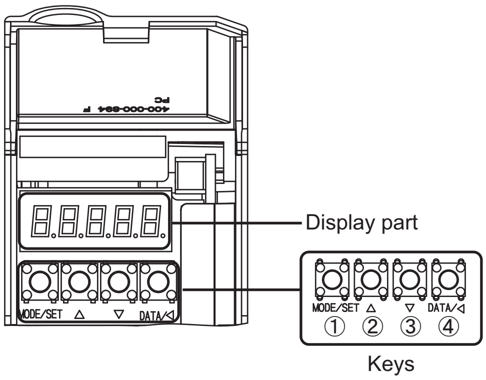
2

Panel Operator

2.1 Panel Operator

Panel operator consists of display part and keys.
Parameter setting, status display and execution of utility function are enabled using the panel operator.

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

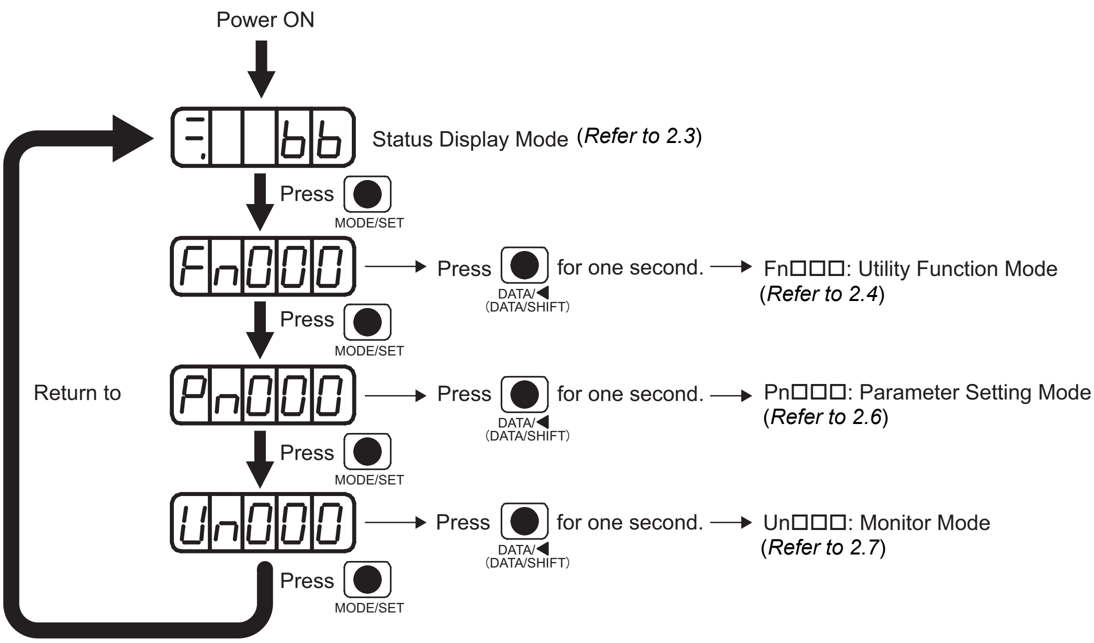


Key No.	Key Name	Function
①	MODE/SET Key	• To select a display mode. • To set the set value.
②	UP Key	To increase the set value.
③	DOWN Key	To decrease the set value.
④	DATA/SHIFT Key	• To display the set value. • To move to the next digit on the left when blinking.

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.

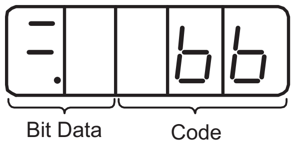
2.2 Display Mode Selection

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

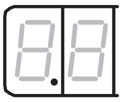
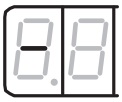
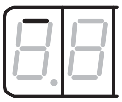
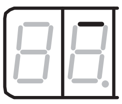
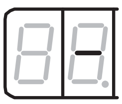
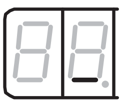
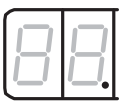


2.3 Status Display Mode

The display shows the following status.



Code	Meaning	Code	Meaning
bb	Baseblock Servo OFF (servomotor power OFF)	not	Reverse Run Prohibited N-OT is OFF.
run	Run Servo ON (servomotor power ON)	Hbb	Hard Wire Base Block The SERVOPACK is baseblocked by the safety function.
Pot	Forward Run Prohibited P-OT is OFF.	(Example: Run Status) run Run Status ↕ tSt Test without Motor	Mode Test without Motor Status display differs depending on the status of motor and SERVOPACK. Refer to *4.5 Test Without Motor Function.*
		A.020	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/force 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 mm/s) ∗ Always light in force 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)
	Movement Detection (/TGON) Light if motor speed exceeds the value set in Pn502. (Factory setting: 20 mm/s)
	In speed/force control mode: Speed Reference Input Light if input speed reference exceeds the value set in Pn502. (Factory setting: 20 mm/s). In position control mode: Reference Pulse Input Light if reference pulse is input. Does not light if no reference pulse is input.
	In speed/force control mode: Force Reference Input Light if input force reference exceeds preset value (10% of the rated force). Does not light if input force 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.

Fn003

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	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn003	▲ ▼	Press the UP or the DOWN Key to select the Fn003.
3	-. .CSr	DATA/◀	Press the DATA/SHIFT Key for approximately one second, and the display shown on the left appears.
4	. .CSr	MODE/SET	Press the MODE/SET Key. The servomotor is turned to Servo ON.
5	. .CSr	▲ ▼	When the parameter is set to Pn000.0 = 0 (default), pressing the UP Key will run the motor in the forward direction. Pressing the DOWN Key will run the motor in the reverse direction. When the parameter is set to Pn000.0 = 1, the movement direction of the motor is reversed.
6	. .CSr 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	Fn003	DATA/◀	Press the DATA/SHIFT Key for approximately one second. "Fn003" is displayed again.
8	To enable the change in the setting, turn OFF the power and ON again.		

2.5 How to Read a Parameter Explanation

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

2.5.1 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
- Force : Force control

Pn406	Emergency Stop Force			Speed Position Force	
	Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
	0 to 800	1	800	After restart	Setup

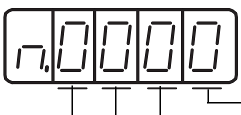
- Setting Range: Indicates setting range for the parameter. The range is decided so that the maximum value can be set even in combination with a servomotor with different specifications.
- Setting Unit: Indicates minimum setting unit for the parameter.
- Factory Setting: Indicates parameter value before shipment (Factory setting).
- When Enabled: 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).
- Classification: "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 *2.5.3 Explanation Method for Tuning Parameters.*

2.5.2 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).		

- Pn50A: The number of the parameter
- n.2□□□ / n.8□□□: 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).
- Meaning: 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
1st digit	Pn000.0 or n.□□□x	Indicates the value for the 1st digit of parameter Pn000.
2nd digit	Pn000.1 or n.□□x□	Indicates the value for the 2nd digit of parameter Pn000.
3rd digit	Pn000.2 or n.□x□□	Indicates the value for the 3rd digit of parameter Pn000.
4th digit	Pn000.3 or n.x□□□	Indicates the value for the 4th digit of parameter Pn000.

2.5.3 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		Meaning	When Enabled	Classification
Pn00B	n.□□□0	Displays only setup parameters. (Factory setting)	After restart	Setup
	n.□□□1	Displays all parameters.		

2.6 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.

Pn100

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 (function selection type).

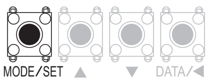
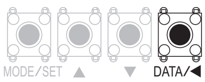
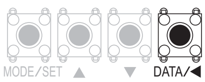
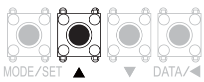
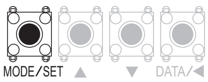
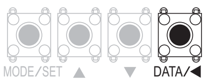
The operation method differs between two types.
As for the operation method of parameter setting type, refer to *2.6.1*.
As for the operation method of function selection type, refer to *2.6.2*.

2.6.1 Parameter Setting Mode for Parameter Setting Type

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

(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."

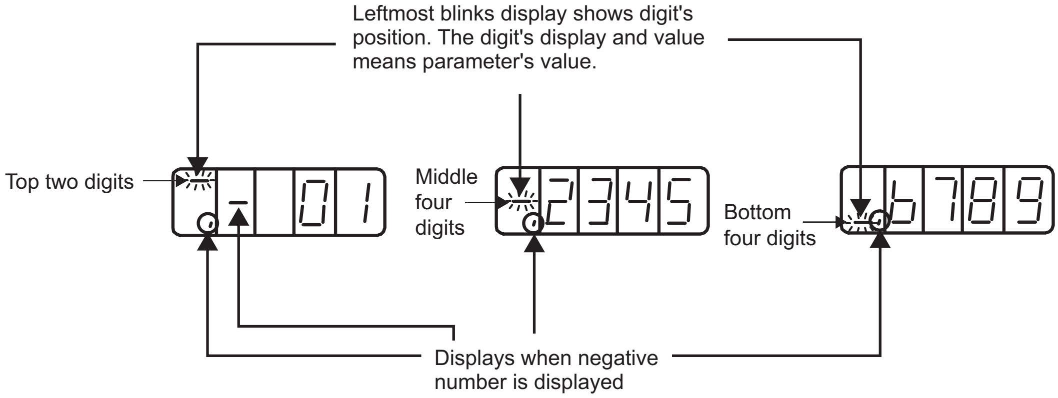
Step	Display after Operation	Keys	Description
1	Pn100		Press the MODE/SET Key to select the parameter setting mode. If Pn100 is not displayed, press the UP or the DOWN Key to select Pn100.
2	0040.0		Press the DATA/SHIFT Key for approximately one second. The current data of Pn100 is displayed.
3	0040.0		Press the DATA/SHIFT Key to select "4." "4" will blink and be able to be changed.
4	0100.0		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	0100.0 Display blinks		Press the DATA/SHIFT Key. The value blinks and is saved. The data for the speed loop gain (Pn100) is changed from "40.0" to "100.0."
6	Pn100		Press the DATA/SHIFT Key for approximately one second. "Pn100" is displayed again.

Panel Operator

2

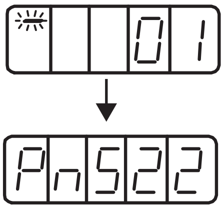
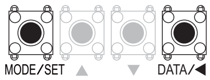
(2) Parameters with Setting Ranges of Six Digits or More

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



Procedures for setting of "Pn522 = 0123456789" are shown below.

Step	Display after Operation	Keys	Description
1	Pn522	MODE/SET ▲ ▼ DATA/◀	Press the MODE/SET Key to select the parameter setting mode (Pn□□□). If Pn522 is not displayed, press the UP Key or the DOWN Key to select Pn522.
2	Before changing bottom four digits 0007 ↓ After changing bottom four digits 6789	MODE/SET ▲ ▼ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The current data for bottom four digits of Pn522 are displayed. (In this case, "0007" is displayed.) Press the DATA/SHIFT Key to move to other digits, and change the value by pressing the UP/DOWN Key. (In this case, "6789" is set.)
3	Before changing middle four digits 0000 ↓ After changing middle four digits 2345	MODE/SET ▲ ▼ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The current data for middle four digits are displayed. (In this case, "0000" is displayed.) Press the DATA/SHIFT Key to move to other digits, and change the value by pressing the UP/DOWN Key. (In this case, "2345" is set.)
4	Before changing top two digits 00 ↓ After changing top two digits 01	MODE/SET ▲ ▼ DATA/◀	Press the DATA/SHIFT Key for approximately one second. The current data for top two digits are displayed. (In this case, "00" is displayed.) Press the DATA/SHIFT Key to move to other digit, and change the value by pressing the UP/DOWN Key. (In this case, "01" is set.) The value "0123456789" is set.

Step	Display after Operation	Keys	Description
5			Press the MODE/SET Key to save the value to the SERVOPACK. During saving, top two digits blink. After the saving is completed, press the DATA/SHIFT Key for approximately one second. "Fn522" is displayed again.

<Note>

Setting negative numbers

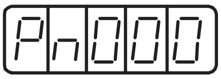
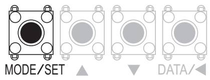
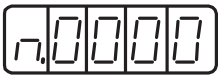
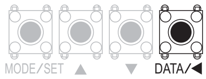
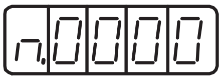
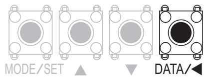
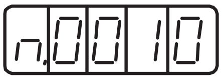
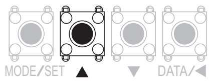
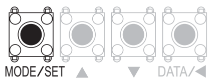
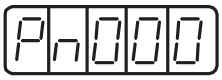
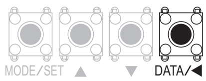
- For the parameters that accept a negative value setting, display "0000000000" and then press the DOWN Key to set negative numbers.
- When setting negative numbers, the value increases by pressing the DOWN Key and decreases by pressing the UP Key.
- Press the DATA/SHIFT Key to move to other digits.
- A - (minus) sign is displayed when the top two digits are displayed.

2.6.2 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.

(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.

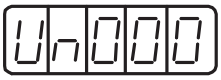
Step	Display after Operation	Keys	Description
1			Press the MODE/SET Key to select the parameter setting mode. If Pn000 is not displayed, press the UP or the DOWN Key to select Pn000.
2			Press the DATA/SHIFT Key for approximately one second. The current data of Pn000 is displayed.
3			Press the DATA/SHIFT Key once to select the second digit of current data.
4			Press the UP Key once to change "n.0010." (Set the control method to position control.)
5	 Display blinks		Press the DATA/SHIFT Key. 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.		

2.7 Monitor Mode (Un□□□)

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

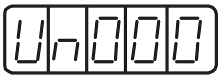
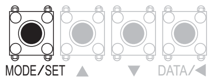
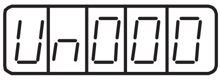
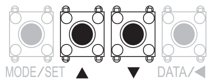
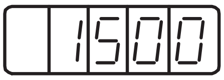
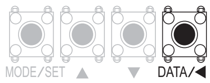
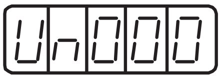
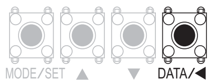
For details, refer to *8.2 Operation in Monitor Mode*.

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 Un000.
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).

Panel Operator

2

3

Wiring and Connection

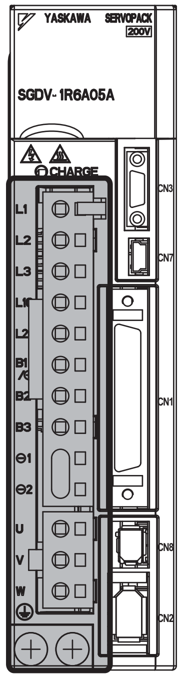
3.1 Main Circuit Wiring

The names, specifications, and functions of the main circuit terminals are given on the following page.

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.



: Main terminals

Name	Terminal Symbols	Model SGDV-□□□□	Description
Main circuit input terminals	L1, L2	□□□F	Single-phase 100 to 115 V, +10% to –15% (50/60 Hz)
	L1, L2, L3	□□□A	Three-phase 200 to 230 V, +10% to –15% (50/60 Hz)
		□□□D	Three-phase 380 to 480 V, +10% to –15% (50/60 Hz)
Control power input terminals	L1C, L2C	□□□F	Single-phase 100 to 115 V, +10% to –15% (50/60 Hz)
		□□□A	Single-phase 200 to 230 V, +10% to –15% (50/60 Hz)
	24V, 0V	□□□D	24 VDC, ±15%
External regenerative resistor terminals	B1/ ⊕ , B2, or B1, B2	R70F, R90F, 2R1F, 2R8F, R70A, R90A, 1R6A, 2R8A	If the regenerative capacity is insufficient, connect an external regenerative resistor (option) between B1/ ⊕ and B2.
		3R8A, 5R5A, 7R6A, 120A, 180A, 200A, 330A, 1R9D, 3R5D, 5R4D, 8R4D, 120D, 170D	If the internal regenerative resistor is insufficient, remove the wire between B2 and B3 and connect an external regenerative resistor (option) between B1/ ⊕ and B2, or B1 and B2.
		470A, 550A, 590A, 780A, 210D, 260D, 280D, 370D	Connect a regenerative resistor unit (option) between B1/ ⊕ and B2, or B1 and B2.
DC reactor connection terminal for power supply harmonic suppression	⊖ 1, ⊖ 2	□□□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.
Main circuit plus terminal	B1/ ⊕ or B1	□□□A □□□D	Use when DC power supply input is used.
Main circuit minus terminal	⊖ 2 or ⊖	□□□A □□□D	

Name	Terminal Symbols	Model SGDV-□□□□	Description
Linear Servomotor connection terminals	U, V, W	Use for connecting to the linear 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 surrounding air temperature with the rated current.
2. Use a wire with a minimum withstand voltage of 600 V for the main circuit.
3. If wires are bundled in PVC or metal ducts, take into account the reduction of the allowable current.
4. Use a heat-resistant wire under high surrounding air or panel temperatures, where polyvinyl chloride insulated wires will rapidly deteriorate.

(1) Wire Types

Use the following type of wire for main circuit.

Cable Type		Allowable Conductor Temperature °C
Symbol	Name	
IV	600 V polyvinyl chloride insulated wire	60
HIV	600 V grade heat-resistant polyvinyl chloride insulated wire	75

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

- 600 V grade heat-resistant polyvinyl chloride insulated wire (HIV)

AWG Size	Nominal Cross Section Diameter (mm^2)	Configuration (Number of Wires/mm^2)	Conductive Resistance (Ω/km)	Allowable Current at Surrounding Air 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
4	22.0	7/2.0	0.85	91	81	66

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

(2) Single-phase, 100 V

<table>
<tr><th rowspan="2">External Terminal Name</th><th rowspan="2">Terminal Symbols</th><th colspan="4">SERVOPACK Model SGDV-</th></tr>
<tr><th>R70</th><th>R90</th><th>2R1</th><th>2R8</th></tr>
<tr><td>Main circuit power input terminals</td><td>L1, L2</td><td colspan="2">HIV1.25</td><td colspan="2">HIV2.0</td></tr>
<tr><td>Control power input terminals</td><td>L1C, L2C</td><td colspan="4">HIV1.25</td></tr>
<tr><td>Servomotor connection terminals</td><td>U, V, W</td><td colspan="4">HIV1.25</td></tr>
<tr><td>External regenerative resistor connection terminals</td><td>B1/⊕, B2</td><td colspan="4">HIV1.25</td></tr>
<tr><td>Ground terminal</td><td>⏚</td><td colspan="4">HIV2.0 or higher</td></tr>
</table>

(3) Three-phase, 200 V

<table>
<tr><th rowspan="2">External Terminal Name</th><th rowspan="2">Terminal Symbols</th><th colspan="15">SERVOPACK Model SGDV-</th></tr>
<tr><th>R70</th><th>R90</th><th>1R6</th><th>2R8</th><th>3R8</th><th>5R5</th><th>7R6</th><th>120</th><th>180</th><th>200</th><th>330</th><th>470</th><th>550</th><th>590</th><th>780</th></tr>
<tr><td>Main circuit power input terminals</td><td>L1, L2, L3</td><td colspan="3">HIV1.25</td><td colspan="5">HIV2.0</td><td colspan="2">HIV3.5</td><td>HIV 5.5</td><td>HIV 8.0</td><td>HIV 14.0</td><td colspan="2">HIV22.0</td></tr>
<tr><td>Control power input terminals</td><td>L1C, L2C</td><td colspan="15">HIV1.25</td></tr>
<tr><td>Servomotor connection terminals</td><td>U, V, W</td><td colspan="4">HIV1.25</td><td colspan="4">HIV2.0</td><td>HIV 3.5</td><td>HIV 5.5</td><td>HIV 8.0</td><td colspan="2">HIV14.0</td><td colspan="2">HIV22.0</td></tr>
<tr><td>External regenerative resistor connection terminals</td><td>B1/⊕, B2</td><td colspan="8">HIV1.25</td><td>HIV 2.0</td><td>HIV 3.5</td><td>HIV 5.5</td><td colspan="2">HIV8.0</td><td colspan="2">HIV22.0</td></tr>
<tr><td>Ground terminal</td><td>⏚</td><td colspan="15">HIV2.0 or higher</td></tr>
</table>

(4) Three-phase, 400 V

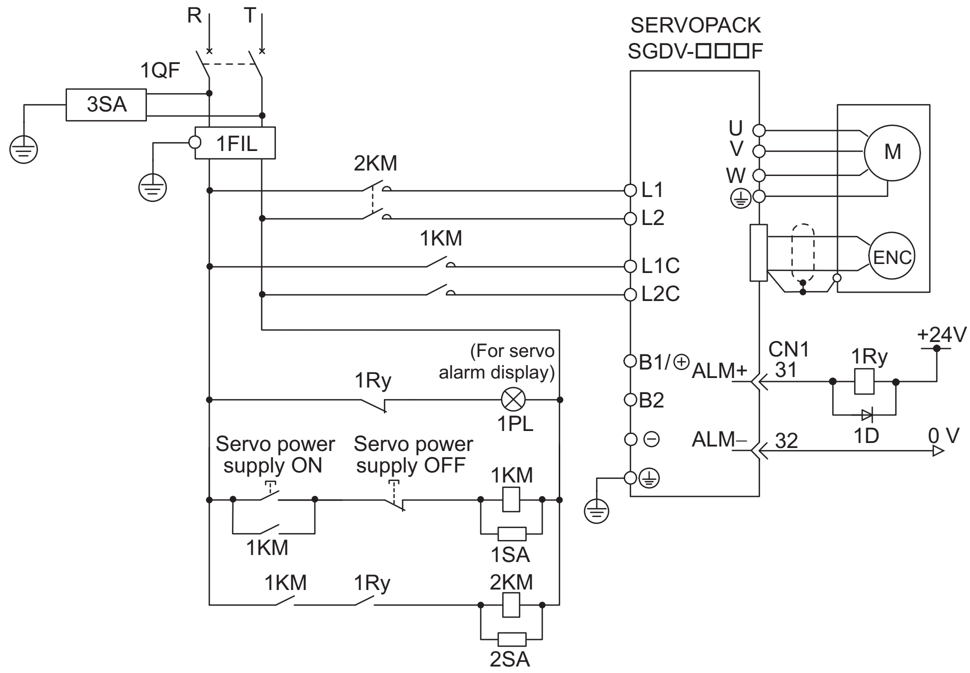
<table>
<tr><th rowspan="2">External Terminal Name</th><th rowspan="2">Terminal Symbols</th><th colspan="10">SERVOPACK Model SGDV-</th></tr>
<tr><th>1R9</th><th>3R5</th><th>5R4</th><th>8R4</th><th>120</th><th>170</th><th>210</th><th>260</th><th>280</th><th>370</th></tr>
<tr><td>Main circuit power input terminals</td><td>L1, L2, L3</td><td colspan="3">HIV1.25</td><td colspan="2">HIV2.0</td><td colspan="2">HIV3.5</td><td>HIV 5.5</td><td>HIV 8.0</td><td>HIV 14.0</td></tr>
<tr><td>Control power input terminals</td><td>24V, 0V</td><td colspan="10">HIV1.25</td></tr>
<tr><td>Servomotor connection terminals</td><td>U, V, W</td><td colspan="3">HIV1.25</td><td colspan="2">HIV2.0</td><td>HIV 3.5</td><td colspan="2">HIV5.5</td><td>HIV 8.0</td><td>HIV 14.0</td></tr>
<tr><td>External regenerative resistor connection terminals</td><td>B1/⊕, B2
(B1, B2)</td><td colspan="5">HIV1.25</td><td>HIV 2.0</td><td colspan="2">HIV3.5</td><td>HIV 5.5</td><td>HIV 8.0</td></tr>
<tr><td>Ground terminal</td><td>⏚</td><td colspan="10">HIV2.0 or higher</td></tr>
</table>

3.1.3 Typical Main Circuit Wiring Examples

This section describes the typical main circuit wiring examples.

⚠ WARNING
• Do not touch the power terminals while the charge indicator is ON 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.

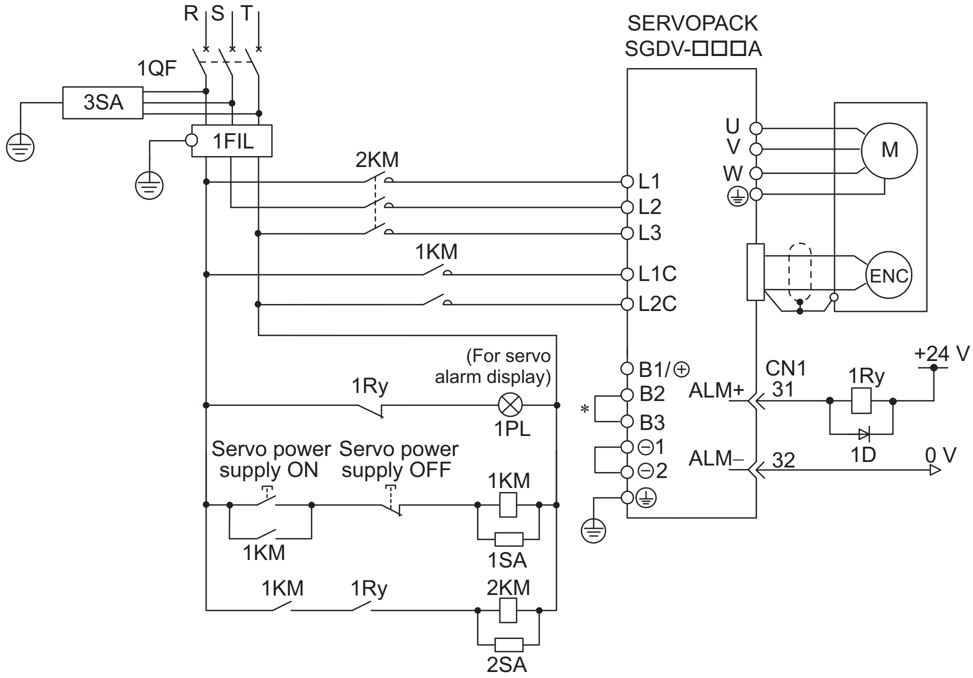
■ Single-phase 100 V, SGDV-□□□F (SGDV-R70F, R90F, 2R1F, 2R8F)



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

■ Three-phase 200 V, SGDV-□□□A

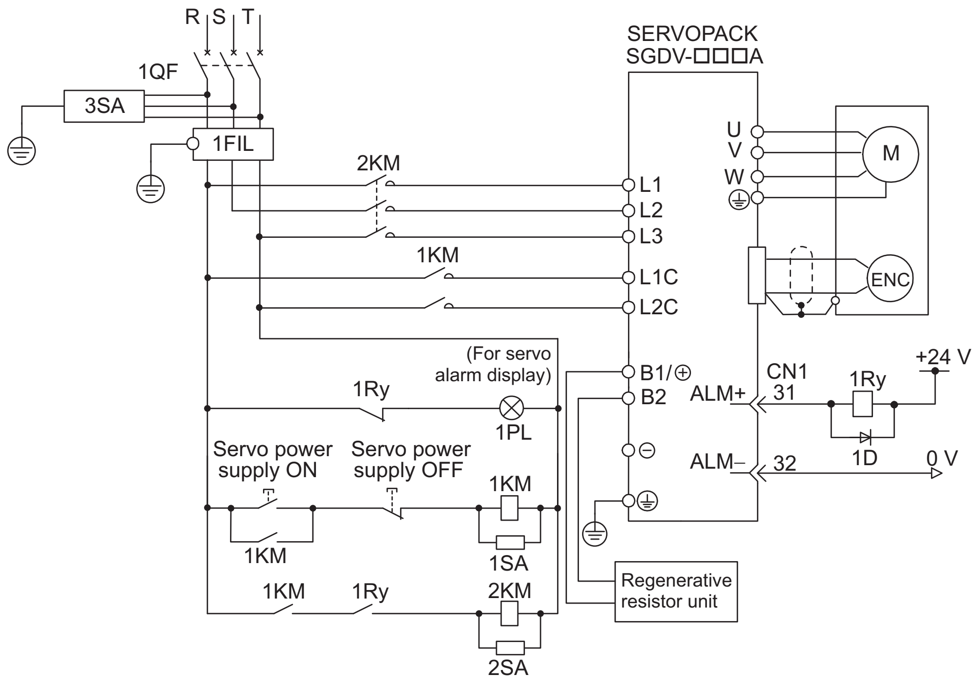
- SGDV-R70A, R90A, 1R6A, 2R8A, 3R8A, 5R5A, 7R6A, 120A, 180A, 200A, 330A



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

* For SGDV-R70A, -R90A, -1R6A, -2R8A, terminals B2 and B3 are not short-circuited.

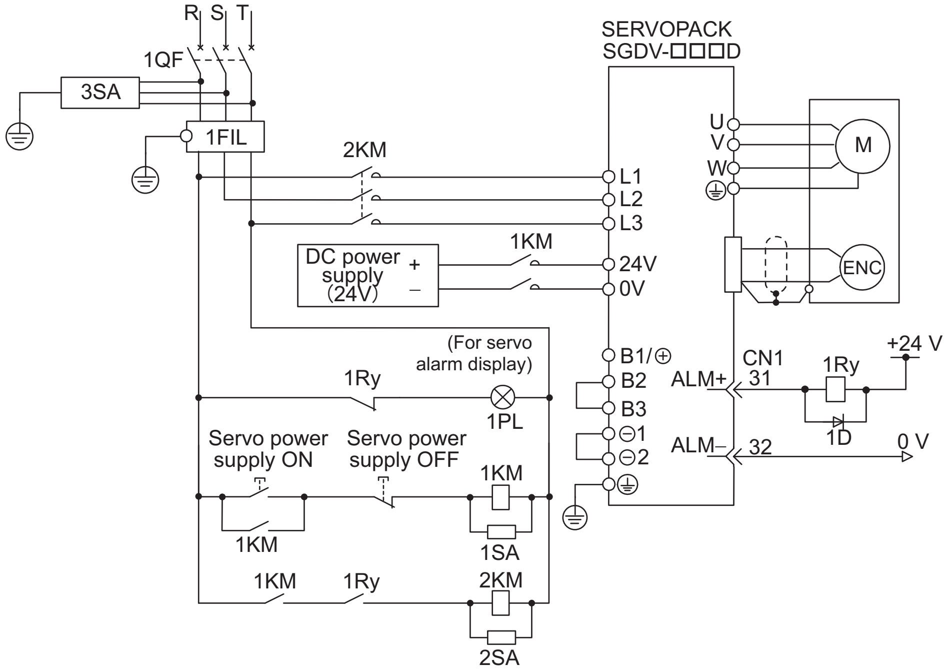
- SGDV-470A, 550A, 590A, 780A



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

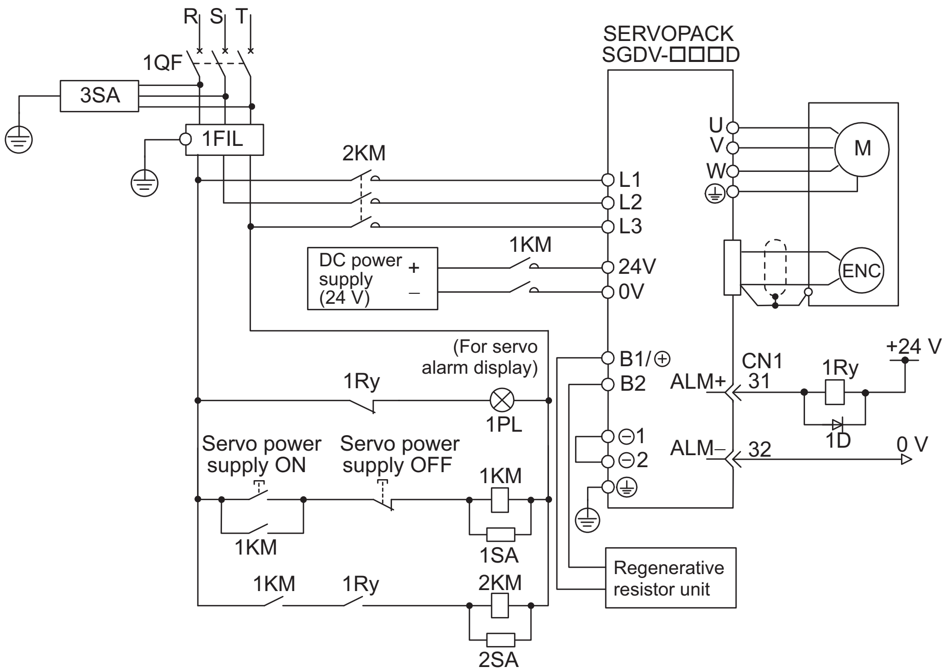
■ Three-phase 400 V, SGDV-□□□D

- SGDV-1R9D, 3R5D, 5R4D, 8R4D, 120D, 170D



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

- SGDV-210D, 260D, 280D, 370D



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

3.1.4 General Precautions for Wiring

IMPORTANT

Use a molded-case circuit breaker (1QF) or fuse to protect the main circuit.

- The SERVOPACK connects directly to a commercial power supply; it is not isolated through a transformer or other device.
  Always use a molded-case circuit breaker (1QF) or fuse to protect the servo system from accidents involving different power system voltages or other accidents.

Install a ground fault detector.

- 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 causes 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 Product Catalog* (KAEP S800000 42). 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 for serial converter unit.
- The maximum wiring length is 3 m for signal lines and 50 m for encoder lines for serial converter unit.

Observe the following precautions when wiring the ground.

- Use a cable as thick as possible (at least 2.0 mm^2)
- Grounding to a resistance of 100Ω 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. Only AC power can be input to the 100 V SERVOPACKs.
  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.
- Linear servomotor returns a regenerated energy to the power supply. 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.
- With a DC power input, connect an external inrush current limit circuit.
  Failure to observe this caution may result in damage to the product.

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

■ Three-phase, 200 V

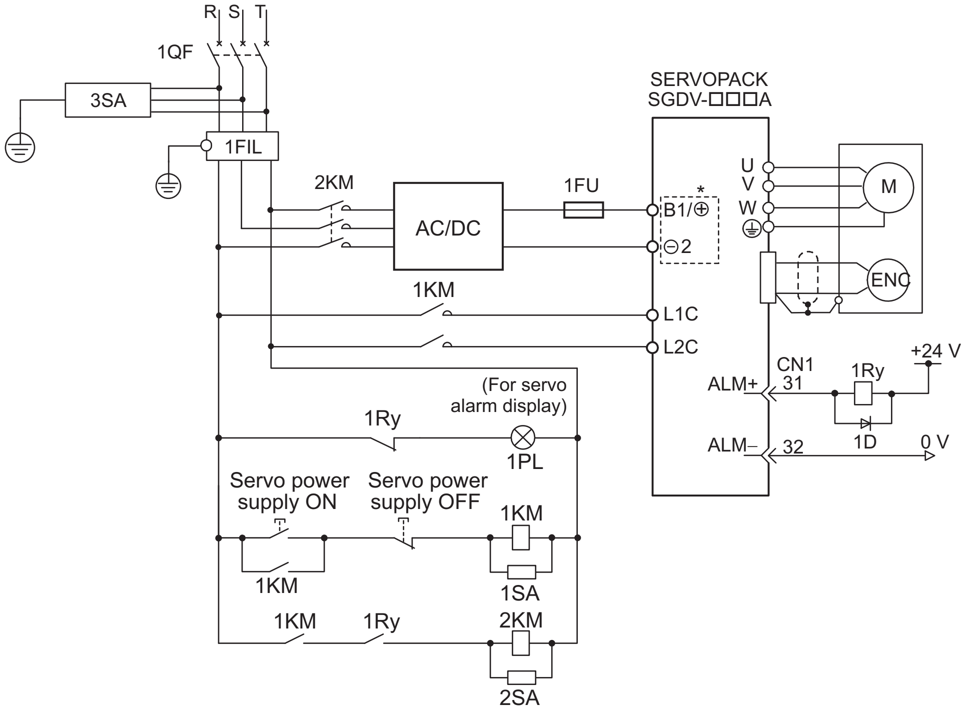
SERVOPACK model SGDV-	Terminal Name and Description		
	Main circuit plus terminal	Main circuit minus terminal	Control power supply input terminal
	270 to 320 VDC	0 VDC	200 to 230 VAC
R70A, R90A, 1R6A, 2R8A, 3R8A, 5R5A, 7R6A, 120A, 180A, 200A, 330A	B1/ ⊕	⊖ 2	L1C, L2C
470A, 550A, 590A, 780A	B1/ ⊕	⊖	L1C, L2C

■ 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 to 648 VDC	0 VDC	24 VDC ± 15%
1R9D, 3R5D, 5R4D, 8R4D, 120D, 210D, 260D, 280D, 370D	B1/ ⊕	⊖ 2	24 V, 0 V
170D	⊕	⊖ 2	24 V, 0 V

(2) Wiring Example with DC Power Supply Input

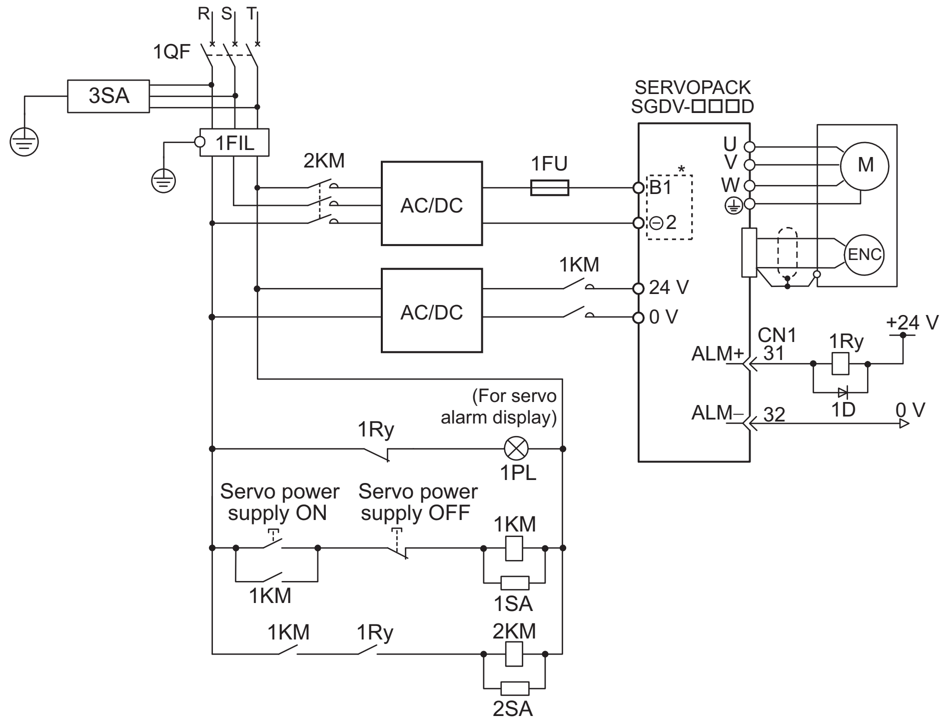
■ 200 V SERVOPACK SGDV-□□□A



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

1PL: Indicator lamp
1SA: Surge absorber
2SA: Surge absorber
3SA: Surge absorber
1D: Flywheel diode

■ 400 V SERVOPACK SGDV-□□□D



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

1PL: Indicator lamp
1SA: Surge absorber
2SA: Surge absorber
3SA: Surge absorber
1D: Flywheel diode

* 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□□	Enables use of AC power input.	After restart	Setup
	n.□1□□	Enables use of DC power input.		

3.1.6 Precautions When Using the SERVOPACK with Single-phase, 200 V Power Input

Some models of Σ-V series three-phase 200 V power input SERVOPACK can be used also with a single-phase 200 V power supply.

The following models support single-phase 200 V power input.
SGDV-R70A, -R90A, -1R6A, -2R8A, -5R5A

When using the SERVOPACK with single-phase, 200 V power input, set parameter Pn00B.2 to 1.

(1) Parameter Setting

■ Single-phase Power Input Selection

Parameter		Meaning	When Enabled	Classification
Pn00B	n.□0□□	Enables use of three-phase power supply for three-phase SERVOPACK. [factory setting]	After restart	Setup
	n.□1□□	Enables use of single-phase power supply for three-phase SERVOPACK.		

⚠ WARNING

- If a single-phase 200 V is input to a SGDV-R70A, -R90A, -1R6A, -2R8A, or -5R5A single-phase power input supported SERVOPACK without having changed the setting of Pn00B.2 to 1 (single-phase power input), the main circuit cable open phase alarm (A.F10) will be detected.
- The SERVOPACK models, SGDV-R70A, -R90A, -1R6A, -2R8A, and -5R5A, support single-phase 200 V power input. If a single-phase 200 V is input to the SERVOPACK models that do not support single-phase power input, the main circuit cable open phase alarm (A.F10) will be detected.
- When using a single-phase 200 V power supply, the SGDV-R70A, -R90A, -1R6A, -2R8A, or -5R5A SERVOPACK may not be able to produce the same servomotor force-speed characteristics as using a three-phase 200 V power input. Refer to the diagram of each motor force-speed characteristics in *Σ-V Series Product Catalog* (KAEPS80000042).

(2) Main Circuit Power Input

Connect a single-phase 200 V power supply of the following specifications to L1 and L2 terminals.

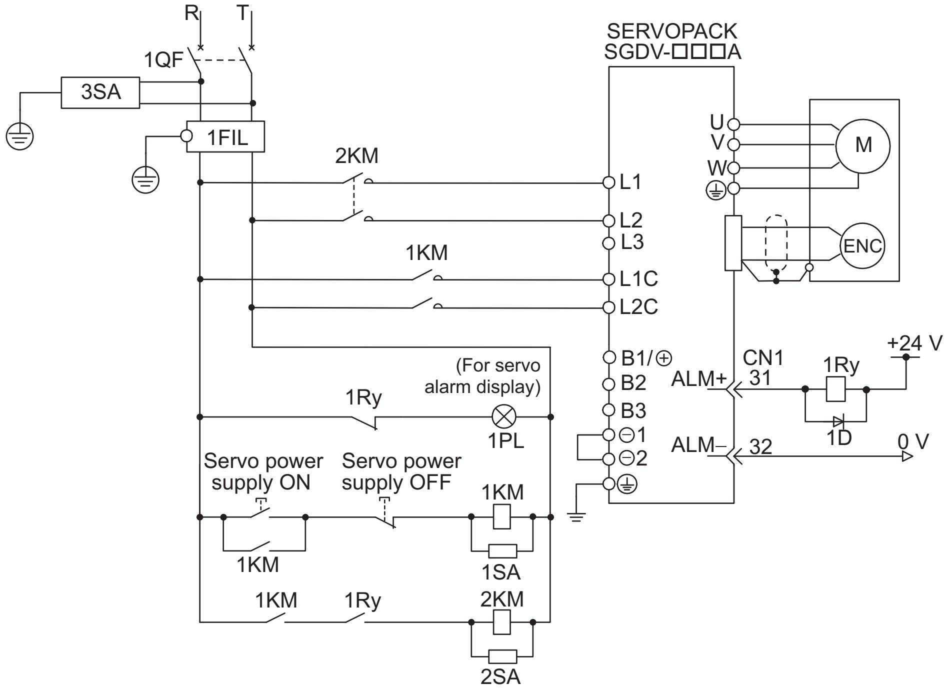
The specifications of the power supplies other than the main circuit power supply are the same as for three-phase power supply input.

Terminal Symbols	Name	Model SGDV-□□□□	Rating
L1, L2,	Main circuit power input terminals	R70A, R90A, 1R6A, 2R8A, 5R5A	Single-phase 200 V to 230 V, +10% to –15% (50/60 Hz)
L3*	–		None

* Do not use L3 terminal.

(3) Wiring Example with Single-phase 200 V Power Supply Input

■ Single-phase 200 V SERVOPACK SGDV-R70A, -R90A, -1R6A, -2R8A, -5R5A



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

1PL : Indicator lamp
1SA: Surge absorber
2SA: Surge absorber
3SA: Surge absorber
1D: Flywheel diode

(4) Power Supply Capacities and Power Losses

The following table shows SERVOPACK's power supply capacities and power losses when using single-phase 200 V power supply.

Main Power Supply	Maximum Applicable Servomotor Capacity [kW]	SERVOPACK Model SGDV-	Power Supply Capacity per SERVOPACK [kVA]	Output Current [Arms]	Main Circuit Power Loss [W]	Regenerative Resistor Power Loss [W]	Control Circuit Power Loss [W]	Total Power Loss [W]
Single-phase 200 V	0.05	R70A	0.2	0.66	5.2	–	17	22.2
	0.1	R90A	0.3	0.91	7.4			24.4
	0.2	1R6A	0.7	1.6	13.7			30.7
	0.4	2R8A	1.2	2.8	24.9			41.9
	0.75	5R5A	1.9	5.5	52.7	8		77.7

Note 1. SGDV-R70A, -R90A, -1R6A, and -2R8A SERVOPACKs do not have built-in regenerative resistors. If the regenerative energy exceeds the specified value, connect an external regenerative resistor.
2. Regenerative resistor power losses are allowable losses. Take the following action if this value is exceeded.
• Remove the lead from the internal regenerative resistor in the SERVOPACK. (SGDV-5R5A)
• Install an external regenerative resistor.
3. External regenerative resistors are options.

(5) Molded-case Circuit Breaker and Fuse Capacities

The following table shows the molded-case circuit breaker and fuse capacities when using single-phase 200 V power supply.

Main Power Supply	Maximum Applicable Servomotor Capacity [kW]	SERVOPACK Model SGDV-	Power Supply Capacity per SERVOPACK [kVA]	Current Capacity		Inrush Current	
				Main Circuit [Arms]	Control Circuit [Arms]	Main Circuit [A0-p]	Control Circuit [A0-p]
Single-phase 200 V	0.05	R70A	0.2	2	0.2	33	70
	0.1	R90A	0.3	2			
	0.2	1R6A	0.7	3			
	0.4	2R8A	1.2	5			
	0.75	5R5A	1.9	9			33

Note: To comply with the low voltage directive, connect a fuse to the input side. Select the fuse for the input side from among models that are compliant with UL standards.
The table above also provides the net values of current capacity and inrush current. Select a fuse and a molded-case circuit breaker which meet the breaking characteristics shown below.
- Main circuit, control circuit: No breaking at three times the current values shown in the table for 5 s.
- Inrush current: No breaking at the current values shown in the table for 20 ms.

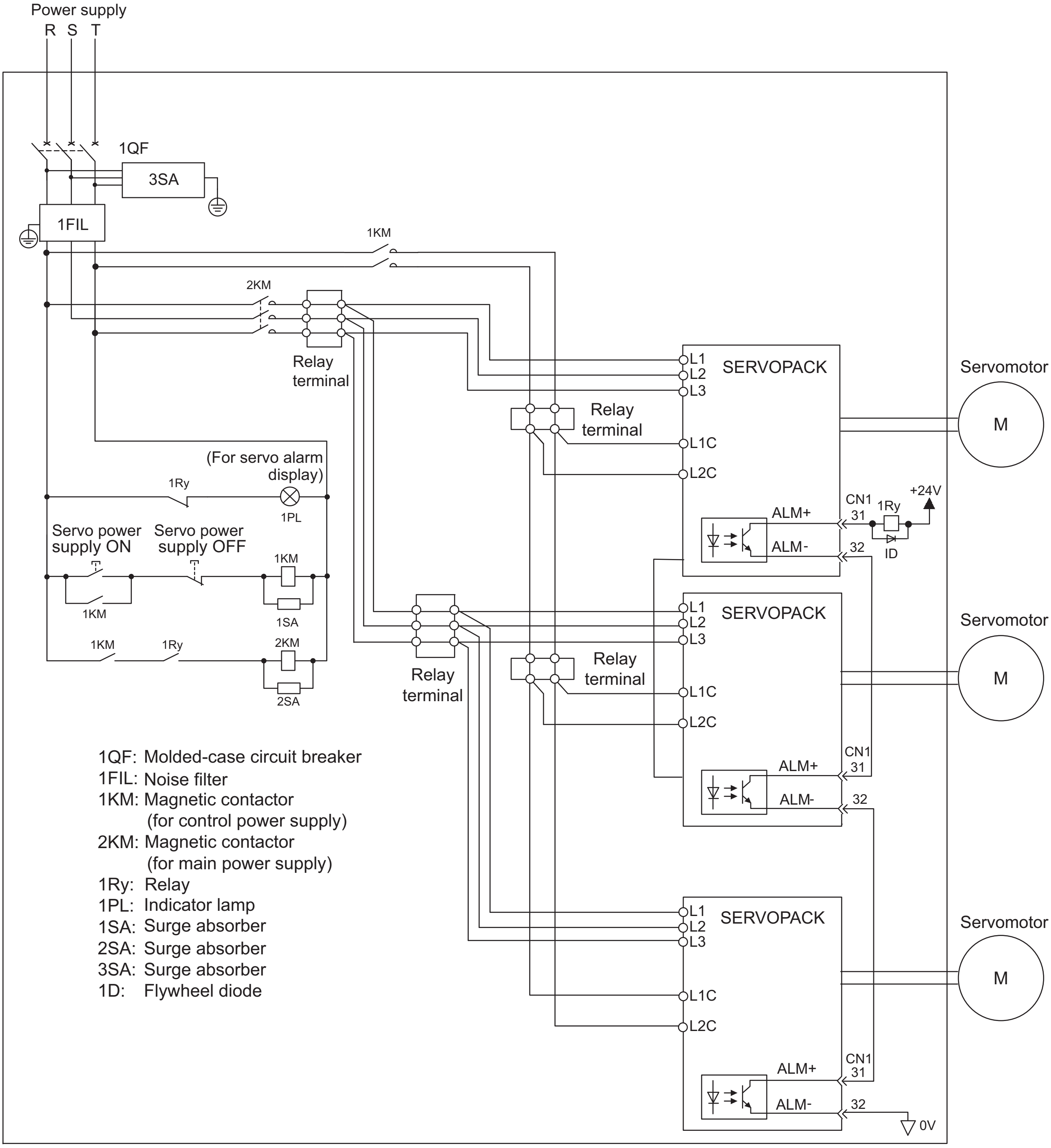
3.1.7 Precautions When Using More Than One SERVOPACK

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.



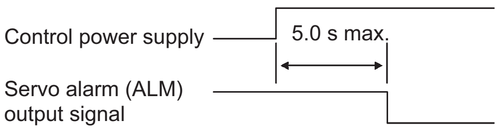
(2) Precautions

Multiple servos can share a single molded-case circuit breaker (1QF) or noise filter. Always select a QF or noise filter that has enough capacity for the total power capacity (load conditions) of those servos.

3.1.8 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.

IMPORTANT

- When turning ON the control power supply and the main circuit power supply, turn them ON at the same time or after the control power supply. When turning OFF the power supplies, first turn OFF the power for the main circuit and then turn OFF the control 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 movement direction.	5.6.1
			Control switching	Position ↔ speed Position ↔ force Force ↔ 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 force limit ON, Reverse external force limit ON	Force 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: The 24 V power supply is not included. 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
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
Force	T-REF	9 (10)	Inputs force 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, /N-CL, and /P-DET input signals can be changed by using the parameters. Refer to *3.3.1 Input Signal Allocations*.

(2) Output Signals

<table>
<tr><th>Control Method</th><th>Signal Name</th><th>Pin No.</th><th colspan="2">Function</th><th>Refer-ence Section</th></tr>
<tr><td rowspan="8">Common</td><td>ALM+
ALM-</td><td>31
32</td><td colspan="2">Servo alarm: Turns OFF when an error is detected.</td><td>5.10.1</td></tr>
<tr><td>/TGON+
/TGON-</td><td>27
28</td><td colspan="2">Detection during servomotor movement: Turns ON when the servomotor is moving at a speed higher than the motor speed setting.</td><td>5.10.3</td></tr>
<tr><td>/S-RDY+
/S-RDY-</td><td>29
30</td><td colspan="2">Servo ready: ON if there is no servo alarm when the control/main circuit power supply is turned ON.</td><td>5.10.4</td></tr>
<tr><td>PAO
/PAO</td><td>33
34</td><td>Phase-A signal</td><td rowspan="2">Two-phase pulse encoder output pulse signals</td><td rowspan="3">5.3.6
5.9.6</td></tr>
<tr><td>PBO
/PBO</td><td>35
36</td><td>Phase-B signal</td></tr>
<tr><td>PCO
/PCO</td><td>19
20</td><td>Phase-C signal</td><td>Origin pulse signal</td></tr>
<tr><td>ALO1
ALO2
ALO3</td><td>37 (1)
38 (1)
39 (1)</td><td colspan="2">Alarm code output: Outputs 3-bit alarm codes.</td><td>5.10.1</td></tr>
<tr><td>FG</td><td>Shell</td><td colspan="2">Connected to frame ground if the shield wire of the I/O signal cable is connected to the connector shell.</td><td>–</td></tr>
<tr><td>Speed</td><td>/V-CMP+
/V-CMP-</td><td>25
26</td><td colspan="2">Turns ON when whether the motor speed is within the setting range is detected and if it matches the reference speed value.</td><td>5.3.8</td></tr>
<tr><td>Position</td><td>/COIN+
/COIN-</td><td>25
26</td><td colspan="2">Turns ON when the number of position error pulse reaches the value set.</td><td>5.4.5</td></tr>
<tr><td rowspan="3">Reserved</td><td>/CLT
/VLT
/BK
/WARN
/NEAR</td><td>–</td><td colspan="2">Reserved terminals
The functions allocated to /TGON, /S-RDY, and /V-CMP (/COIN) can be changed by using the parameters.</td><td>5.8.5
5.5.3
5.10.2
5.4.6</td></tr>
<tr><td>PL1
PL2
PL3</td><td>3
13
18</td><td colspan="2">Signals of power supply for open-collector reference</td><td>–</td></tr>
<tr><td>–</td><td>16
17
18
23
24
48
49
50</td><td colspan="2">Terminals not used.
Do not connect.</td><td>–</td></tr>
</table>

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 *3.3.2 Output Signal Allocations*.

3.2.2 I/O Signal Connector (CN1) Terminal Layout

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

1	SG	GND
2	SG	GND
3	PL1	Power supply for open-collector reference
4	SEN	SEN signal input
5	V-REF	Speed reference input
6	SG	GND
7	PULS	Reference pulse input
8	/PULS	Reference pulse input
9	T-REF	Force reference input
10	SG	GND
11	SIGN	Reference sign input
12	/SIGN	Reference sign input
13	PL2	Power supply for open-collector reference
14	/CLR	Clear input
15	CLR	Clear input
16	–	–
17	–	–
18	PL3	Power supply for open-collector reference
19	PCO	Encoder output pulse Phase C
20	/PCO	Encoder output pulse Phase C
21	–	–
22	–	–
23	–	–
24	–	–
25	/V-CMP+ (/COIN+)	Speed coincidence detection output
26	/V-CMP- (/COIN-)	Speed coincidence detection output
27	/TGON+	TGON signal output
28	/TGON-	TGON signal output
29	/S-RDY+	Servo ready output
30	/S-RDY-	Servo ready output
31	ALM+	Servo alarm output
32	ALM-	Servo alarm output
33	PAO	Encoder output pulse Phase A
34	/PAO	Encoder output pulse Phase A
35	PBO	Encoder output pulse Phase B
36	/PBO	Encoder output pulse Phase B
37	ALO1	Alarm code output
38	ALO2	Alarm code output
39	ALO3	Alarm code output
40	/S-ON	Servo ON input
41	/P-CON	P control input
42	P-OT	Forward run prohibit input
43	N-OT	Reverse run prohibit input
44	/ALM-RST	Alarm reset input
45	/P-CL	Forward external force limit input
46	/N-CL	Reverse external force limit input
47	+24 V IN	External input power supply
48	–	–
49	–	–
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 Signal Allocations* and *3.3.2 Output Signal Allocations*.
Input signals: /S-ON, /P-CON, P-OT, N-OT, /ALM-RST, /P-CL, /N-CL, and /P-DET
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

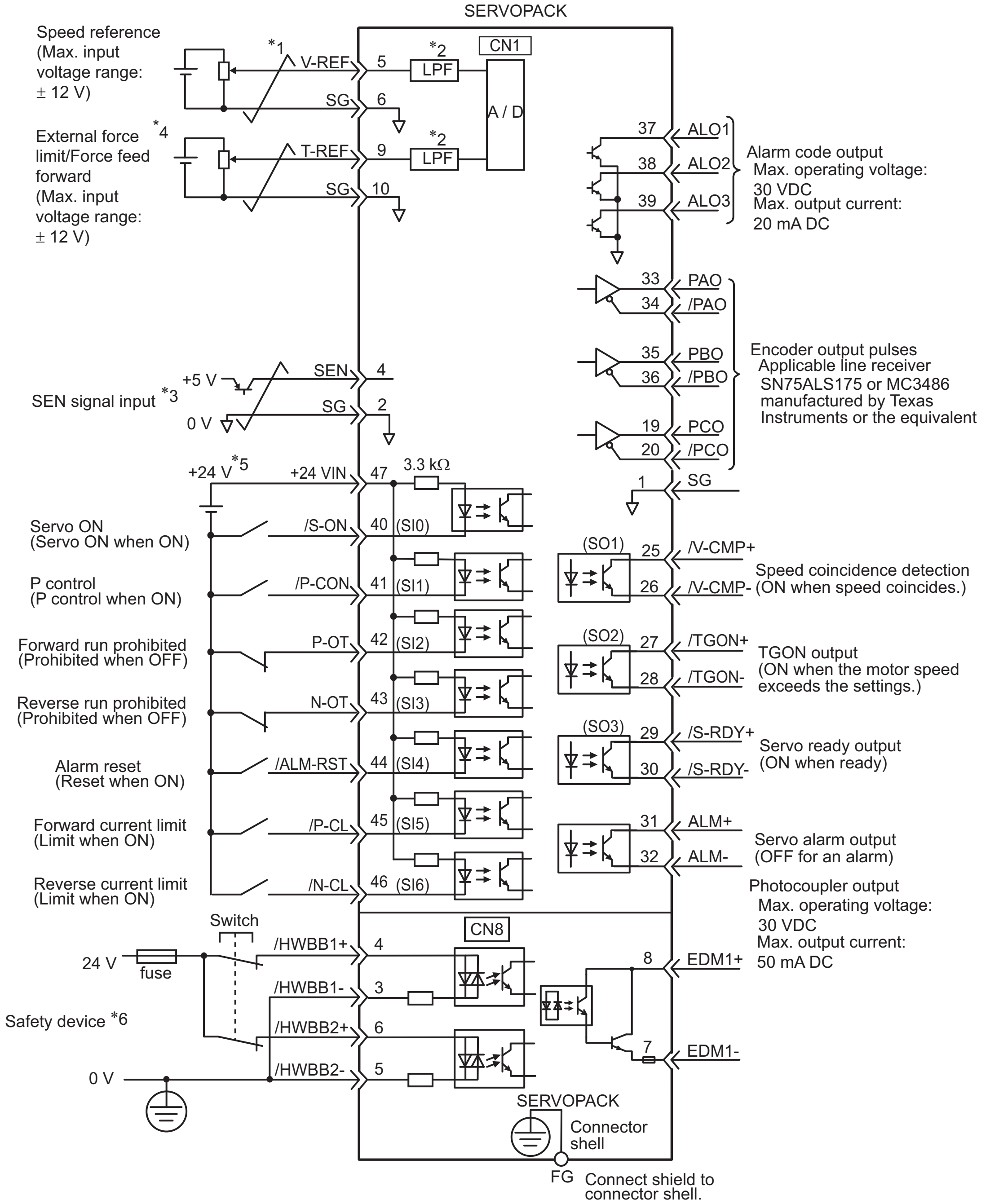
The following table shows the terminal layout of safety function signals (CN8).

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. (twisted-pair symbol) represents twisted-pair wires.

∗2. The time constant for the primary filter is 30 μs.

∗3. Connect when using an absolute linear scale manufactured by Mitutoyo.

∗4. Enabled by the parameter setting.

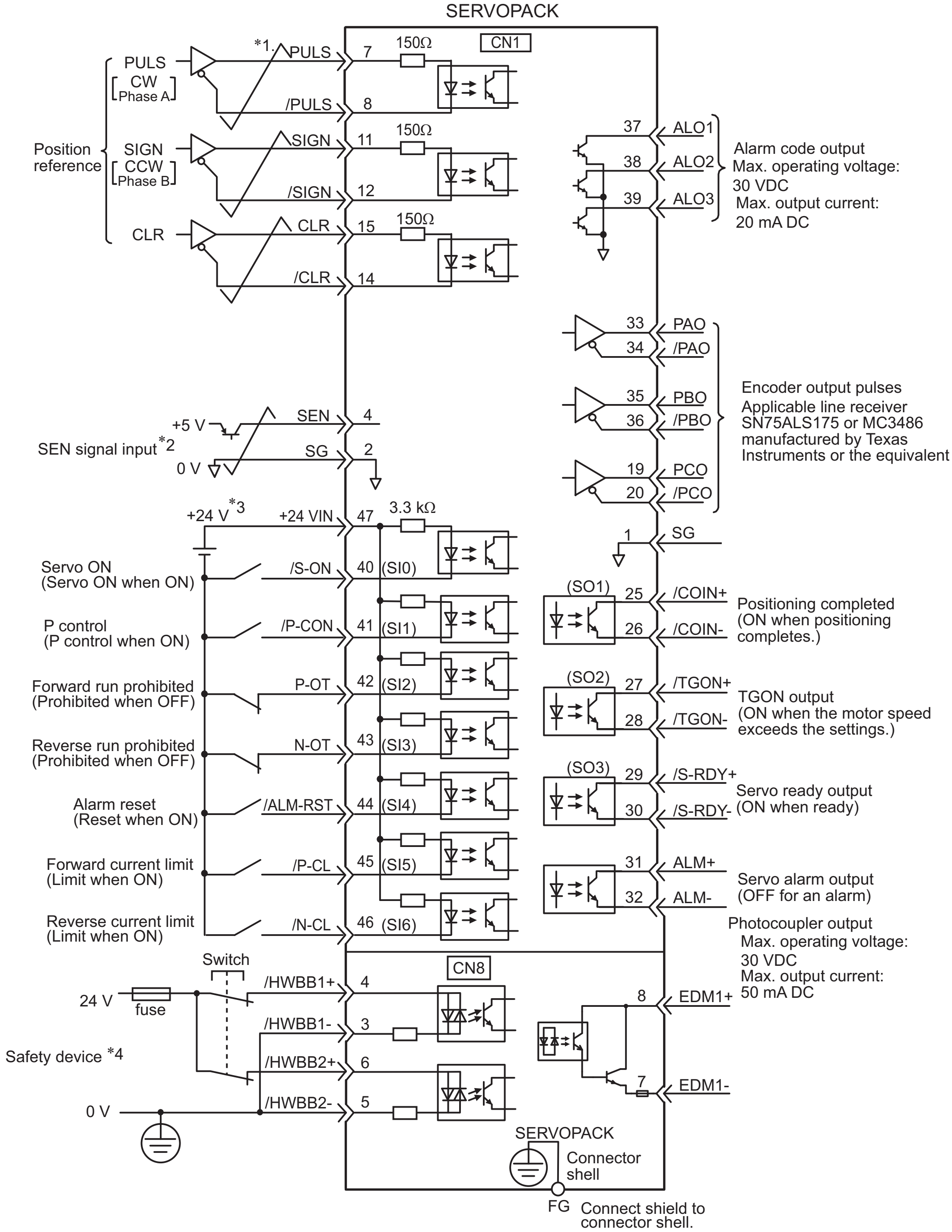
∗5. The 24 VDC power supply is not included. Use a power supply with double insulation or reinforced insulation.

∗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 Signal Allocations* and *3.3.2 Output Signal Allocations*.

3.2.6 Example of I/O Signal Connections in Position Control

Connection example in position control mode is as shown below.



∗1. represents twisted-pair wires.

∗2. Connect when using an absolute linear scale manufactured by Mitutoyo.

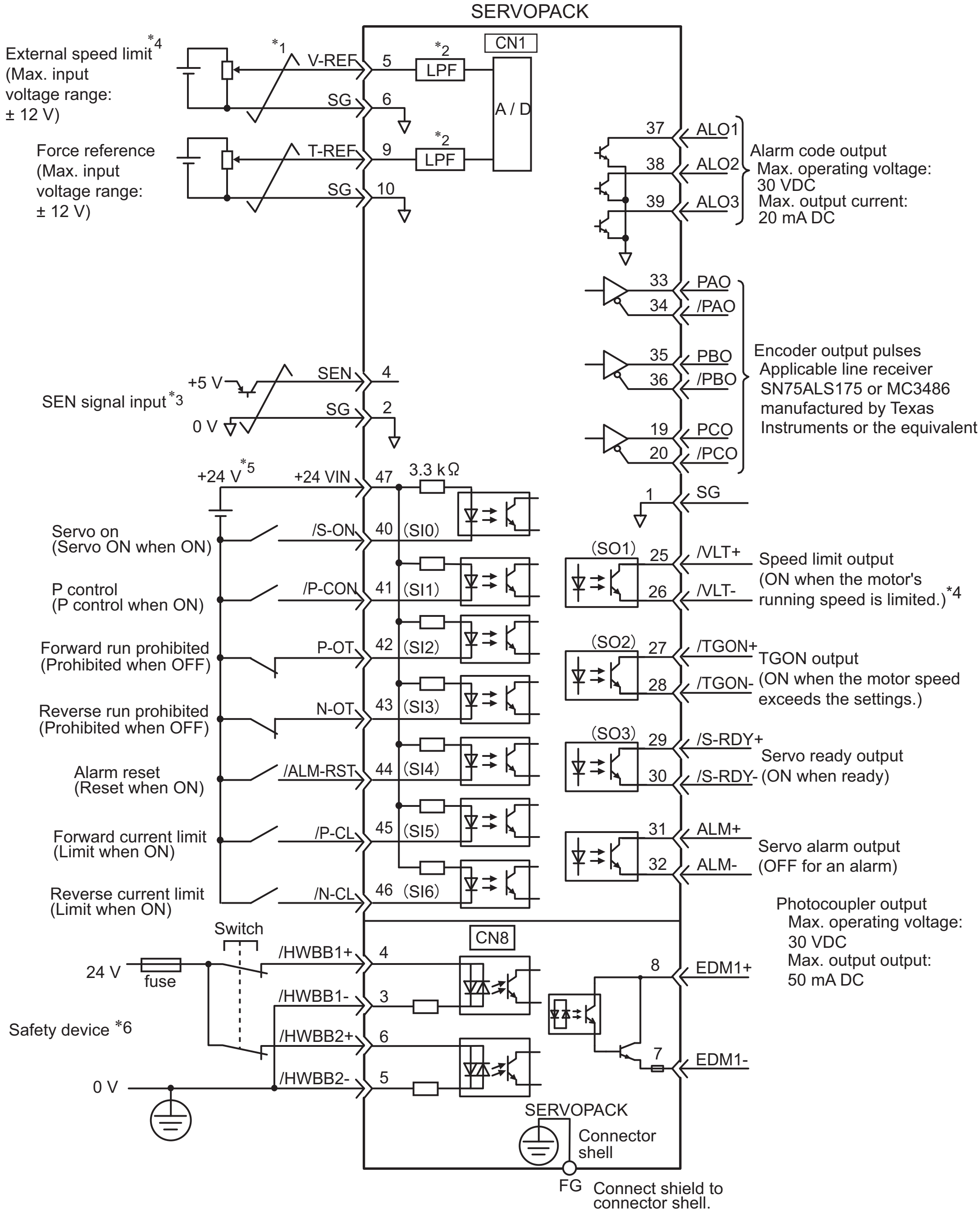
∗3. The 24 VDC power supply is not included. Use a power supply with double insulation or reinforced insulation.

∗4. 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 Signal Allocations* and *3.3.2 Output Signal Allocations*.

3.2.7 Example of I/O Signal Connections in Force Control

Connection example in force control mode is as shown below.



∗1. represents twisted-pair wires.
∗2. The time constant for the primary filter is 30 μs.
∗3. Connect when using an absolute linear scale manufactured by Mitutoyo.
∗4. Enabled by the parameter setting.
∗5. The 24 VDC power supply is not included. Use a power supply with double insulation or reinforced insulation.
∗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 Signal Allocations* and *3.3.2 Output Signal Allocations*.

3.3 I/O Signal Allocations

This section describes the I/O signal allocations.

3.3.1 Input Signal Allocations

In most cases, I/O signals can be used at the factory settings. I/O signals can also be allocated as required.

(1) Using Factory Settings

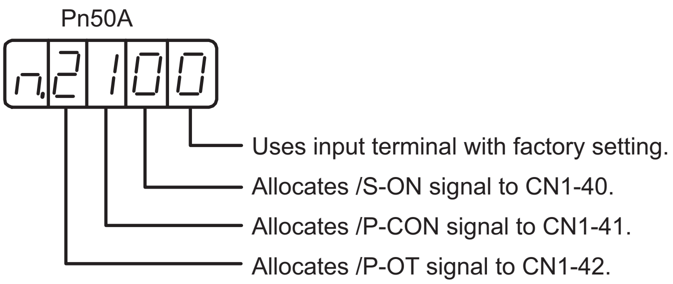
Items in cells with bold lines in the following table are the factory-set signal allocations.

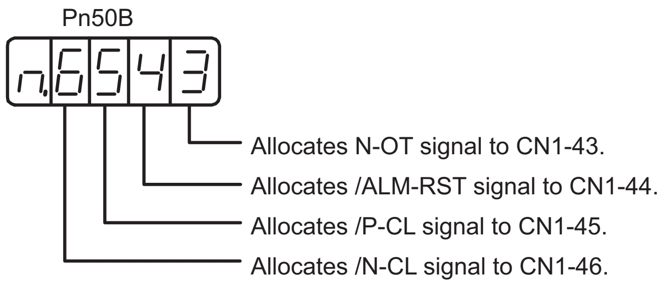
If the control method is changed in Pn000.1, the signals will function as required for the control method.
The factory-set signal allocations will remain unchanged.

<Example>
When the control method is set to speed control with a contact reference, i.e., when Pn000.1 is set to 3, signal /P-CON (CN1-41) will function as /SPD-D, signal /P-CL (CN1-45) as /SPD-A, and signal /N-CL (CN1-46) as /SPD-B.

<table>
<tr><th rowspan="2">Pn000.1 Setting</th><th rowspan="2">Control Method Selection</th><th colspan="7">CN1 Pin No.</th></tr>
<tr><th>40</th><th>41</th><th>42</th><th>43</th><th>44</th><th>45</th><th>46</th></tr>
<tr><td>0</td><td>Speed control (analog reference)</td><td rowspan="12">/S-ON</td><td rowspan="3">Uses as /P-CON</td><td rowspan="12">P-OT</td><td rowspan="12">N-OT</td><td rowspan="12">/ALM-RST</td><td rowspan="3">/P-CL</td><td rowspan="3">/N-CL</td></tr>
<tr><td>1</td><td>Position control (pulse train reference)</td></tr>
<tr><td>2</td><td>Force control (analog reference)</td></tr>
<tr><td>3</td><td>Internal set speed control (contact reference)</td><td rowspan="4">Uses as /SPD-D</td><td rowspan="4">Uses as /SPD-A</td><td rowspan="4">Uses as /SPD-B</td></tr>
<tr><td>4</td><td>Internal set speed control (contact reference) ⇔
Speed control (analog reference)</td></tr>
<tr><td>5</td><td>Internal set speed control (contact reference) ⇔
Position control (pulse train reference)</td></tr>
<tr><td>6</td><td>Speed control (contact reference) ⇔
Force control (analog reference)</td></tr>
<tr><td>7</td><td>Position control (pulse train reference) ⇔
Speed control (analog reference)</td><td rowspan="3">Uses as /C-SEL</td><td rowspan="5">Uses as /P-CL</td><td rowspan="5">Uses as /N-CL</td></tr>
<tr><td>8</td><td>Position control (pulse train reference) ⇔
Force control (analog reference)</td></tr>
<tr><td>9</td><td>Force control (analog reference) ⇔
Speed control (analog reference)</td></tr>
<tr><td>A</td><td>Speed control (analog reference) ⇔ Zero clamp</td><td>Uses as /ZCLAMP</td></tr>
<tr><td>B</td><td>Position control (pulse train reference) ⇔
Position control (Inhibit)</td><td>Uses as /INHIBIT</td></tr>
</table>

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





(2) Changing Input Signal Allocations

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.

When changing input signal allocations, set Pn50A.0 to 1 to enable making the changes.
Input signals are allocated as shown in the following table.

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

<Interpreting the Input Signal Allocation Tables>

The parameter set values to be used are shown.
Signals are allocated to CN1 pins according to the selected set values.
Values in cells in bold lines are the factory settings.

Level at which input signal allocations are valid.

Input Signal Names and Parameters	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**	L	/S-ON	**0**	1	2	3	4	5	6	7	8
	H	S-ON	9	A	B	C	D	E	F		

If always ON (7) or always OFF (8) is set, signals will be processed in the SERVOPACK, which will eliminate the need for wiring changes.

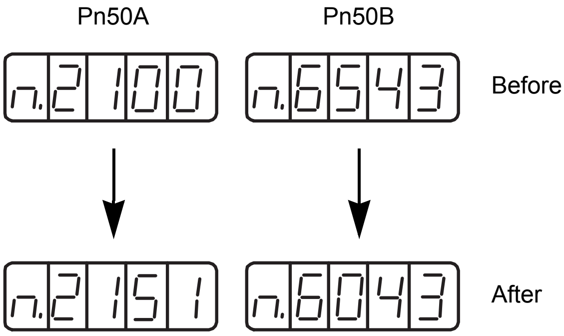
Wiring and Connection

3

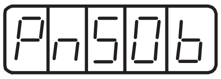
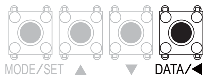
Input Signal Names and Parameters	Validity Level	Input Signal	CN1 Pin Numbers							Connection Not Required (SERVOPACK judges the connection)	
			40	41	42	43	44	45	46	Always ON	Always OFF
Servo ON **Pn50A.1**	L	/S-ON	0	1	2	3	4	5	6	7	8
	H	S-ON	9	A	B	C	D	E	F		
Proportional Operation Reference **Pn50A.2**	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**	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**	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**	L	ARM-RST	0	1	2	3	4	5	6	-	8
	H	/ARM-RST	9	A	B	C	D	E	F		
Forward External Force Limit **Pn50B.2**	L	/P-CL	0	1	2	3	4	5	6	7	8
	H	P-CL	9	A	B	C	D	E	F		
Reserve External Force Limit **Pn50B.3**	L	/N-CL	0	1	2	3	4	5	6	7	8
	H	N-CL	9	A	B	C	D	E	F		
Switching Servomotor Movement Direction **Pn50C.0**	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**	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**	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**	L	/C-SEL	0	1	2	3	4	5	6	7	8
	H	C-SEL	9	A	B	C	D	E	F		
Zero Clamp **Pn50D.0**	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**	L	/INHIBIT	0	1	2	3	4	5	6	7	8
	H	INHIBIT	9	A	B	C	D	E	F		
Polarity Detection **Pn50D.3**	L	/P-DET	0	1	2	3	4	5	6	7	8
	H	P-DET	9	A	B	C	D	E	F		
Gain Changeover 1 **Pn50D.2**	L	/G-SEL	0	1	2	3	4	5	6	7	8
	H	G-SEL	9	A	B	C	D	E	F		

(3) Example of Input Signal Allocation

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



Step	Display after Operation	Keys	Description
1	Pn50A	MODE/SET ▲ ▼	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	DATA/◀	Press the DATA/SHIFT Key for approximately one second to display the current data of Pn50A. (/S-ON is allocated on CN1-40.)
3	n.2101	▲	Press the UP key to set to "1." (Sequence input signals can be freely set.)
4	n.2151	DATA/◀	Press the DATA/SHIFT Key to select the second digit from the right. Press the UP key to set to "5." (Changes the allocation of /S-ON from CN1-40 to CN1-45.)
5	n.2151 Display blinks.	MODE/SET	Press the MODE/SET Key. The data blinks and is saved.
6	Pn50A	DATA/◀	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	DATA/◀	Press the DATA/SHIFT Key for approximately one second to display the current data of Pn50B. (/P-CL is allocated on CN1-45.)
9	n.6043	DATA/◀	Press the DATA/SHIFT Key to select the third digit from the right. Press the DOWN Key to set "0." (Changes the allocation of /P-CL from CN1-45 to CN1-40.)
10	n.6043 Display blinks.	MODE/SET	Press the MODE/SET Key. The value blinks and is saved.

Step	Display after Operation	Keys	Description
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

(4) Checking Input Signals

Input signal status can be checked using the input signal monitor (Un005). As for the input signal monitor (Un005), refer to *8.6 Monitoring Input Signals.*

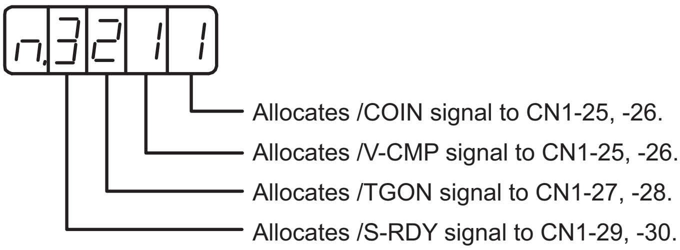
3.3.2 Output Signal Allocations

Output signals can be allocated to I/O signal connectors (CN1) in accordance with the parameter setting of Pn50E, Pn50F, Pn510 and Pn512.

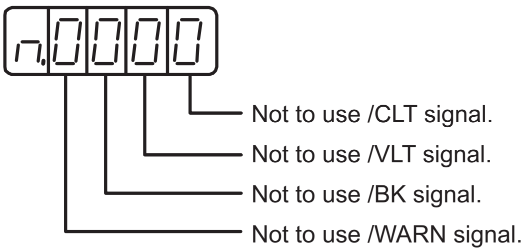
(1) Factory Setting

Factory setting can be checked using the following parameters.

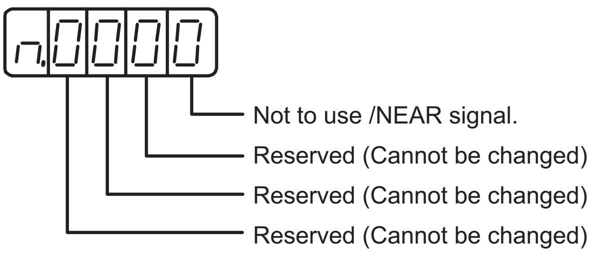
Pn50E

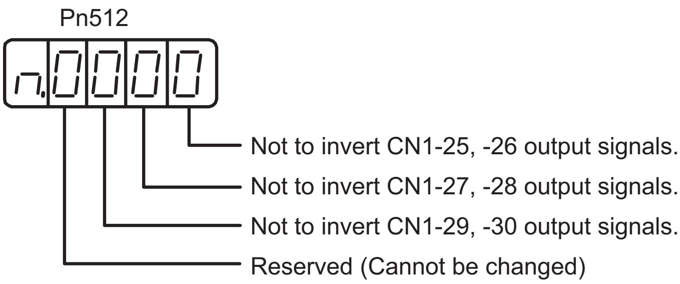


Pn50F



Pn510




Pn512
n.0000
Not to invert CN1-25, -26 output signals.
Not to invert CN1-27, -28 output signals.
Not to invert CN1-29, -30 output signals.
Reserved (Cannot be changed)

(2) Changing Output Signal Allocations

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.

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

<Interpreting the Output Signal Allocation Tables>

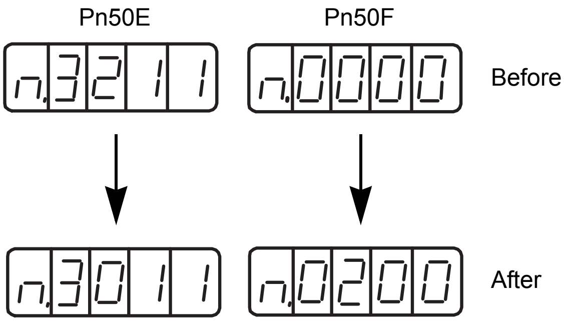
The parameter set values to be used are shown.
Signals are allocated to CN1 pins according to the selected set values.
Values in cells in bold lines are the factory settings.

Output Signal Names and Parameters	Output Signal	CN1 Pin Numbers			Invalid (not use)
		25 (26)	27 (28)	29 (30)	
Positioning Completion **Pn50E.0**	/COIN	1	2	3	0

Output Signal Names and Parameters	Output Signal	CN1 Pin Numbers			Invalid (not use)
		25 (26)	27 (28)	29 (30)	
Positioning Completion **Pn50E.0**	/COIN	1	2	3	0
Speed Coincidence Detection **Pn50E.1**	/V-CMP	1	2	3	0
Movement Detection **Pn50E.2**	/TGON	1	2	3	0
Servo Ready **Pn50E.3**	/S-RDY	1	2	3	0
Force Limit Detection **Pn50F.0**	/CLT	1	2	3	0
Speed Limit Detection **Pn50F.1**	/VLT	1	2	3	0
Brake **Pn50F.2**	/BK	1	2	3	0
Warning **Pn50F.3**	/WARN	1	2	3	0
Near **Pn510.0**	/NEAR	1	2	3	0
Pn512.0=1	Polarity inversion of CN1-25 (26)				0 (Not invert at factory setting)
Pn512.1=1	Polarity inversion of CN1-27 (28)				
Pn512.2=1	Polarity inversion of CN1-29 (30)				

(3) Example of Output Signal Allocation

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



Step	Display after Operation	Keys	Description
1	Pn50E	MODE/SET ▲ ▼	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	n.3211	DATA/◄	Press the DATA/SHIFT Key for approximately one second to display the current data of Pn50E. (/TGON is allocated on CN1-27 (28).)
3	n.3011	▼ DATA/◄	Press the DATA/SHIFT Key to select the third digit from the right. Press the DOWN Key to set "0." (Sets /TGON "Invalid.")
4	n.3011 Display blinks.	MODE/SET	Press the MODE/SET Key. The data blinks and is saved.
5	Pn50E	DATA/◄	Press the DATA/SHIFT Key for approximately one second to return to the display Pn50E.
6	Pn50F	▲	Press the UP Key to display Pn50F.
7	n.0000	DATA/◄	Press the DATA/SHIFT Key for approximately one second to display the current data of Pn50F. (/BK is set to "Invalid.")
8	n.0200	▲ DATA/◄	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	n.0200 Display blinks.	MODE/SET	Press the MODE/SET Key. The value blinks and is saved.
10	Pn50F	DATA/◄	Press the DATA/SHIFT Key for approximately one second to return to the display Pn50F. /TGON is set as "Invalid" and /BK is allocated on CN1-27 (28).
11	Turn the power OFF and ON again to enable the changes of output signal selection (Pn50E and Pn50F).		

(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 *8.7 Monitoring Output Signals.*

3.4 Examples of Connection to Host Controller

This section shows examples of SERVOPACK I/O signal connection to the host controller.

3.4.1 Connection Examples of Reference Input Circuits to SERVOPACK

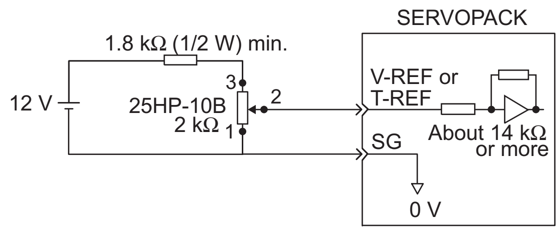
(1) Analog Input Circuit

CN1 connector terminals, 5-6 (speed reference input) and 9-10 (force reference input) are explained below. Analog signals are either speed or force reference signals at the impedance below.

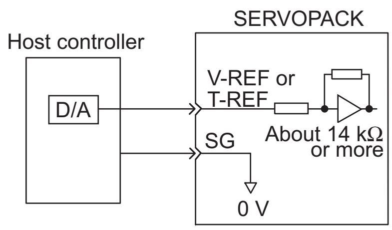
- Reference speed input: About 14 kΩ or more
- Reference force input: About 14 kΩ or more

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

Analog Voltage Input Circuit



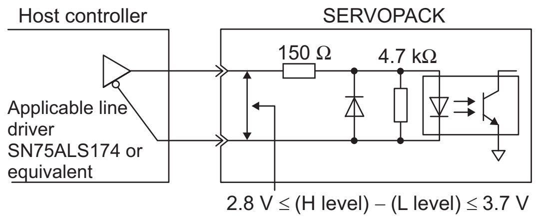
Analog Voltage Input Circuit (D/A)



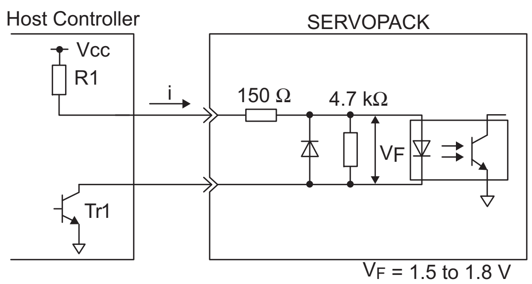
(2) Position Reference Input Circuit

CN1 connector terminals, 7-8 (reference pulse input) and 11-12 (reference sign input) are explained below.
An output circuit for the reference pulse and position error pulse clear signal at the host controller can be among line-driver or open-collector outputs. The following shows by type.

Line-driver Output Circuit



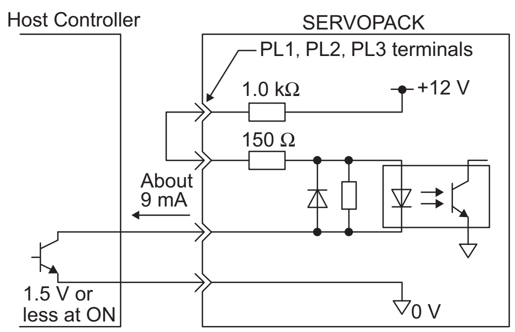
Open-collector Output, Example 1:
The power supply in this example is not included with the Σ-V.



Use the examples below to set pull-up resistor R1 so the input current, i, falls between 7 mA and 15 mA.

Application Examples		
R1 = 2.2 kΩ with a Vcc of 24 V ±5%	R1 = 1 kΩ with a Vcc of 12 V ±5%	R1 = 180 Ω with a Vcc of 5 V ±5%

Open-collector Output, Example 2:
Built-in 12 V Power Supply: Non-insulated line receiver

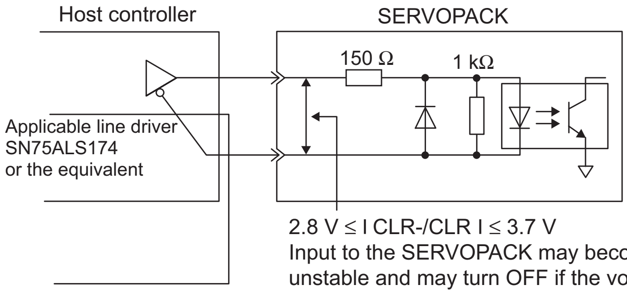


(3) Clear Input Circuit

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

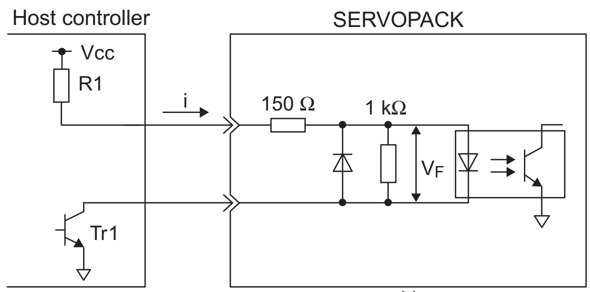
An output circuit for the reference pulse and position error pulse clear signal at the host controller can be either line-driver or open-collector outputs. The following shows by type.

Line-driver Output Circuit



2.8 V ≤ I CLR-/CLR I ≤ 3.7 V
Input to the SERVOPACK may become unstable and may turn OFF if the voltage difference between the CLR signal and /CLR signal (|CLR-/CLR|) is less than 2.8 V.

Open-collector Output, Example 1:
The power supply in this example is not included with the Σ-V.



V_F = 1.5 to 1.8 V

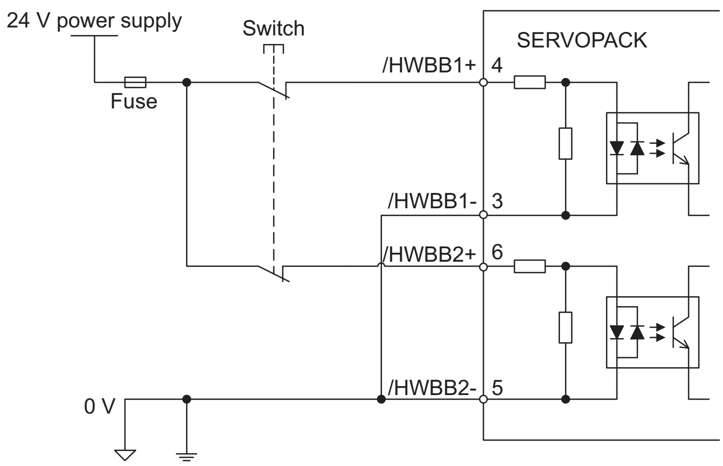
Use the examples below to set pull-up resistor R1 so the input current, i, falls between 7 mA and 15 mA.

Application Examples		
R1 = 2.2 kΩ with a Vcc of 24 V ±5%	R1 = 4.7 kΩ with a Vcc of 12 V ±5%	R1 = 180 Ω with a Vcc of 5 V ±5%

(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.

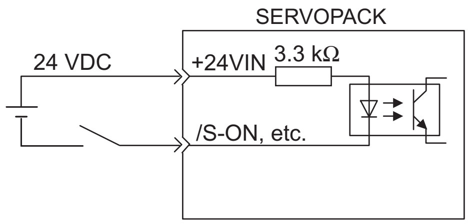
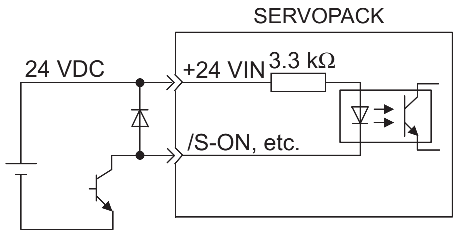
Input Signal Connection Example



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.

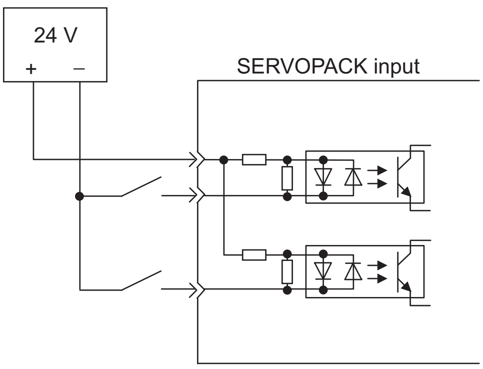
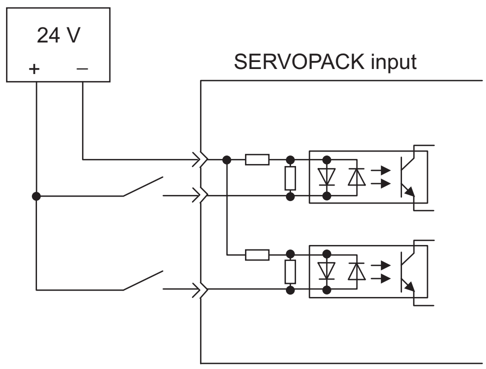
Relay Circuit Example	Open-collector Circuit Example
	

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

For SEN input signal circuit, refer to *5.9.2 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.

Sink Circuit	Source Circuit
	

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

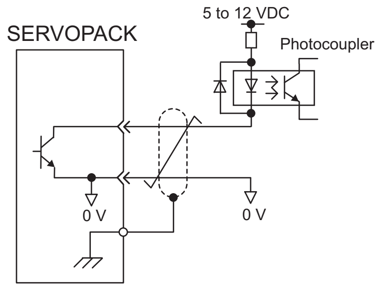
3.4.3 Connection Examples of Output Circuits to SERVOPACK

There are three types of SERVOPACK output circuits:

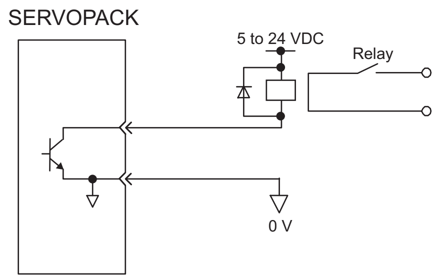
(1) Open-collector Output Circuit

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.

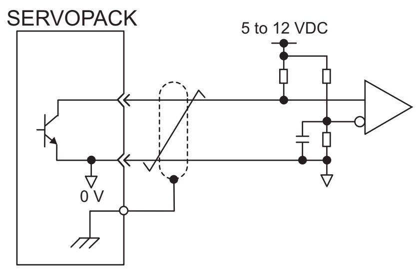
Photocoupler Circuit Example



Relay Circuit Example



Line Receiver Circuit Example

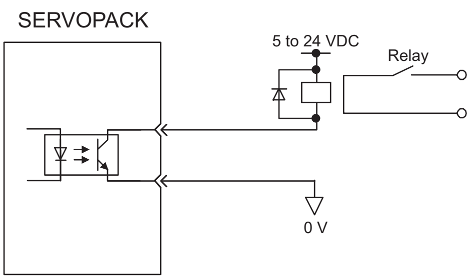


Note: The maximum allowable voltage and current capacities for open-collector output circuits are as follows.
- Voltage: 30 VDC
- Current: 20 mA DC

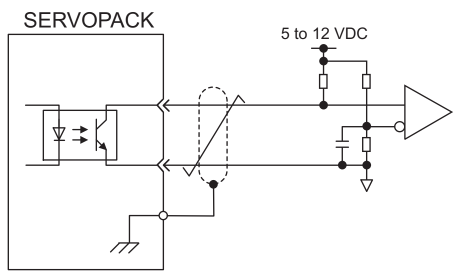
(2) Photocoupler Output Circuit

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.

Relay Circuit Example



Line Receiver Circuit Example



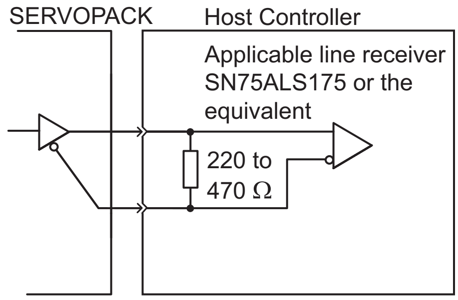
Note: The maximum allowable voltage and current capacities for photocoupler output circuits are as follows.
- Voltage: 30 VDC
- Current: 5 to 50 mA DC

(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.

Line Receiver Circuit Example



(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.

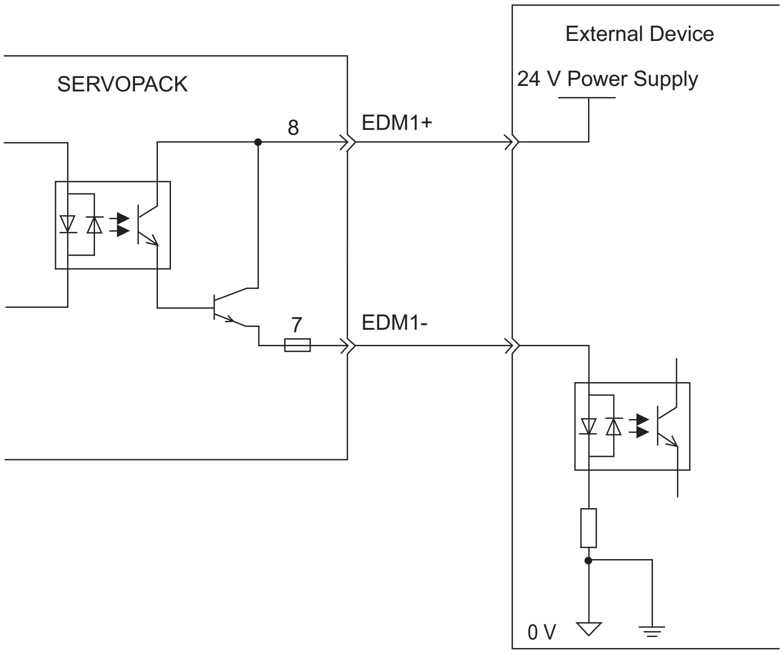
⚠ WARNING
The EDM1 signal is not a safety output. Use it only for monitoring a failure.

(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	CN8-8 CN8-7	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

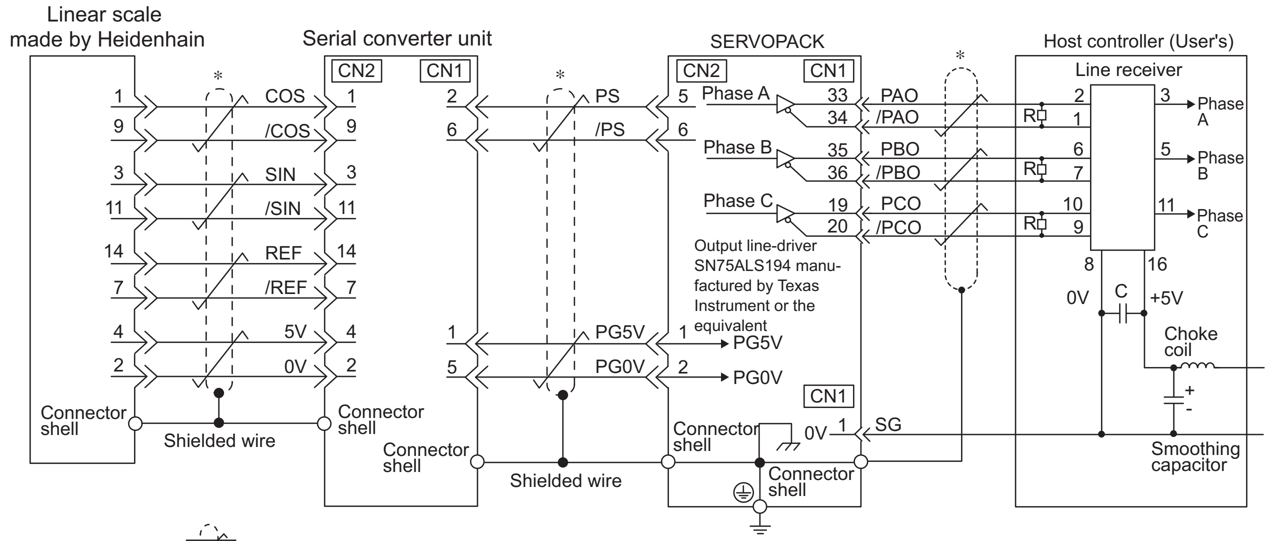
3.5 Examples of Linear Scale Connection

This section describes the connection example of output signals between linear scale, SERVOPACK and host controller.
CN2 linear scale connector terminal layout is also described.

3.5.1 Connection Example of a Linear Scale

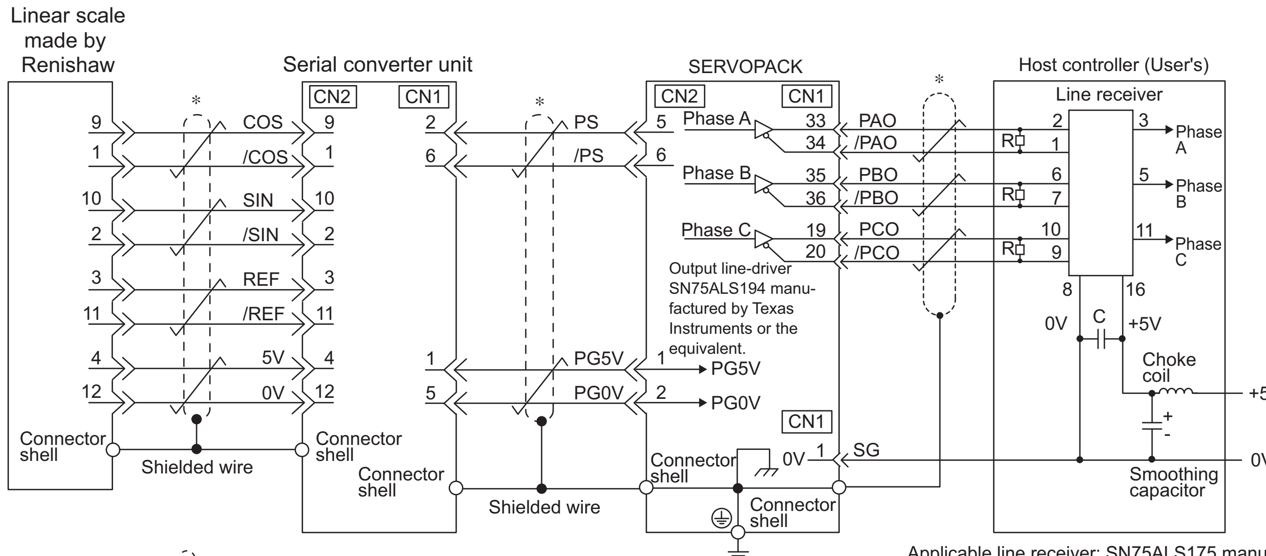
The following diagram shows the example of connecting linear scale.

(1) Linear Scale Made by Heidenhain



* : represents shielded twisted-pair wires

(2) Linear Scale Made by Renishaw

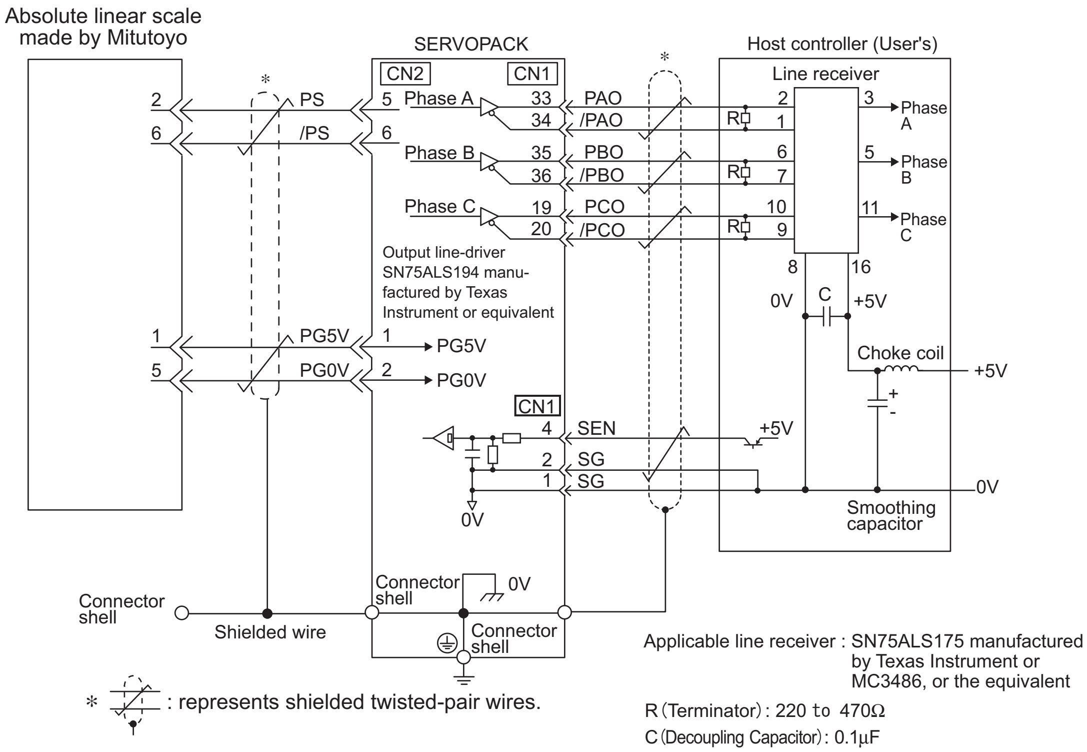


Applicable line receiver: SN75ALS175 manufactured by Texas Instruments or MC3486, or the equivalent

* : represents shielded twisted-pair wires.

R (Terminator): 220 to 470Ω
C (Decoupling Capacitor): 0.1μF

(3) Absolute Linear Scale Made by Mitutoyo



3.5.2 CN2 Linear Scale Connector Terminal Layout

1	PG 5 V	PG power supply +5 V	2	PG 0 V	PG power supply 0 V
3	–	–	4	–	–
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 Product Catalog* (KAEP S800000 42).

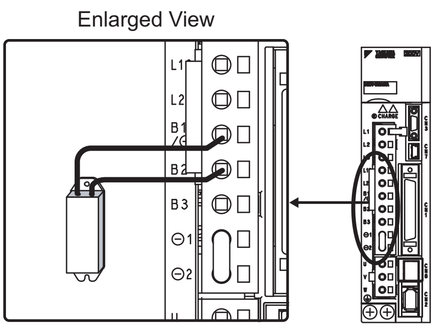
⚠ WARNING
• Be sure to connect the regenerative resistor correctly. Failure to observe this warning may result in fire or damage to the product.

3.6.1 Connecting Regenerative Resistors

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

(1) SERVOPACKs: Model SGDV-R70F, R90F, 2R1F, 2R8F, R70A, R90A, 1R6A, 2R8A

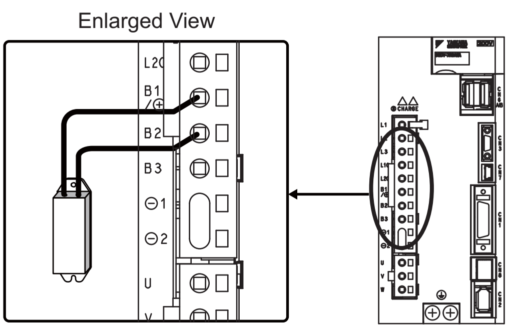
Connect an external regenerative resistor between B1/⊕ and B2 terminals. After connecting a resistor, select the capacity. For more information on how to set the capacity of regenerative resistors, refer to *3.6.2 Setting Regenerative Resistor Capacity*.



(2) SERVOPACKs: Model SGDV-3R8A, 5R5A, 7R6A, 120A, 180A, 200A, 330A, 1R9D, 3R5D, 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. After connecting a resistor, select the capacity. For more information on how to set the capacity of regenerative resistors, refer to *3.6.2 Setting Regenerative Resistor Capacity*.

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



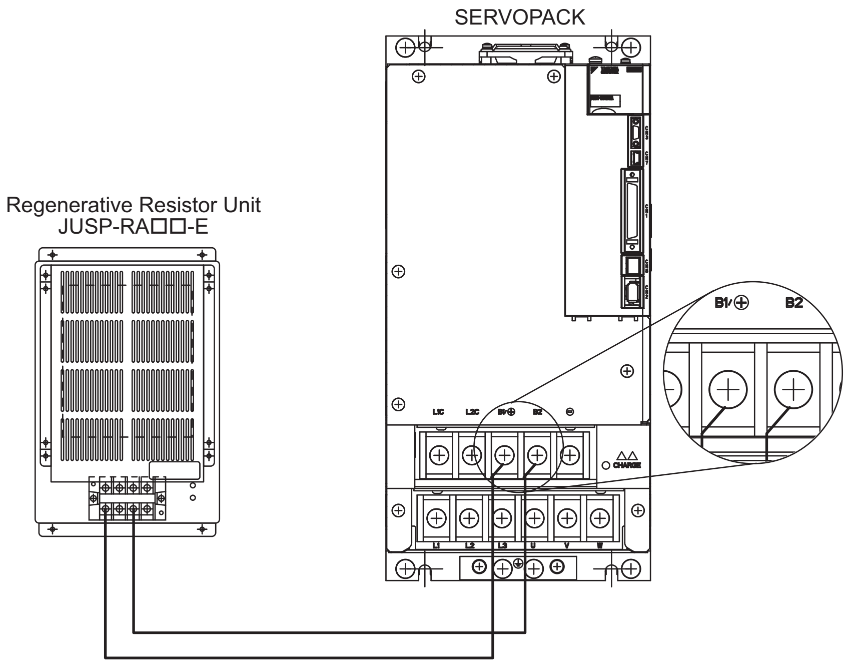
(3) SERVOPACKs: Model SGDV-470A, 550A, 590A, 780A, 210D, 260D, 280D, 370D

No built-in regenerative resistor is provided, so the external regenerative resistor is required. The regenerative resistor units are as follow:

Main Circuit Power Supply	Applicable SERVOPACK Model SGDV	Applicable Regenerative Resistor Unit	Resistance (Ω)	Specifications
Three-phase 200 V	470A	JUSP-RA04-E	6.25	25 Ω (220 W); 4 resistors in parallel
	550A, 590A, 780A	JUSP-RA05-E	3.13	25 Ω (220 W); 8 resistors in parallel
Three-phase 400 V	210D, 260D	JUSP-RA18-E	18	18 Ω (220 W); 2 resistors in series with 2 in parallel.
	280D, 370D	JUSP-RA19-E	14.25	28.5 Ω (220 W); 2 resistors in series with 4 in parallel.

Connect a regenerative resistor unit between B1/⊕ and B2 terminals.

When using a regenerative resistor unit, set Pn600 to 0W (factory setting).



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.

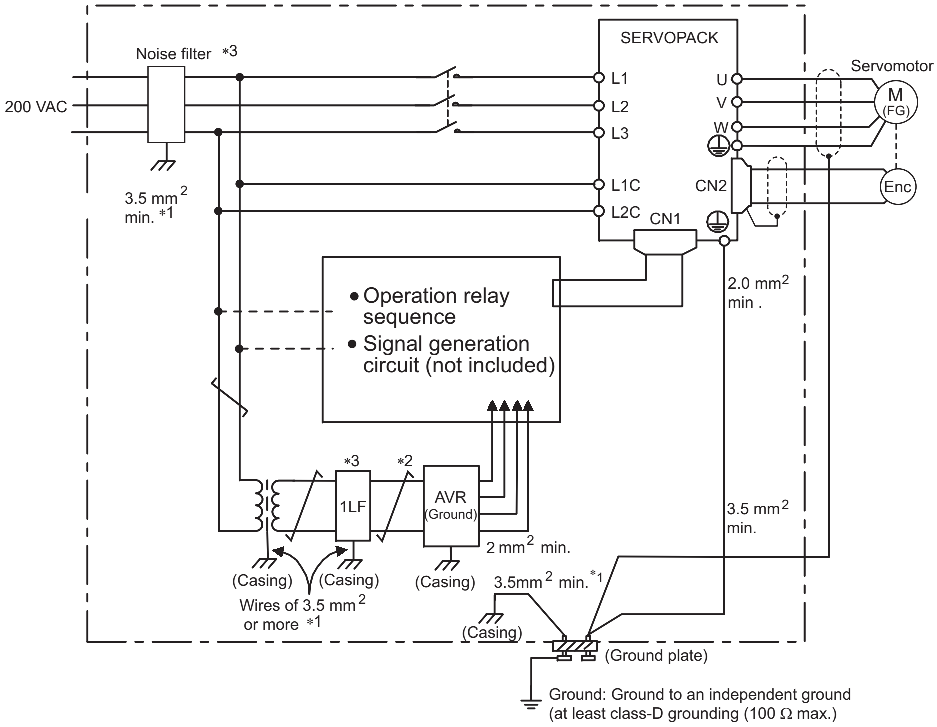
To prevent malfunction due to noise, take the following actions:

- Position the input reference device and noise filter as close to the SERVOPACK as possible.
- Always install a surge absorber 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 mm^2 (preferably, plain stitch cooper wire).

*2. (twisted-pair symbol) 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 ⏚. Also be sure to ground the ground terminal ⏚.

Ground both coil assembly and magnetic way of the linear servomotor.

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.

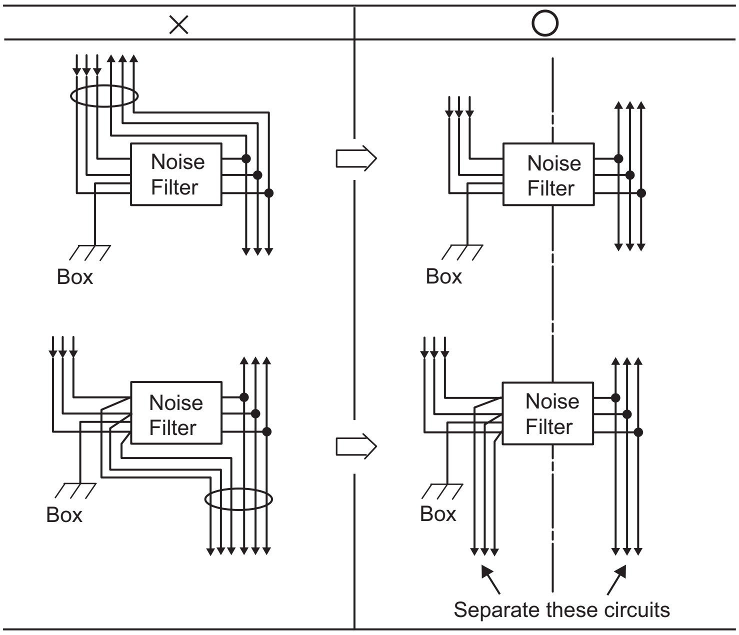
3.7.2 Precautions on Connecting Noise Filter

This section describes the precautions on installing a noise filter.

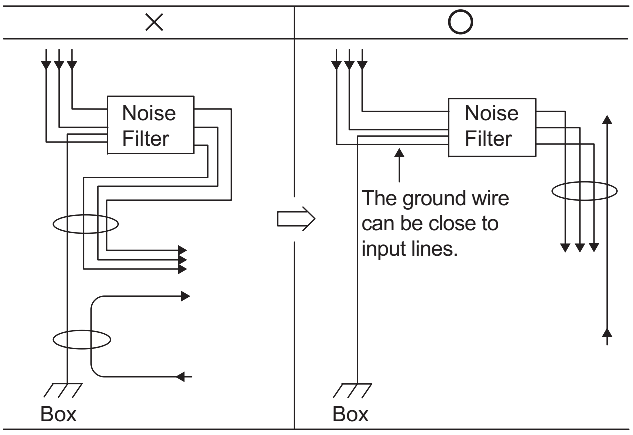
(1) Precautions on Using Noise Filters

Always observe the following installation and wiring instructions.

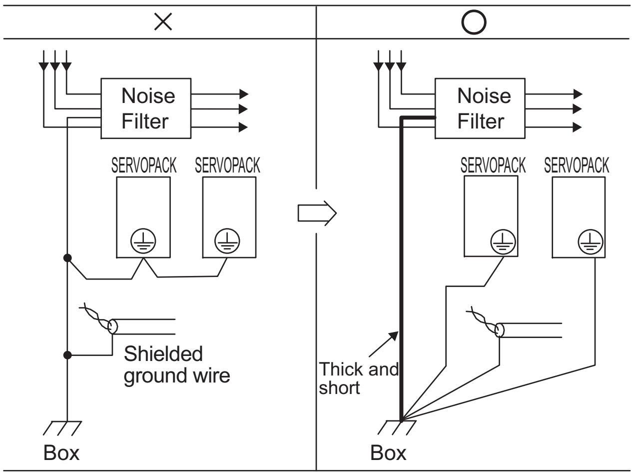
Do not put the input and output lines in the same duct or bundle them together.



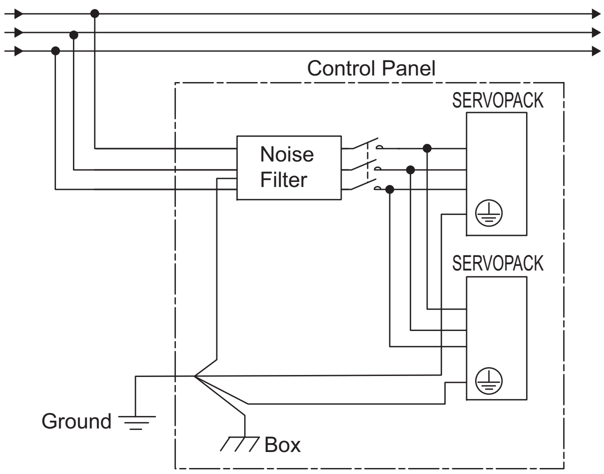
Separate the noise filter ground wire from the output lines.
Do not accommodate the noise filter ground wire, output lines and other signal lines in the same duct or bundle them together.



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



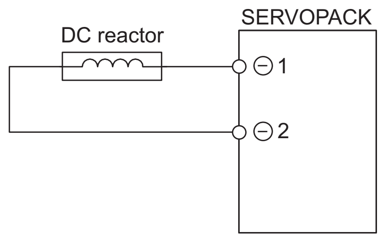
If a noise filter is located inside a control panel, connect the noise filter ground wire and the ground wires from other devices inside the control panel to the ground plate for the control panel first, then ground these wires.



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 Product Catalog* (KAEP S800000 42).
Connect a reactor as shown in the following diagram.

DC Reactor
Three-phase input



4

Trial Operation

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) Linear 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?

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 *1.7 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 Linear Servomotor without Load

For the trial operation for linear servomotor without load, refer to *Σ-V series User's Manual, Setup, Linear Motor* (SIEP S800000 44).

4.3 Trial Operation for Linear Servomotor without Load from Host Reference

For the trial operation for linear servomotor without load from host reference, refer to *Σ-V series User's Manual, Setup, Linear Motor* (SIEP S800000 44).

4.4 Trial Operation with the Linear Servomotor Connected to the Machine

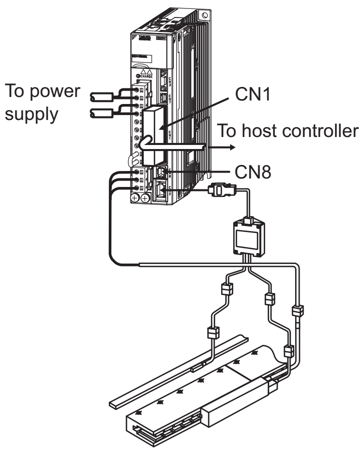
Perform the following steps for trial operation when the linear servomotor is connected to the machine. The steps are specified on the condition that trial operation has been completed in each control.

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	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. Note: • 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 force will be output. In this case, "Hbb" will be displayed on the Panel Operator or the Digital Operator.	*5.11 Safety Function* *5.2.3 Overtravel*
2	Set the necessary parameters for control mode.	*5.3 Operating Using Speed Control with Analog Voltage Reference* *5.4 Operating Using Position Control with Pulse Train Reference* *5.5 Operating Using Force Control with Analog Voltage Reference*
3	Connect the servomotor to the machine, while the power is turned OFF.  	
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.	*5.2.4 Stopping Servomotors after /S_ON Turned OFF or Alarm Occurrence*
5	Perform trial operation for the 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.	*Σ-V series User's Manual, Setup, Linear Motor (SIEPS80000044).*

Step	Operation	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 *10.4 Parameter Recording Table*. Then the trial operation with the servomotor connected to the machine is completed. Note: If the JUSP-OP05A digital operator is used, parameters can be saved. SigmaWin+, which is a tool for supporting the servo drive, can then manage the saved parameters in files.	

4.5 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 while using this function regardless of whether the motor is actually connected or not.

Note: The direction in which the motor is moving can only be checked with this function if the motor is connected.

4.5.1 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.

If the encoder cable is disconnected and then connected again during the test without motor after having started the test with the encoder cable connected, the utility functions that can be executed are limited to: Items marked with "○" in the "Motor not connected" column in the following utility function table.

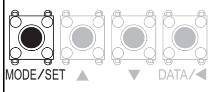
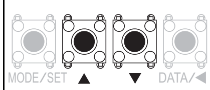
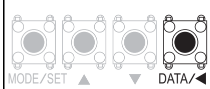
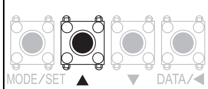
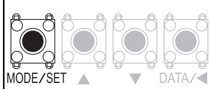
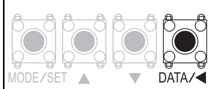
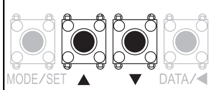
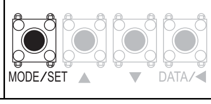
Fn No.	Contents	Can be used or not	
		Motor not connected	Motor connected
Fn000	Alarm traceback data display	○	○
Fn002	JOG operation	○	○
Fn003	Origin search	○	○
Fn004	Program JOG operation	○	○
Fn005	Initialize parameter settings	○	○
Fn006	Clear alarm traceback data	○	○
Fn008	Absolute encoder multi-turn reset and encoder alarm reset	×	○
Fn009	Automatic tuning of analog (speed, force) reference offset	○	○
Fn00A	Manual servo tuning of speed reference offset	○	○
Fn00B	Manual servo tuning of force 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	○	○
Fn014	Reset configuration error of option module	○	○
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	×	×
Fn202	Advanced autotuning by reference	×	×

Fn No.	Contents	Can be used or not	
		Motor not connected	Motor connected
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

4.5.2 Operating Procedure

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

Step	Display after Operation	Keys	Description
1	Fn000		Press the MODE/SET Key to select the utility function mode.
2	Pn00C		Press the UP or DOWN Key to select the Pn00C.
3	n.0000		Press the DATA/SHIFT Key for approximately one second. The current data of Pn00C is displayed.
4	n.0001		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	n.0001 (Display blinks)		Press the MODE/SET Key for approximately one second. The display began to blink and the test without motor is enabled.
6	n.0001		Press the DATA/SHIFT Key once to select the second digit of the data.
7	n.0101		Press the UP or DOWN Key to select the encoder type. n.□□0□ : incremental encoder (factory setting) n.□□1□ : absolute encoder
8	n.0101		Press the MODE/SET Key for approximately one second. The display began to blink and the incremental encoder is selected.
9	To enable the change in the setting, turn OFF the power and ON again.		

4.5.3 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	Disables the test without motor. (factory setting)	After restart	Setup
	n.□□□1	Enables the test without motor.		
	n.□0□□	Sets the linear scale type to incremental for the test without motor.		
	n.□1□□	Sets the linear scale type to absolute for the test without motor.		

(2) Mass Ratio

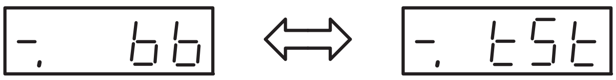
Pn103	Mass Ratio		Speed Position Force		
	Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
	0 to 20000	1%	100	Immediately	Tuning

4.5.4 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***.



Displayed alternately

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 run 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.

```
∗BB          −PRM/MON−
Un000=  00000
Un002=  00000
Un008=  0000000000
Un00D=  0000000000
```

(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 run 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

Operation

5.1 Control Selection

The controls supported by the SGDV 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. • 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□	Force Control (Analog voltage reference)	Controls the servomotor's output force by means of an analog voltage force reference. Use to output the required amount of force for operations such as pressing.	5.5 Operating Using Force 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. 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 Signal Allocations.*

IMPORTANT

Always input the servo ON signal before inputting the position/speed/force 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/force reference, be sure to implement safety measures for unexpected operation of the servomotor.
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. The servo will be turned OFF, if a reference is not sent during an alarm or if Pn50A is changed so the servo ON signal is not enabled. Confirm that the servo is turned OFF.

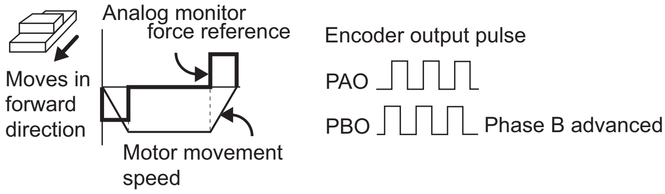
5.2.2 Servomotor Movement Direction

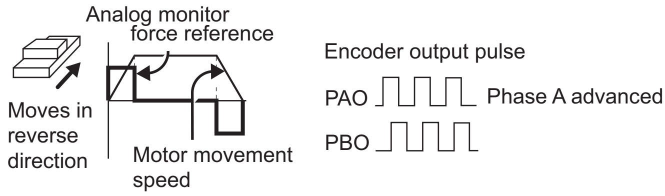
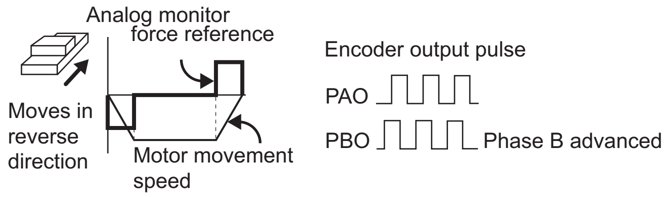
The servomotor movement direction can be reversed with parameter Pn000.

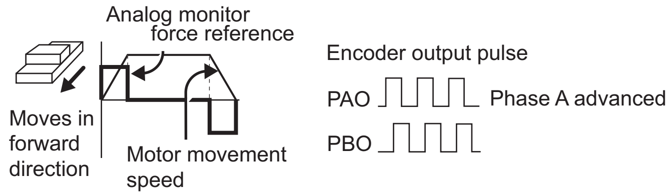
This causes the travel direction (+, -) of the shaft reverse, but the encoder pulse output and analog monitor signal polarity do not change.

Before performing this operation. Motor Phase (Pn080.1) must be set correctly. For the setting method, refer to *Σ-V series User's Manual, Setup, Linear Motor* (SIEPS80000044).

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

<table>
<tr><th colspan="2">Parameter</th><th>Meaning</th></tr>
<tr><td rowspan="2">Pn000</td><td>n.□□□0
Standard setting
(Forward movement is the linear scale counting up direction.)
(Factory setting)</td><td>■ Forward Reference


■ Reverse Reference

</td></tr>
<tr><td>n.□□□1
Reverse movement Mode
(Forward movement is the linear scale counting down direction.)</td><td>■ Forward Reference


■ Reverse Reference

</td></tr>
</table>

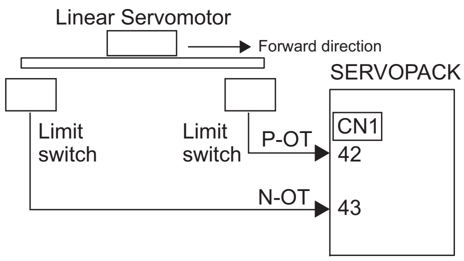
Note 1. The count of linear scale can be checked with Feedback Pulse Counter (Un00D).
2. According to the change of motor movement direction, the direction of overtravel forward/reverse is also switched.
For Pn000 = n.□□□0: The linear scale counting up direction is forward movement (P-OT).
For Pn000 = n.□□□1: The linear scale counting down direction is forward movement (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 oxidation of the contacts.



(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.

Movement 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 movement.)		
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 movement.)		

- 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 Signal Allocations*.

(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					
	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 force (Pn406), then places it into Zero Clamp (Servolock) Mode.		
	n.□□2□		Coast	Decelerates the servomotor with emergency stop force (Pn406), then places it into Coast (power OFF) Mode.		

- A servomotor under force 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 *5.2.4 Stopping Servomotors after /S_ON Turned OFF or Alarm Occurrence*.

(4) Emergency Stop Force for Overtravel

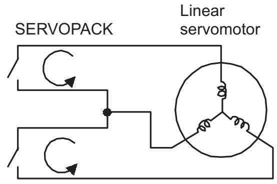
Pn406	Emergency Stop Force Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup

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

■ Zero Clamp Mode

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

5.2.4 Stopping Servomotors after /S_ON Turned OFF or Alarm Occurrence

The stopping method can be selected after the /S_ON (Servo ON) signal turns OFF or an alarm occurs.

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.
- If the main circuit power supply (L1, L2, and L3) or the control power supply (L1C, L2C or 24V, 0V depending on the SERVOPACK model) is turned OFF, but the /S_ON signal is not OFF, the stopping method for servomotor cannot be set by parameters. Use the following method to stop the servomotor.

  If turning OFF the main circuit power supply, but the /S_ON signal is not OFF, the servomotor will be stopped by dynamic braking.

  If turning OFF the control power supply, but the /S_ON signal is not OFF, the stopping method will vary with the SERVOPACK model. Two stopping methods are available.
  - SERVOPACKs stop by coasting
    Applicable models: SGDV-330A, 470A, 550A, 590A, 780A, 280D, 370D
  - SERVOPACKs stop by dynamic braking
    Applicable models: All SERVOPACKs other than those listed for coasting.
- If the servomotor must be stopped by coasting rather than by dynamic braking when the main circuit power supply or the control power supply is OFF, but the /S_ON signal is not OFF, arrange the sequence externally so the current will be cut off for wires U, V, and W.
- 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.
  For example, for multiple axes coupling operation (a twin-drive operation), machinery damage may result if a zero-speed stop alarm occurs for one of the coupled shafts and the other shaft stops by dynamic brake. In such cases, change the method to the DB stopping method.

(1) Stopping Method for Servomotor after /S-ON signal is Turned OFF

Use Pn 001.0 to select the stopping method for the servomotor after the /S_ON signal is OFF.

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

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 moves at very low speed.

Operation

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(2) Stopping Method for Servomotor When an Alarm Occurs

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 force 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.

Note: Refer to the information on alarm stopping methods in *9.1.1 List of Alarms*.

■ Stopping Method for Servomotor for Gr.1 Alarms (Alarms that Result in a DB Stop)

The stopping method of the servomotor when a Gr.1 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	Stops the servomotor by dynamic braking (DB), then holds it in Dynamic Brake Mode. [Factory setting]	After restart	Setup
	n.□□□1		Coast	Stops the servomotor by dynamic braking (DB), then places it into Coast (power OFF) Mode.		
	n.□□□2	Coast to a stop	Coast	Stops the servomotor by coasting and continues in Coast mode (power off).		

■ Stopping Method for Servomotor for Gr.2 Alarms (Alarms that Result in a Zero-speed Stop)

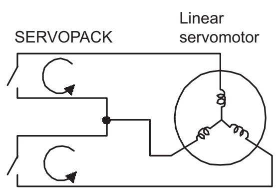
Parameter		Stop Mode	Mode After Stopping	Meaning	When Enabled	Classification
Pn00B	Pn001					
n.□□0□ [Factory setting]	n.□□□0 [Factory setting]	Zero-speed stopping	Dynamic Brake	Stops the servomotor by zero-speed stop, then holds it in Dynamic Brake Mode.	After restart	Setup
	n.□□□1		Coast	Stops the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

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

<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.

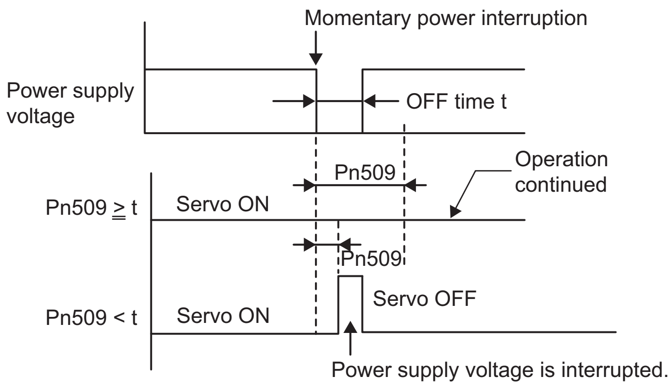


5.2.5 Power Loss Settings

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

Pn509	Instantaneous Power Cut Hold Time Speed Position Force				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 200 V SERVOPACKs is approximately 100 ms, but the time of the control power supply for the 100 V SERVOPACKs is approximately 65 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.
- The holding time of the control power supply (24 VDC) for the 400 V SERVOPACKs depends on the capability of the power supply (not included). Check the power supply before using the application.

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.

5.2.6 Motor Maximum Speed

By setting a lower speed, the following effects can be obtained.

- More delicate speed control and more strict protection by generating the overspeed alarm (A.510)
- Allows the upper limit of Encoder Output Pulse (Pn281) to be set higher.
  For details, refer to *5.3.6 Encoder Pulse Output*.

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

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

The force limit function detects a low voltage and limits the output current if the power supply voltage for the main circuit drops to a specified value or below.

This function complies with SEMI F47 standards for semiconductor production equipment.

Combining this function with the parameter for Instantaneous Power Cut Hold Time allows the servomotor to continue operating without stopping for an alarm or without recovery work even if the power supply voltage drops.

IMPORTANT

- The function is able to cope with instantaneous power interruptions in the voltage and time ranges stipulated in SEMI F47. An uninterruptible power supply (UPS) is required as a backup for instantaneous power interruptions that exceed these voltage and time ranges.
- The function is intended for voltage drops in the main circuit power supply. The following restrictions apply when it is used to provide an instantaneous power cut hold time in the control power supply. (There are no restrictions for the 200 V SERVOPACKs.)

  <Control Power Supply Restrictions>

  400 V SERVOPACKs: Provide the control power supply from a 24 VDC power supply that complies with SEMI F47 standards.

  100 V SERVOPACKs: Provide the control power supply from an uninterruptible power supply (UPS).

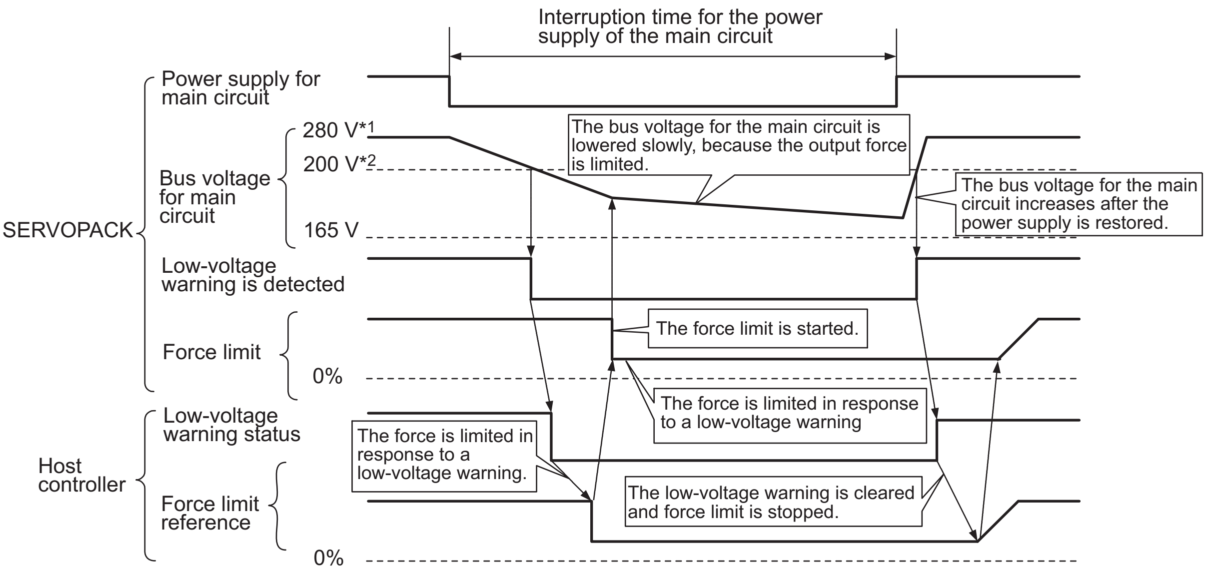
- Set the host controller and SERVOPACK force limit so that a force reference that exceeds the specified acceleration will not be output when the power supply for the main circuit is restored.
- Do not limit the force to values lower than the holding force for the vertical axis.
- This function controls force within the range of the SERVOPACK's capability when the power is cut. It is not intended for use under all load and operating conditions. Use the actual device to set parameters while confirming correct operation.
- Setting the Instantaneous Power Cut Hold Time lengthens the amount of time from when the power supply is turned OFF until the motor current turns OFF. Use the input/output of the servo ON signal to stop the motor current.

(1) Execution Method

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

■ Execution with Host Controller

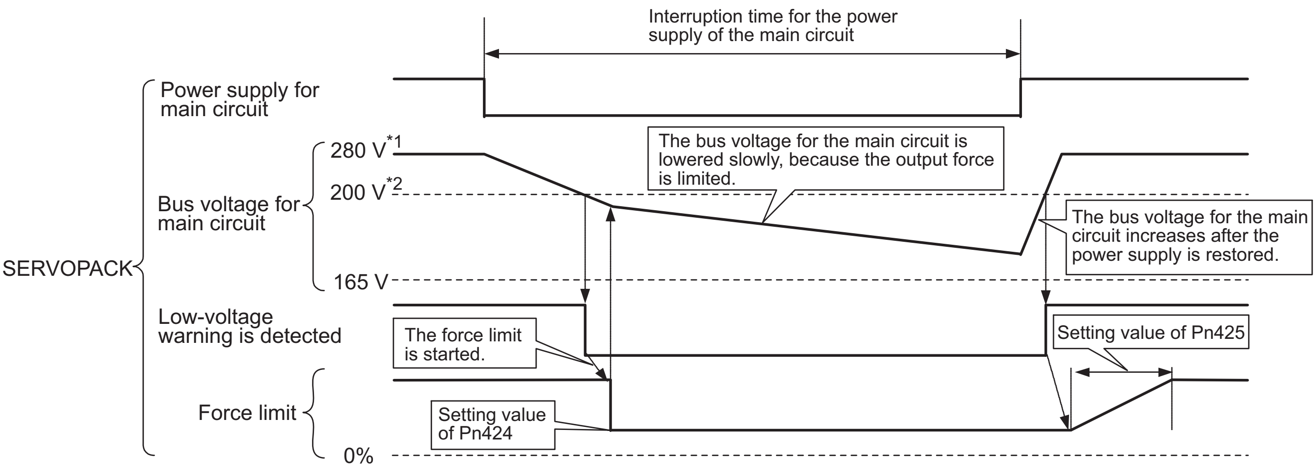
The host controller limits the force in response to a low-voltage warning.
The limited force is reset when the low-voltage warning is cleared.



∗1. 560 V for 400 V power supply.
∗2. 400 V for 400 V power supply.

■ Execution Independently with SERVOPACK

The force is limited in the SERVOPACK in response to a low-voltage warning.
The SERVOPACK resets the limited force 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.



∗1. 560 V for 400 V power supply.
∗2. 400 V for 400 V power supply.

(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 force.		
	n.□□2□	A main circuit low voltage is detected, and the SERVOPACK independently limits the force using Pn424 and Pn425.		

Pn424	Force Limit at Main Circuit Voltage Drop Speed Position Force				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1% *	50	Immediately	Setup
Pn425	Release Time for Force Limit at Main Circuit Voltage Drop Speed Position Force				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	1 ms	100	Immediately	Setup

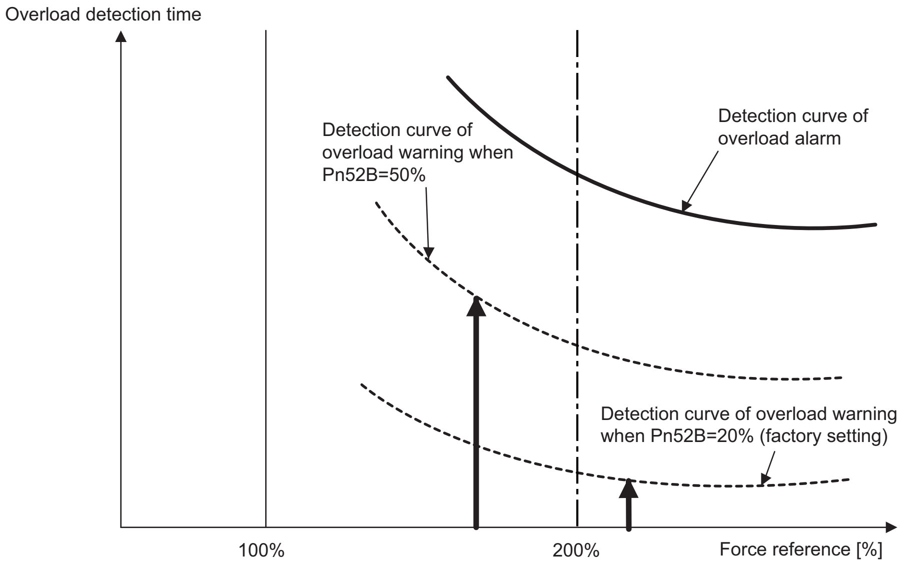
* The setting unit is a percentage of the rated force.

5.2.8 Setting Motor Overload Detection Level

In this SERVOPACK, the detection timing of the warnings and alarms can be changed by changing how to detect a overload warning (A.910) and overload (continuous overload) alarm (A.720).
The overload characteristics and the detection level of the overload (instantaneous overload) alarm (A.710) cannot be changed.

(1) Changing Detection Timing of Overload Warning (A.910)

The overload warning level is set by default to 20% so that an overload warning is detected in 20% of the time required to detect an overload alarm. The time required to detect an overload warning can be changed by changing the setting of the overload warning level parameter (Pn52B). This protective function enables the overload warning output signal (/WARN) serve as a protective function and to be output at the best timing for your system.
The following graph shows an example of the detection of an overload warning when the overload warning level (Pn52B) is changed from 20% to 50%. An overload warning is detected in half of the time required to detect an overload alarm.



Pn52B	Overload Warning Level — Speed / Position / Force				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 100	1%	20	Immediately	Setup

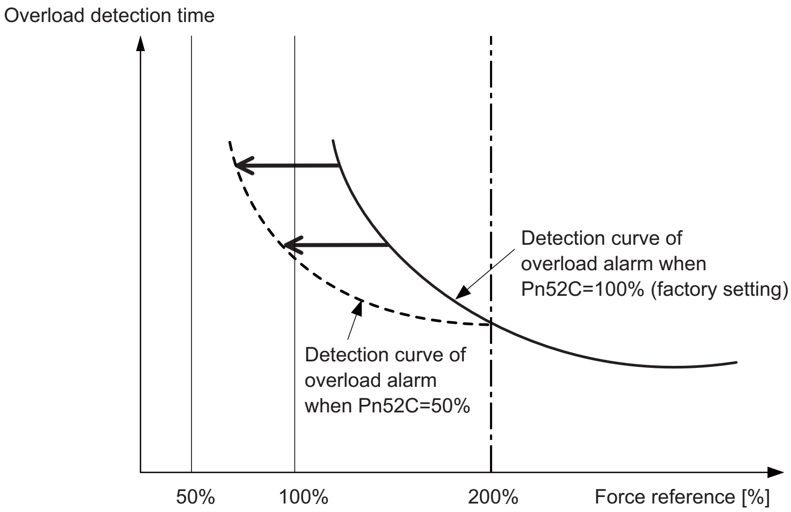
(2) Changing Detection Timing of Overload Alarm (A.720)

An overload alarm (continuous overload) can be detected earlier to protect the motor from overloading. The time required to detect an overload alarm can be shortened by using the derated motor base current obtained with the following equation. The detection level of the overload (instantaneous overload) alarm (A.710) cannot be changed.

Motor base current × Derating of base current at detecting motor overload of Motor (Pn52C)
= Derated motor base current

Motor base current: Threshold value of motor current to start calculation for overload alarm
Derating of motor base current at detecting motor overload of Motor (Pn52C): Derating of motor base current

The following graph shows an example of the detection of an overload alarm when Pn52C is set to 50%. The calculation for the overload alarm of motors starts at 50% of the motor base current and then an overload alarm will be detected earlier.
Changing the setting of Pn52C will change the detection timing of the overload alarm, so the time required to detect the overload warning will also be changed.



Pn52C	Derating of Base Current at Detecting Overload of Motor Speed Position Force				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	1%	100	After restart	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

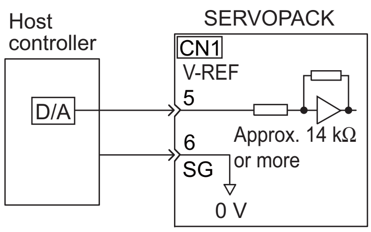
Input Specifications
Maximum allowable input voltage: ±12 VDC

<Setting Example>

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

Speed Reference Input	Movement Direction	Motor Speed	SGLGW-30A Servomotor
+6 V	Forward	Rated motor speed	1500 mm/s
-3 V	Reverse	1/2 rated motor speed	-750 mm/s
+1 V	Forward	1/6 rated motor speed	250 mm/s

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.

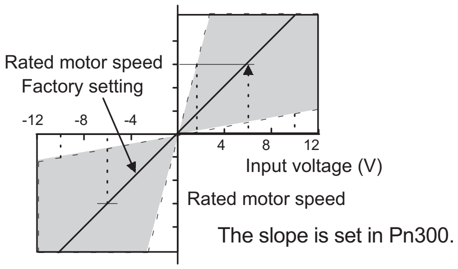


Note: Always use twisted-pair cable to control noise.

(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 (Speed, Position, Force)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	150 to 3000	0.01 V/rated speed	600	Immediately	Setup



5.3.2 Reference Offset Adjustment

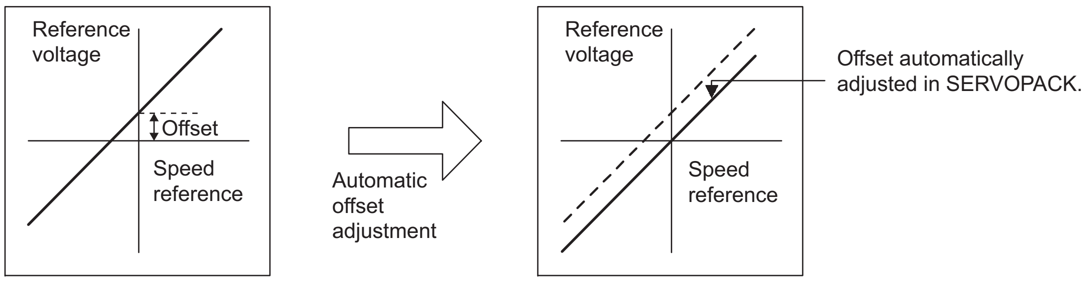
In speed control, the servomotor may move at a very low speed with an analog voltage reference of 0 V. This occurs because the reference voltage of the host or external circuit has a slight offset of a few millivolts.

If the servomotor moves at a very low 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 force) reference offset (Fn009). Manual adjustment uses the manual adjustment parameter for speed reference offset (fn00A).

(1) Automatic Adjustment of the Speed Reference Offset

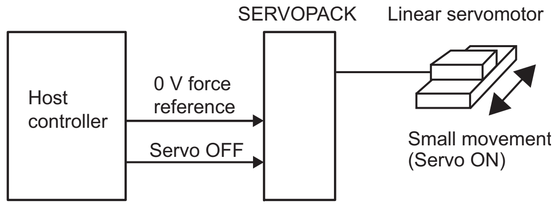
The automatic adjustment of the offset automatically measures the amount of offset and adjusts the reference voltage.



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.

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

Step	Display after Operation	Keys	Description
1			Turn OFF the servo ON (S/_ON) signal, and input the 0 V reference voltage from the host controller or external circuit. 
2	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
3	Fn009	▲ ▼	Press the UP or the DOWN Key to select Fn009.
4	rEF_o	DATA/◀	Press the DATA/SHIFT Key for approximately one second. "rEF_o" is displayed.
5	donE	MODE/SET	Press the MODE/SET Key. The reference offset is automatically adjusted. When completed, "donE" blinks for approximately one second.
6	rEF_o		After "donE" is displayed, "rEF_o" is displayed again.
7	Fn009	DATA/◀	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*.

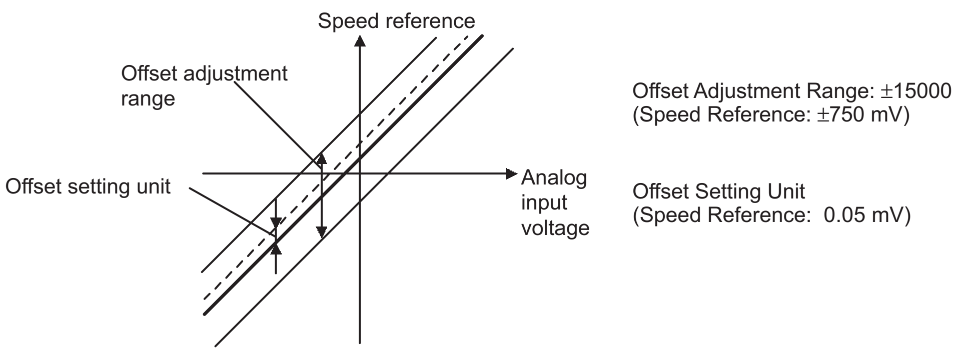
(2) Manual Servo Tuning of the Speed Reference Offset

This method adjust the offset inputting the amount of offset.

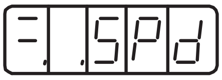
Use the speed reference offset manual servo tuning (Fn00A) in the following situations:

- 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	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn00A	▲ ▼	Press the UP or the DOWN Key to select Fn00A.
3		DATA/◄	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	00000	DATA/◄	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 offset.
7		MODE/SET	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	Fn00A	DATA/◄	Press the DATA/SHIFT Key for approximately one second. "Fn00A" is displayed again.

5.3.3 Soft Start

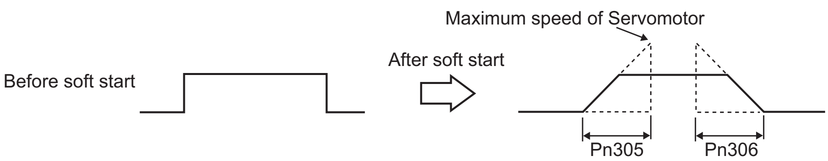
The soft start is a function to convert stepped speed reference input into constant acceleration and deceleration. The time can be set separately for acceleration and deceleration.

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.



Operation

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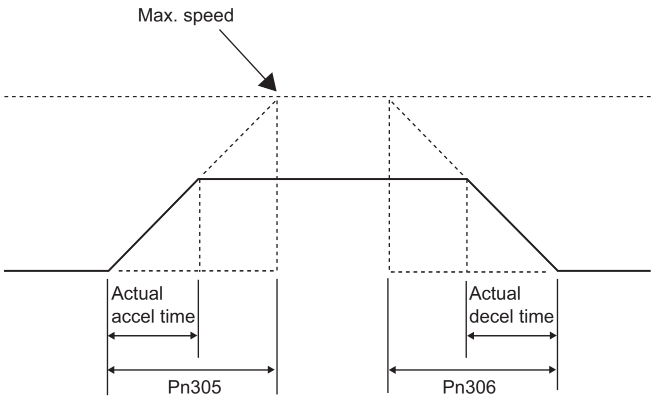
Actual accel/decel time can be calculated with the following equation.

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



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 — Speed, Position, Force				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	40	Immediately	Setup

5.3.5 Zero Clamp Function

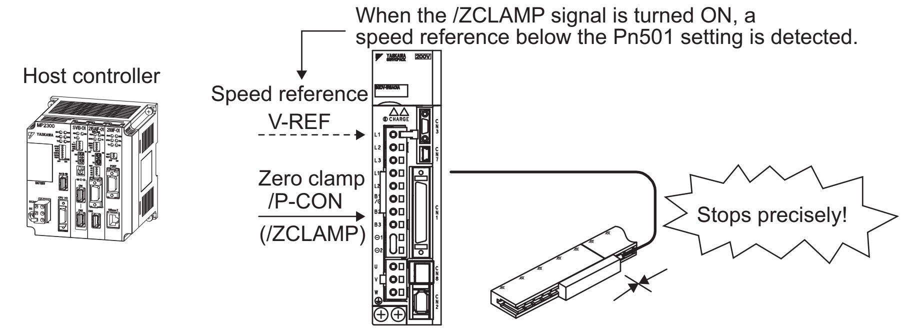
The zero clamp function locks the servo when the input voltage of the speed reference (V-REF) drops below the set speed in the zero clamp level parameter (Pn501) while the zero clamp signal (/P-CON or /ZCLAMP) is ON. The SERVOPACK internally forms a position loop, ignoring the speed reference.

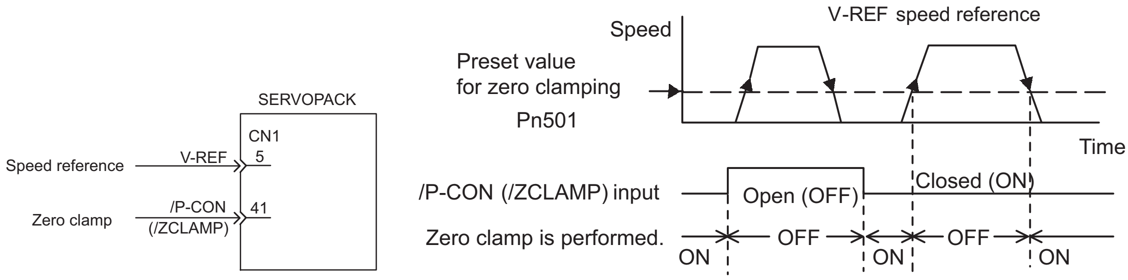
The servomotor is clamped within one pulse of when the zero clamp function is turned ON, and will still return to the zero clamp position even if it is forcibly moved by external force.

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*.

Operation

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(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 Signal Allocations*.

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 (Pn501).
			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) <=> Force control (analog reference)	/ZCLAMP		
	n.□□7□	Position control (pulse train reference) <=> Speed control (analog reference)	/ZCLAMP		
	n.□□9□	Force control (analog reference) <=> Speed control (analog reference)	/ZCLAMP		

Note: 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.

Pn580	Zero Clamp Level		Speed		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 mm/s	10	Immediately	Setup

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

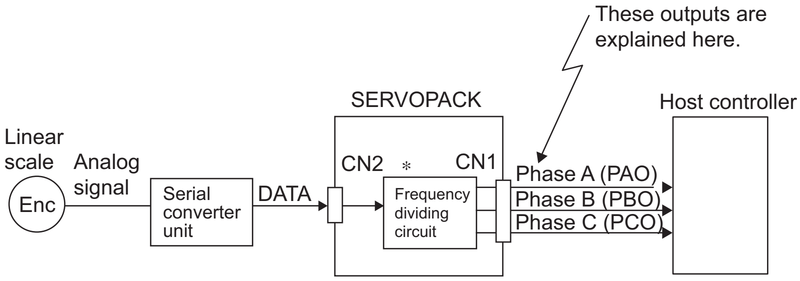
Encoder pulse output shows the feedback of position.
This signal processes the encoder output inside the SERVOPACK and then outputs externally in the pulse form.

Signals and output phase form are as shown below.

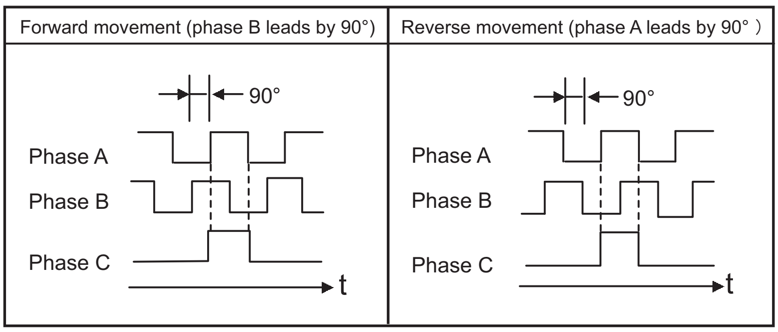
(1) Signals

Type	Signal Name	Connector Pin Number	Name
Output	PAO	CN1-33	Encoder output phase A
	/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*
	/PCO	CN1-20	Encoder output phase /C*

* Phase C: Refer to *(3) Encoder Output Signals from SERVOPACK with a Linear Scale by Reinshaw*.



(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 movement mode (Pn000.0 = 1), the output phase form is the same as that for the standard setting (Pn000.0 = 0).

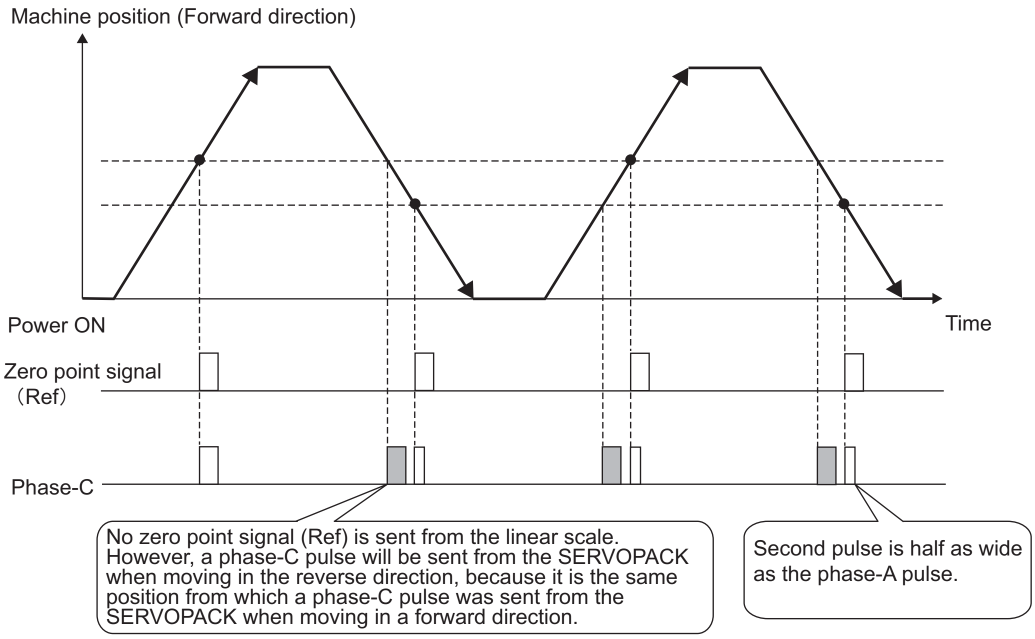
(3) Encoder Output Signals from SERVOPACK with a Linear Scale by Reinshaw

The output position of the zero point signal (Ref) may vary in some models of the linear scale made by Renishaw.

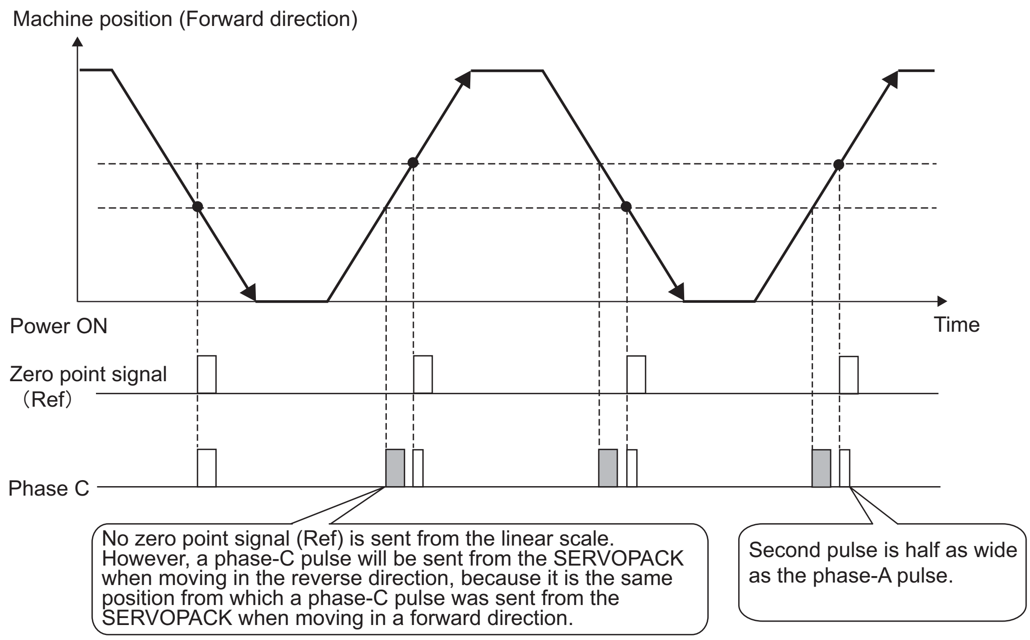
If using a Renishaw model, the phase-C pulses of the SERVOPACK are output at two positions.

For details on the specifications of the zero-point signals for a linear scale, refer to the manual for the Renishaw linear scale.

- When Passing the 1st Zero Point Signal (Ref) in Forward Direction after Power ON



- When Passing the 1st Zero Point Signal (Ref) in Reverse Direction after Power ON



(4) 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
Output	SG*	CN1-1, CN1-2	Signal Ground

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

5.3.7 Encoder Pulse Output Setting

Set the encoder pulse output using the following parameter.

Pn281	Encoder Output Pulses (Speed, Position, Force)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 4096	1 P{(Pn282) × 4}	20	After restart	Setup

Set the encoder output pulse for encoder pulse output signals (PAO, /PAO, PBO, /PBO) externally from the SERVOPACK.

Feedback pulses per linear scale pitch (Pn282) are divided inside the SERVOPACK by the value set in Pn281 before being output. Set according to the system specifications of the machine or host controller.

The setting range varies with the linear servomotor maximum speed (Pn385) and linear scale pitch (Pn282).

The upper limit value for Pn281 can be obtained by the following equation.

$$\text{Upper limit value for Pn281} = \frac{\text{Pn282}}{\text{Pn385}} \times 72$$

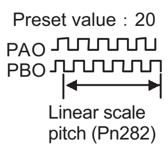
Note 1. When the scale pitch is 4 μm, the motor maximum speed is limited to 1 ms/s because of the maximum response frequency of serial converter unit.
2. If the set value is out of the setting range or does not satisfy the setting conditions, the alarm "Encoder Output Pulse Setting Error" (A.041) is output.
If the motor speed exceeds the upper limit value according to the set encoder output pulse, the alarm "Overspeed of Encoder Output Pulse Rate" (A.511) is output.
3. The upper limit of encoder output pulse is limited by the frequency dividing specification of serial converter unit.
4. When an absolute linear scale is used, the linear scale pitch becomes the value which is obtained by "resolution (μm/pulse)×29". (The set value in Pn282 becomes invalid.)

■ Setting Example (Incremental Encoder)

When the linear scale pitch = 20 μm (Pn282 = 20.00) and the motor maximum speed = 5 m/s (Pn385 = 50), Pn281 = 28 is accepted, but Pn281 = 29 is not accepted and A.041 is output.

■ Output Example (Incremental Encoder)

When Pn281 = 20 (20-edge output (5-pulse output) per linear scale pitch),



5.3.8 Speed Coincidence Signal Setting

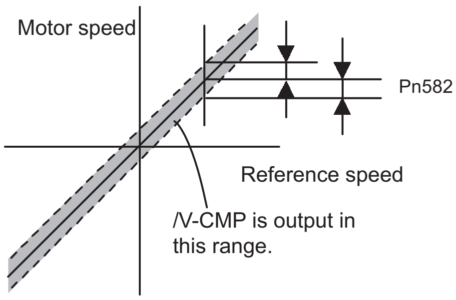
The speed coincidence (/V-CMP) output signal is output when the actual servomotor speed during speed control is the same as the speed reference input. The host controller uses the signal as an interlock.

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 *3.3.2 Output Signal Allocations*.

Pn582	Speed Coincidence Signal Output Width Speed				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1 mm/s	10	Immediately	Setup

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



/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 force control.

<Example>

The /V-CMP signal is output at 1900 to 2100 mm/s if the Pn582 is set to 100 and the reference speed is 2000 mm/s.

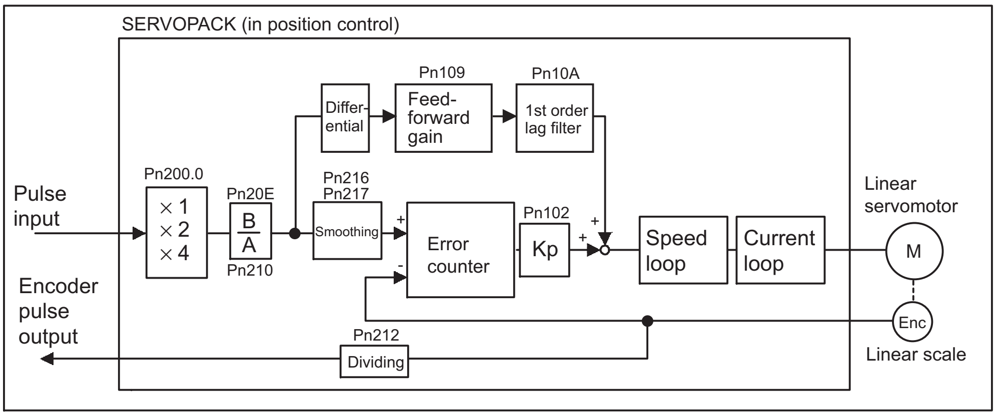
5.4 Operating Using Position Control with Pulse Train Reference

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.

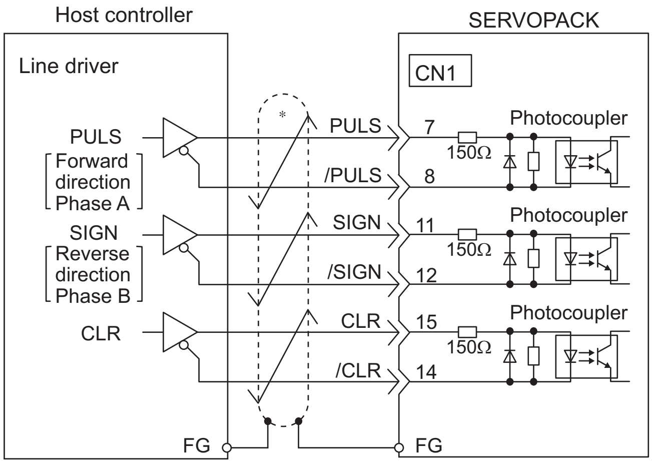
Parameter		Meaning	When Enabled	Classification
Pn200	n.0□□□	Uses the reference input filter for line driver signal. (Maximum reference frequency: 1 Mpps) [Factory setting]	After restart	Setup
	n.1□□□	Uses the reference input filter for open-collector signal. (Maximum reference frequency: 200 kpps)		
	n.2□□□	Uses the reference input filter for line driver signal. (Maximum reference frequency: 4 Mpps)		

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: SN75ALS174 manufactured by Texas Instruments Inc., or MC3487 or equivalent

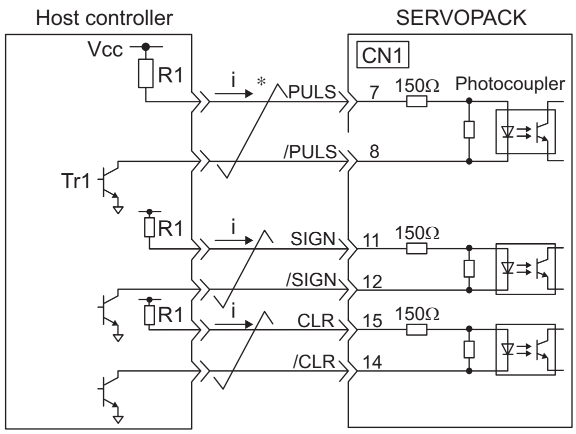
■ Line Driver Output



* represents twisted-pair wires.

■ Open-collector Output

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



■ Example

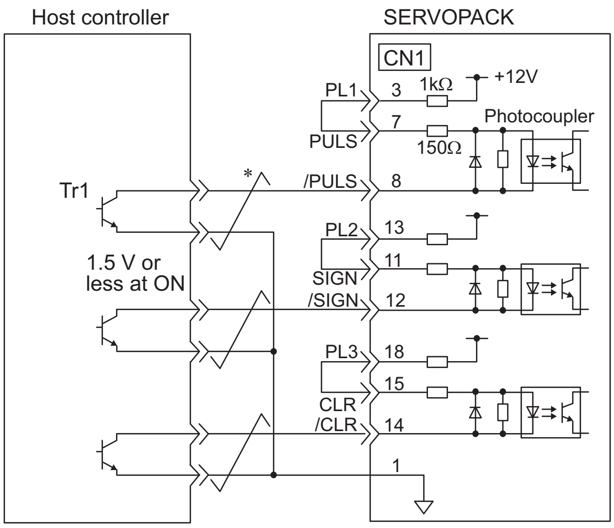
- When Vcc is +24 V: R1 = 2.2 kΩ
- When Vcc is +12 V: R1 = 1 kΩ
- When Vcc is +5 V: R1 = 180 Ω

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

* represents twisted-pair wires.

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.



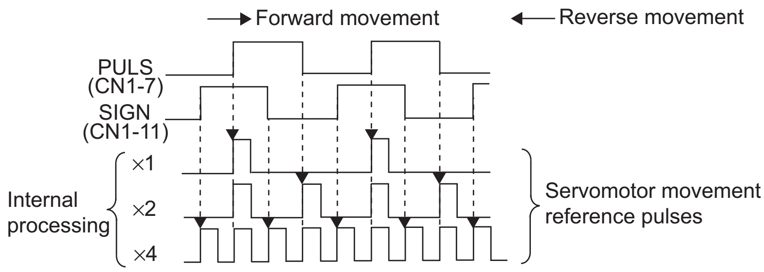
* represents twisted-pair wires.

(4) Pulse Reference Input Signal Form

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

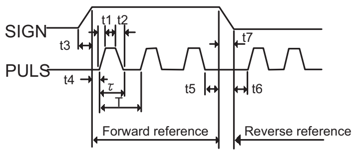
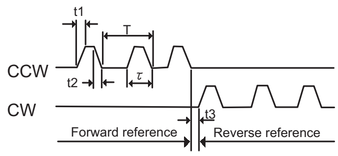
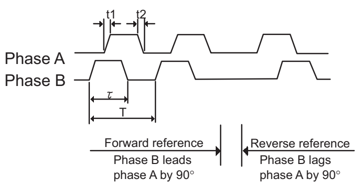
Parameter		Reference Pulse Form	Input Pulse Multi-plier	Forward Movement Reference	Reverse Movement Reference
Pn200	n.□□□0	Sign + pulse train (Positive logic) (Factory setting)	–	PULS (CN1-7) SIGN (CN1-11) H level	PULS (CN1-7) SIGN (CN1-11) L level
	n.□□□1	Forward direction pulse + Reverse direction pulse (Positive logic)	–	PULS (CN1-7) L level SIGN (CN1-11)	PULS (CN1-7) SIGN (CN1-11) L level
	n.□□□2	Two-phase pulse train with 90° phase differential	×1	90° PULS (CN1-7) SIGN (CN1-11)	90° 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) L level	PULS (CN1-7) SIGN (CN1-11) H level
	n.□□□6	Forward direction pulse + Reverse direction pulse (negative logic)	–	PULS (CN1-7) H level SIGN (CN1-11)	PULS (CN1-7) SIGN (CN1-11) H level

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

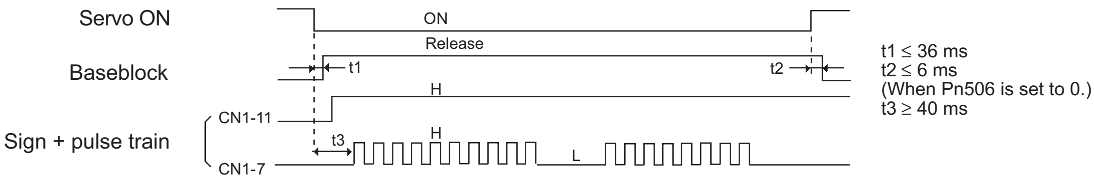
Reference pulse form and input timing are as shown below.

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 ≤ 0.025 μs t4, t5, t6 ≥ 0.5 μs τ ≥ 0.125 μs T-τ = 0.125 μs	Sign (SIGN) H = Forward reference L = Reverse reference
Forward direction pulse + reverse direction pulse Maximum reference frequency: 4 Mpps* (In case of open-collector output, maximum reference frequency: 200 kpps)		t1, t2 ≤ 0.025 μs t3 ≥ 0.5 μs τ ≥ 0.125 μs T-τ = 0.125 μs	
Two-phase pulse train with 90° phase differential (phase A + phase B) Maximum reference frequency: 1 Mpps* (In case of open-collector output, maximum reference frequency: 200 kpps)		t1 ≤ 0.1 μs t2 ≥ 0.1 μs τ ≥ 0.5 μs T-τ = 0.5 μs	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
×4 input pulse multiplier: 1 Mpps

(6) I/O Signal Timing Example

Input/Output signal timing are as shown below.



Note: 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 (t3).

5.4.2 Clear Signal

Clear input signal sets SERVOPACK error counter to zero.

(1) Signal Setting

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

(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) Clears at ON	After restart	Setup
	n.□□1□	Clears at the rising edge.	CLR (CN1-15) ON Clears here just once.		
	n.□□2□	Clears at OFF. Position error pulses do not accumulate while the signal is at OFF.	CLR (CN1-15) Clears at OFF		
	n.□□3□	Clears at the falling edge.	CLR (CN1-15) OFF Clears here just once.		

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 move slowly due to drift in the speed loop.

■ Pulse Width of Clear Signal

When the parameter Pn200.1 is set to 0 or 2, the width of a clear signal must be at least 250 µs to reset the error counter.
When the parameter Pn200.1 is set to 1 or 3, the width of a clear signal must be at least 20 µs to reset the error counter.

(3) 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) Scale Feedback Resolution

• Incremental Encoder

The scale feedback resolution from the SERVOPACK is 1/256 of the scale pitch (Pn282).

Scale Pitch	Pulse Resolution
40 µm	0.156 µm
20 µm	0.078 µm
4 µm	0.016 µm

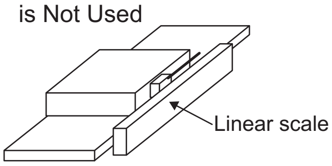
• Absolute Encoder

Model	Resolution
ST781A	0.5 µm
ST782A	
ST783A	0.1 µm
ST784A	

(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. One reference pulse from the host controller, i.e., the minimum position data unit, is called a reference unit.

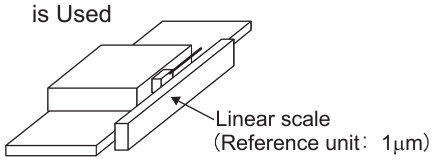
When the Electronic Gear is Not Used



To move a workpiece 10 mm

The scale pitch is 20 µm. Therefore,
10 × 1000 ÷ 20 × 256=128000 pulses
128000 pulses are input as reference pulses.
The equation must be calculated at the host controller.

When the Electronic Gear is Used



To move a workpiece 10 mm using reference units

1 reference unit is 1 µm.
To move a workpiece 10 mm (10000 µm),
1 pulse = 1 µm,
10000/1=10000 pulses.
Input 10000 pulses as reference input.

(3) Electric Gear Ratio

Set the electric gear ratio using Pn20E and Pn210.

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

The electronic gear ratio to be set can be calculated by the following equation:

Electronic gear ratio: $\frac{B}{A} = \frac{Pn20E}{Pn210} = \frac{\text{Travel distance per reference unit}}{\text{Scale pitch}} \times 256$

> **IMPORTANT**
>
> Electronic gear ratio setting range: 0.001 ≤ Electronic gear ratio (B/A) ≤ 4000
>
> 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.

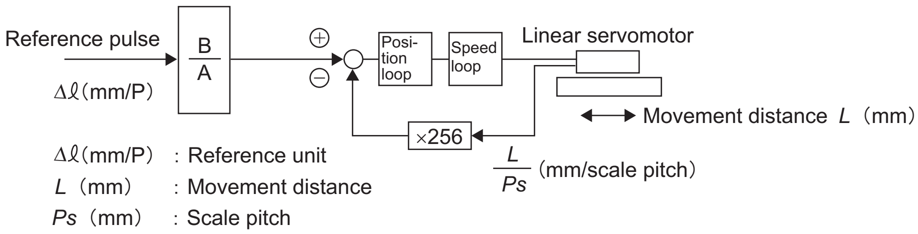
(4) Procedure for Setting the Electronic Gear Ratio

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

Step	Operation
1	Check the scale pitch. Check the scale pitch of linear scale used.
2	Determine the reference unit used. Determine the reference unit from the host controller, considering the machine specifications and positioning accuracy.
3	Calculate the electronic gear ratio. Use the electronic gear ratio equation to calculate the ratio.
4	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.



$$\frac{L}{\Delta \ell} \times \left(\frac{B}{A}\right) = 256 \times \frac{L}{Ps}$$

$$\left(\frac{B}{A}\right) = \frac{256 \times L \times \Delta \ell}{Ps \times L} = \frac{256 \times \Delta \ell}{Ps}$$

Set A and B with the following parameters.

$\boxed{A}$: Pn210 $\boxed{B}$: Pn20E

(6) Electronic Gear Ratio Setting Example

An example of electronic gear ratio setting is given below.

Step	Operation	Load Configuration	
1	Check the scale pitch.	0.02 mm (20 μm)	
2	Determine the reference unit.	1 reference unit: 0.001 mm (1 μm)	
3	Calculate the electronic gear ratio.	$\frac{B}{A} = \frac{1(\mu m)}{20(\mu m)} \times 256$	
4	Set parameters.	Pn20E	256
		Pn210	20

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			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.1 ms	0*	Immediately	Setup
Pn217	Average Movement Time of Position Reference			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	0.1 ms	0*	Immediately	Setup

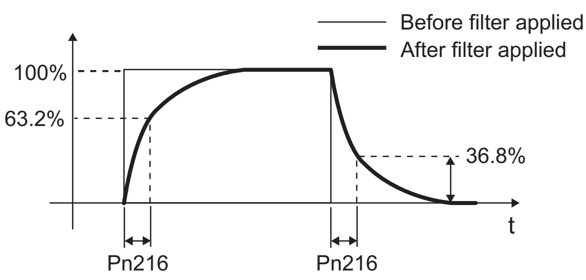
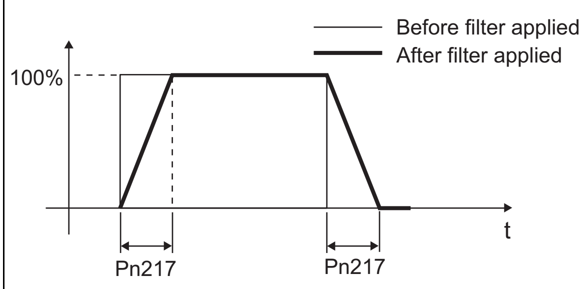
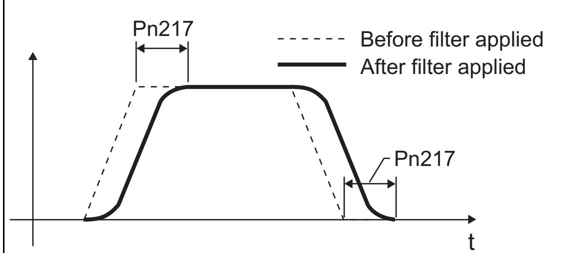
* When set to 0, a filter becomes ineffective.

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.

<Note>

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

Acceleration/Deceleration Filter	Average Movement Time Filter
 Response waveform for stepwise input	 Response waveform for stepwise input
	 Response waveform for ramp reference input

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.

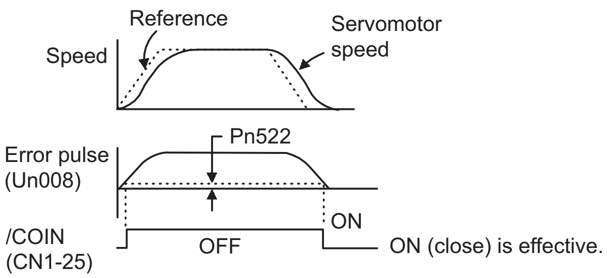
Use this signal to check the completion of positioning from the host controller.

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 *3.3.2 Output Signal Allocations*.
- 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 force control mode.

<table>
<tr><td rowspan="3">Pn522</td><td colspan="4">Positioning Completed Width   Position</td><td rowspan="2">Classification</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Factory Setting</td><td>When Enabled</td></tr>
<tr><td>0 to 1073741824(2^{30})</td><td>1 reference unit</td><td>7</td><td>Immediately</td><td>Setup</td></tr>
</table>

- 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.

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□□□	/COIN Output Timing	When the absolute value of the position error is below the positioning completed width setting. [Factory 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.

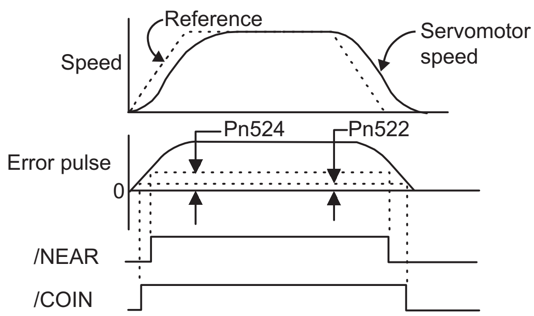
This signal is generally used in combination with the positioning completed output signal.

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 *3.3.2 Output Signal Allocations* for details.

Pn524	NEAR Signal Width Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824(2^{30})	1 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).

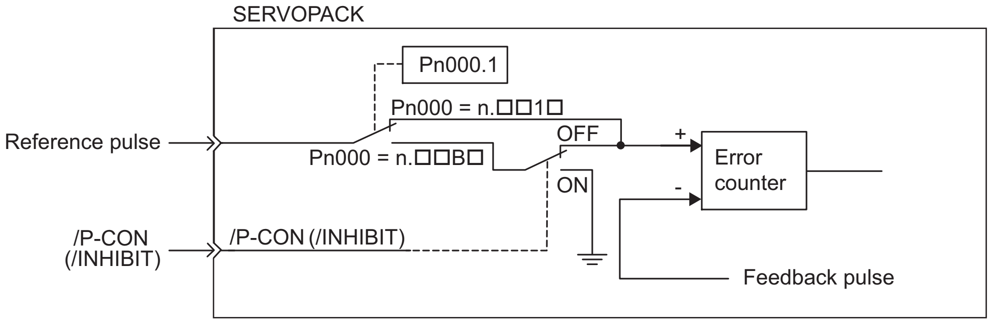
Operation

5

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 Signal Allocationss to Input Terminals*.

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)⇔Force control (analog reference)	/INHIBIT		

5.5 Operating Using Force Control with Analog Voltage Reference

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

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

Select the force control with analog voltage reference with Pn000.

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

5.5.1 Basic Settings for Force Control Mode

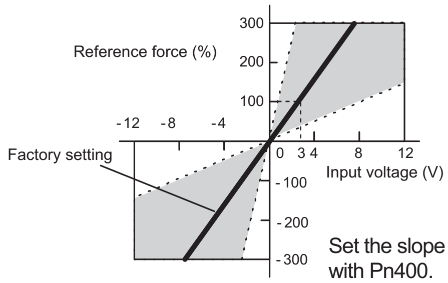
Set the following signal and parameter for force control with analog voltage reference.

(1) Signal Setting

Set the following input signals.

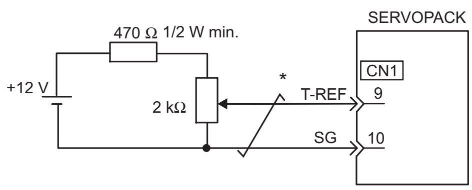
Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-9	Force Reference Input
	SG	CN1-10	Signal Ground for Force Reference Input

Max. allowable input voltage is ±12 VDC.



<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.

• Checking the Internal Force Reference
Use the following method to check the internal force reference.

1. With the panel operator:
Use the Monitor Mode (Un002). Refer to *8 Monitor Modes (Un□□□)*.

2. With an analog monitor:
The internal force 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 force reference (T-REF) that is necessary to operate the servomotor at the rated force.

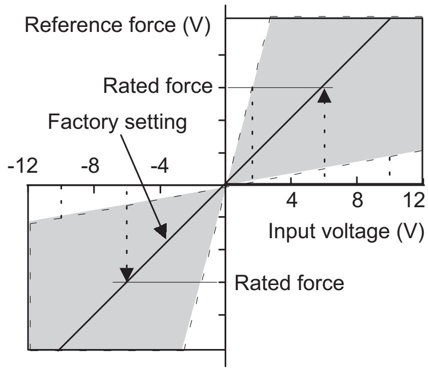
Pn400	Force Reference Input Gain (Speed, Position, Force)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	0.1 V/rated force	30	Immediately	Setup

<Example>

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

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

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



5.5.2 Adjustment of Reference Offset

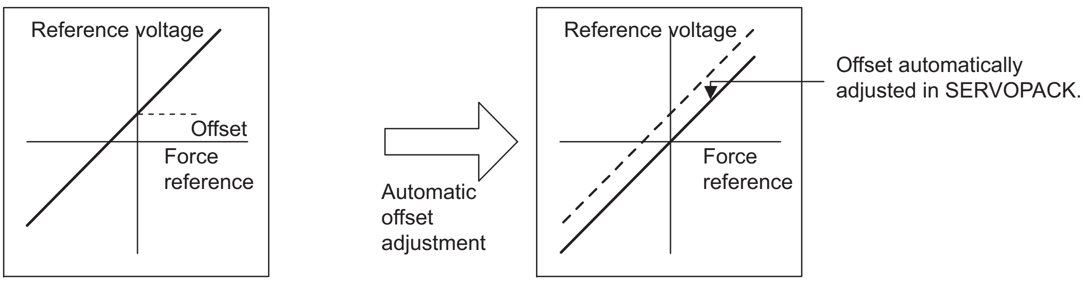
In force control, the servomotor may move at a very low speed with an analog voltage reference of 0 V. This occurs because the reference voltage of the host controller or external circuit has a minute offset of a few millivolts. It is called "offset".

If the servomotor moves 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 force) reference offset (Fn009). Manual adjustment uses the manual adjustment parameter for force reference offset (Fn00B).

(1) Automatic Adjustment of Force Reference Offset

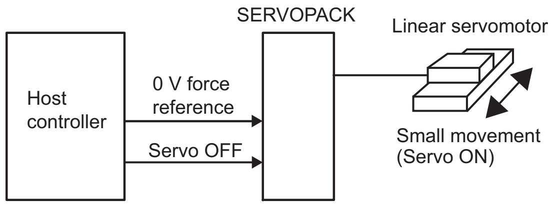
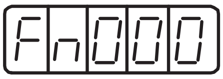
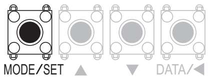
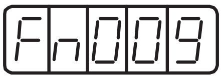
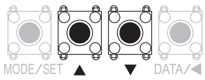
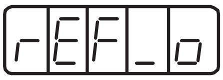
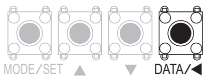
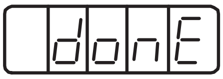
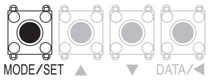
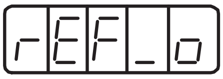
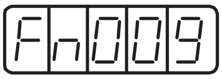
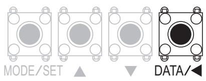
The automatic adjustment of force reference offset (Fn009) automatically measures the offset and adjusts the reference voltage.



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

Use the following steps for automatic adjustment of the force 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 servo ON (S/_ON) signal, 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 force reference offset described in *(2) Manual Adjustment of Reference Offset*.

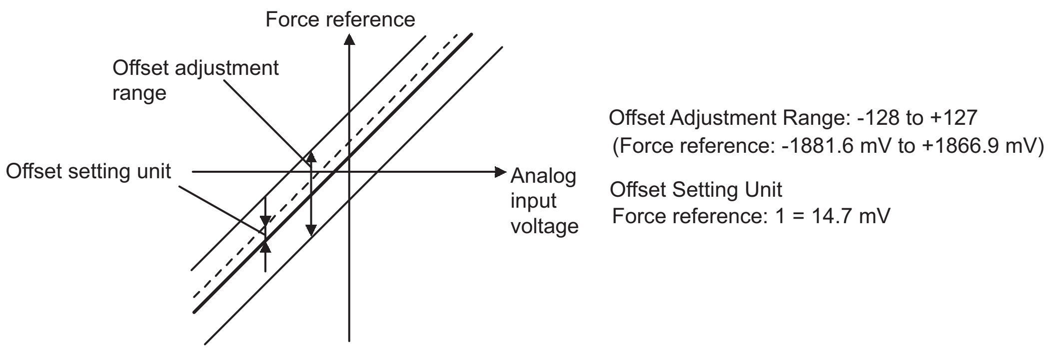
(2) Manual Adjustment of Reference Offset

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

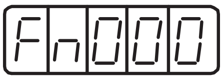
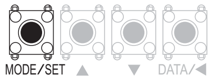
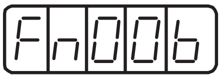
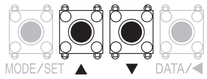
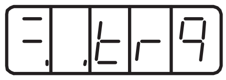
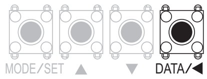
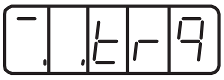
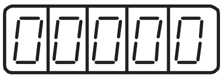
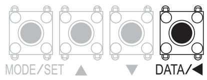
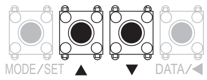
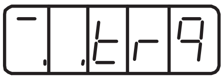
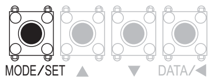
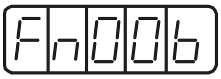
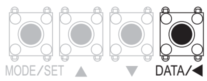
Manual servo tuning of the force reference offset (Fn00B) is used in the following cases.

- 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 force reference offset.

The offset adjustment range and setting units are as follows:



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

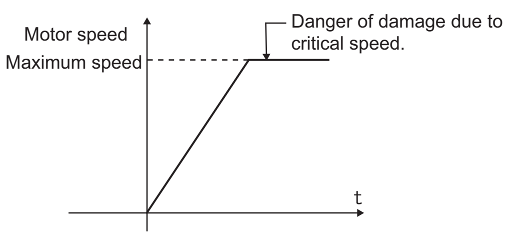
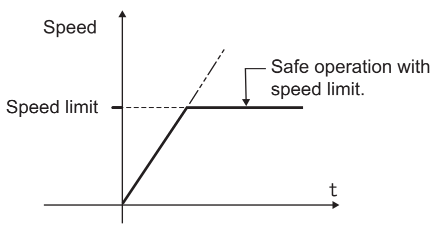
Step	Display after Operation	Keys	Description
1			Press the MODE/SET Key to select the utility function mode.
2			Press the UP or the DOWN Key to select Fn00B.
3			Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4			Turn ON the servo ON (/S-ON) signal. The display shown on the left appears.
5			Press the DATA/SHIFT Key for less than one second. The force 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 Force Control

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

The reference force is used to control the servomotor but not the motor speed. If the reference force for the load of the machine is too large, the force of the motor may be greater than the load of the machine. The motor will move at a much greater speed. If so, 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 force 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.

With No Speed Limit	With Speed Limit
	

Refer to the following parameters for speed limit.

Operation

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(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 *3.3.2 Output Signal Allocations*.

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

Select the speed limit mode with Pn002.

Parameter		Meaning	When Enabled	Classification
Pn002	n.□□0□	Uses the value set in Pn480 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 Pn480.

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

Pn480	Speed Limit During Force Control (Force)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 mm/s	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 movement number and the value of Pn480 as speed limit value.	After restart	Setup
	n.□□1□	Use the smaller value between excessive speed detection speed and the value of Pn480 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

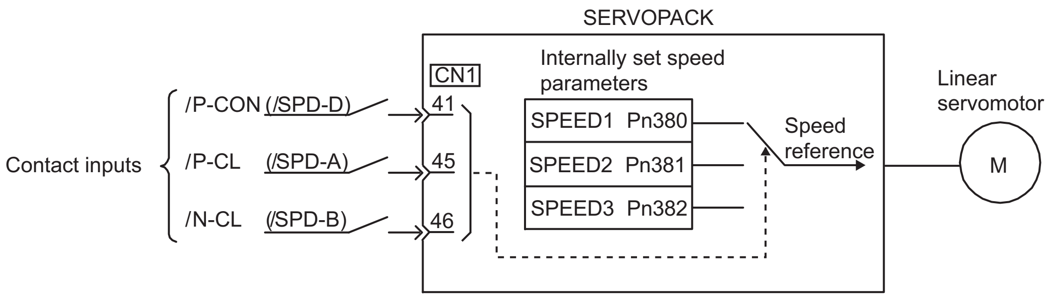
Inputs an analog voltage reference as the servomotor speed limit value during force control.

<Notes>
- The smaller value of the speed limit input from the V-REF on the Pn480 (Speed Limit during Force 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 Speed Position Force				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	150 to 3000	0.01 V/rated speed	600	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 movement 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.

Pn380	Internally Set Speed 1		Speed		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 mm/s	10	Immediately	Setup

Pn381	Internally Set Speed 2		Speed		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 mm/s	20	Immediately	Setup

Pn382	Internally Set Speed 3		Speed		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 mm/s	30	Immediately	Setup

Note: The maximum speed of the servomotor is used whenever the value exceeds the maximum speed is set in the Pn380 to Pn382.

(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 Movement Direction	Speed
/P-CON	/P-CL	/N-CL		
OFF	OFF	OFF	Forward	Stops at 0 of the internally set speed.
	OFF	ON		Pn380: Internally Set Speed 1 (SPEED1)
	ON	ON		Pn381: Internally Set Speed 2 (SPEED2)
	ON	OFF		Pn382: Internally Set Speed 3 (SPEED3)
ON	OFF	OFF	Reverse	Stops at 0 of the internally set speed.
	OFF	ON		Pn380: Internally Set Speed 1 (SPEED1)
	ON	ON		Pn381: Internally Set Speed 2 (SPEED2)
	ON	OFF		Pn382: Internally Set Speed 3 (SPEED3)

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

Input Signal			Motor Movement Direction	Speed
/SPD-D	/SPD-A	/SPD-B		
OFF	OFF	OFF	Forward	Stops at 0 of the internally set speed.
	OFF	ON		Pn380: Internally Set Speed 1 (SPEED1)
	ON	ON		Pn381: Internally Set Speed 2 (SPEED2)
	ON	OFF		Pn382: Internally Set Speed 3 (SPEED3)
ON	OFF	OFF	Reverse	Stops at 0 of the internally set speed.
	OFF	ON		Pn380: Internally Set Speed 1 (SPEED1)
	ON	ON		Pn381: Internally Set Speed 2 (SPEED2)
	ON	OFF		Pn382: Internally Set Speed 3 (SPEED3)

<Note>
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) ⇔ 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	Pn380: Internally Set Speed 1 (SPEED1)
ON	ON	Pn381: Internally Set Speed 2 (SPEED2)
ON	OFF	Pn382: Internally Set Speed 3 (SPEED3)

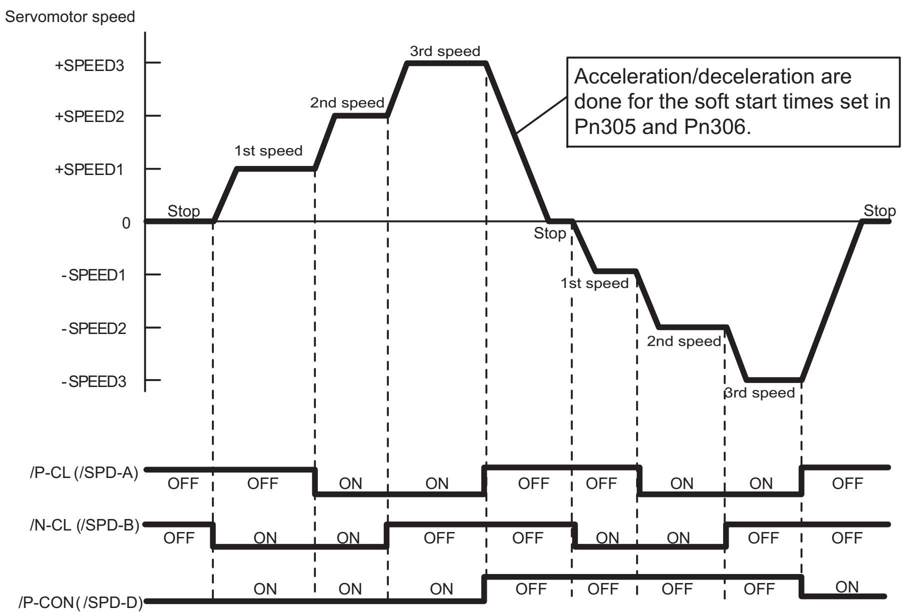
■ Changing Sequence Signal Allocations for Each Signal (Pn50A.0 = 1)

Input Signal			Speed
/SPD-A	/SPD-B	/C-SEL	
OFF	OFF	OFF	Stops at 0 of the Internally Set Speed
OFF	ON	OFF	Pn380: Internally Set Speed 1 (SPEED1)
ON	ON	OFF	Pn381: Internally Set Speed 2 (SPEED2)
ON	OFF	OFF	Pn382: 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 Signal Allocations to Input Terminals*.

5.6.2 Example of Operating with Internally Set Speed

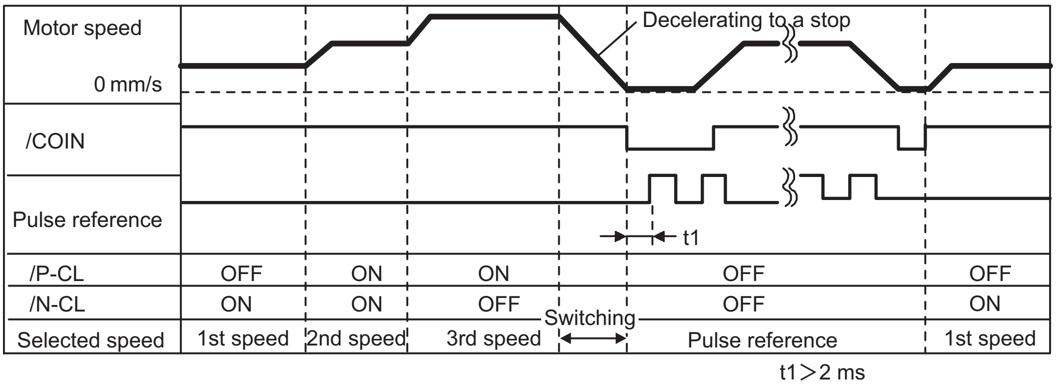
Operating example of speed control with internally set speed is as shown below.
This example combines speed control with internally set speed with soft start function.
The shock that results when the speed is changed can be reduced by using the soft start function.



IMPORTANT

- When Pn000.1 = 5 (Internally set speed control ⇔ 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.
2. The t1 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.
3. 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.
4. The position control can be changed to the speed control while the motor is moving.

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) ⇔ Force control (analog voltage reference)		
	n.□□7□	Position control (pulse train reference) ⇔ Speed control (analog voltage reference)		
	n.□□8□	Position control (pulse train reference) ⇔ Force control (analog voltage reference)		
	n.□□9□	Force 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	Force
			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 Signal Allocations*.

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)

<table>
<tr><th rowspan="2">Type</th><th rowspan="2">Signal Name</th><th rowspan="2">Connector Pin Number</th><th rowspan="2">Setting</th><th colspan="5">Pn000 Setting and Control Mode</th></tr>
<tr><th>n.□□7□</th><th>n.□□8□</th><th>n.□□9□</th><th>n.□□A□</th><th>n.□□B□</th></tr>
<tr><td rowspan="2">Input</td><td rowspan="2">/P-CON</td><td rowspan="2">CN1-41</td><td>ON</td><td>Speed</td><td>Force</td><td>Speed</td><td>Zero clamp</td><td>INHIBIT</td></tr>
<tr><td>OFF</td><td>Position</td><td>Position</td><td>Force</td><td>Speed</td><td>Position</td></tr>
</table>

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

<table>
<tr><th rowspan="2">Type</th><th rowspan="2">Signal Name</th><th rowspan="2">Connector Pin Number</th><th rowspan="2">Setting</th><th colspan="5">Pn000 Setting and Control Mode</th></tr>
<tr><th>n.□□7□</th><th>n.□□8□</th><th>n.□□9□</th><th>n.□□A□</th><th>n.□□B□</th></tr>
<tr><td rowspan="6">Input</td><td rowspan="2">/C-SEL</td><td rowspan="6">Must be allocated</td><td>ON</td><td>Speed</td><td>Force</td><td>Speed</td><td rowspan="2">Can not be switched.</td><td rowspan="2">Cannot be switched.</td></tr>
<tr><td>OFF</td><td>Position</td><td>Position</td><td>Force</td></tr>
<tr><td rowspan="2">/ZCLAMP</td><td>ON</td><td rowspan="2">Cannot be switched.</td><td rowspan="2">Cannot be switched.</td><td rowspan="2">Cannot be switched.</td><td>Zero clamp</td><td rowspan="2">Cannot be switched.</td></tr>
<tr><td>OFF</td><td>Speed</td></tr>
<tr><td rowspan="2">/INHIBIT</td><td>ON</td><td rowspan="2">Cannot be switched.</td><td rowspan="2">Cannot be switched.</td><td rowspan="2">Cannot be switched.</td><td rowspan="2">Cannot be switched.</td><td>Reference pulse inhibited</td></tr>
<tr><td>OFF</td><td>Position</td></tr>
</table>

Operation

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5.8 Limiting Force

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

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

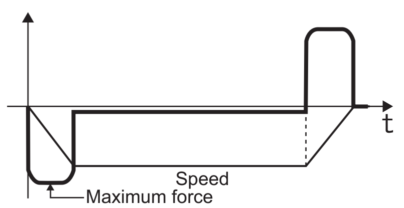
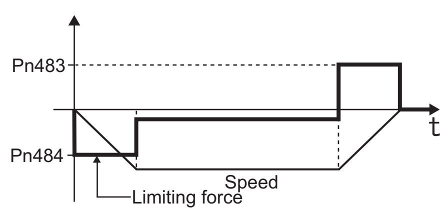
5.8.1 Internal Force Limit

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

Pn483	Forward Force Limit	Speed	Position	Force	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	30	Immediately	Setup

Pn484	Reverse Force Limit	Speed	Position	Force	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	30	Immediately	Setup

Alalog Monitor Output

No Internal Force Limit (Maximum Force Can Be Output)	Internal Force Limit
	

The setting unit is a percentage of rated force.

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

5.8.2 External Force Limit

Use this function to limit force 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 force limit ON	The value set in Pn483 or Pn404 (whichever is smaller)
			OFF	Forward external force limit OFF	Pn483
Input	/N-CL	CN1-46 [Factory setting]	ON	Reverse external force limit ON	The value set in Pn484 or Pn405 (whichever is smaller)
			OFF	Reverse external force limit OFF	Pn484

Note: When using external force 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 Signal Allocations*.

(2) Related Parameters

Set the following parameters for external force limit.

Pn404	Forward External Force Limit		Speed Position Force		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	100	Immediately	Setup
Pn405	Reverse External Force Limit		Speed Position Force		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 force. (Rated force limits 100 %).

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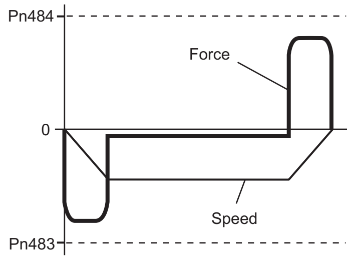
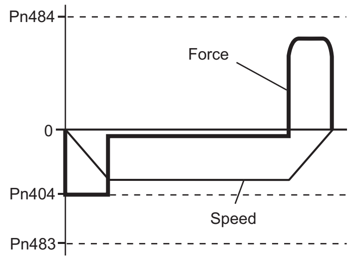
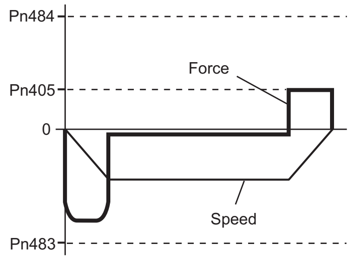
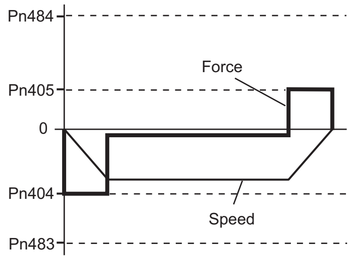
(3) Changes in Output Force during External Force Limiting

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

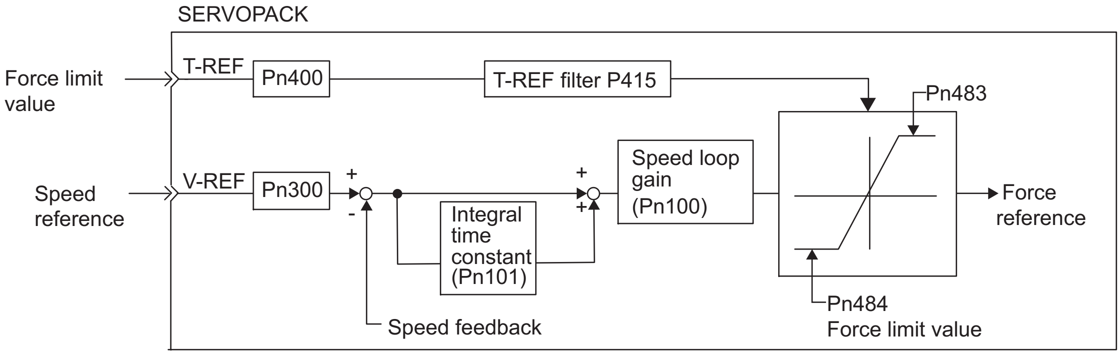
In this example, the servomotor movement direction is Pn000.0 = 0 (linear scale counting up direction = forward).

/N-CL Status		/P-CL (Forward external force limit input) OFF	/P-CL (Forward external force limit input) ON
/N-CL (Reverse external force limit input)	OFF		
	ON		

5.8.3 Force Limiting Using an Analog Voltage Reference

Force limiting by analog voltage reference limits force by assigning a force 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 force control.

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



There is no polarity in the input voltage of the analog voltage reference for force limiting. The absolute values of both + and - voltages are input, and a force 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 force by analog voltage reference.

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

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

Maximum allowable input voltage is ±12 VDC.

(2) Related Parameter

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

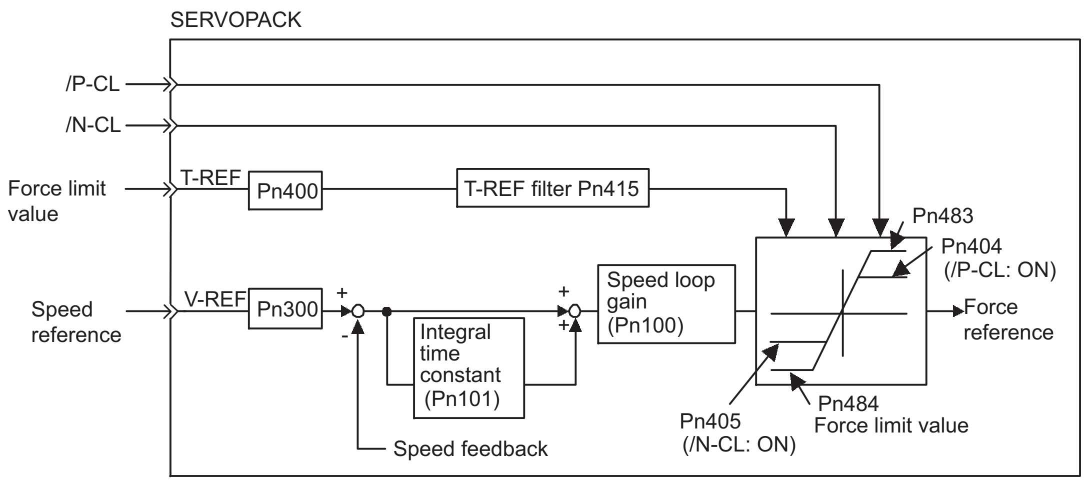
Parameter		Meaning	When Enabled	Classification
Pn002	n.□□□1	Speed control option: Uses the T-REF terminal to be used as an external force limit input.	After restart	Setup

Pn415	T-REF Filter Time Constant Speed Position Force				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	0	Immediately	Setup

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

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

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



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

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(1) Input Signals

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

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

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

Maximum allowable input voltage is ±12 VDC.

Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit Value
Input	/P-CL	CN1-45 [Factory setting]	ON	Forward external force limit ON	The analog voltage reference limit or the value set in Pn483 or Pn404 (whichever is smaller)
			OFF	Forward external force limit OFF	Pn483
Input	/N-CL	CN1-46 [Factory setting]	ON	Reverse external force limit ON	The analog voltage reference limit or the value set in Pn484 or Pn405 (whichever is smaller)
			OFF	Reverse external force limit OFF	Pn484

Note 1. When using the force limit by external force 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 Signal Allocations*.
2. This setting is enabled when Pn002.0 is set to 3.

(2) Related Parameters

Set the following parameters for force limit by external force 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 an analog voltage reference input.	After restart	Setup

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

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

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

Pn415	T-REF Filter Time Constant		Speed Position Force		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	0	Immediately	Setup

5.8.5 Checking Output Force Limiting during Operation

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

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

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

5.9 Setting Absolute Linear Scale

The Σ-V SERVOPACK is compatible with an absolute linear scale manufactured by Mitutoyo. (Model: ABS ST78□A)

With an absolute position system using an absolute linear scale, homing is not necessary every time the power is turned ON, so an immediate start of operation is possible.

⚠ WARNING

- Be sure to correctly set up the absolute position system.
  Be sure to set up the system again after the system configuration is altered by changes such as the replacement of the SERVOPACK, the absolute linear scale, or any of their parts.
  Failure to observe this warning may cause the servomotor to overrun and may result in injury or damage to the product.

5.9.1 Setup Procedure

Step	Operation	Reference
1	Perform all necessary wiring and set the required safety function.	*3 Wiring and Connection*
2	Turn ON the SERVOPACK and confirm that the SERVOPACK operates correctly.	
3	Write the motor parameters and the scale constants into the absolute linear scale using the specified tool.	*5 Trial Operation* of *Σ-V series User's Manual, Setup, Linear Motor* (SIEP S800000 44)
4	Perform polarity detection (Fn080).*1	*5.9.4 Polarity Detection (Fn080)*
5	Perform origin setting (Fn020).*2	*5.9.5 Origin Setting (Fn020)*
6	Turn the power supply OFF and then ON again.	
7	Perform polarity detection (Fn080).	*5.9.4 Polarity Detection (Fn080)*

*1. Perform this step only when the servomotor must move from the current position to a position that will be set as the origin after an electrical current is applied to the servomotor.

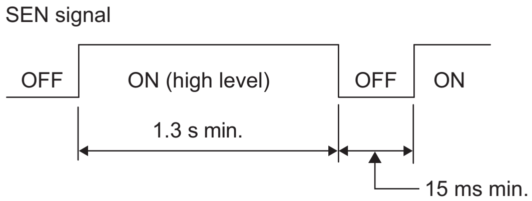
*2. This step can be skipped in the following cases.
- After setting the origin for the absolute linear scale itself
- After replacing only the SERVOPACK

5.9.2 Setting the SEN Signal

The SEN signal must be set for the SERVOPACK to output absolute data. Set the SEN signal as follows.

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.



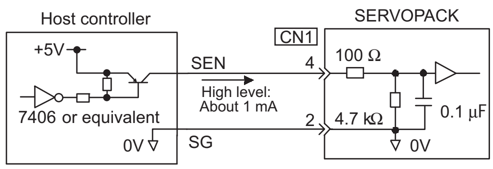
- SEN Signal cannot be received during Servo ON.

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 serial 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."

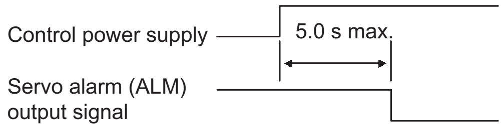


We recommend a PNP transistor.
Signal levels
High: 4.0 V min., Low: 0.8 V max.

5.9.3 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.

5.9.4 Polarity Detection (Fn080)

The polarity detection function is used to detect the polarity and save the servomotor phase data in the SERVOPACK. After executing this function once, polarity detection is not necessary every time the power is turned ON, so an immediate start of operation is possible.

Follow the steps below to detect the polarity.

Step	Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn080	▲ ▼	Press the UP or the DOWN Key to select Fn080.
3	-.PdEt	DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	.PdEt	MODE/SET	Press the MODE/SET Key to start polarity detection.
5	-.PdEt		After polarity detection is completed, the display shown on the left will appear. The servo for the linear servomotor will turn OFF.
6	Fn080	DATA/◀	Press the DATA/SHIFT Key for approximately one second. "Fn080" is displayed again.

5.9.5 Origin Setting (Fn020)

The origin setting function is used to set the current position as the origin. After executing this function once, origin setting is not necessary every time the power is turned ON, so an immediate start of operation is possible.

Follow the steps below to detect the polarity.

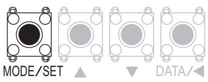
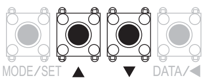
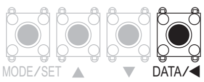
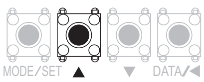
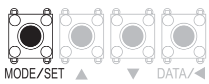
> **⚠ IMPORTANT**
>
> - After execution of origin setting, the servo ready (/S-RDY) signal will become inactive and the servo will be unable to draw power since the system position data will have been changed. Always turn the power supply OFF and then ON again after execution of origin setting.
> - After execution of origin setting, the servomotor phase data in the SERVOPACK will be discarded. Execute polarity detection (Fn080) again to save the servomotor phase data in the SERVOPACK.

(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

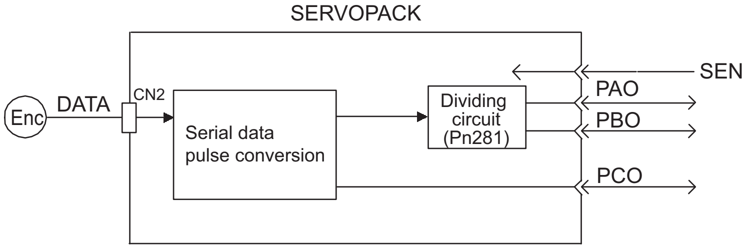
Step	Display after Operation	Keys	Operation
1	Fn000		Press the MODE/SET Key to select the utility function mode.
2	Fn020		Press the UP or the DOWN Key to select Fn020.
3	OSEt 1		Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	OSEt5		Press the UP Key until "OSET5" 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	donE		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	OSEt5	After one second	After "donE" is displayed, "OSET5" is displayed again.
7	Fn020		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.		

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.

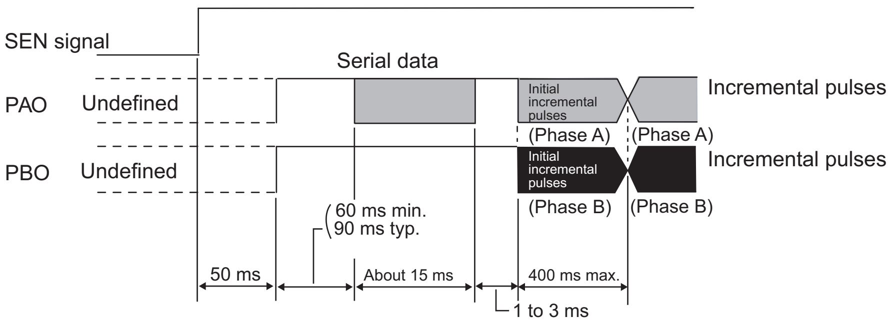


Signal Name	Status	Contents
PAO	At initialization	Serial data Initial incremental pulses
	Normal time	Incremental pulses
PBO	At initialization	Initial incremental pulses
	Normal time	Incremental pulses
PCO	Always	Origin pulses

(2) Absolute Encoder Transmission Sequence and Contents

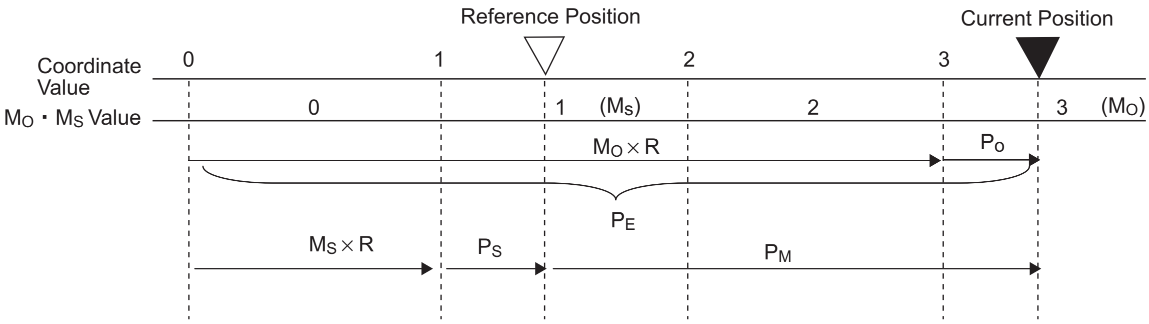
■ Absolute Encoder Transmission Sequence

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:
Outputs the current position as serial data after dividing using the value set at Pn281.
Unit: 1048576 pulse/serial data "1"

Initial incremental data:
Outputs the current position as pulse data after dividing using the value set at Pn281.
Pulse range: 0 to 1048576 pulse
Output pulse rate: Approx. 2.7 Mpps



Final absolute data P_M is calculated by following formula.

$P_E = M \times R + P_O$

$P_M = P_E - P_S$

Note: In the case of reverse direction mode (Pn000.0 = 1), use the above-mentioned formula.

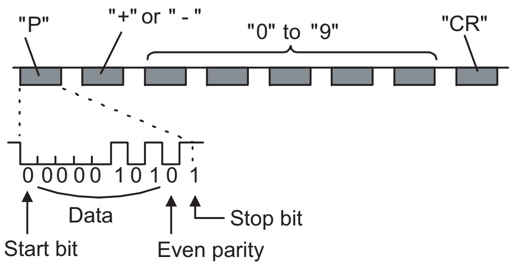
Signal	Meaning
P_E	Current value of scale
M_O	Serial data value at current position
P_O	Initial incremental pulses at current position
M_S	Serial data value at reference position
P_S	Initial incremental pulses at reference position
P_M	Current value required for the user’s system.
R	1048576

Note: When processing the absolute encoder reception sequence, do not perform counter reset using PCO output.

(3) Detailed Signal Specifications

Refer to the following detailed signal specifications.

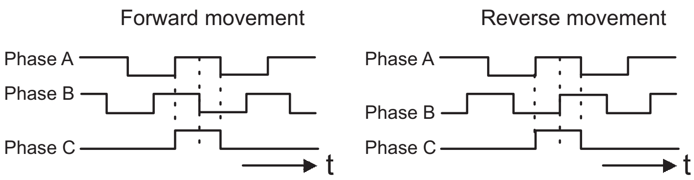
■ PAO Serial Data Specifications

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	8 characters, as shown below.  Note: • The range for absolute value data is "P+00000" (CR) or "P-00000" (CR). • The serial data range is "+32767" to "-32768." When this range is exceeded, the data changes from "+32767" to "-32678" or from "-32678" to "+32767." • In the case of reverse direction mode (Pn000.0 = 1), the sign reverses.

■ 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*.

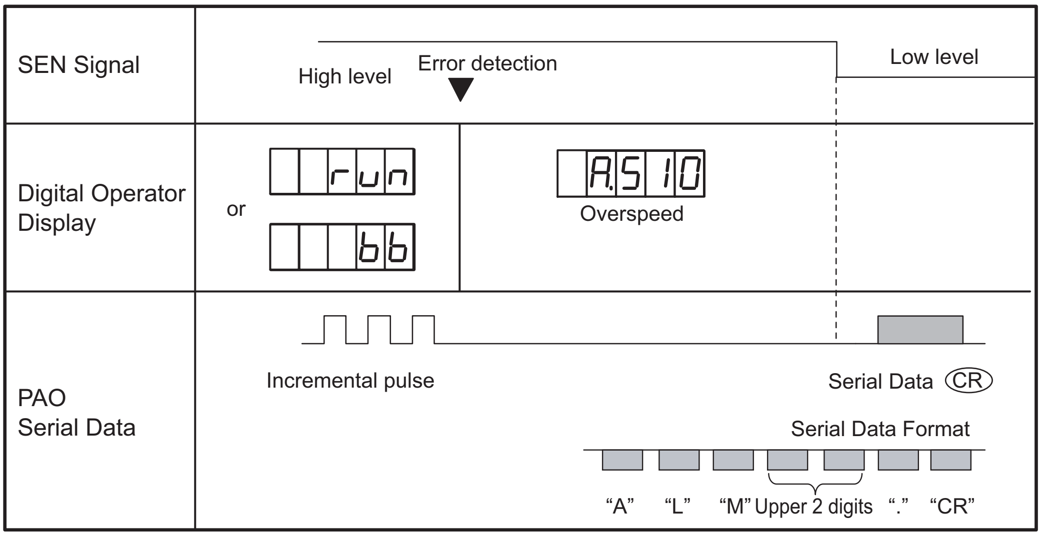


(4) Transferring Alarm Contents

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.



5.10 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 *9.1.1 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.

> **IMPORTANT**
> Be sure to eliminate the cause before resetting the alarm.

■ 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).

The /ALM-RST signal can be allocated to another output terminal using Pn50E. For details, refer to *3.3.2 Output Signal Allocations*.

■ 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 *3.3.2 Output Signal Allocations*.

(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□□□	Outputs alarm codes alone for alarm codes ALO1, ALO2 and ALO3.	After restart	Setup
	n.1□□□	Outputs both alarm and warning codes for alarm codes ALO1, ALO2 and ALO3, and outputs an alarm code when an alarm occurs.		

5.10.3 Movement Detection Output Signal (/TGON)

This output signal indicates that the servomotor is moving at the speed set for Pn581 or a higher speed.

The status of the signal can be checked with the panel operator or digital operator.

(1) Signal Specifications

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/TGON	CN1-27, 28 [Factory setting]	ON (close)	Servomotor is moving (motor speed is above the setting in Pn581.)
			OFF (open)	Servomotor is moving (motor speed is below the setting in Pn581.)

The /TGON signal can be allocated to another output terminal using Pn50E. For details, refer to *3.3.2 Output Signal Allocations*.

(2) Related Parameters

Set the range in which the /TGON signal is output using the following parameter.

Pn581	Zero Speed Level		Speed Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 10000	1 mm/s	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. This is when the main circuit power supply is ON, a hardwire baseblock is not applied, and no servo alarms occur.

* If an absolute linear scale 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.

The /S-RDY signal can be allocated to another output terminal using Pn50E. For details, refer to *3.3.2 Output Signal Allocations*.

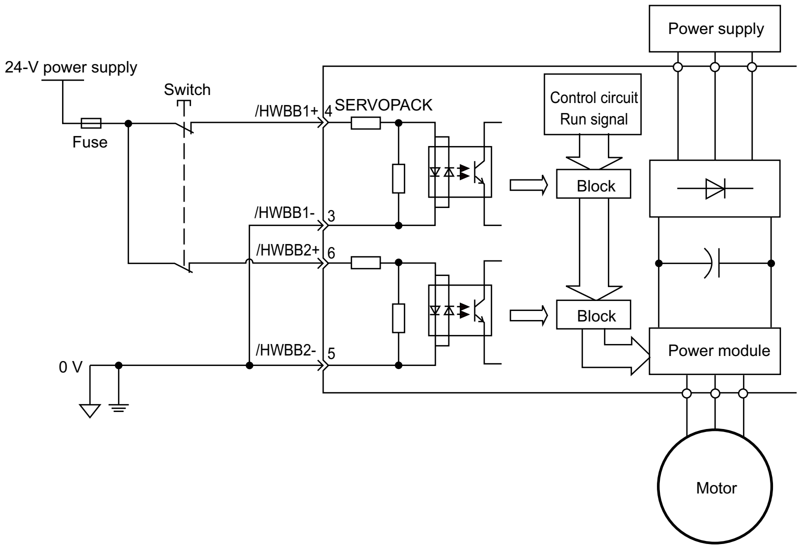
For details on the hard wire base block function and the servo ready output signal, refer to *5.11.1 Hard Wire Base Block (HWBB) Function*.

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.

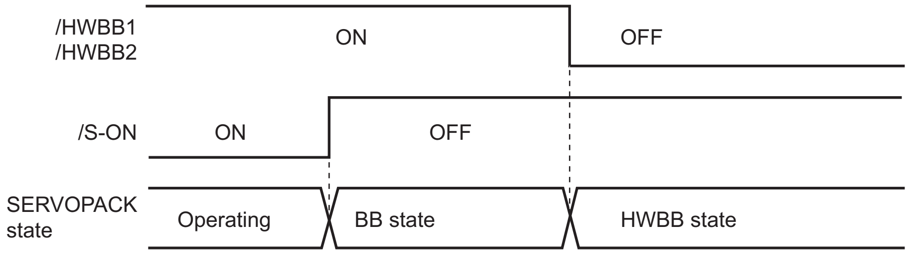
EN954 Category3
IEC61508 SIL2

The following risks can be estimated even if the HWBB function is used. These risks must be included in the risk assessment.

- The motor 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 servo drive or electrically isolates it. Take measures to shut off the power to the servo drive when performing maintenance on it, etc.

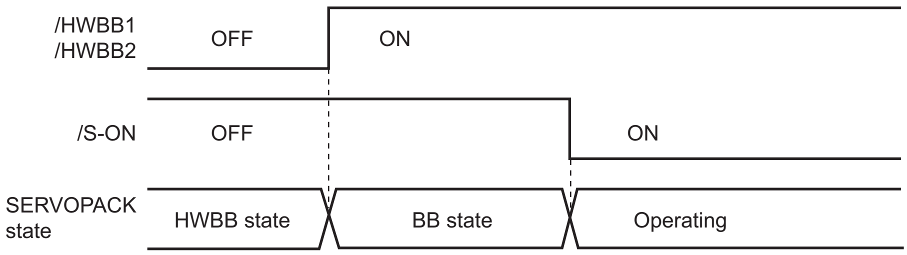
(2) Hard Wire Base Block (HWBB) State

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.



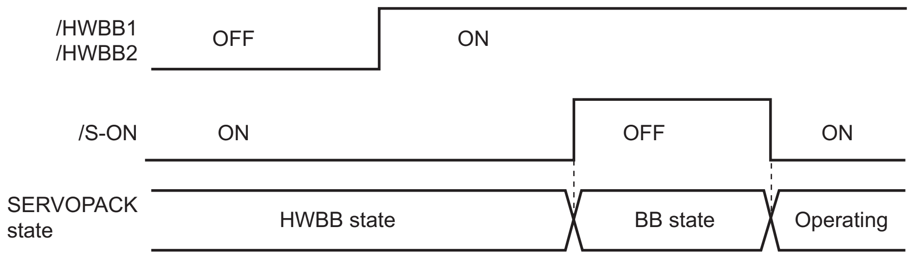
(3) Resetting the HWBB State

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.

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 be 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.

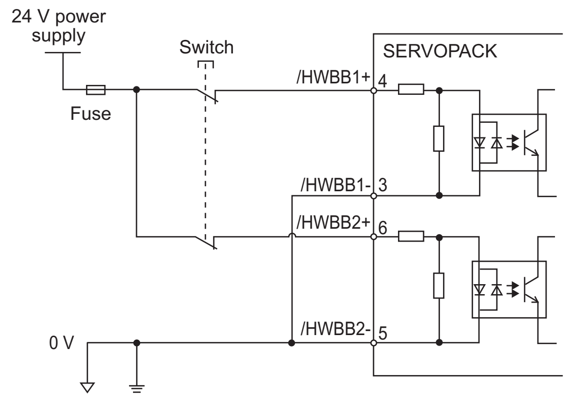
IMPORTANT

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)



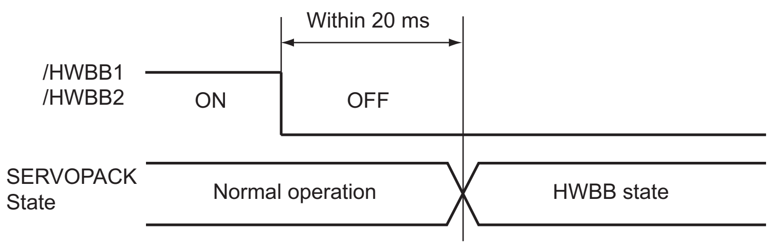
■ Specifications of Input Signals (HWBB Signals)

Type	Signal Name	Pin Number	State	Meaning
Input	/HWBB1	CN8-4 CN8-3	ON	Normal operation
			OFF	Requires the HWBB function by using the hardwired circuits.
	/HWBB2	CN8-6 CN8-5	ON	Normal operation
			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 1. The OFF status is not recognized if the /HWBB1 and /HWBB2 signals are 0.5 ms or shorter.
2. The status of input signals can be checked with monitor display function. For details, refer to *8.7 Monitoring Output Signals*.

(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.

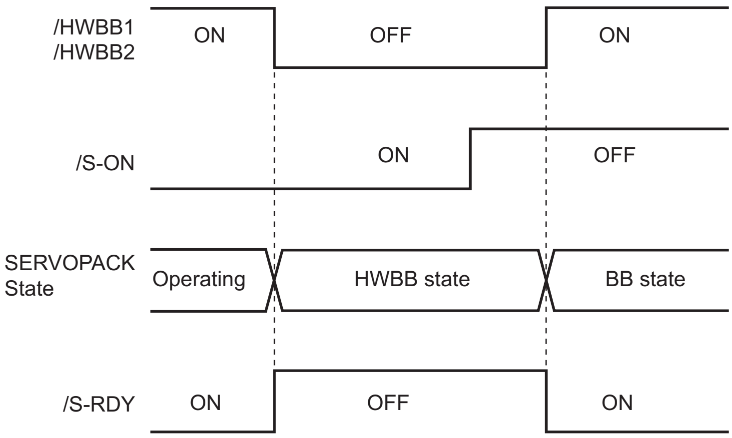
- JOG operation (Fn002)
- Origin search (Fn003)
- Program JOG operation (Fn004)
- Advanced autotuning (Fn201)
- EasyFFT (Fn206)
- Automatic offset-adjustment of motor current detection signal (Fn00E)

(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.

(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.

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

In the HWBB state, the servo alarm output signal (ALM) and alarm code output signals (AOL1, AOL2, and AOL3) are not sent.

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.

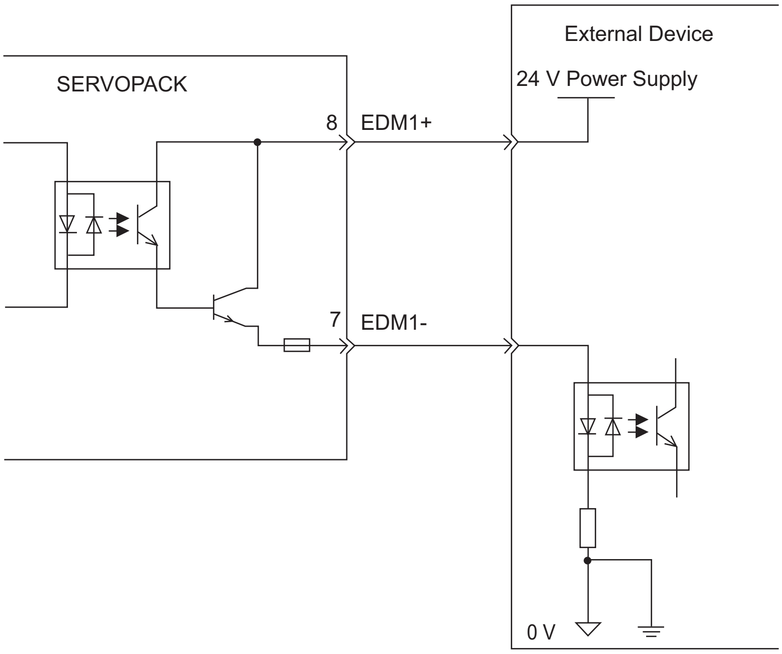
> ⚠ **WARNING**
>
> The EDM1 signal is not a safety output. Use it only for monitoring a failure.

(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	CN8-8 CN8-7	ON	Both baseblocks by /HWBB1 signal and /HWBB2 signal normally activate.
			OFF	–

Electrical characteristics of EDM1 signal are as follows.

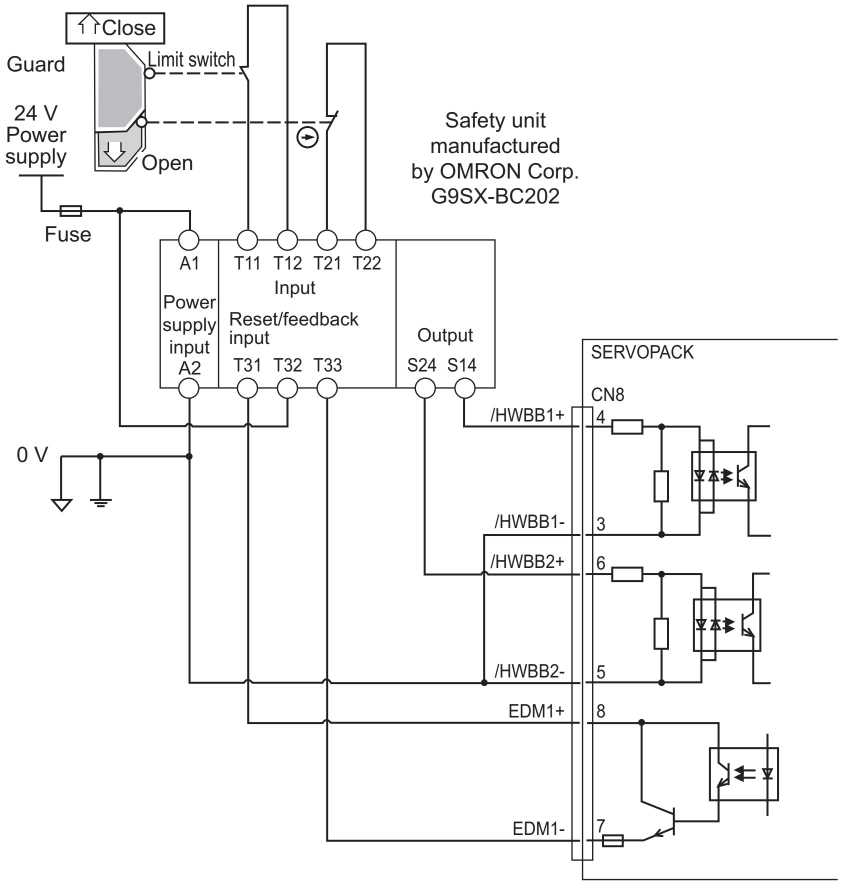
Items	Characteristics	Remarks
Maximum Allowable Voltage	30 VDC	–
Maximum Current	50 m ADC	–
Maximum Voltage Drop at ON	1.0 V	Voltage between EDM1+ to EDM1- at current is 50 mA.
Maximum Delay Time	20 ms	Time from change of /HWBB1, /HWBB2 to change of EDM1

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 reset, 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 EMD1+ to EMD1-, because the EMD1 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 reset 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

1	Request to open the guard.
↓	
2	When the motor is operating, output the stop command from the host controller and turn OFF the servo.
↓	
3	The guard opens.
↓	
4	The /HWBB1 and /HWBB2 signals are OFF and HWBB function operates. (The operation in the guard is available.)
↓	
5	The guard closes.
↓	
6	Turn ON the servo from the host controller.

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 move 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 movement 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 servo drive or electrically insulate the servo drive. When maintaining the servo drive, be sure to turn OFF the power supply to the servo drive independently.
  Failure to observe this warning may cause an electric shock.

6

Adjustments

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.

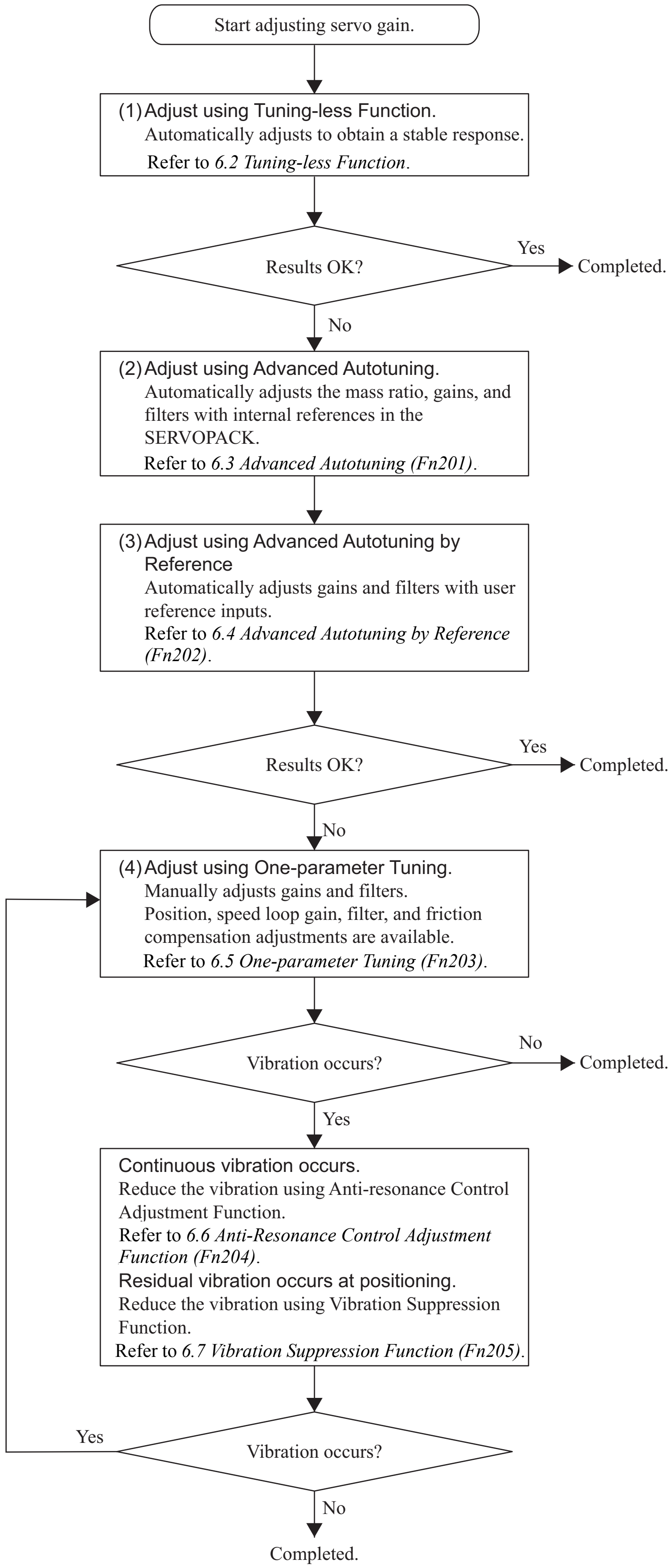
This section describes the following utility adjustment functions.

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 mass ratio, 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.



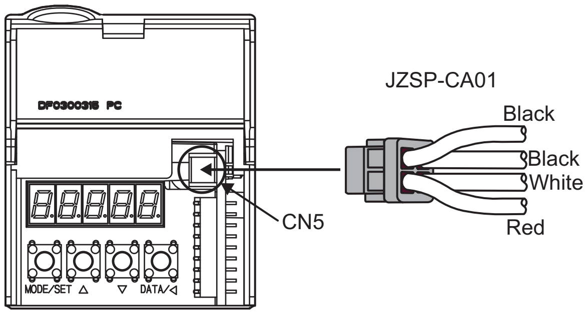
6.1.3 Monitoring Analog Signals

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.

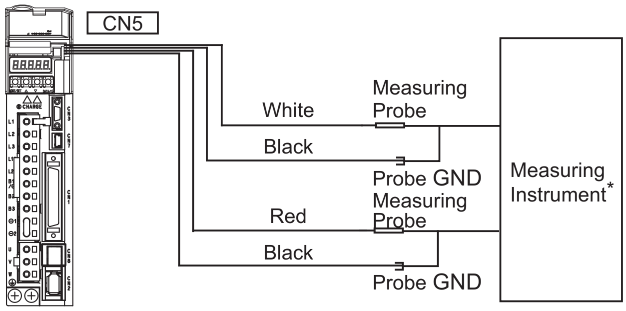
The settings and parameters related to monitoring analog signals are described below.

(1) Connector CN5 for Analog Monitor

To monitor analog signals, connect a measuring instrument with cable (JZSP-CA01-E) to the connector CN5.



■ Connection Example



∗The measuring instrument is not included.

Line Color	Signal Name	Factory Setting
White	Analog monitor 1	Force reference: 1 V/100% rated force
Red	Analog monitor 2	Motor speed: 1 V/10000 mm/s
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) × (Signal selection (Pn006=n.00□□) × Multiplier (Pn552) + Offset voltage [V] (Pn550))

Analog monitor 2 output voltage = (-1) × (Signal selection (Pn007=n.00□□) × Multiplier (Pn553) + Offset voltage [V] (Pn551))

(3) Related Parameters

The monitor factor can be changed by setting following parameters.

Parameter	Name				Classification
Pn006.0, Pn006.1	Analog Monitor 1 Signal Selection	Speed Position Force			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 Force			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	00 to 0D	–	02	Immediately	Setup
Pn550	Analog Monitor 1 Offset Voltage	Speed Position Force			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 Force			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.1 V	0	Immediately	Setup
Pn552	Analog Monitor 1 Magnification	Speed Position Force			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.01 times	100	Immediately	Setup
Pn553	Analog Monitor 2 Magnification	Speed Position Force			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.01 times	100	Immediately	Setup

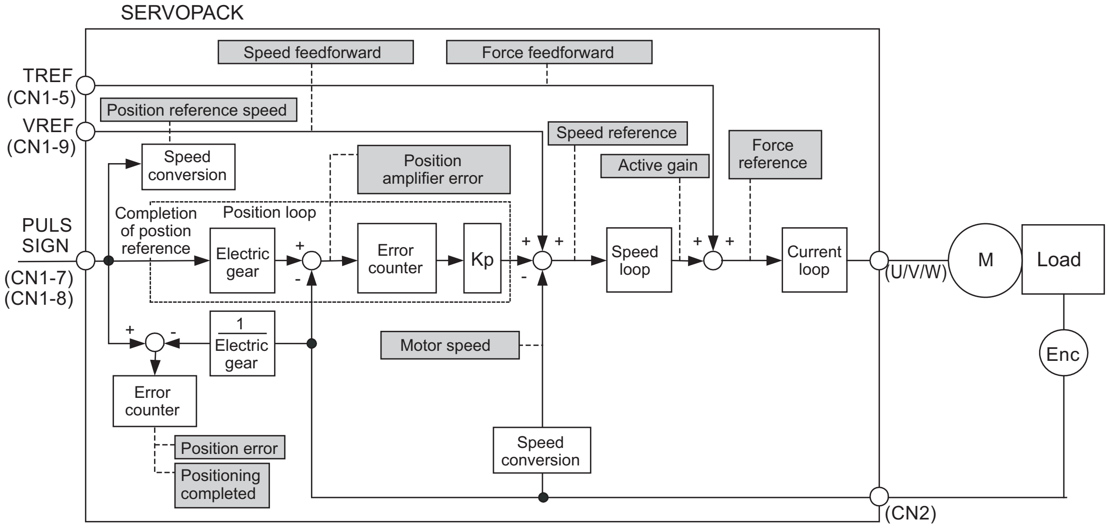
(4) Monitor Signals

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 mm/s	Pn007 Factory Setting
	n.□□01	Speed reference	1 V/1000 mm/s	
	n.□□02	Force reference	1 V/100% rated force	Pn006 Factory Setting
	n.□□03	Position error*	0.05 V/reference unit	0 V at speed/force 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 mm/s	–
	n.□□06	Reserved	–	–
	n.□□07	Reserved	–	–
	n.□□08	Positioning completed	Positioning completed: 5 V Positioning not completed: 0 V	–
	n.□□09	Speed feedforward	1 V/1000 mm/s	–
	n.□□0A	Force feedforward	1 V/100% rated force	–
	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	

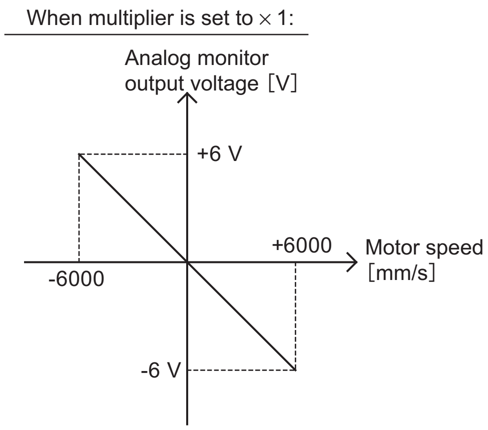
* When using speed control, the position error monitor signal is 0.

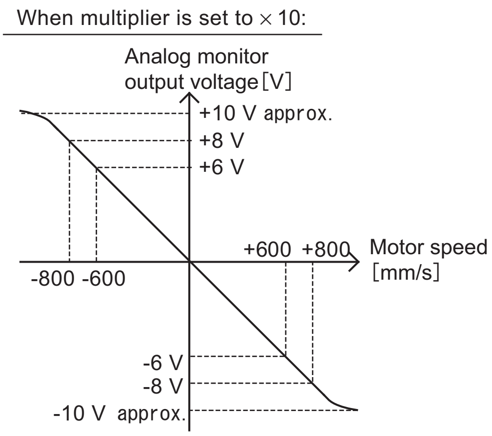
The following diagram shows the analog monitor output at position control.



<Example>

Analog monitor output at n.□□00 (motor speed setting)





Note: Linear effective range: within ± 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 moving 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) Force Limit

Calculate the force required to operate the machine. Set the force limits so that the output force will not be greater than required. Setting the force limits can reduce the amount of shock applied to the machine in collisions and other cases.
Use the following parameters to set the force limits.
Pn483: Forward Force Limit [%]
Pn484: Reverse Force Limit [%]
For details, refer to *5.8.1 Internal Force Limit*, and *5.8.2 External Force 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 with the following equation.

$$\text{Position Error} = \frac{\text{Max. feed speed [reference unit/s]}}{\text{Pn102}}$$

Note: Pn102: Position Loop Gain [0.1/s]

• Excessive Position Error Alarm Level (Pn520 [reference unit])

$$\text{Pn520} > \frac{\text{Max. feed speed [reference unit/s]}}{\text{Pn102}} \times \underline{\underline{(1.2 \text{ to } 2)}}$$

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

■ 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 Pn584. 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 be 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 *9 Troubleshooting* and take the corrective actions.

(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 baseblock. 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

Pn584	Speed Limit Level at Servo ON (Position)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 mm/s	10000	Immediately	Setup

The parameter Pn584 (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 Pn584. 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 be 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 *9 Troubleshooting* and take the corrective actions.

6.2 Tuning-less Function

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.
- The servomotor may vibrate if the mass ratio exceeds the allowable mass of the servomotor.
  If vibration occurs, set the mode to 2 in Fn200 or lower the level.

(1) 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.

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 force control.

When the host controller has a position loop in speed control, set 1 to Pn170.1.

■ Control Function Restrictions

Control Function	Available/Not available	Remarks
Anti-resonance control	Not available	
Friction compensation	Not available	
Gain switching	Not available	

■ Adjustment Function Restriction

Adjustment Function	Available//Not available	Remarks
One-parameter tuning (Fn203)	Not available	
EasyFFT (Fn206)	Available	While this function is being used, the tuning-less function cannot be used temporarily.
Initialize vibration detection level (Fn01B)	Available	
Advanced autotuning (Fn201)	Available	• This function can be used when Jcalc is set to ON. • During or after use of this function, the tuning-less function cannot be used.
Advanced autotuning by reference (Fn202)	Not available	
Anti-resonance control adjustment function (Fn204)	Not available	
Vibration suppression function (Fn205)	Not available	
Offline mass calculating *	Not available	
Mechanical analysis *	Available	While this function is being used, 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□□	Does not set the 2nd notch filter automatically.	Immediately	Tuning
	n.□1□□	Sets the 2nd notch filter automatically. [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	RUN —FUNCTION— Fn080:Pole Detect Fn200:TuneLvl Set Fn201:AAT Fn202:Ref−AAT	∧ ∨	Display the main menu of the utility function mode, and select Fn200.
2	RUN —TuneLvlSet— Mode=1	DATA	Press the DATA Key to display the tuning-less mode 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. • If the response waveform causes overshooting or if the mass exceeds the allowable level (i.e., outside the scope of product guarantee), press the ∧ Key and change the mode to 2.
3	RUN —TuneLvlSet— Level=4	DATA	Press the DATA Key to display the tuning level setting screen.
4	RUN —TuneLvlSet— Level=4 NF2 2nd notch filter	∧ ∨ JOG SVON	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.) 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 JOG SVON Key to automatically set a notch filter for the vibration frequency. If the tuning level is changed, the automatically set notch filter will be canceled. If vibration occurs, however, the notch filter will be set again.
5	Done —TuneLvlSet— Level=4	DATA	Press the DATA Key. "Done" will blink and the settings will be saved in EEPROM.
6	RUN —FUNCTION— Fn030 Fn200 Fn201 Fn202	MODE/SET	Press the MODE/SET Key to complete the tuning-less operation. The screen in step 1 will appear again.

Note: For the basic operation of the digital operator, refer to *Σ-V series User's Manual, Operation of Digital Operator* (SIEPS80000055).

(3) Operating Procedure with Panel Operator

Step	Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn200	▲ ▼	Press the UP or the DOWN Key to select the Fn200.
3	d0001	DATA/◀	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	d0002	▲	If the noise is generated, change the setting using the UP Key.
5	L0004	DATA/◀	Press the DATA/SHIFT Key for approximately one second to change to tuning level setting screen.
6	L0004	▲ ▼ DATA/◀	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. If the tuning level is changed, the automatically set notch filter will be canceled. If vibration occurs, however, the notch filter will be set again.
7	donE (Display blinks)	MODE/SET	Press the MODE/SET Key. "donE" will blink and the settings will be saved in EEPROM.
8	Fn200	DATA/◀	Press the DATA/SHIFT Key for more than one second. "Fn200" is displayed again.

(4) Parameters Disabled by Tuning-less Function

Item	Name	Pn Number	Function to use parameters					Remarks
			Speed Limit during Force Control	Zero Clamp during Force Control	Zero-speed Stop during Force 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	×	×	×	○	○	
	Mass 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.

(5) Tuning-less Function by SERVOPACK Software Version

When using a direct-drive servomotor, two types of tuning-less functions with differing responsiveness are available and have different versions of the SERVOPACK software: Tuning-less Type 1 with version 000A or earlier and Type 2 with version 000B or later.
With SERVOPACK software 000B or later for Type 2, the level of noise produced is lower than that of SERVOPACK software 000A or earlier for Type 1. Tuning-less Type 2 is enabled by default. When compatibility with SERVOPACK software 000A or earlier is required, select Tuning-less Type 1 (Pn14F.1 = 0).

Software Version*	Tuning-less Type	Meaning
000A or earlier	Tuning-less type 1	–
000B or later	Tuning-less type 2	The level of noise produced is lower than that of Type 1.

* The software version number of your SERVOPACK can be checked with Fn012.

Parameter		Meaning	When Enabled	Classification
Pn14F	n.□□0□	Tuning-less type 1	After restart	Tuning
	n.□□1□	Tuning-less type 2 [Factory setting]		

6.3 Advanced Autotuning (Fn201)

This section describes the adjustment using advanced autotuning.

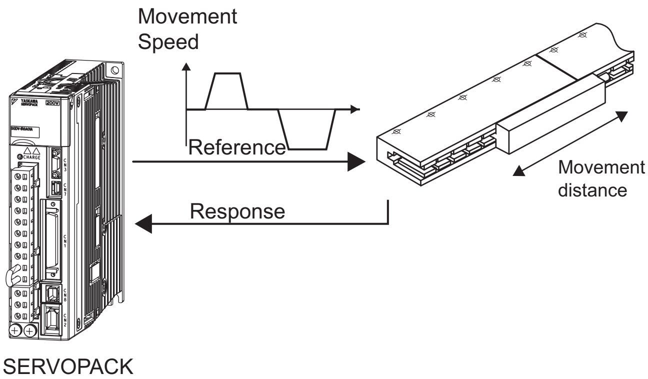
6.3.1 Advanced Autotuning

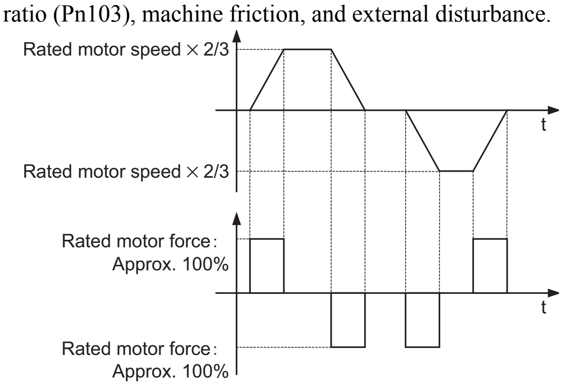
Advanced autotuning automatically operates the SERVOPACK (in reciprocating movement in the forward and reverse directions) within set limits and makes adjustment automatically according to the mechanical characteristics while the SERVOPACK is operating.

Advanced autotuning can be performed without connecting the host.
The following automatic operation specifications apply.

- Motor speed: Rated motor speed × 2/3
- Acceleration force*: Approximately 100% of rated motor force
- Movement distance: Set in unit of 1000 reference unit. Factory setting is 90 mm.

* The acceleration force varies with the influence of the mass ratio (Pn103), machine friction, and external disturbance.





Advanced autotuning performs the following adjustments.

- Mass ratio
- Gains (e.g., position loop gain and speed loop gain)
- Filters (force 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 mass.

Setting	Contents
Jcalc = ON	Calculates the mass.
Jcalc = OFF	Does not calculate the mass.

Tuning level can be set to select an adjustment type.

Tuning Level	Adjustment Type
Mode 1	Makes adjustments for feedback control, not for model following control.[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 or linear servomotor.
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 (mass is not calculated) be sure to set a suitable value for the mass ratio (Pn103). If the setting greatly differs from the actual mass 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).
- Before performing advanced autotuning with the tuning-less function enabled (Pn170 =□□□1: Factory setting), always set Jcalc to ON to calculate the mass ratio. The tuning-less function will automatically be disabled, and the gain will be set by advanced autotuning.
  With Jcalc set to OFF so the mass ratio is not calculated, "Error" will be displayed on the panel operator, and advanced autotuning will not be performed.
- If the operation conditions, such as the machine-load or drive system, are changed after advanced autotuning, then change the related parameters to disable any values that were adjusted before performing advanced autotuning once again. If advanced autotuning is performed without changing the parameters, machine vibration may occur, resulting in damage to the machine.
  Pn00B.0=1 (Displays all parameters.)
  Pn140.0=0 (Does not use model following control.)
  Pn160.0=0 (Does not use anti-resonance control.)
  Pn408=n.00□0 (Does not use friction compensation, 1st notch filter, or 2nd notch filter.)

(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 force control.
- Automatic gain switching must be disabled.
- The write prohibited setting (Fn010) must not be set.

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.
When using speed control, set the tuning level to Mode 1.

(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 mass 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 5 mm 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 mass 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 mass, an error will result when P control operation is used while the mass is being calculated.

- The mode switch is used.

Note: If a setting is made for calculating the mass, the mode switch function will be disabled while the mass is being calculated. At that time, PI control will be used. The mode switch function will be enabled after calculating the mass.

- The positioning completed width is small.
  Advanced autotuning makes adjustments by referring to the positioning completed width (Pn522). If the SERVOPACK is operated in position control (Pn000.1=1), set the electronic gear ratio (Pn20E/Pn210) and positioning completed width (Pn522). If the SERVOPACK is operated in speed control (Pn000.1=0), use the factory settings. After the adjustments, the maximum overshoot becomes the positioning completed width. Setting smaller value to Overshoot Detection Level (Pn561) makes adjustments giving priority to overshooting suppression.

IMPORTANT

- Advanced autotuning makes adjustments by referring to the positioning completed width (Pn522). If the SERVOPACK is operated in position control (Pn000.1=1), set the electronic gear ratio (Pn20E/Pn210) and positioning completed width (Pn522) to the actual value during operation. If the SERVOPACK is operated in speed control (Pn000.1=0), use the factory settings.

Change only the overshoot detection level (Pn561) to finely adjust the without changing the positioning completed width (Pn522). Because Pn561 is set by default to 100%, the allowable amount of overshooting is the same amount as that for the positioning completed width.
When Pn561 is set to 0%, the amount of overshooting can be adjusted to prevent any overshooting in the positioning completed width. If the setting of Pn561 is changed, however, the positioning time may be extended.

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

Adjustments

6

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□	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 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□□	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.

When 2 or 3 is set to the mode, the friction compensation function is automatically enabled.

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 force 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 force feedforward (T-REF) input.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□	Model following control is not used together with external speed/force feedforward input. [Factory setting]	Immediately	Tuning
	n.1□□□	Model following control is used together with external speed/force 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 force feedforward (T-REF) input. An improper speed feedforward (V-REF) input or force feedforward (T-REF) input may result in overshooting.

Refer to *6.8.2 Force 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 User's Manual, Operation of Digital Operator* (SIEP S800000 55) for basic key operations of the Digital Operator.

Note: The function cannot be performed from the Panel Operator.

(1) Operating Procedure

<table>
<tr><th>Step</th><th>Display after Operation</th><th>Keys</th><th>Operation</th></tr>
<tr><td>1</td><td>BB —FUNCTION—
Fn200:TuneLvl Set
Fn201:AAT
Fn202:Ref-AAT
Fn203:OnePrmTun</td><td>MODE/SET
∧ ∨</td><td>Display the main menu of the utility function mode, and select Fn201.</td></tr>
<tr><td>2</td><td>BB Advanced AT
Jcalc=ON
Mode=2 Type=2
Stroke=+00288000
(0090.0)rev</td><td>DATA</td><td>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.</td></tr>
<tr><td>3</td><td>BB Advanced AT
Jcalc=ON
Mode=2 Type=2
Stroke=+00288000
(0090.0)rev</td><td>∧ ∨
SCROLL</td><td>Press the ∧, ∨ or SCROLL Key and set the items in steps 3-1 to 3-4.</td></tr>
<tr><td>3-1</td><td colspan="3">■Calculating Mass
Select the mode to be used.
Normally, set Jcalc to ON.
Jcalc = ON: Mass calculated
Jcalc = OFF: Mass not calculated
<Note>
If the mass is already known from the machine specifications, set the value in Pn103 and set Jcalc to OFF.</td></tr>
<tr><td>3-2</td><td colspan="3">■Tuning Level
Select the tuning level.
Mode = 1: Makes adjustments for feedback control, not for model following control. [Standard]
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.</td></tr>
<tr><td>3-3</td><td colspan="3">■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.
<Note>
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 or linear servomotor [Factory setting].
Type = 3: Selects a filter suitable for rigid systems, such as a gear.</td></tr>
<tr><td>3-4</td><td colspan="3">■STROKE (Travel Distance) Setting
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 movement, and the positive (+) direction is for forward movement.
Initial value:
90 mm
Note:
• Move the position using JOG operation to where a suitable movable range is ensured.
• Set the travel distance to at least 5 mm; otherwise, "Error" will be displayed and the travel distance cannot be set.
• To calculate the mass ratio and ensure precise tuning, it is recommended to set the travel distance to 90 mm.</td></tr>
<tr><td>4</td><td>BB ADVANCED AT
Pn103=00000
Pn100=0040.0
Pn101=0020.00
Pn102=0040.0</td><td>DATA</td><td>Press the DATA Key. The advanced autotuning execution screen will be displayed.</td></tr>
<tr><td>5</td><td>RUN ADVANCED AT
Pn103=00000
Pn100=0040.0
Pn101=0020.00
Pn141=0050.0</td><td>JOG SVON</td><td>Press the JOG SVON Key. The servo will be ON and the display will change from "BB" to "RUN."
*If the level is set to 2 or 3, the "Pn102" display will change to the "Pn141."</td></tr>
</table>

Step	Display after Operation	Keys	Operation
6	RUN ADVANCED AT Pn103=00300 Pn100=0040.0 Pn101=0020.00 Pn141=0050.0	∧ ∨ DATA MODE/SET	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 mass ratio will start. While the 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 mass ratio will be displayed. The servo will remain ON, but the auto run operation will enter HOLD status. Note: • In the case of calculating the mass only, press the DATA Key to save the calculated value to the SERVOPACK. Then press the MODE/SET 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 mass ratio does not start, "NO-OP" will blink. Refer to *(2) Failure in Operation*, and take a corrective action to enable operation. • If the calculation of the mass ratio is not completed normally because the required conditions are not met, "Pn103=ERR" will be displayed. Refer to *(3) Errors during Calculation of Mass Ratio*, press the MODE/SET Key to cancel the function, modify the settings, and then restart. If the mass ratio is not calculated, the set value for Pn103 will be displayed but not blink.
7	Adj ADVANCED AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0	∧ ∨	When the ∧ or ∨ Key is pressed according to the sign (+ or -) of the value set for STROKE (travel distance), the calculated value of the mass ratio will be written to the SERVOPACK and the auto run operation will restart. While the servomotor is running, the notch filter, the force reference filter, and gains will be automatically set. "Adj" will blink during the auto setting operation. Note: • Precise adjustments cannot be made and "Error" will be displayed as the status if there is vibration when starting adjustments or the positioning completion signal turns ON/OFF. If that occurs, make adjustments using one-parameter tuning (Fn203).
8	End ADVANCED AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0		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.
9	Done ADVANCED AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0	DATA	Press the DATA Key. The values adjusted will be written to the SERVOPACK, "Done" will blink for two seconds, and "Adj" will be displayed again. Not to save the values, press the MODE/SET Key.
10	BB —FUNCTION— Fn200:TuneLvl Set Fn201:AAT Fn202:Ref-AAT Fn203:OnePrmTun	MODE/SET	Press the MODE/SET Key to complete the advanced autotuning operation. The screen in step 1 will appear again.

(2) 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 (mass ratio not calculated) and the tuning-less function is set to effective.

Press the MODE/SET Key and stop the adjustment once, and take a corrective action to enable operation.

■ Probable Causes of "Error" Blinking and Remedies

Press the MODE/SET Key and stop the adjustment once, and take the following remedies to enable operation.

Error	Probable Cause	Corrective Actions
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. When 2 is set to the mode, change the setting to 3 or 1, and perform advanced autotuning again. If there is machine vibration, suppress the vibration with the anti-resonance control adjustment function and the vibration suppression function.
The mass ratio cannot be calculated when the tuning-less function was activated.	Jcalc was set to OFF, so the mass ratio was not calculated and the tuning-less function was activated.	• Turn OFF the tuning-less function. • Set Jcalc to ON, so the mass ratio will be calculated.
An error occurred during the calculation of the mass ratio.	Refer to *(3) Errors during Calculation of Mass Ratio*.	
Travel distance setting error	The travel distance is set to approximately 5 mm or less, which is less than the minimum adjustable travel distance.	Increase the travel distance. It is recommended to set the travel distance to 90 mm.
The positioning completion signal (/COIN) did not turn ON within approximately 10 seconds after positioning adjustment was completed.	The positioning completed 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.

(3) Errors during Calculation of Mass Ratio

The following table shows the probable causes of errors that may occur during the calculation of the 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 mass ratio	The SERVOPACK started calculating the mass ratio, but the calculation was not completed.	• Increase the speed loop gain (Pn100). • Increase the STROKE (travel distance).
Err2	Failure in calculation of mass ratio	The 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 mass ratio (Pn324).
Err4	Force limit error	The force limit was reached.	• Increase the force limit value. • Double the calculation starting level of the mass ratio (Pn324).

Error Display	Error Type	Cause	Corrective Action
Err5	Proportional control error	While calculating the mass ratio, the speed control was set to proportional control with P-CON input.	Operate the SERVOPACK with PI control while calculating the 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	Force Reference Filter Time Constant
Pn408	Notch Filter Selection/Friction Compensation Selection
Pn409	1st Notch Filter Frequency
Pn40A	1st Notch Filter Q Value
Pn40C	2nd Notch Filter Frequency
Pn40D	2nd Notch Filter Q Value

6.4 Advanced Autotuning by Reference (Fn202)

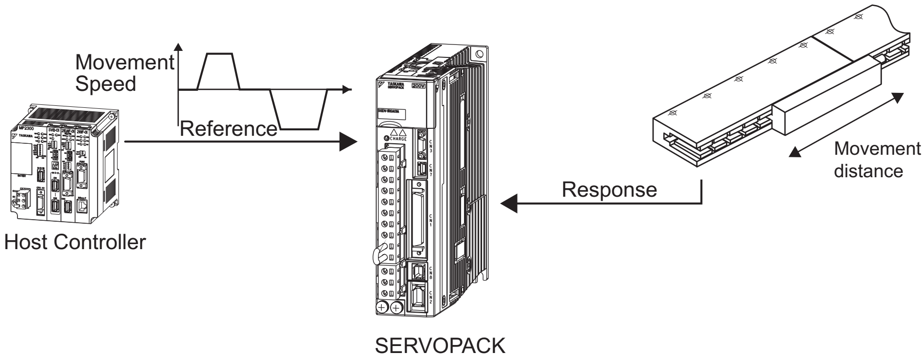
Adjustments with advanced autotuning by reference are described below.

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 mass 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 (force 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	Makes adjustments for feedback control, not for model following control. [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 or linear servomotor.
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 mass ratio (Pn103) using advanced autotuning before advanced autotuning by reference is performed. If the setting greatly differs from the actual mass 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 completed width (Pn522).
- The motor speed in response to references from the host controller must be the same as or larger than the set zero speed level (Pn581).
- 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.

IMPORTANT

- Advanced autotuning makes adjustments by referring to the positioning completed width (Pn522). If the SERVOPACK is operated in position control (Pn000.1=1), set the electronic gear ratio (Pn20E/Pn210) and positioning completed width (Pn522) to the actual value during operation.

Change only the overshoot detection level (Pn561) to finely adjust the without changing the positioning completed width (Pn522). Because Pn561 is set by default to 100%, the allowable amount of overshooting is the same amount as that for the positioning completed width.
When Pn561 is set to 0%, the amount of overshooting can be adjusted to prevent any overshooting in the positioning completed width. If the setting of Pn561 is changed, however, the positioning time may be extended.

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

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 force 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 force feedforward (T-REF) input.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□	Model following control is not used together with external speed/force feedforward input. [Factory setting]	Immediately	Tuning
	n.1□□□	Model following control is used together with external speed/force 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 force feedforward (T-REF) input. An improper speed feedforward (V-REF) input or force feedforward (T-REF) input may result in overshooting.

Refer to *6.8.2 Force 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 *Σ-V series 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 for feedback control, not for model following control. [Standard] 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.		
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. <Note> 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 or linear servomotor [Factory setting]. Type = 3: Selects a filter suitable for rigid systems, such as a gear.		
4	BB Advanced AT Pn103=00000 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=00300 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=00300 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=00300 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	DONE Advanced AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0	DATA	Press the DATA Key. The adjusted values will be written to the SERVOPACK, "DONE" will blink for two seconds. Not to save the values set in step 6, press the MODE/SET Key.
9	BB —FUNCTION— Fn201:AAT Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup	MODE/SET	Press the MODE/SET Key to complete the advanced autotuning by reference operation. The screen in step 1 will appear again.

(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 MODE/SET Key and stop the adjustment once, and take a corrective action to enable operation.

■ Probable Causes of "Error" Blinking and Remedies

Press the MODE/SET 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	Force Reference Filter Time Constant
Pn408	Notch Filter Selection/Friction Compensation Selection
Pn409	1st Notch Filter Frequency
Pn40A	1st Notch Filter Q Value
Pn40C	2nd Notch Filter Frequency
Pn40D	2nd 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 for feedback control, not for model following control. [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	Selects a filter suitable for the belt drive mechanism or other mechanism.
Type = 2	Selects a filter suitable for a ball screw drive mechanism or linear servomotor.
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 (force reference filter and notch filter)
- Friction compensation
- Anti-resonance control

Refer to *6.5.4 Related Parameters* for parameters used for adjustments.

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 mass ratio (Pn103) using advanced autotuning before one-parameter tuning is performed. If the setting greatly differs from the actual mass 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    —OnePrmTun—
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.

When 2 or 3 is set to the mode, the friction compensation function is automatically enabled.

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 force 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 force feedforward (T-REF) input.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□	Model following control is not used together with external speed/force feedforward input. [Factory setting]	Immediately	Tuning
	n.1□□□	Model following control is used together with external speed/force 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 force feedforward (T-REF) input. An improper speed feedforward (V-REF) input or force feedforward (T-REF) input may result in overshooting.

Refer to *6.8.2 Force 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 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	RUN —FUNCTION— Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup	MODE/SET ∧ ∨	Display the main menu of the utility function mode, and select Fn203.
2	BB —OnePrmTun— Pn103=00300	DATA	Press the DATA Key to display the mass 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	BB —OnePrmTun— Setting Tuning Mode = 2 Type = 2	DATA	Press the DATA Key to display the initial setting screen for one-parameter tuning.
4	BB —OnePrmTun— Setting Tuning Mode = 2 Type = 2	∧ ∨ SCROLL	Press the ∧ , ∨ or SCROLL 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 for feedback control, giving priority to stability. Tuning Mode = 1: Makes adjustments for feedback control, giving priority to responsiveness. Tuning Mode = 2: Makes adjustments for positioning. Tuning Mode = 3: Make adjustments for positioning, giving priority to overshooting suppression. 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. <Note> 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 or linear servomotor [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]

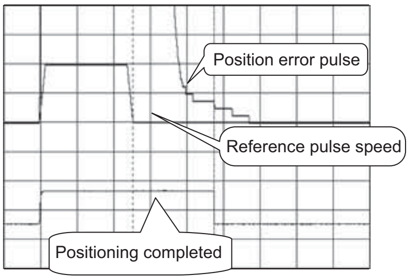
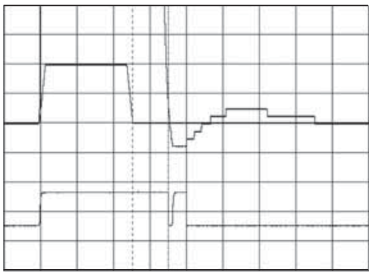
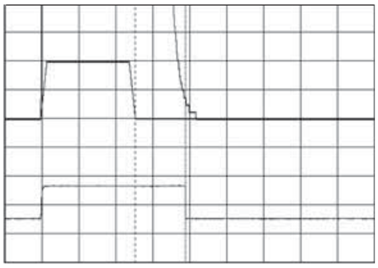
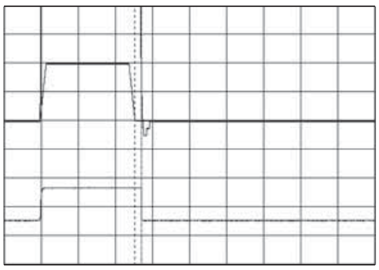
Step	Display after Operation	Keys	Operation
1			Input an external /S-ON signal. The display will change from "BB" to "RUN." Input a reference from the host controller.
2	RUN —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn141=0050.0	DATA	The set value will be displayed. Press the DATA Key after checking the value.
3	RUN —OnePrmTun— LEVEL = 0040 NF1 ARES	< > ∧ ∨ JOG SVON DATA	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 JOG SVON Key. The SERVOPACK will detect the vibration frequencies automatically and make notch filter or anti-resonance control settings. If the vibration is great, the vibration frequency will be detected even if the JOG SVON Key is not pressed and a notch filter or anti-resonance control will be set. Select the digit with the < or > Key, adjust the level with ∧ or ∨ Key, and press the DATA 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. When anti-resonance control is set, "ARES" is displayed.
4	RUN —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn102=0040.8	DATA	A confirmation screen is displayed after level adjustment. Check the value and press the DATA Key.
5	DONE —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn102=0040.8	DATA	Press the DATA Key. The adjusted values will be written to the SERVOPACK, "DONE" will blink for two seconds. Not to save the values set in step 3, press the MODE/SET Key. The screen in step 3 will appear with the < Key.
6	RUN —FUNCTION— Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup	MODE/SET	Press the MODE/SET Key to complete the one-parameter tuning operation. The screen in step 1 will appear again.

(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	RUN —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn141=0050.0	DATA	The set value will be displayed. Press the DATA Key after checking the value.
3	RUN —OnePrmTun— FF LEVEL = 0050.0 FB LEVEL = 0040.0 NF1 ARES	<, >, ∧, ∨ JOG SVON, DATA	Mode 2 or 3 is 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 JOG SVON Key. The SERVOPACK will detect the vibration frequencies automatically and make notch filter or anti-resonance control settings. If the vibration is great, the vibration frequency will be detected even if the JOG SVON Key is not pressed and a notch filter or anti-resonance control will be set. The positioning time will become shorter if the FF level is increased. If the FF level is too high, over-shooting will result. Adjust FF level and FB level with the <, >, ∧ or ∨ Keys, and press the DATA Key. Note: • 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.
4	RUN —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn141=0050.0 NF1	DATA	A confirmation screen is displayed after adjustment.
5	DONE —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn141=0050.0 NF1	DATA	Press the DATA Key. The adjusted values will be written to the SERVOPACK, "DONE" will blink for two seconds. Not to save the values set in step 3, press the MODE/SET Key. The screen in step 3 will appear with the < Key.
6	RUN —FUNCTION— Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup	MODE/SET	Press the MODE/SET 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 mass 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 FB level is increased. If the overshooting is solved, go to step 4.
4		The graph shows overshooting generated with the FF level increased in step 3. In this state, the overshooting occurs, 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. If vibration occurs before the overshooting is eliminated, the vibration will be suppressed by the automatic notch filter. Note: The vibration frequencies may not be detected if the amplitude is too small. If that occurs, press the JOG SVON Key to forcibly detect the vibration frequencies.
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	Force Reference Filter Time Constant
Pn408	Notch Filter Selection/Friction Compensation Selection
Pn409	1st Notch Filter Frequency
Pn40A	1st Notch Filter Q Value
Pn40C	2nd Notch Filter Frequency
Pn40D	2nd 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	• The vibration frequencies are unknown. • This function is being used for the first time.
1	NO	• 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 mass ratio (Pn103) using advanced autotuning before executing the anti-resonance control adjustment function. If the setting greatly differs from the actual mass 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 force 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 mass ratio must be set correctly. Perform advanced autotuning to set the mass ratio (Pn103).

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 User's Manual, Operation of Digital Operator* (SIEPS80000055) for basic key operations of the Digital Operator.

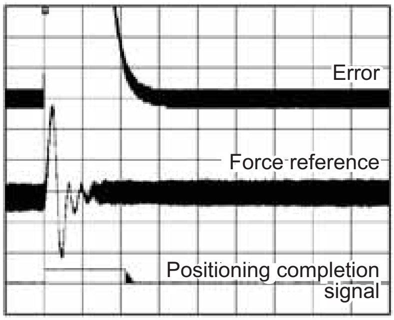
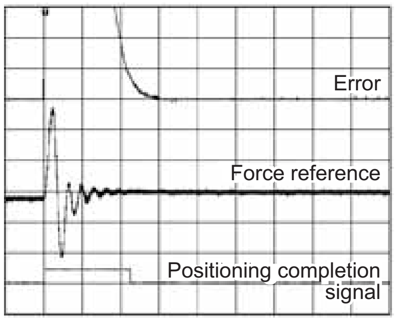
Note: • The function cannot be performed from the Panel Operator.
• Use this function if vibration is generated when a control reference is input.

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 6-42.
2. Starting Execution without Vibration Suppression When the Anti-resonance Control Adjustment Function Has Not Been Used → See page 6-44.
3. Starting Execution for Fine-tuning When the Anti-resonance Control Adjustment Function Has Been Used → See page 6-46.

(1) Starting Execution with Vibration Suppression When the Anti-Resonance Control Adjustment Function Has Not Been Used

Step	Display after Operation	Keys	Operation
1	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET ∧ ∨	Display the main menu of the utility function mode, and select Fn204.
2	RUN —Vib Sup— Tuning Mode = 0	DATA	Press the DATA 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	RUN —Vib Sup— Tuning Mode = 0	∧ ∨ DATA	Press the ∧ or ∨ Key and select the tuning mode "0".

Step	Display after Operation	Keys	Operation
4	RUN —Vib Sup— freq = ---- Hz damp = 00000	DATA	Press the DATA 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. 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.
5	RUN —Vib Sup— freq = 0400 Hz damp = 00000		The vibration frequency will be displayed if vibration is detected. 
6	RUN —Vib Sup— freq = 0400 Hz damp = 00020	DATA	Press the DATA Key. The cursor will move to "damp," and "freq" will be displayed normally.
7	RUN —Vib Sup— freq = 0400 Hz damp = 00120	< > ∧ ∨	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.
8	RUN —Vib Sup— freq = 0400 Hz damp = 00120	SCROLL	Press the SCROLL Key. The cursor will move from "damp" to "freq".
9	RUN —Vib Sup— freq = 0420 Hz damp = 00120	< > ∧ ∨	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.
10	RUN —Vib Sup— freq = 0420 Hz damp = 00120	DATA	Press DATA Key to save the settings.

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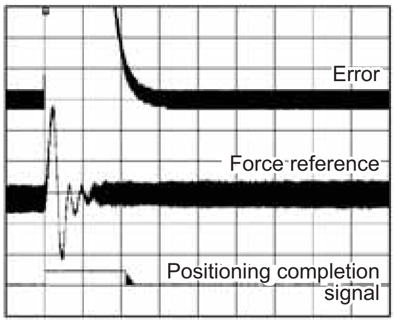
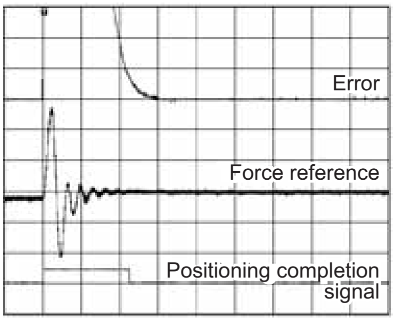
Step	Display after Operation	Keys	Operation
11	DONE —Vib Sup— freq = 0420 Hz damp = 00120		"DONE" will blink for two seconds.
12	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET	Press the MODE/SET Key to complete the anti-resonance control adjustment function. The 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	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET ∧ ∨	Display the main menu of the utility function mode, and select Fn204.
2	RUN —Vib Sup— Tuning Mode = 0	DATA	Press the DATA Key to display the initial setting screen for tuning mode.
3	RUN —FUNCTION— Tuning Mode = 1	∧ ∨ DATA	Press the ∧ or ∨ Key and select the tuning mode "1".
4	RUN —Vib Sup— freq = 0420 Hz damp = 00000	DATA	Press the DATA Key while "Tuning Mode = 1" is displayed. The screen shown on the left will appear and "freq" will blink. 
5	RUN —Vib Sup— freq = 0400 Hz damp = 00000	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to adjust the frequency.
6	RUN —Vib Sup— freq = 0400 Hz damp = 00000	SCROLL	Press the SCROLL Key. The cursor will move to "damp".

Step	Display after Operation	Keys	Operation
7	RUN — Vib Sup— freq = 0400 Hz damp = 00020	< > ∧ ∨	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.
8	RUN — Vib Sup— freq = 0400 Hz damp = 00120	SCROLL	Press the SCROLL Key. The cursor will move from "damp" to "freq".
9	RUN — Vib Sup— freq = 0400 Hz damp = 00120	< > ∧ ∨	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.
10	RUN — Vib Sup— freq = 0400 Hz damp = 00120	DATA	Press DATA Key to save the settings.
11	DONE — Vib Sup— freq = 0400 Hz damp = 0150		"DONE" will blink for two seconds.
12	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET	Press the MODE/SET Key to complete the anti-resonance control adjustment function. The screen in step 1 will appear again.

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(3) Starting Execution for Fine-tuning When the Anti-Resonance Control Adjustment Function Has Been Used

Step	Display after Operation	Keys	Operation
1	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET ∧ ∨	Display the main menu of the utility function mode, and select Fn204.
2	RUN —FUNCTION— Tuning Mode = 1	DATA	Press the DATA 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	RUN — Vib Sup— freq = 0400 Hz damp = 00120	DATA	Press the DATA Key while "Tuning Mode = 1" is displayed. The screen shown on the left will appear and "damp" will blink.
4	RUN — Vib Sup— freq = 0400 Hz damp = 00150	< > ∧ ∨	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	RUN — Vib Sup— freq = 0400 Hz damp = 0150	SCROLL	Press the SCROLL Key. The cursor will move from "damp" to "freq".
6	RUN — Vib Sup— freq = 0420 Hz damp = 0150	< > ∧ ∨	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	DONE — Vib Sup— freq = 0420 Hz damp = 0150	DATA	Press DATA Key to save the settings.
8	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET	Press the MODE/SET 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 mass ratio (Pn103) using advanced autotuning before executing this function. If the setting greatly differs from the actual mass 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.

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.

<Note>
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 force 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 force feedforward (T-REF) input.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□	Model following control is not used together with external speed/force feedforward input. [Factory setting]	Immediately	Tuning
	n.1□□□	Model following control is used together with external speed/force 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 force feedforward (T-REF) input. An improper speed feedforward (V-REF) input or force feedforward (T-REF) input may result in overshooting.

Refer to *6.8.2 Force Feedforward* and *6.8.3 Speed Feedforward* for details.

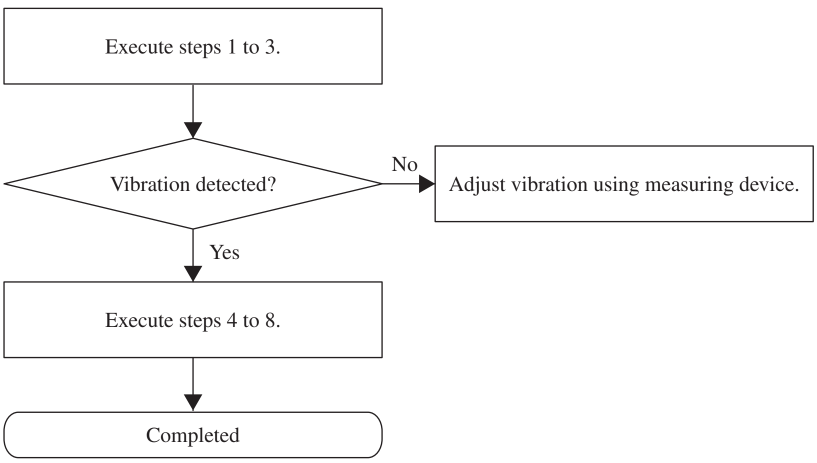
6.7.2 Vibration Suppression Function Operating Procedure

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 User's Manual, Operation of Digital Operator* (SIEPS80000055) for basic key operations of the Digital Operator.

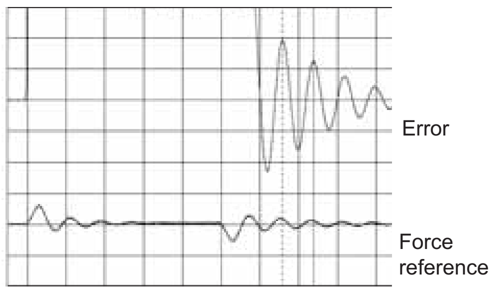
Note: • The function cannot be performed from the Panel Operator.
• If this function is aborted by pressing the MODE/SET Key, the SERVOPACK will continue operating until the motor comes to a stop. After the motor stops, the set value will return to the previous value.

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	RUN —FUNCTION— Fn204:A−Vib Sup Fn205:Vib Sup Fn206:Easy FFT Fn207:V−Monitor	MODE/SET ∧ ∨	Display the main menu of the utility function mode, and select Fn205.
3	RUN —Vib Sup— Measure f=−−−−−Hz Setting f=050. 0Hz	DATA	Press the DATA Key. The display shown on the left will appear. Measure f: Measurement frequency Setting f: Setting frequency [Factory-set to the set value for Pn145] Note: If the setting frequency and actual operating frequency are different, "Setting" will blink. The detected vibration frequency will be displayed. RUN —Vib Sup— Measure f=010. 4Hz Setting f=050. 0Hz 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. RUN —Vib Sup— Measure f =−−−−−Hz Setting f =050. 0Hz
4	RUN —Vib Sup— Measure f=010. 4Hz Setting f=010. 4Hz	SCROLL	Press the SCROLL Key. The displayed measure f value will be displayed as the setting f value as well. 
5	RUN —Vib Sup— Measure f=010. 4Hz Setting f=012. 4Hz	< > ∧ ∨	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. Note: If the setting frequency and actual operating frequency are different, "Setting" will blink.

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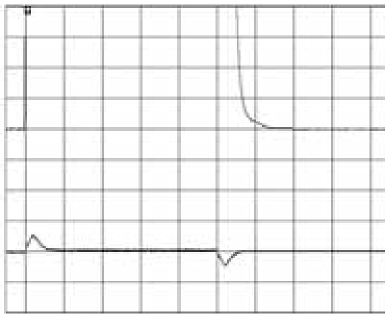
Step	Display after Operation	Keys	Operation
6	RUN —Vib Sup— Measure f=010. 4Hz Setting f=012. 4Hz	DATA	Press the DATA Key. The "Setting f" will change to usual display and the frequency currently displayed will be set for the vibration suppression function. 
7	DONE —Vib Sup— Measure f =-----Hz Setting f =012. 4Hz	DATA	Press the DATA Key to save the settings.
8	RUN —FUNCTION— Fn204 Fn205 Fn206 Fn207	MODE/SET	Press the MODE/SET Key to complete the vibration suppression function. The screen in step 1 will appear again.

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*
Force Feedforward Pn002 Pn400 Pn415	While in position control or speed control, force feedforward input is applied into the force reference input terminal and added to the internal force 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 (force, 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), force 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 SEROVO-PACK. The user must select the switching conditions.	Speed Position	*6.8.6*

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(2) Adjustment Functions to Reduce Vibration

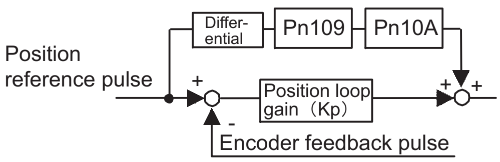
Adjustment Functions and Related Parameters	Description	Characteristics	Applicable Control Mode	Reference
Speed Reference Filter Pn307	A first order lag filter for the speed reference input.	Enables smooth operation. If a large value is set, however, the responsiveness will decrease.	Speed	*5.3.4*
Force Reference Filter Pn401	Sets a filter time constant with the first order lag filter and a notch filter arranged in series to the force reference.	Effective in almost all frequency bands. If a large value (low frequency) is set, the responsiveness will decrease.	Speed Position Force	*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 force reference.	Mainly effective for vibration between 500 and 2,000 Hz. Vibration 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 Force	*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	0.01 ms	0	Immediately	Tuning

Note: Too high value may cause the machine to vibrate. For ordinary machines, set 80% or less in this parameter.

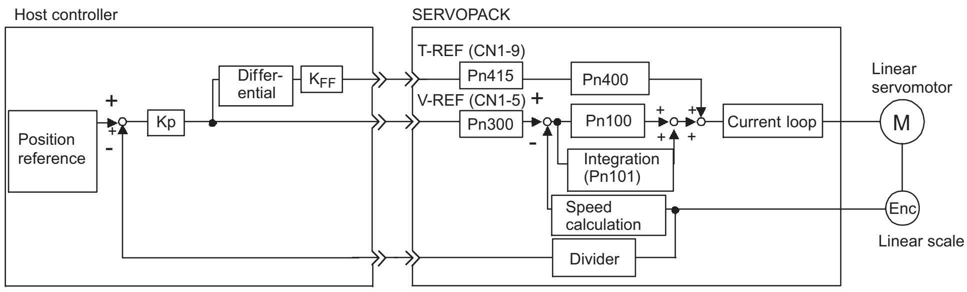
6.8.2 Force Feedforward

The force feedforward function is valid only in speed control and position control.

The force feedforward function shortens positioning time, The host controller differentiates a speed reference to generate a force feedforward reference, and inputs the force 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 force feedforward reference to T-REF (CN1-9 and -10) from the host controller.



Kp: Position loop gain
K_{FF}: Feedforward gain

(2) Related Parameters

Force feedforward is set using the parameters Pn002, Pn400 and Pn415.

The factory setting is Pn400 = 3.0. If, for example, the force feedforward value is ±3V, then, the force is limited to ±100% of the rated force.

Parameter		Function	When Enabled	Classification
Pn002	n.□□□0	Disabled	After restart	Setup
	n.□□□2	Uses T-REF terminal for force feedforward input.		

Pn400	Force Reference Input Gain (Speed, Position, Force)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	0.1V/rated force	30	Immediately	Setup

Note 1. Too high a force feedforward value will result in overshooting or undershooting. To prevent such troubles, set the optimum value while observing the system responsiveness.
2. The force feedforward function cannot be used with force limiting by analog voltage reference.

Pn415	Filter Time Constant (Speed, Position, Force)				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 force feedforward (T-REF) input.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□	Model following control is not used together with external speed/force feedforward input.	Immediately	Tuning
	n.1□□□	Model following control is used together with external speed/force 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 force feedforward (T-REF) together. If the speed feedforward (V-REF) value and force feedforward (T-REF) value are improperly input, overshooting may occur.

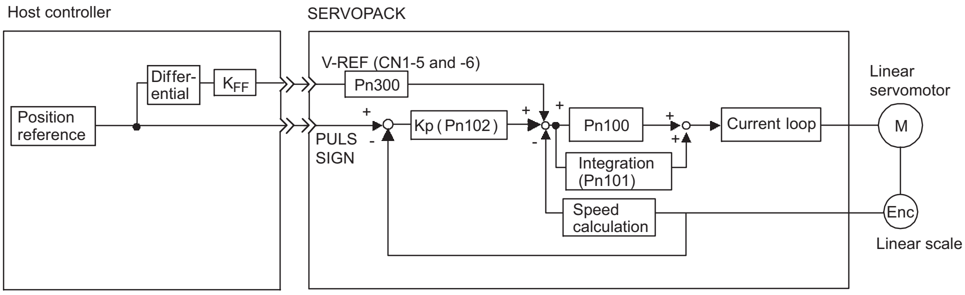
6.8.3 Speed Feedforward

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.



Kp: Position loop gain
K_{FF}: Feedforward gain

(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 ±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 — Speed / Position / Force				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	150 to 3000	0.01 V/rated speed	600	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 force feedforward (T-REF) input.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□	Model following control is not used together with external speed/force feedforward input. [Factory setting]	Immediately	Tuning
	n.1□□□	Model following control is used together with external speed/force 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 force feedforward (T-REF) together.
>
> If the speed feedforward (V-REF) value and force 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.

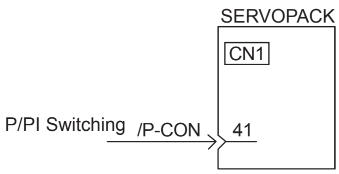
Proportional control operation is set using parameter Pn000 (1st digit) and input signal (/P-CON).

(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	Input signal /P-CON (CN1-41) is used to select PI control or P control.  CN1-41 is OFF (high level): PI control CN1-41 is ON (low level): P control	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.

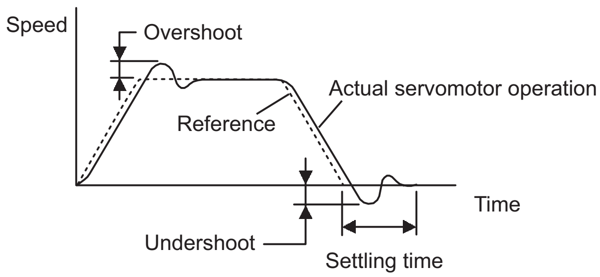
Parameter		Contents	Proportional Control Enabled/ Disabled	/P-CON Signal Allocation	When Enabled	Classification
Pn000	n.□□0□	Speed control (analog reference)	Enabled	Not required	After restart	Setup
	n.□□1□	Position control (pulse train reference)	Enabled	Not required		
	n.□□2□	Force control (analog 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)⇔ Force 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)⇔ Force control (analog reference)	Enabled	Required		
	n.□□9□	Force 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*.

<Notes>
- 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 force reference level for detection point. [Factory setting]	Pn10C	Immediately	Setup
	n.□□□1	Uses a speed reference level for detection point.	Pn181		
	n.□□□2	Uses an acceleration level for detection point.	Pn182		
	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 (Force Reference) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	200	Immediately	Tuning

Pn181	Mode Switch (Speed Reference) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 mm/s	0	Immediately	Tuning

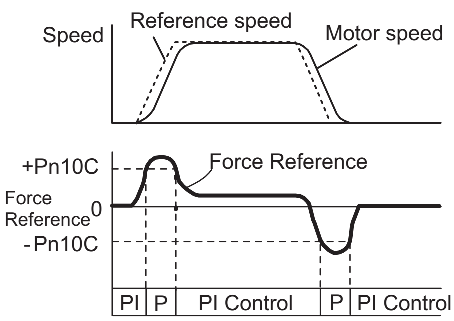
Pn182	Mode Switch (Acceleration) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 30000	1 mm/s^2	0	Immediately	Tuning

Pn10F	Mode Switch (Position Error) 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.

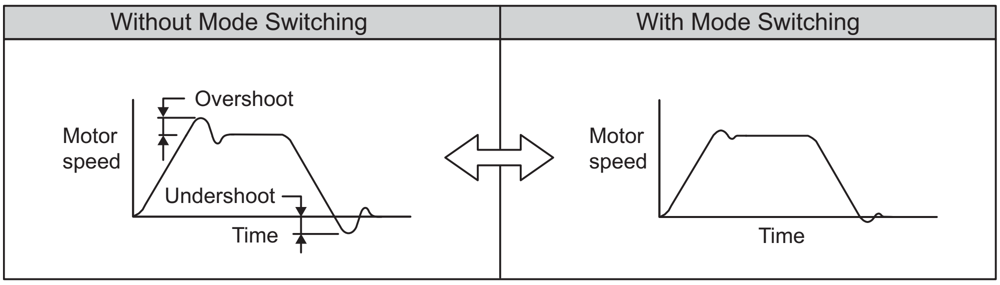
■ Using the Force Reference Level to Switch Modes (Factory Setting)

With this setting, the speed loop is switched to P control when the value of force reference input exceeds the force set in Pn10C. The factory setting for the force reference detection point is 200% of the rated force.



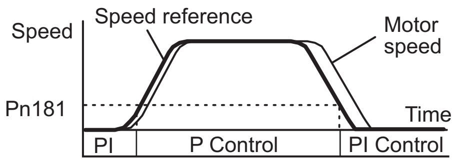
<Example>

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 force saturation during acceleration or deceleration. The mode switch function suppresses force saturation and eliminates the overshooting or undershooting of the motor speed.



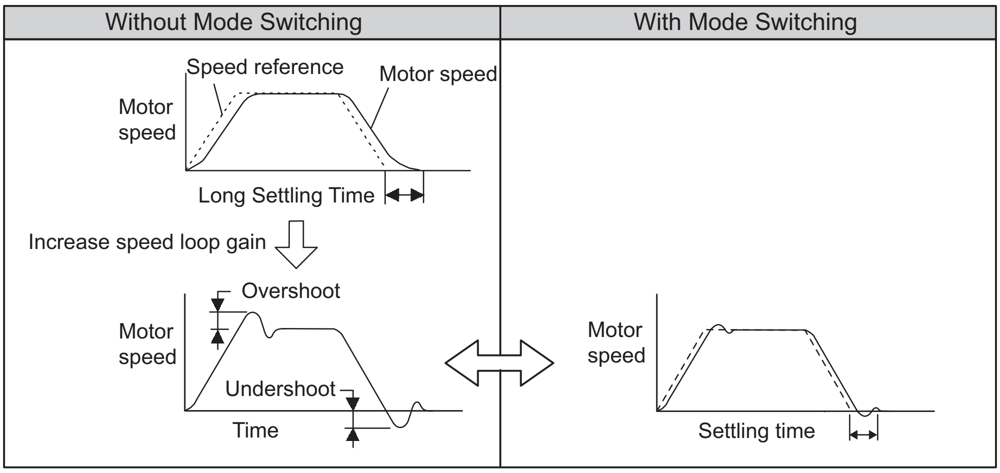
■ Using the Speed Reference Level to Switch Modes

With this setting, the speed loop is switched to P control when the value of speed reference input exceeds the speed set in Pn181.



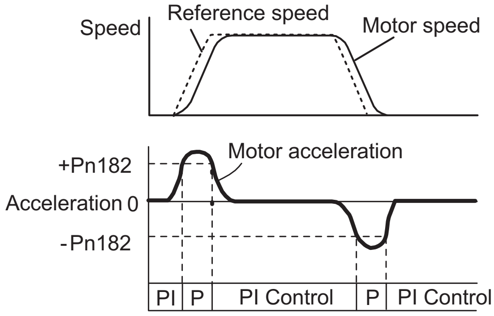
<Example>

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.



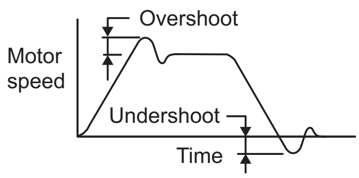
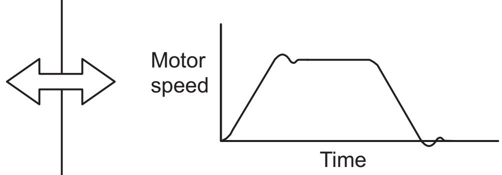
■ Using the Acceleration Level to Switch Modes

With this setting, the speed loop is switched to P control when the speed reference exceeds the acceleration rate set in Pn182.



<Example>

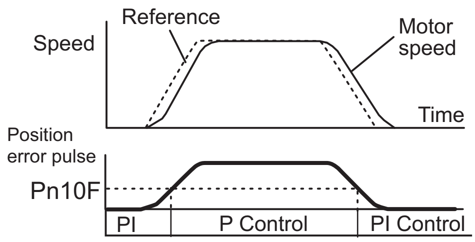
If the mode switch function is not being used and the SERVOPACK is always operated with PI control, the speed of the motor may overshoot or undershoot due to force saturation during acceleration or deceleration. The mode switch function suppresses force saturation and eliminates the overshooting or undershooting of the motor speed.

Without Mode Switching	With Mode Switching
	

■ 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.



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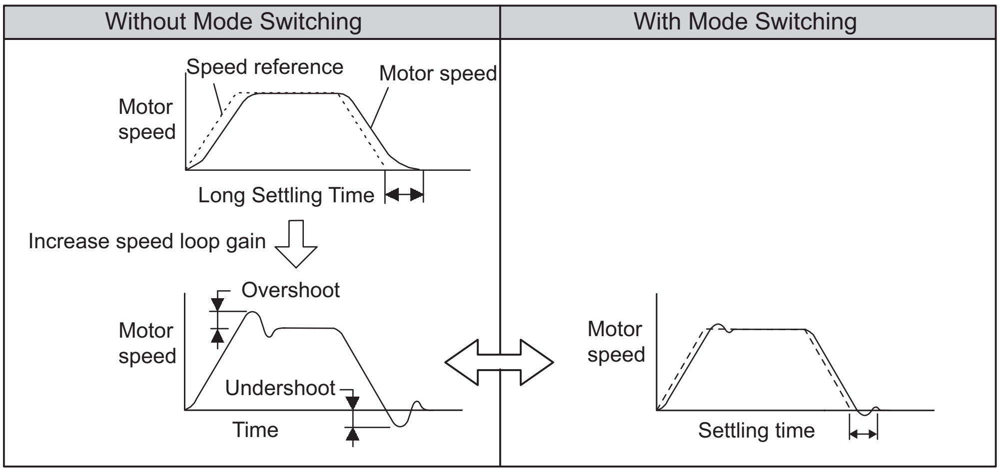
<Example>

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	Force 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 Force 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 Force Reference Filter Time Constant	Pn148 * 2nd Model Following Control Gain	Pn149 * 2nd Model Following Control Gain Compensation	Pn122 2nd Gain for Friction Compensation

* The switching gain settings for the model following control gain and the model following control gain compensation are available only for manual gain switching. To enable the gain switching of the these parameters, a gain switching input signal must be sent, and the following conditions must be met.
- No command being executed.
- Motor having been completely stopped.

If these conditions are not satisfied, the applicable parameters will not be switched although the other parameters shown in this table will be switched.

(2) Manual Gain Switching

Manual gain switching uses an external input signal (/G-SEL1) to switch gain setting 1 and gain setting 2.

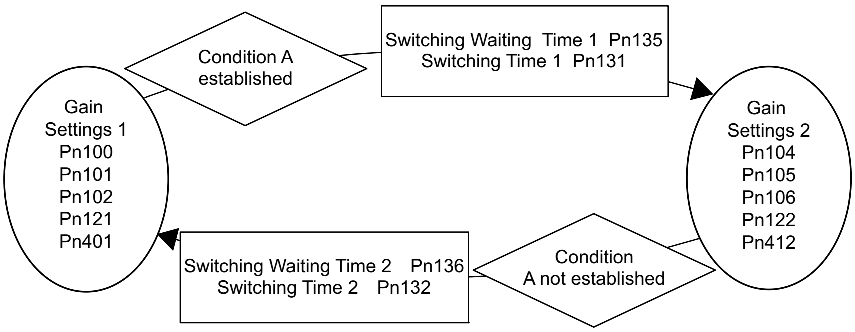
Parameter Setting	Switching Setting	Setting
Pn139=n.□□□0 Manual Gain Switching	OFF (H level)	Gain Setting 1
	ON (L level)	Gain Setting 2

(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

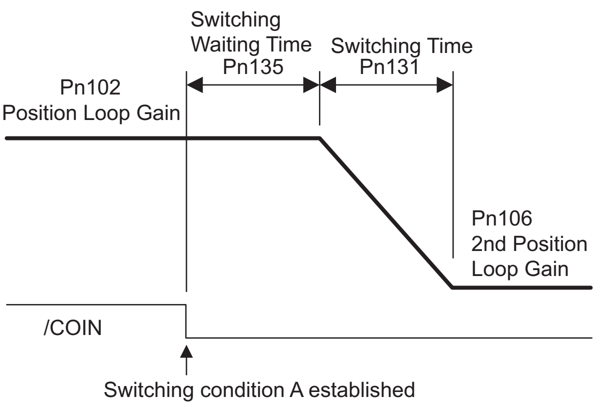
Automatic switching pattern 1 (Pn139.0 = 2)



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.



<Note>
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	0.1 Hz	400	Immediately	Tuning
Pn105	2nd Speed Loop Integral Time Constant		Speed	Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	15 to 51200	0.01 ms	2000	Immediately	Tuning
Pn106	2nd Position Loop Gain			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1/s	400	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 Force Reference Filter Time Constant	Speed	Position	Force	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning
Pn122	2nd Gain for Friction Compensation		Speed	Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 1000	1 %	100	Immediately	Tuning

(5) Parameters for Automatic Gain Switching

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		

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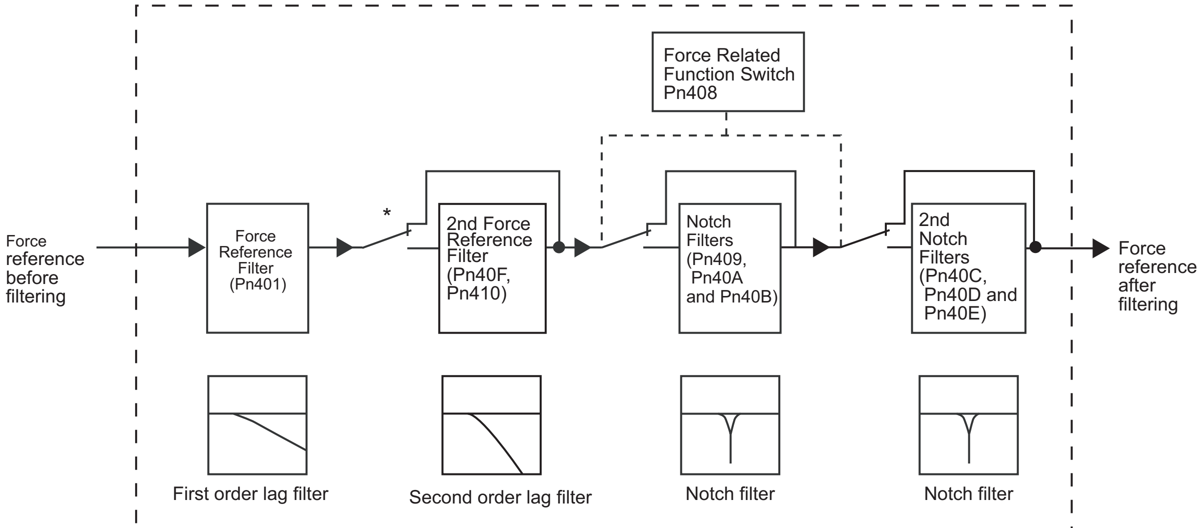
6.8.7 Force Reference Filter

As shown in the following diagram, the force 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.



* The 2nd torque reference filter is available when Pn40F is set to a value less than 5000 and not available when Pn40F is set to 5000 (factory setting).

(1) Force Reference Filter

If you suspect that machine vibration is being caused by the servo drive, 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	Force Reference Filter Time Constant (Speed) (Position) (Force)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning

■ Guidelines for Force Reference Filter Setting

• Speed Loop Gain (Pn100) and Force Reference Filter Time Constant (Pn401)

Adjusted value for stable control Pn401[ms] $\leq$ 1000 / (2 $\pi \times$ Pn100 [Hz] $\times$ 4)

Critical gains Pn401[ms] $<$ 1000 / (2 $\pi \times$ Pn100 [Hz] $\times$ 1)

■ Decimal Point in Parameter Setting

For SGDV SERVOPACKs, the parameter settings are shown with a decimal point on the digital operator and in the manuals. For example, the setting of Pn100 (Speed Loop Gain) is shown as Pn100 = 40.0. This means that the Pn100 is set to 40.0 Hz. The guidelines for force reference filter setting should be read as shown in the following example.

Example: Speed Loop Gain and Force Reference Filter

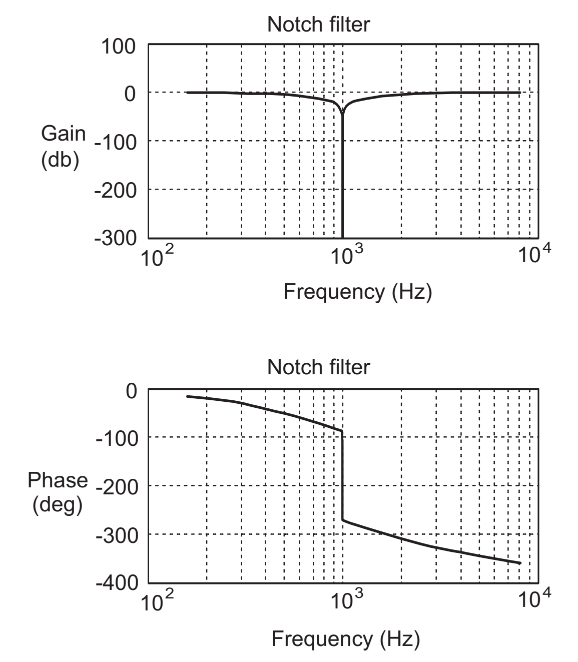
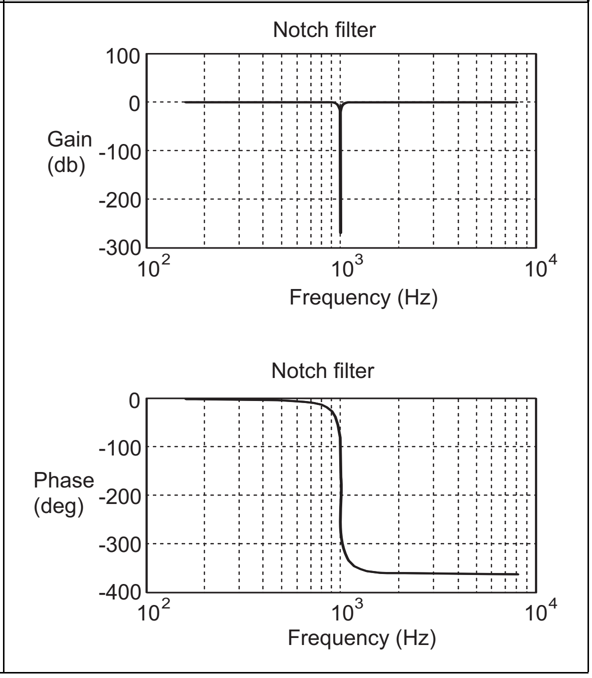
Adjusted value for stable control: Pn101[ms] $\geq$ 1000 / ($2\pi \times$ Pn100 [Hz] $\times$ 4)

If Pn100 = 40.0 [Hz]

then Pn101 = 1000 / ($2\pi \times 40.0 \times 4$) = approx. 0.99 [ms]

(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.

Q value = 0.7	Q value = 1.0
	

Set the notch filter enabled/disabled with Pn408.

Parameter		Function	When Enabled	Classification
Pn408	n.□□□0	1st notch filter disabled. [Factory setting]	Immediately	Setup
	n.□□□1	1st notch filter enabled.		
	n.□0□□	2nd notch filter disabled. [Factory setting]		
	n.□1□□	2nd notch filter enabled.		

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Set the machine's vibration frequency in the parameter of a notch filter that is being used.

Parameter					
Pn409	1st Notch Filter Frequency		Speed Position	Force	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning
Pn410	2nd Force Reference Filter Q Value		Speed Position	Force	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	50	Immediately	Tuning
Pn40A	1st Notch Filter Q Value		Speed Position	Force	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning
Pn40B	1st Notch Filter Depth		Speed Position	Force	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning
Pn40C	2nd Notch Filter Frequency		Speed Position	Force	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	Force	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning
Pn40E	2nd Notch Filter Depth		Speed Position	Force	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning
Pn40F	2nd Force Reference Filter Frequency		Speed Position	Force	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	100 to 5000	1 Hz	5000	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.

Parameter					
Pn11F	Position Integral Time Constant			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 50000	0.1 ms	0	Immediately	Tuning

6.8.9 Friction Compensation

Friction compensation rectifies the viscous friction change and regular load change.

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		Speed	Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 1000	1 %	100	Immediately	Tuning
Pn123	Friction Compensation Coefficient		Speed	Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1 %	0	Immediately	Tuning
Pn124	Friction Compensation Frequency Correction		Speed	Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.1 Hz	0	Immediately	Tuning
Pn125	Friction Compensation Gain Correction		Speed	Position	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.

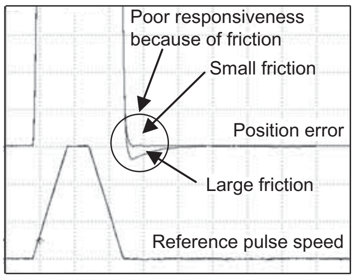
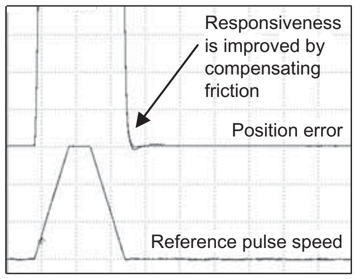
⚠ CAUTION

Before using friction compensation, set the mass ratio (Pn103) as correctly as possible.
If the wrong mass ratio is set, vibration may result.

Step	Operation
1	Set the following parameters for friction compensation to the factory setting as follows. Friction compensation gain (Pn121): 100 Friction compensation coefficient (Pn123): 0 Friction compensation frequency correction (Pn124): 0 Friction compensation gain correction (Pn125): 100 Note: Always use the factory-set values for friction compensation frequency correction (Pn124) and friction compensation gain correction (Pn125).

Adjustments

6

Step	Operation
2	To check the effect of friction compensation, increase the friction compensation coefficient (Pn123). Note: The upper limit of the friction compensation coefficient (Pn123) is 95%.
3	If the friction compensation is insufficient in step 2, increase the set value in Pn121 to where the equipment does not vibrate. Note: The SERVOPACK may vibrate if Pn121 is set to a value the same as or higher than the resonance frequency of the equipment. If necessary, adjust Pn121 in increments of 10.0 Hz. **Effect of Adjustment** The following graph shows the responsiveness before and after adjustment.  Before Adjustment ⇒  After Adjustment **Effect of Adjustment Parameters** Pn121: Friction Compensation Gain 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. Pn123: Friction Compensation Coefficient 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.

6.8.10 Current Control Mode Selection

This function reduces high-frequency noises while the motor is being stopped. This function is enabled by default and set to be effective under different application conditions.

Input Voltage	SERVOPACK Model SGDV-
200 V	120A□□A, 180A□□A, 200A□□A, 330A□□A, 470A□□A, 550A□□A, 590A□□A, 780A□□A
400 V	3R5D□□A, 5R4D□□A, 8R4D□□A, 120D□□A, 170D□□A, 210D□□A, 260D□□A, 280D□□A, 370D□□A

Parameter		Meaning	When Enabled	Classification
Pn009	n.□□0□	Selects the current control mode 1. (Does not perform the switching.)	After restart	Tuning
	n.□□1□	Selects the current control mode 2. (Perform the switching.) [Factory setting]		

IMPORTANT

- When this function is executed, the load ratio may increase while the servomotor is being stopped.

6.8.11 Current Gain Level Setting

This function reduces noises by adjusting the parameter value for current control inside the SERVOPACK in accordance with the parameter value for the speed loop gain (Pn100). To change the parameter value for current control, the current gain level must be changed from 2000%, which is the default value of Pn13D to disable this function. This function is always disabled in force control mode (Pn000.1 = 2).

Pn13D	Current Gain Level		Speed Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	100 to 2000	1 %	2000	Immediately	Tuning

Note: If the set value of Pn13D is decreased, the level of noise will be lowered, but the responsiveness of the SERVOPACK will also be degraded. Lower the current gain level to one at which SERVOPACK responsiveness can be secured.

IMPORTANT

- If the parameter setting of the current gain level is changed, the responsiveness characteristic of the speed loop will also change. The servo must, therefore, be readjusted again.

6.8.12 Speed Detection Method Selection

This function can ensure smooth movement of the motor while the motor is running. This function is disabled by default. Set the value of Pn009.2 = 1 to enable this function.

Parameter		Meaning	When Enabled	Classification
Pn009	n. □0□□	Selects speed detection 1. [Factory setting]	After restart	Tuning
	n. □1□□	Selects speed detection 2.		

IMPORTANT

- If this function is changed, the responsiveness characteristic of the speed loop will also change. The servo must, therefore, be readjusted again.

7

Utility Functions (Fn□□□)

7.1 List of Utility Functions

Utility functions are used to execute parameters related to linear 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
Fn009	Automatic tuning of analog (speed, force) reference offset	○	○	5.3.2 5.5.2
Fn00A	Manual servo tuning of speed reference offset	○	○	5.3.2
Fn00B	Manual servo tuning of force 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
Fn014	Resets configuration error of option module	○	○	7.15
Fn01B	Initializes vibration detection level	○	○	7.16
Fn01E	SERVOPACK and servomotor ID Display	×	○	7.17
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	○	○	7.18
Fn207	Online vibration monitor	○	○	7.19
Fn080	Polarity detection	○	○	5.9.4
Fn020	Origin setting	×	○	5.9.5
Fn030	Software reset	○	○	7.20

○: 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>

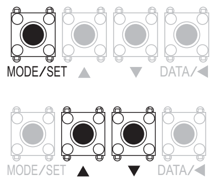
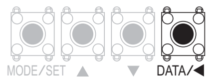
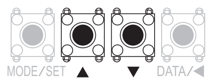
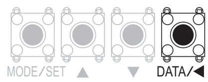
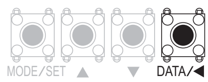
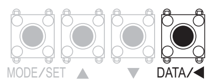
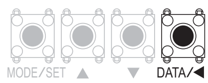
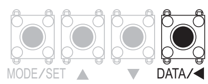
If 36000 is displayed,

3600000 [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	Fn000		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	0. 810		Press the DATA/SHIFT Key for approximately one second. The latest alarm data is displayed.
3	1. C90 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	_3456		Press the DATA/SHIFT Key for less than one second. The lower four digits of Time Stamp are displayed.
5	-7890		Press the DATA/SHIFT Key for less than one second. The middle four digits of Time Stamp are displayed.
6	‾ 00		Press the DATA/SHIFT Key for less than one second. The higher two digits of Time Stamp are displayed.
7	1. C90		Press the DATA/SHIFT Key for less than one second. The alarm number is displayed again.
8	Fn000		Press the DATA/SHIFT Key for approximately one second. "Fn000" is displayed again.

<Notes>

- 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

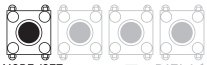
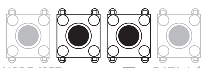
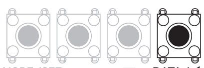
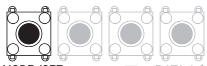
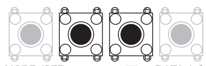
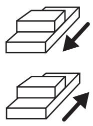
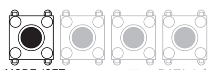
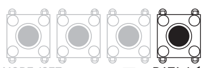
The following settings are required before performing JOG operation.

- 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 Pn383.

Pn383	JOG Speed	Speed / Position / Force			Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 mm/s	50	Immediately	Setup

(2) Operating Procedure

Follow the steps below to set the JOG speed. The following example is given when the moving direction of servomotor is set as Pn000.0=0(linear scale counting up direction is regarded as the forward run).

Step	Display after Operation	Keys	Operation
1	Fn000		Press the MODE/SET Key to select the utility function mode.
2	Fn002		Press the UP or DOWN Key to select Fn002.
3	-. .JoG		Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	. .JoG		Press the MODE/SET Key. The servo turns ON.
5	. .JoG		The servomotor will rotate at the present speed set in Pn383 while the UP Key (for forward run) or DOWN Key (for reverse run) is pressed.  Motor forward run Motor reverse run
6	-. .JoG		The servo will be turned OFF (i.e., the motor will be turned OFF) when the MODE/SET Key is pressed. The servo can be turned OFF by pressing the DATA/SHIFT Key for approximately one second.
7	Fn002		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 linear scale (phase-C) and to clamp at the position. This mode is used when the motor shaft needs to be aligned to the machine.

⚠ CAUTION
• 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: 15 mm/s

(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	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn003	▲ ▼	Press the UP or DOWN Key to select the Fn003.
3	-. .CSr	DATA/◀	Press the DATA/SHIFT Key for approximately one second, and the display shown on the left appears.
4	. .CSr	MODE/SET	Press the MODE/SET Key. The servomotor is turned to Servo ON.
5	. .CSr	▲ ▼	Pressing the UP Key will move the motor in the forward direction. Pressing the DOWN Key will move the motor in the reverse direction. The movement of the servomotor changes according to the setting of Pn000.0. Parameter / UP key (Forward) / DOWN key (Reverse): Pn000 n.□□□0: linear scale counting up / linear scale counting down Pn000 n.□□□1: linear scale counting down / linear scale counting up Note: Direction when viewed from the load of the servomotor.
6	. .CSr 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	Fn003	DATA/◀	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.
- 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

Parameter	Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
Pn530 Program JOG Operation Related Switch (Speed, Position, Force)	0000 to 0005	–	0000	Immediately	Setup
Pn531 Program JOG Movement Distance (Speed, Position, Force)	1 to 1073741824(2^{30})	1 reference unit	32768	Immediately	Setup
Pn585 Program JOG Movement Speed (Speed, Position, Force)	1 to 10000	1 mm/s	50	Immediately	Setup
Pn534 Program JOG Acceleration/Deceleration Time (Speed, Position, Force)	2 to 10000	1 ms	100	Immediately	Setup
Pn535 Program JOG Waiting Time (Speed, Position, Force)	0 to 10000	1 ms	100	Immediately	Setup
Pn536 Number of Times of Program JOG Movement (Speed, Position, Force)	0 to 1000	1 time	1	Immediately	Setup

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.

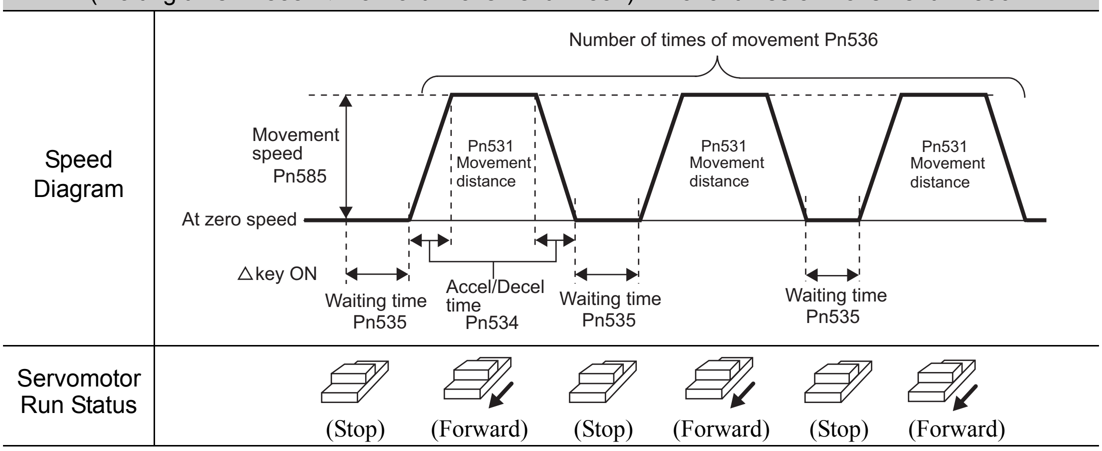
Note: 1. 2 or 3 is set to Pn530.0, infinite time operation is disabled.
2. 0 or 1 is set to Pn530.0, movement is one direction. Take note of movable range.

(5) Program Operation Patterns

The following example is given when the movement direction of the Servomotor is set as Pn000.0 = 1 (linear scale counting up direction is regarded as the forward run).

Pn530.0 = 0

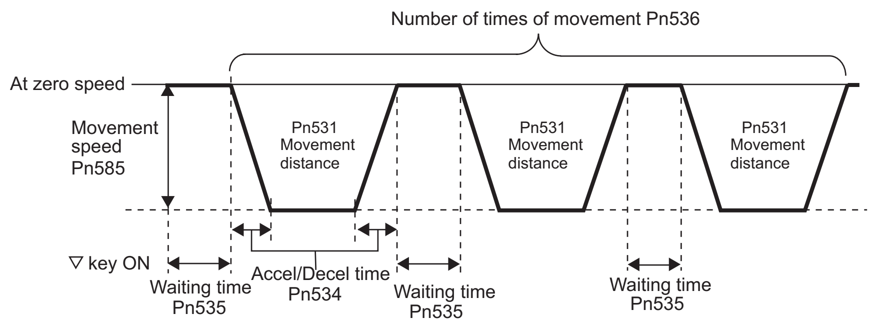
(Waiting time Pn535 → Forward movement Pn531) × No. of times of movement Pn536



Pn530.0 = 1

(Waiting time Pn535 → Reverse movement Pn531) × No. of times of movement Pn536

Speed Diagram



Servomotor Run Status

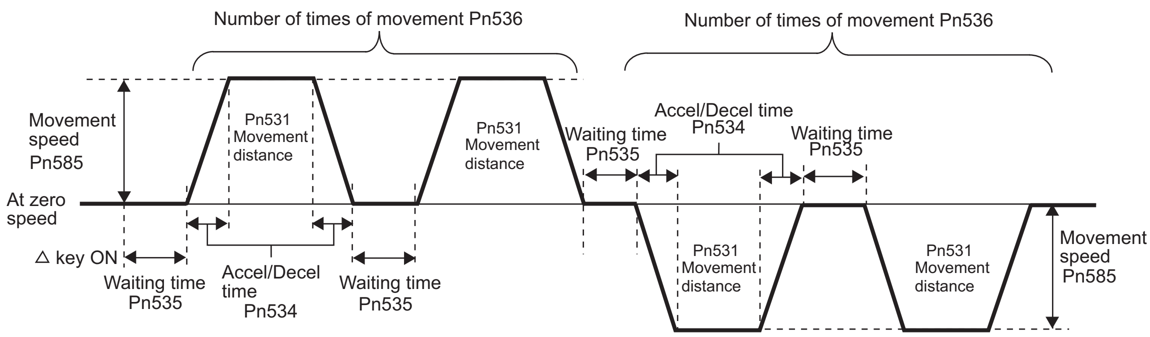
(Stop) (Reverse) (Stop) (Reverse) (Stop) (Reverse)

Pn530.0 = 2

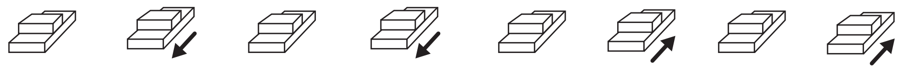
(Waiting time Pn535 → Forward movement Pn531) × No. of times of movement Pn536

(Waiting time Pn535 → Reverse movement Pn531) × No. of times of movement Pn536

Speed Diagram



Servomotor Run Status



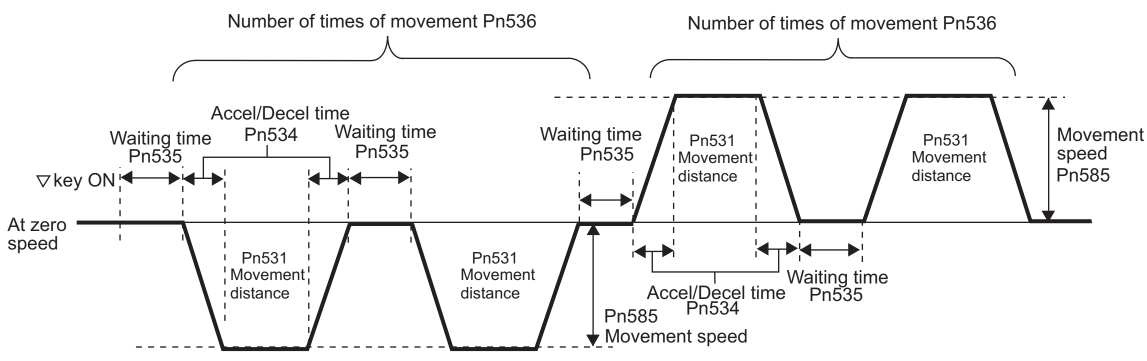
(Stop) (Forward) (Stop) (Forward) (Stop) (Reverse) (Stop) (Reverse)

Pn530.0 = 3

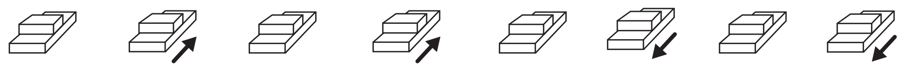
(Waiting time Pn535 → Reverse movement Pn531) × No. of times of movement Pn536

(Waiting time Pn535 → Forward movement Pn531) × No. of times of movement Pn536

Speed Diagram

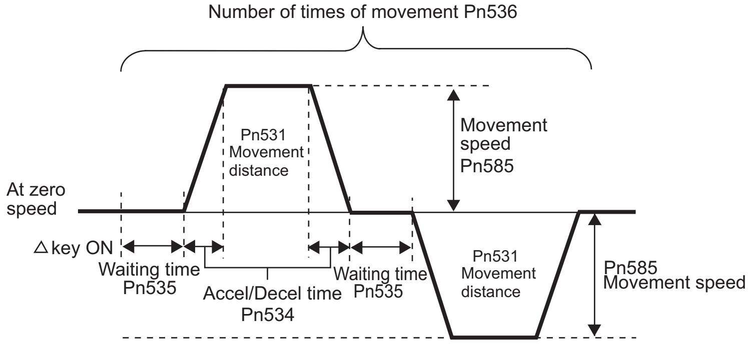
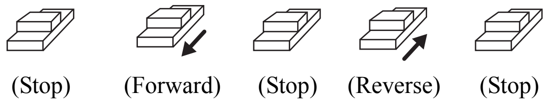


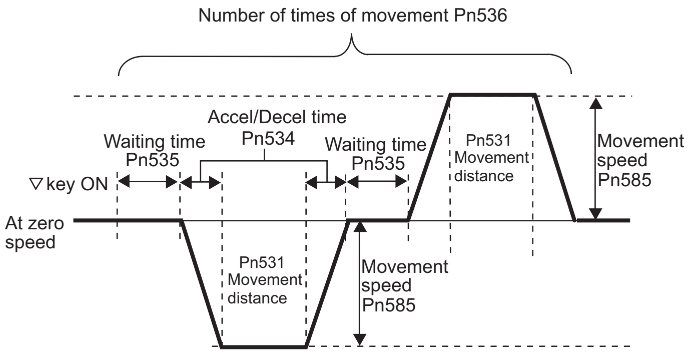
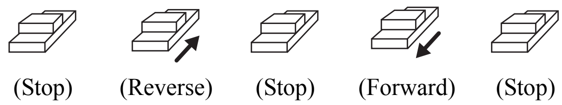
Servomotor Run Status



(Stop) (Reverse) (Stop) (Reverse) (Stop) (Forward) (Stop) (Forward)

Note: When 3 is set to Pn530.0, infinite time operation is disabled.

Pn530.0 = 4	
(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reserve movement Pn531) × No. of times of movement Pn536	
Speed Diagram	
Servomotor Run Status	

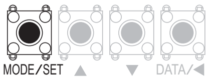
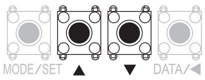
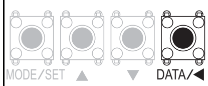
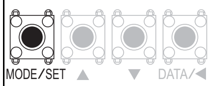
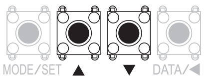
Pn530.0 = 5	
(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × No. of times of movement Pn536	
Speed Diagram	
Servomotor Run Status	

Utility Functions (Fn□□□)

7

(6) Operating Procedure

Follow the steps below to perform the program JOG operation.

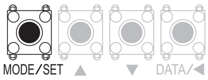
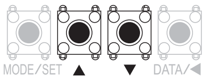
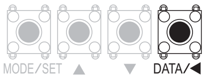
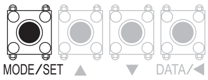
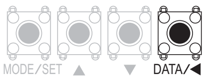
Step	Display after Operation	Keys	Operation
1	Fn000		Press the MODE/SET Key to select the utility function mode.
2	Fn004		Press the UP or DOWN Key to select Fn004.
3	=.PJOG		Press the DATA/SHIFT Key for more than one second. The display shown on the left appears.
4	‾.PJOG		Press the MODE/SET Key. The servo turns ON.
5	.PJOG		Press the UP or DOWN Key according to the first movement direction of the operation pattern. After the preset waiting time, the movement starts. Notes: • 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	‾. .End (Blinking)		"End" blinks when the program JOG operation movement completes, and the display of step 4 appears. Notes: • 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	Fn000		Press the MODE/SET Key to select the utility function mode.
2	Fn005		Press the UP or DOWN Key to select Fn005.
3	P.InIt		Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	P.InIt Display blinks		Press the MODE/SET Key. Then, the parameters will be initialized. During initialization, the display shown on the left blinks.
5	donE Display blinks		When the initialization of parameter setting completes, the display shown on the left blinks for about one second.
6	P.InIt		The display changes from "donE" to the display shown on the left.
7	Fn005		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.		

Utility Functions (Fn□□□)

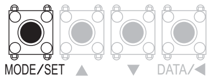
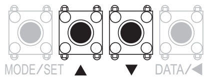
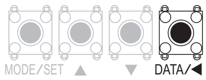
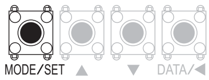
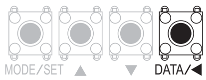
7

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.

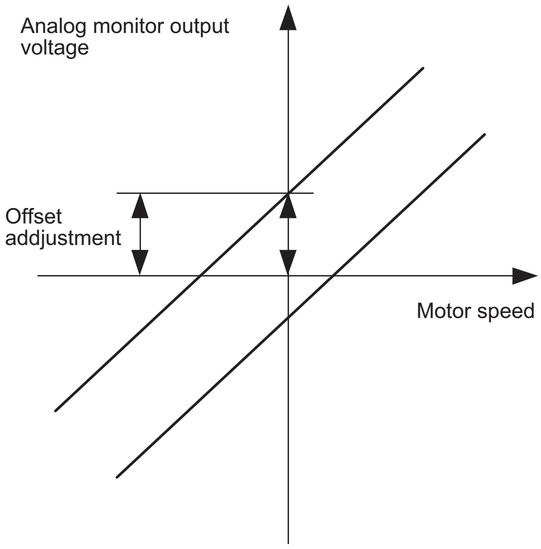
Step	Display after Operation	Keys	Operation
1	Fn000		Press the MODE/SET Key to select the utility function mode.
2	Fn006		Press the UP or DOWN Key to select Fn006.
3	trCLr		Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	donE Display blinks		Press the MODE/SET Key to clear the alarm history. The display shown on the left blinks for about one second when the data is cleared.
5	trCLr		The display changes from "donE" to the display shown on the left.
6	Fn006		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 (force reference monitor output and motor speed monitor output). The offsets for the force 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

<Notes>

- 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 force 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	Fn000	MODE/SET ▲ ▼ DATA/◀	Press the MODE/SET Key to select the utility function mode.
2	Fn00C	MODE/SET ▲ ▼ DATA/◀	Press the UP or DOWN Key to select Fn00C.
3	Ch1_o	MODE/SET ▲ ▼ DATA/◀	Press the DATE/SHIFT Key for approximately one second. The display shown on the left appears.
4	Ch2_o	MODE/SET ▲ ▼ DATA/◀	Press the MODE/SET Key to select channel-1 or channel-2 monitor output.

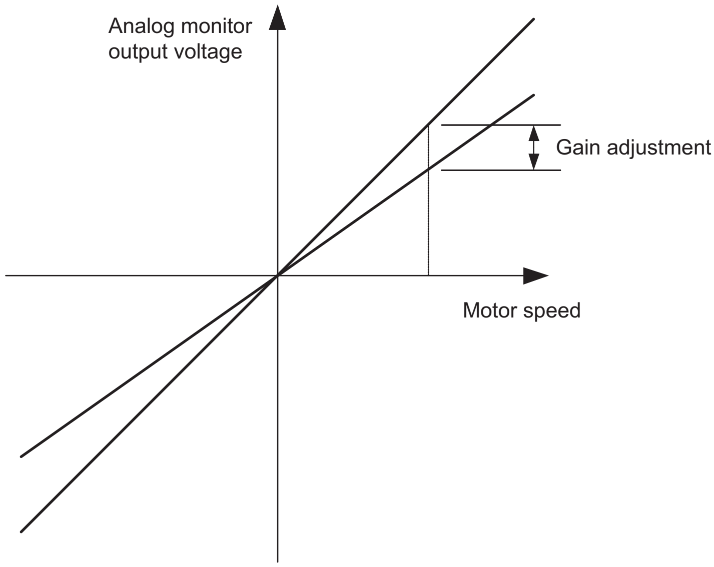
Step	Display after Operation	Keys	Operation
5	0000	DATA/◀	Press the DATA/SHIFT Key for less than one second. Zero adjustment data will be displayed as shown on the left.
6	-0001	▲ ▼	Press the UP or DOWN Key to change the data. This completes zero adjustment of the analog monitor output.
7	Ch2_o	DATA/◀	Press the DATA/SHIFT Key for less than one second. The zero adjustment data will be displayed as shown on the left. To adjust a different channel, switch the monitor channel using steps 4 through 6.
8	Fn00C	DATA/◀	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 (force reference monitor output and motor speed monitor output). The gains for the force 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 × 0.4%) = 50%
Therefore, the monitor output voltage is 0.5 times as high.

<Setting the Set Value to 125>
100% + (125 × 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

<Notes>
- 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	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn00d	▲ ▼	Press the UP or DOWN Key to select Fn00D.
3	Ch1_o	DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	Ch2_o	MODE/SET	Press the MODE/SET Key to select channel-1 or channel-2 monitor output.
5	0000	DATA/◀	Press the DATA/SHIFT Key for less than one second. Gain adjustment data will be displayed as shown on the left.
6	-0001	▲ ▼	Press the UP or DOWN Key to change the data. This completes gain adjustment of the analog monitor output.
7	Ch2_o	DATA/◀	Press the DATA/SHIFT Key for less than one second. The gain adjustment data will be displayed as shown on the left. To adjust a different channel, switch the monitor channel using steps 4 through 6.
8	Fn00d	DATA/◀	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 force ripple caused by current offset. Basically, the user need not perform this adjustment.

IMPORTANT

- Be sure to perform this function with the servo OFF.
- Execute the automatic offset adjustment if the force ripple is too big when compared with that of other SERVOPACKs.

Follow the steps below.

Step	Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn00E	▲ ▼	Press the UP or DOWN Key to select Fn00E.
3	Cur_o	DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	donE Display blinks	MODE/SET	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	Cur_o		The display changes from "donE" to the display shown on the left.
6	Fn00E	DATA/◀	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 force 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 mm/s.
> - Adjust the operator until the force 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	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn00F	▲ ▼	Press the UP or DOWN Key to select Fn00F.
3	Cu1_o	DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown on the left (phase U) appears.
4	0000	DATA/◀	Press the DATA/SHIFT Key for less than one second to display the phase-U offset amount.
5	-0010	▲ ▼	Press the UP or DOWN Key to adjust the offset. Carefully adjust the offset while monitoring the force reference monitor signal. Adjustable range: –512 to +511
6	Cu1_o	DATA/◀	Press the DATA/SHIFT Key for less than one second. The display shown on the left appears.
7	Cu2_o	MODE/SET	Press the MODE/SET Key. The display shown on the left appears (phase V).
8	0000	DATA/◀	Press the DATA/SHIFT Key for less than one second to display the phase-V offset amount.
9	-0010	▲ ▼	Press the UP or DOWN Key to adjust the offset. Carefully adjust the offset while monitoring the force reference monitor signal. Adjustable range: –512 to +511
10	Cu2_o	DATA/◀	Press the DATA/SHIFT Key for less than one second. The display shown on the left appears.
11	Fn00F	DATA/◀	When the offset adjustment completes, press the DATA/SHIFT Key for approximately one second. "Fn00F" is displayed again.

7.12 Write Prohibited Setting (Fn010)

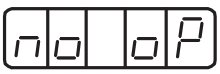
Prohibiting writing prevents writing parameters by mistake.

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
Fn009	Automatic tuning of analog (speed, force) reference offset	5.3.2 5.5.2
Fn00A	Manual servo tuning of speed reference offset	5.3.2
Fn00B	Manual servo tuning of force 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
Fn014	Resets configuration error of option module	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	7.18
Fn207	Online vibration monitor	7.19

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:

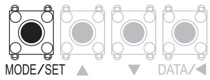
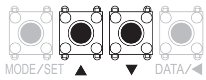
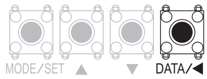
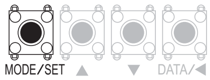
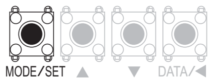
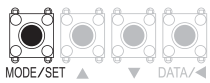
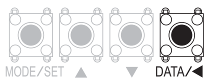
- "0000": Write permitted (Releases write prohibited mode.)
- "0001": Write prohibited (Parameters become write prohibited from the next power ON.)

Step	Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn010	▲ ▼	Press the UP or DOWN Key to select Fn010.
3	P.0000	DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	P.0001	▲ ▼	Press the UP or DOWN Key to set a value: "0000": Write permitted, "0001": Write prohibited
5	donE Display blinks	MODE/SET	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	P.0001		The display changes from "donE" to "P.000□."
7	Fn010	DATA/◀	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.

<table>
<tr><th>Step</th><th>Display after Operation</th><th>Keys</th><th>Operation</th></tr>
<tr><td>1</td><td>Fn000</td><td></td><td>Press the MODE/SET Key to select the utility function mode.</td></tr>
<tr><td>2</td><td>Fn011</td><td></td><td>Press the UP or DOWN Key to select Fn011.</td></tr>
<tr><td>3</td><td>F.0140</td><td></td><td>Press the DATA/SHIFT Key for approximately one second to display the servomotor model and voltage code.
F.0140
<table>
<tr><th colspan="2">Servomotor Voltage</th></tr>
<tr><td>Data</td><td>Type</td></tr>
<tr><td>02</td><td>400 VAC</td></tr>
<tr><td>01</td><td>200 VAC</td></tr>
</table>
<table>
<tr><th colspan="2">Servomotor Model</th></tr>
<tr><td>Data</td><td>Model</td></tr>
<tr><td>40</td><td>linear motor</td></tr>
</table></td></tr>
<tr><td>4</td><td>P.0010</td><td></td><td>Press the MODE/SET Key to display the servomotor capacity.
P.0010
Servomotor capacity in units of 10 W
The above example indicates 100 W</td></tr>
<tr><td>5</td><td>E.0008</td><td></td><td>Press the MODE/SET Key, and the encoder type and resolution code will be displayed.
E.0008
<table>
<tr><th colspan="2">Encoder Type</th></tr>
<tr><td>Data</td><td>Type</td></tr>
<tr><td>00</td><td>Incremental</td></tr>
<tr><td>01</td><td>Absolute</td></tr>
</table>
<table>
<tr><th colspan="2">Encoder Resolution</th></tr>
<tr><td>Data</td><td>Resolution</td></tr>
<tr><td>8</td><td>8-bit</td></tr>
<tr><td>12</td><td>12-bit</td></tr>
</table></td></tr>
<tr><td>6</td><td>y.0010</td><td></td><td>Press the MODE/SET Key to display the SERVOPACK's code for custom orders.
y.0010
Code for custom orders
* The display "y.0000" means standard model.</td></tr>
<tr><td>7</td><td>Fn011</td><td></td><td>Press the DATA/SHIFT Key for approximately one second. "Fn011" is displayed again.</td></tr>
</table>

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	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn012	▲ ▼	Press the UP or DOWN Key to select Fn012.
3	r.0001	DATA/◀	Press the DATA/SHIFT Key for approximately one second to display the SERVOPACK software version number.
4	E.0001	MODE/SET	Press the MODE/SET Key to display the encoder software version number.
5	Fn012	DATA/◀	Press the DATA/SHIFT Key for approximately one second. "Fn012" is displayed again.

7.15 Resetting Configuration Error of Option Module (Fn014)

The SERVOPACK with option module recognizes installation status and types of option module which is connected to SERVOPACK. If an error is detected, the SERVOPACK issues an alarm.

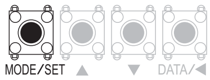
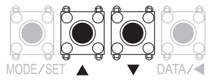
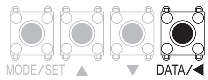
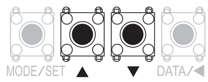
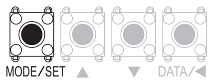
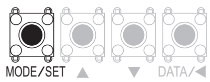
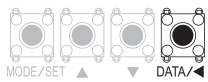
This function resets these alarms.

For alarm types and corrective actions, refer to *9 Troubleshooting*.

Note 1. Alarms related to option modules 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	Fn000		Press the MODE/SET Key to select the utility function mode.
2	Fn014		Press the UP or DOWN Key to select Fn014.
3	o.SAFE		Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	o.FEEd		Press the UP or DOWN Key to select option module to be cleared.
5	o. In It		Press the MODE/SET Key for approximately one second. The display shown on the left appears.
6	o. In It Display blinks ↓ done		Press the MODE/SET Key again. The display changes shown on the left and the configuration error of option module is cleared.
7	o. In It		The display changes from "done" to the display shown on the left.
8	Fn014		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 (Pn384) 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).

$$\text{Detection level} = \frac{\text{Vibration detection level (Pn384[mm/s])} \times \text{Detection sensibility (Pn311[\%])}}{100}$$

<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 (Pn384) 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.

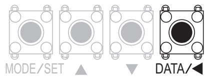
IMPORTANT

- 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 mass 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	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn01b	▲ ▼	Press the UP or DOWN Key to select Fn01b.
3	d.init	DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	d.init Display blinks	MODE/SET	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: • Operate the SERVOPACK with the references that will used for actual operation. • If the servomotor is moving at 10% or less of the maximum speed, "Error" will be displayed.
5	donE	MODE/SET	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	Fn01b		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 Force		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 500	1%	100	Immediately	Setup
Pn384	Vibration Detection Level		Speed Position Force		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 5000	1 mm/s	10	Immediately	Setup

Note: Pn384 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 module 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	• SERVOPACK model • SERVOPACK serial number • SERVOPACK manufacturing date • SERVOPACK input voltage (V) • Maximum applicable motor capacity (W) • Maximum applicable motor rated current (Arms)
Servomotor	• Servomotor model • Servomotor serial number • Servomotor manufacturing date • Servomotor input voltage (V) • Servomotor capacity (W) • Servomotor rated current (Arms)
Encoder	• Encoder model • Encoder serial number • Encoder manufacturing date • Encoder type/resolution
Feedback Option Module	• Feedback option module model • Feedback option module serial number (Reserved area) • Feedback option module manufacturing date • Feedback option module 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 EasyFFT (Fn206)

⚠ WARNING

- The servomotor moves at minimal speed when EasyFFT is executed. Do not touch the servomotor or machine during execution of EasyFFT, otherwise injury may result.

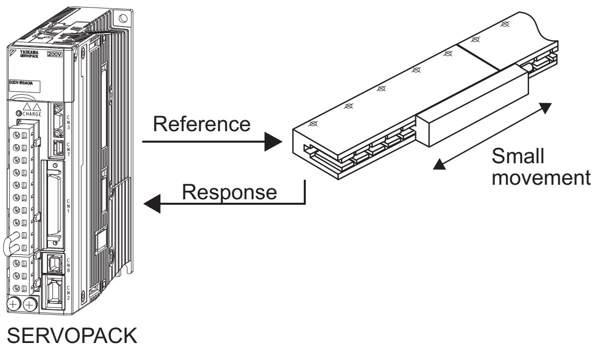
⚠ CAUTION

- 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.

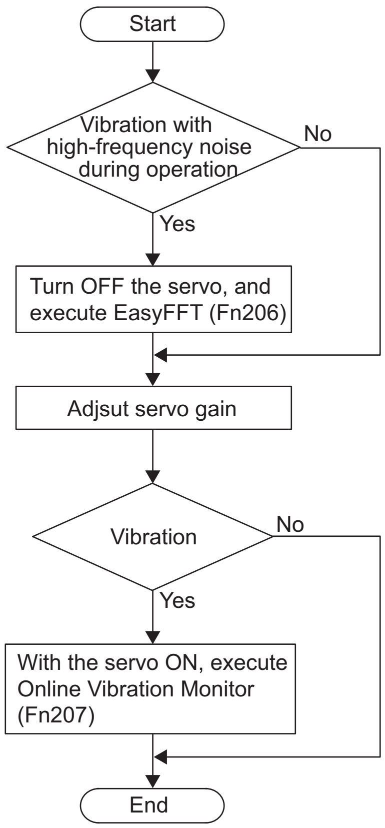
This function detects and sets the frequency as a parameter for the notch filter according to the machine characteristics. This setting function is called EasyFFT.

EasyFFT sends a frequency waveform reference from the SERVOPACK to the servomotor and moves 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.



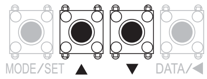
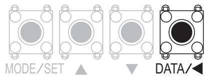
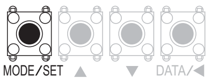
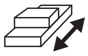
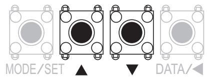
IMPORTANT

- 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

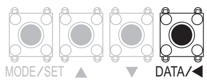
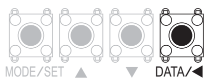
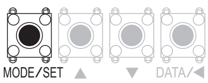
Follow the steps below.

Step	Display after Operation	Keys	Operation
1	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn206	▲ ▼	Press the UP or DOWN Key to select Fn206.
3	In. 15 Setting reference amplitude	DATA/◀	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	In. 16		Press the UP or DOWN Key to set a reference amplitude. Reference amplitude setting: 1 to 800 Note: • 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	F. Run ready status		Press the DATA/SHIFT Key for approximately one second to enter the run ready status.
6	. .run		Press the MODE/SET Key to enter Servo ON status (the motor power ON) Note: Press the MODE/SET Key to turn the servo OFF. "F" is displayed to indicate the run ready status.
7	E_FFt 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 10 mm 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: • Do not enter the machine's working area, because the servomotor moves. 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	F 1250 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.

Step	Display after Operation	Keys	Operation
9	. .run		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	Fn206		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	donE Display blinks Pn408=n.□□□1 Pn409=1375 (Hz) ↓ . .run		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

Utility Functions (Fn□□□)

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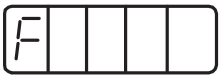
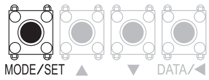
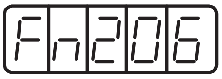
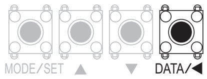
Step	Display after Operation	Keys	Operation
12	 Run ready status		Press the MODE/SET Key to return to the display of run ready status.
13			Press the DATA/SHIFT Key for approximately one second. "Fn206" is displayed again.

(2) Related Parameters

Use the following parameters as required.

Pn456	Sweep Force Reference Amplitude Speed Position Force				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 Force				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning

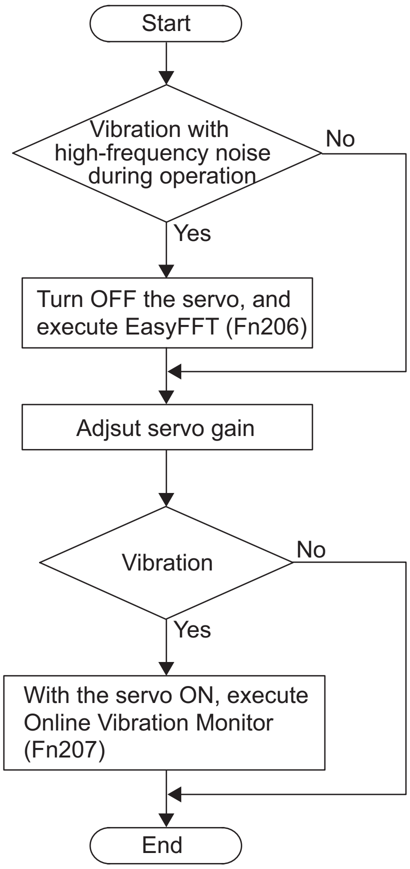
Pn40C	2nd Notch FIlter Frequency Speed Position Force				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning

7.19 Online Vibration Monitor (Fn207)

The machine vibration can sometimes be suppressed by setting a notch filter or force 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 force 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	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn207	▲ ▼	Press the UP or DOWN Key to select the Fn207.
3	F	DATA/◀	Press the DATA/SHIFT Key for approximately one second. The display shown on the left appears.
4	F Display blinks	MODE/SET	Press the MODE/SET Key. "F" will blink, and the detection of frequencies will start automatically.
5	F 1250 Detection result example	MODE/SET	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: • 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	Fn207	DATA/◀	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	donE	MODE/SET	If the MODE/SET Key is pressed, the optimum notch filter frequency or force reference filter time constant for the frequency value will be set automatically, and "donE" will be displayed if the setting is completed normally.
8	Fn207	DATA/◀	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	Force Reference Filter Time Constant
Pn408	Force Related Function Switch
Pn409	1st Notch Filter Frequency

7.20 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	Fn000	MODE/SET	Press the MODE/SET Key to select the utility function mode.
2	Fn030	▲ ▼	Press the UP or DOWN Key to select Fn030.
3	SrSt1	DATA/◀	Press the DATE/SHIFT key for approximately one second. The display shown on the left appears.
4	SrSt5 ↓ - Display after operation	MODE/SET	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		MODE/SET	Press the MODE/SET Key. The panel display will disappear. Note: This function cannot be executed while the servo is ON.
6	. . bb	DATA/◀	The status display screen, which is the same as the screen that is displayed immediately after the power turned ON, will appear.

8

Monitor Modes (Un□□□)

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.

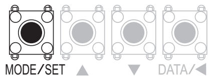
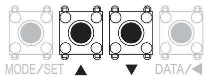
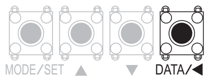
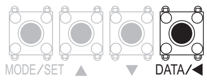
Refer to the following table.

Parameter No.	Content of Display	Unit
Un000	Motor moving speed	mm/s
Un001	Speed reference	mm/s
Un002	Internal force reference (in percentage to the rated force)	%
Un003	Electric angle 1 (32-bit decimal code)	pulse
Un004	Electric angle 2 (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)	mm/s
Un008	Error counter (position error amount) (valid only in position control)	reference unit
Un009	Accumulated load ratio (in percentage to the rated force: effective force 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) (valid only in position control)	reference unit
Un00D*3	Feedback pulse counter (1/256 of linear scale pitch): 32-bit decimal code)	encoder pulse
Un010	Allowable maximum motor speed of Encoder output resolution	–
Un011	Hall sensor signal monitor	–
Un084	Linear scale pitch (Scale pitch = Un084 × 10^{Un085} [pm])	–
Un085	Linear scale pitch index (Scale pitch = Un084 × 10^{Un085} [pm])	–

∗1. For details, refer to *8.6 Monitoring Input Signals*.
∗2. For details, refer to *8.7 Monitoring Output Signals*.
∗3. For details, refer to *8.3 Monitor Display of Reference Pulse Counter (Un00C) and Feedback Pulse Counter (Un00D)*.

8.2 Operation in Monitor Mode

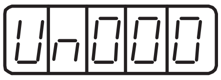
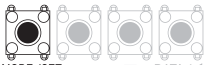
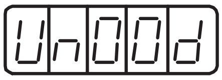
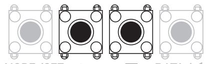
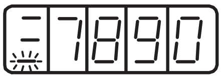
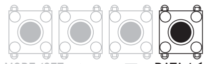
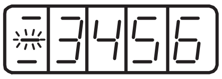
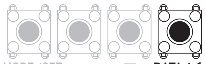
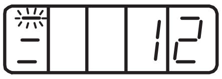
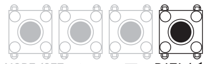
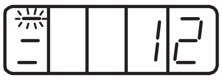
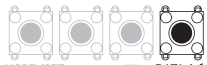
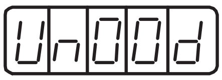
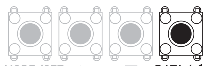
The example below shows how to display the contents of monitor number Un000 (when the servomotor moves at 1500 mm/s)

Step	Display after Operation	Keys	Operation
1	Un000		Press the MODE/SET Key to select the monitor mode.
2	Un000		Press the UP or DOWN Key to select the monitor number to be displayed.
3	1500		Press the DATA/SHIFT Key for approximately one second to display the data of Un000 (motor speed).
4	Un000		Press the DATA/SHIFT Key for approximately one second to return to the display of step 1.

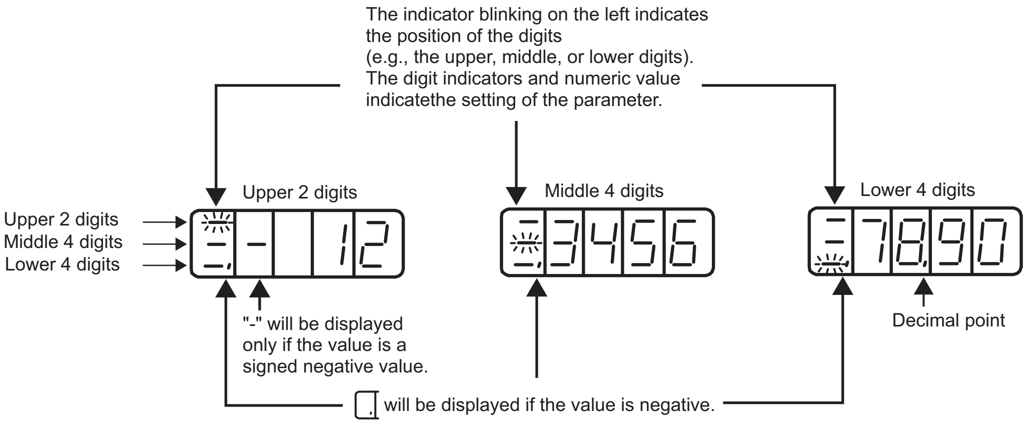
8.3 Monitor Display of Reference Pulse Counter (Un00C) and Feedback Pulse Counter (Un00D)

The monitor display of reference pulse counter and feedback pulse counter is expressed in 32-bit decimal.

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. (In this case "Un00D")
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. Note: 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	Upper 2 digits 		To clear the 32-bit counter, press the UP and DOWN Keys at the same time when data is displayed.
7			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.

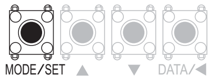
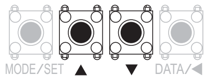
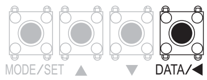
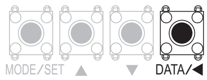


The number of pulses between -2147483648 (-2^{31}) and 2147483647 (-2^{31}) is displayed continuously. When the number of pulses is outside this range, the display will change as follows:

- 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 Allowable Maximum Motor Speed and Encoder Output Resolution Monitor

This section describes the monitor display for determining the maximum speed (Pn385) for the encoder output pulse (Pn281). Adjust the setting of Pn080.3 to select the location to be monitored.

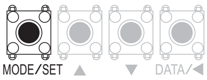
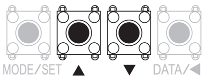
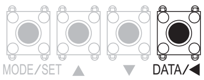
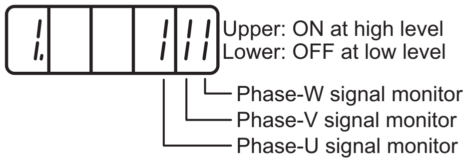
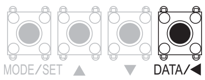
Step	Display after Operation	Keys	Operation
1	Un000		Press the MODE/SET Key to select the monitor mode.
2	Un010		Press the UP or DOWN Key to select Un010.
3	00050		Press the DATA/SHIFT Key for approximately one second. The output pulse of the encoder or the motor's maximum speed that can be set according to Pn080.3 appears.
4	Un010		Press the DATA/SHIFT Key for approximately one second to return to the display of step 2.

<Notes>

- When Pn080.3 = 0, the encoder output pulse (Pn281) that can be set is displayed.
- When Pn080.3 = 1, the maximum motor speed (Pn385) that can be set is displayed. (Units: mm/s)

8.5 Hall Sensor Signal Monitor

This section describes the monitor display for the signal patterns of the hall sensor.

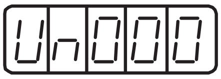
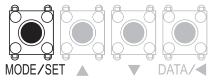
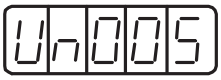
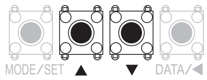
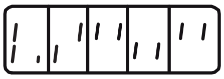
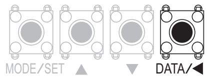
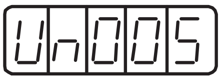
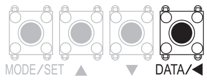
<table>
<tr><th>Step</th><th>Display after Operation</th><th>Keys</th><th>Operation</th></tr>
<tr><td>1</td><td>Un000</td><td></td><td>Press the MODE/SET Key to select the monitor mode.</td></tr>
<tr><td>2</td><td>Un011</td><td></td><td>Press the UP or DOWN Key to select Un011.</td></tr>
<tr><td>3</td><td>1.   111</td><td></td><td>Press the DATA/SHIFT Key for approximately one second to display the hall sensor signal pattern.

<table>
<tr><th rowspan="2">Hall Sensor Signal Pattern</th><th colspan="3">Signal Monitor</th></tr>
<tr><th>Phase-U</th><th>Phase-V</th><th>Phase-W</th></tr>
<tr><td>0</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td>1</td><td>L</td><td>L</td><td>H</td></tr>
<tr><td>2</td><td>L</td><td>H</td><td>L</td></tr>
<tr><td>3</td><td>L</td><td>H</td><td>H</td></tr>
<tr><td>4</td><td>H</td><td>L</td><td>L</td></tr>
<tr><td>5</td><td>H</td><td>L</td><td>H</td></tr>
<tr><td>6</td><td>H</td><td>H</td><td>L</td></tr>
<tr><td>7</td><td>H</td><td>H</td><td>H</td></tr>
</table></td></tr>
<tr><td>4</td><td>Un011</td><td></td><td>Press the DATA/SHIFT Key for approximately one second to return to the display of step 2.</td></tr>
</table>

8.6 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.

8.6.1 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 *8.6.2 Interpreting Input Signal Display Status.*
4			Press the DATA/SHIFT Key for approximately one second to return to the display of step 2.

8.6.2 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.

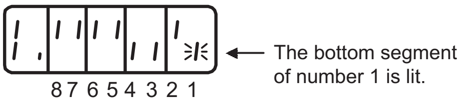
- When the input is in OFF (open) status, the top segment (LED) is lit.
- When the input is in ON (short-circuited) status, the bottom segment (LED) is lit.

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

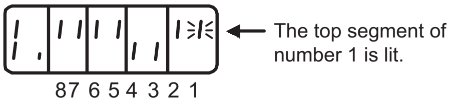
8.6.3 Input Signal Display Example

Input signals are displayed as shown below.

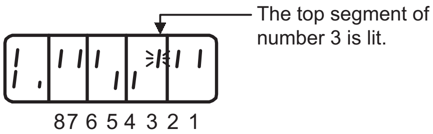
- When /S-ON signal is ON (Servo ON at L level)



- When /S-ON signal is OFF



- When P-OT signal operates (Operates at “H” level)

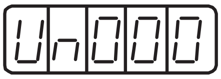
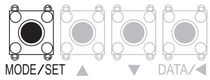
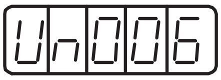
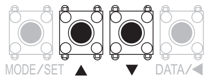
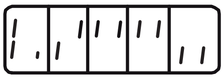
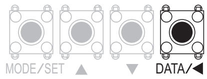
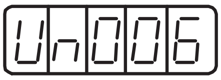
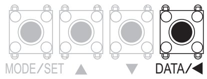


8.7 Monitoring Output Signals

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.

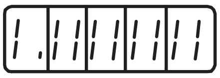
8.7.1 Checking Output Signal Status

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 *8.7.2 Interpreting Output Signal Display Status*.
4			Press the DATA/SHIFT Key for approximately one second to return to the display of step 2.

8.7.2 Interpreting Output Signal Display Status

The status of allocated signals is displayed on the 7-segment display on the Panel Operator.



Top: OFF(H level)
Bottom: ON(L level)
7 6 5 4 3 2 1 Number

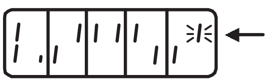
• When the output is in OFF (open) status, the top segment (LED) is lit.
• When the output is in ON (short-circuited) status, the bottom segment (LED) is lit.

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	ALO1
6	CN1-38	ALO2
7	CN1-39	ALO3
8	–	Reserved

8.7.3 Output Signal Display Example

Output signals are displayed as shown below.

• When ALM signal operates (alarm at H level)



The top segment of number 1 is lit.
7 6 5 4 3 2 1

8.8 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 0FFF is set (factory setting), the SERVOPACK becomes the status display mode (bb, run) at power ON.

Pn52F	Monitor Display at Power ON	Speed	Position	Force	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 0FFF	–	0FFF	Immediately	Setup

8.9 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	ALO1
	6	CN1-38	ALO2
	7	CN1-39	ALO3
	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.

9

Troubleshooting

9.1 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 *9.1.1 List of Alarms*.

The causes of alarms and troubleshooting methods are provided in *9.1.2 Troubleshooting of Alarms*.

9.1.1 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 force 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.

<table>
<tr><th rowspan="2">Alarm Display</th><th rowspan="2">Alarm Name</th><th rowspan="2">Meaning</th><th rowspan="2">Servo-motor Stop Method</th><th rowspan="2">Alarm Reset</th><th colspan="3">Alarm Code Output</th></tr>
<tr><th>ALO1</th><th>ALO2</th><th>ALO3</th></tr>
<tr><td>A.020</td><td>Parameter Checksum Error 1</td><td>The data of the parameter in the SERVOPACK is incorrect.</td><td>Gr.1</td><td>N/A</td><td rowspan="13">H</td><td rowspan="13">H</td><td rowspan="13">H</td></tr>
<tr><td>A.021</td><td>Parameter Format Error 1</td><td>The data of the parameter in the SERVOPACK is incorrect.</td><td>Gr.1</td><td>N/A</td></tr>
<tr><td>A.022</td><td>System Checksum Error 1</td><td>The data of the parameter in the SERVOPACK is incorrect.</td><td>Gr.1</td><td>N/A</td></tr>
<tr><td>A.023</td><td>Parameter Password Error 1</td><td>The data of the parameter in the SERVOPACK is incorrect.</td><td>Gr.1</td><td>N/A</td></tr>
<tr><td>A.030</td><td>Main Circuit Detector Error</td><td>Detection data for power circuit is incorrect.</td><td>Gr.1</td><td>Available</td></tr>
<tr><td>A.040</td><td>Parameter Setting Error 1</td><td>The parameter setting is outside the allowable setting range.</td><td>Gr.1</td><td>N/A</td></tr>
<tr><td>A.041</td><td>Encoder Output Pulse Setting Error</td><td>The encoder output pulse setting (pulse unit) (Pn212) is outside the allowable setting range or not satisfies the setting conditions.</td><td>Gr.1</td><td>N/A</td></tr>
<tr><td>A.042</td><td>Parameter Combination Error</td><td>Combination of some parameters exceeds the setting range.</td><td>Gr.1</td><td>N/A</td></tr>
<tr><td>A.044</td><td>Fully-closed Loop Control Parameter Setting Error</td><td>The settings of the option module and Pn00B.3, Pn002.3 do not match.</td><td>Gr.1</td><td>N/A</td></tr>
<tr><td>A.050</td><td>Combination Error</td><td>The SERVOPACK and the servomotor capacities do not match each other.</td><td>Gr.1</td><td>Available</td></tr>
<tr><td>A.051</td><td>Unsupported Device Alarm</td><td>The device unit unsupported was connected.</td><td>Gr.1</td><td>N/A</td></tr>
<tr><td>A.080</td><td>Linear Scale Pitch Setting Error</td><td>The setting of the linear scale pitch (Pn282) has not been changed from the default setting.</td><td>Gr.1</td><td>N/A</td></tr>
<tr><td>A.0b0</td><td>Cancelled Servo ON Command Alarm</td><td>The Host controller reference was sent to turn the Servo ON after the Servo ON function was used with the utility function.</td><td>Gr.1</td><td>Available</td></tr>
<tr><td>A.100</td><td>Overcurrent or Heat Sink Overheated</td><td>An overcurrent flowed through the IGBT. Heat sink of the SERVOPACK was overheated.</td><td>Gr.1</td><td>N/A</td><td>L</td><td>H</td><td>H</td></tr>
</table>

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.450	Main-Circuit Capacitor Overvoltage	The capacitor of the main circuit has deteriorated or is faulty.	Gr.1	N/A			
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.550	Maximum Speed Setting Error	The Pn385 setting is greater than the maximum speed.	Gr.1	Available			
A.710	Overload: High Load	The motor was operating for several seconds to several tens of seconds under a force largely exceeding ratings.	Gr.2	Available	L	L	L
A.720	Overload: Low Load	The motor was operating continuously under a force largely exceeding ratings.	Gr.1	Available			
A.730 **A.731**	Dynamic Brake Overload	When the dynamic brake was applied, moving 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.820	Encoder Checksum Error	The checksum results of encoder memory is incorrect.	Gr.1	N/A	H	H	H
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.890	Encoder Scale Error	A linear scale fault occurred	Gr.1	N/A			
A.891	Encoder Module Error	Encoder module is faulty.	Gr.1	N/A			

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 Force Input Read Error	The A/D converter for force 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	"Internal program error 0" of the SERVOPACK occurred.	Gr.1	N/A			
A.bF1	System Alarm 1	"Internal program error 1" of the SERVOPACK occurred.	Gr.1	N/A			
A.bF2	System Alarm 2	"Internal program error 2" of the SERVOPACK occurred.	Gr.1	N/A			
A.bF3	System Alarm 3	"Internal program error 3" of the SERVOPACK occurred.	Gr.1	N/A			
A.bF4	System Alarm 4	"Internal program error 4" of the SERVOPACK 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	Available			
A.C52	Polarity Detection Uncompleted	The servo was turned ON under the condition of polarity detection uncompleted.	Gr.1	Available			
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	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 SERVOPACK 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 SERVOPACK.	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			

<table>
<tr><th rowspan="2">Alarm Display</th><th rowspan="2">Alarm Name</th><th rowspan="2">Meaning</th><th rowspan="2">Servo-motor Stop Method</th><th rowspan="2">Alarm Reset</th><th colspan="3">Alarm Code Output</th></tr>
<tr><th>ALO1</th><th>ALO2</th><th>ALO3</th></tr>
<tr><td>A.d00</td><td>Position Error Pulse Overflow</td><td>Position error pulses exceeded parameter (Pn520).</td><td>Gr.1</td><td>Available</td><td rowspan="4">L</td><td rowspan="4">L</td><td rowspan="4">H</td></tr>
<tr><td>A.d01</td><td>Position Error Pulse Overflow Alarm at Servo ON</td><td>Position error pulses accumulated too much.</td><td>Gr.1</td><td>Available</td></tr>
<tr><td>A.d02</td><td>Position Error Pulse Overflow Alarm by Speed Limit at Servo ON</td><td>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.</td><td>Gr.2</td><td>Available</td></tr>
<tr><td>A.d30</td><td>Position Data Overflow</td><td>The position data exceeded ±1879048192.</td><td>Gr.1</td><td>N/A</td></tr>
<tr><td>A.Eb1</td><td>Safety Function Signal Input Timing Error</td><td>The safety function signal input timing is faulty.</td><td>Gr.1</td><td>N/A</td><td rowspan="2">H</td><td rowspan="2">L</td><td>L</td></tr>
<tr><td>A.F10</td><td>Main Circuit Cable Open Phase</td><td>With the main power supply ON, voltage was low for more than 1 second in phase-R, -S or -T.</td><td>Gr.2</td><td>Available</td><td>H</td></tr>
<tr><td>CPF00</td><td>Digital Operator Transmission Error 1</td><td rowspan="2">Digital operator (JUSP-OP05A) fails to communicate with the SERVOPACK (e.g., CPU error).</td><td>–</td><td>N/A</td><td rowspan="2" colspan="3">Not decided</td></tr>
<tr><td>CPF01</td><td>Digital Operator Transmission Error 2</td><td>–</td><td>N/A</td></tr>
<tr><td>A.– –</td><td>Not an error</td><td>Normal operation status</td><td>–</td><td>–</td><td>H</td><td>H</td><td>H</td></tr>
</table>

* Only when safety function is used.

9.1.2 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: 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: 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: 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: 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: Main Circuit Detector Error	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.040: 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 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< (Pn20E/Pn210) <4000.	Set the electronic gear ratio in the range: 0.001< (Pn20E/Pn210) <4000.
A.041: Encoder Output Pulse Setting Error	The encoder output pulse (Pn281) is out of the setting range and does not satisfy the setting conditions.	Check the parameter Pn281.	Set Pn281 to a correct value.
A.042: 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.*1	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.*1	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.*1	Reduce the electronic gear ratio (Pn20E/Pn210).
A.044: Fully-closed Loop Control Parameter Setting Error	The setting of the option module does not match with those of Pn00B.3 and Pn002.3.	Check the settings of the option module, Pn00B.3, and Pn002.3.	The setting of option module must be compatible with the settings of Pn00B.3 and Pn002.3. Mount an option module or replace the mounted option module with an appropriate model. Or change the parameter setting.
A.050: 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: (Servomotor capacity)/(SERVOPACK capacity) ≤ 1/4, or (Servomotor capacity)/(SERVOPACK capacity) ≤ 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.
A.051: Unsupported Device Alarm	An unsupported serial converter unit, serial encoder, or linear scale is connected to the SERVOPACK.	Check the product specifications, and select the correct model.	Select the correct combination of units.

*1. Linear scale by Heidenhain or Renishaw : $\frac{\text{Pn585}}{\text{Pn282}[\mu\text{m}]} \times \frac{256}{10^7} \leqq \frac{\text{Pn20E}}{\text{Pn210}}$

Linear scale (ST78☐A) by Mitutoyo $\frac{\text{Pn585}}{\text{Pn282}[\mu\text{m}]} \times \frac{512}{10^7} \leqq \frac{\text{Pn20E}}{\text{Pn210}}$

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.080: Linear Scale Pitch Setting Error	The setting of the linear scale pitch (Pn282) has not been changed from the default setting.	Check the value of Pn282.	Correct the value of Pn282.
A.0b0: 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: 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 Main Circuit Wiring*.	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 Main Circuit Wiring*.	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 Main Circuit Wiring*.	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 Main Circuit Wiring*.	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 Connecting Regenerative Resistors*.	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 servo drive 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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.300: Regeneration Error	Regenerative resistor capacity (Pn600) is set to a value other than 0 for a SGDV-R70, -R90, -1R6, or -2R8 SERVOPACK, 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 mass exceeds the allowable value.	Check the mass.	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 by faulty. Repair or replace the SERVOPACK.
A.320: 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 SERVOPACK 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 SigmaJunmaSize+, etc.	Change the regenerative resistance, regenerative resistor capacity, or SERVOPACK capacity. Reconsider the operation conditions using the capacity selection software SigmaJunmaSize+, 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 SERVOPACK.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.330: 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 SERVOPACK. 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 SERVOPACK.
A.400: Overvoltage (Detected in the SERVOPACK main circuit power supply section.)	For 100 and 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 absorber, etc. Then, turn the power supply ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
	For 100 and 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 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 mass exceeded the allowable value.	Confirm that the mass 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 SERVOPACK may be faulty. Repair or replace the SERVOPACK.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.410: Undervoltage (Detected in the SERVOPACK main circuit power supply section.)	• For 100 VAC SERVOPACKs: The power supply voltage is 49 V or less. • For 200 VAC SERVOPACKs: The power supply voltage is 120 V or less. • For 400 VAC SERVOPACKs: The power supply voltage 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 SERVOPACK, connect an AC/DC reactor, and run the SERVOPACK.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.450: Main-Circuit Capacitor Overvoltage	A SERVOPACK fault occurred.	–	Replace the SERVOPACK.
A.510: 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 SERVOPACK.
A.511: 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 (Pn281).
	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: Vibration Alarm	Abnormal vibration was detected at the servomotor speed.	Check for abnormal noise from the servomotor, and check the speed and force waveform during operation.	Reduce the servomotor speed or reduce the speed loop gain (Pn100).
	The mass ratio (Pn103) value is greater than the actual value or is greatly changed.	Check the mass.	Set the mass ratio (Pn103) to an appropriate value.
A.521: 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 mass 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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.550: Maximum Speed Setting Error	The Pn385 setting is greater than the maximum speed.	Check the value of Pn385 and Un101(Maximum motor speed which is determined by encoder output pulses or by motor itself).	Set Pn385 to a value equal to or lower than the motor maximum speed.
A.710: A.720: 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.
	The setting of the linear scale pitch (Pn282) is incorrect.	Check the setting of Pn282.	Correct the setting of Pn282.
	The setting of the motor phase selection (Pn080.1) is incorrect.	Check the setting of Pn080.1.	Correct the setting of Pn080.1.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.730: A.731: Dynamic Brake Overload (Detected with SGDV-3R8A, -5R5A, -7R6A, -120A, -180A, -200A, -330A, -□□□D SERVOPACKs.)	The servomotor moves because of external force.	Check the operation status.	Take measures to ensure the servomotor will not move because of external force.
	The moving 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.	• Reduce the servomotor reference speed. • Reduce the mass. • 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.740: 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 SERVOPACK.
A.7A0: Heat Sink Overheated (Detected when the heat sink temperature exceeds 100°C.)	The surrounding air temperature is too high.	Check the surrounding air temperature using a thermostat.	Decrease the surrounding air 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 SERVOPACK.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.7AB: 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.
A.820: Encoder Checksum Error (Detected on the encoder side.)	A linear scale fault occurred.	–	The linear scale may be faulty. Repair or replace the linear scale.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.840: Encoder Data Error (Detected on the encoder side.)	A linear scale fault occurred.	–	Turn the power supply OFF and then ON again. If the alarm still occurs, the linear scale may be faulty. Repair or replace the linear scale.
	Malfunction of linear scale because of noise interference, etc.	–	Correct the wiring around the linear scale by separating the encoder cable from the main circuit cable or by checking the grounding and other wiring.
A.850: Encoder Overspeed (Detected when the control power supply was turned OFF and then ON again.) (Detected on the encoder side.)	The servomotor speed is higher than the specified speed, 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 motor speed to a value below the speed specified by the linear scale manufacturer, 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.
A.860: Encoder Overheated (Only when an absolute encoder is connected.) (Detected on the encoder side.)	The surrounding air temperature around the servomotor is too high.	Measure the surrounding air temperature around the servomotor.	The surrounding air 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.890: Encoder Scale Error	A linear scale fault occurred.	–	The linear scale may be faulty. Repair or replace the linear scale.
A.891: 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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.b10: 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: 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.
A.b20: Reference Force Input Read Error (Detected when the servo is ON.)	A malfunction occurred in the reading section of the force reference 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 SERVOPACK.
A.b31: 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 SERVOPACK.
A.b32: 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 SERVOPACK.
A.b33: Current Detection Error 3 (Current detector)	The detection circuit for the current 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 SERVOPACK.
	The servomotor main circuit cable is disconnected.	Check for disconnection of the motor main circuit cable.	Correct the servomotor wiring.
A.bF0: 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 SERVOPACK.
A.bF1: System Alarm 1	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.bF2: System Alarm 2	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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.bF3: System Alarm 3	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.bF4: System Alarm 4	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.C10: 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.
	The setting of the motor phase selection (Pn080.1) is incorrect.	Check the setting of Pn080.1.	Correct the setting of Pn080.1.
	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.C20: Phase Detection Error	The linear scale signal is weak.	Check the voltage of the linear scale signal.	Fine-adjust the installation status of the linear scale head, or replace the linear scale.
	The count-up direction of the linear scale does not match the forward direction of the motor coil assembly.	Check the setting of Pn080.1 (Motor Phase Selection). Check the installation directions for the linear scale and motor coil assembly.	Change the setting of Pn080.1 (Motor Phase Selection). Correctly reinstall the linear scale and motor coil assembly.
	The hall sensor signal is affected by noise.	–	Correct the FG wiring and take measures against noise for the hall sensor wiring.
A.C21: Hall Sensor Error	The hall sensor is protruding from the motor magnetic way.	Check the hall sensor.	Correctly reinstall the motor coil assembly or motor magnetic way.
	The setting of the linear scale pitch (Pn282) is incorrect.	Check the setting of the linear scale pitch (Pn282).	Correct the value of Pn282.
	The hall sensor wiring is incorrect.	Check the hall sensor wiring.	Correct the hall sensor wiring.
	A hall sensor fault occurred.	–	Replace the hall sensor.
A.C22: Phase Information Disagreement	The SERVOPACK phase data does not match that of the linear scale.	–	Execute polarity detection (Fn080).
A.C50: Polarity Detection Error	Parameter settings are incorrect.	Check the linear scale specifications and feedback signal status.	The settings of the linear scale pitch (Pn282) and motor phase selection (Pn080.1) may not match the actual product requirements. Set these parameters to the correct values.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.C50: Polarity Detection Error (cont'd)	Noise interference occurred on the scale signal.	Check the wiring to see if: • Each FG of the serial converter unit and linear servomotor is connected to the FG of the SERVOPACK. • The FG of the SERVOPACK is connected to the FG of the power supply. • The encoder cable is securely shielded. Check to see if the detection reference is repeatedly output in one direction.	Take measures to avoid noise interference by correctly connecting FG lines, shielding the encoder cable, etc.
	An external force was applied to the motor coil assembly.	–	The polarity cannot be properly detected if the detection reference is 0 (zero), but the speed feedback is not 0 (zero) because of an external force, such as cable tension, applied to the motor coil assembly. Take measures to reduce the external force so that the speed feedback becomes 0 for a 0 detection reference. If external force cannot be reduced, increase the value of the changes in the sequence input signal allocation for each signal (Pn481).
	The linear scale resolution is too low.	Check the linear scale pitch to see if it is within 100 μm.	If the linear scale pitch is 100 μm or longer, the SERVOPACK cannot detect the correct speed feedback. Use a scale pitch with higher accuracy (a pitch within 40 μm recommended.) Or, increase the value of the polarity detection reference speed (Pn485). However, note that increasing the value of Pn485 will widen the servomotor movement range required for polarity detection.
A.C51: Overtravel Detection at Polarity Detection	An overtravel signal was detected during polarity detection.	Check the position after overtravel.	Perform the wiring for an overtravel signal. Execute polarity detection at a position where an overtravel signal is not detected.
A.C52: Polarity Detection Uncompleted	The servo has been turned ON under the following circumstances. • Polarity detection was not yet complete. • The /PDET signal was not input.	–	Input the /PDET signal.
A.C53: Out of Range for Polarity Detection	The moving distance exceeded the set value of Pn48E in the middle of detection.	–	Increase the value of the polarity detection range (Pn48E). Or, increase the value of the changes in the sequence input signal allocation for each signal (Pn481).
A.C54: Polarity Detection Error 2	External force was applied to the servomotor.	–	Increase the value of the polarity detection confirmation force reference (Pn495). Increase the value of the polarity detection allowable error range (Pn498). Note that increasing the allowable error will also increase the motor temperature.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.C80: Absolute Encoder Clear 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: 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: 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.
A.C92: 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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.CA0: 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: 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.
A.d00: 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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.d01: 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: 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.d30: Position Data Overflow	The position data exceeded ±1879048192.	Check the input reference pulse counter (Un00C).	Reconsider the operating specifications.
A.EB1: 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.F10: 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 single-phase power is input without setting Pn00B.2 (power supply method for three-phase SERVOPACK) to 1 (single-phase power supply).	Check the power supply and the parameter setting.	Match the parameter setting to the power supply.
	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: 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: 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.

9.2 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 *9.2.1 List of Warnings*.

The causes of alarms and troubleshooting methods are provided in *9.2.2 Troubleshooting of Warnings*.

9.2.1 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.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.

9.2.2 Troubleshooting of Warnings

Refer to the following table to identity 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 moving.	Check whether unusual sound is generated from the motor, and check the speed, and force waveform of the motor.	Lower the motor movement speed or the speed loop gain (Pn100).
		The mass ratio (Pn103) is larger than the actual value or greatly changes.	Check the mass.	Set an appropriate value for the mass ratio (Pn103).

Warning Display	Warning Name	Situation at Warning Occurrence	Cause	Corrective Actions
A.920	Regenerative Overload: Warning before the alarm A320 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 moving energy at a DB stop exceeds the DB resistance capacity.	Check the operating frequency of the DB with power consumed by DB resistance (Un00B).	• Reduce the servomotor reference speed. • Reduce the mass. • 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.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.

9.3 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
Linear Servomotor Does Not Start When Using JOG Operation and Host Reference.	The control power supply is not ON.	Check voltage between control power supply terminals.	Correct the control power circuit.
	The main circuit power supply is not ON.	Check the voltage between power supply terminals.	Correct the power circuit.
	Wrong wiring or disconnection of I/O signal connector CN1	Check if the connector CN1 is properly inserted and connected.	Correct the connector CN1 connection.
	Linear servomotor or serial converter unit wiring disconnected.	Check the wiring.	Correct the wiring.
	The polarity detection is not executed.	Check the parameter Pn080.	Correct the setting of Pn080.
		Check /S-ON or /P-DET input signal.	• When using an incremental linear scale, turn ON /S-ON or /P-DET input signal. • When using an absolute linear scale, turn OFF external /S-ON input signal and execute Fn080.
	A SERVOPACK fault occurred.	Check if the SERVOPACK board is damaged.	Replace the SERVOPACK.
Linear Servomotor Starts in JOG Operation but Does Not Start by Host Reference.	Overloaded	Run under no load.	Reduce load or replace with larger capacity servomotor.
	Speed/position references not input	Check reference input pins.	Input speed/position references 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."
	/S-ON input signal stays OFF.	Check settings of parameters Pn50A.0 and Pn50A.1.	Correct the parameter setting and turn ON /S-ON input signal.
	Control selection is incorrect.	Check parameter Pn000.1.	Set parameters to match the application.
	Reference pulse mode selection is incorrect.	Check the parameter setting for the reference pulse form (Pn200.0).	Correct setting of parameter Pn200.0.
	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.
	Force control: Force reference input is incorrect.	Check T-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 setting of Pn200.0 or the input.
	The error clear counter (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) or reverse run prohibited (N-OT) input signal is turned OFF.	Check P-OT or N-OT input signal.	Turn P-OT or N-OT input signal ON.
Linear Servomotor Moves Instantaneously, and then Stops	Servomotor wiring is incorrect.	Check the servomotor wiring.	Correct the servomotor wiring.
	Serial converter unit wiring is incorrect.	Check the serial converter unit wiring.	Correct the serial converter unit wiring.
	Linear scale wiring is incorrect.	Check the linear scale wiring.	Correct the linear scale wiring.
	Linear scale pitch (Pn282) is incorrect.	Check the setting of Pn282.	Correct the setting of Pn282.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Linear Servomotor Moves Instantaneously, and then Stops (cont'd)	Linear scale counting up direction and linear servomotor coil assembly forward direction do not agree.	Check the directions.	Change the setting of Pn080.1 (Motor Phase Selection). Match the linear scale direction and coil assembly direction.
	Polarity detection is not performed correctly.	Check if the value of Un004 (Electrical Angle 2, angle from 0 (zero) degree of phase-U) at an arbitrary position is between ±10 degrees.	Correct the settings for the polarity detection related parameter.
Linear Servomotor Speed Unstable	Wiring connection to servomotor is defective.	Check connection of power lead (phases U, V, and W) and encoder connectors.	Tighten any loose terminals or connectors.
Linear Servomotor Moves 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 correctly.
	Force control: Force reference input is incorrect.	Check T-REF and SG to confirm if the control method and the input are agreed.	Correct the control mode selection parameter, or the input correctly.
	Speed reference offset is error.	Check if the SERVOPACK offset is adjusted incorrectly.	Adjust the SERVOPACK offset correctly.
	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 correctly.
	A SERVOPACK fault occurred.	Check if the SERVOPACK board is damaged.	Replace the SERVOPACK.
	Linear scale counting up direction and linear servomotor coil assembly forward direction do not agree.	Check the directions.	Change the setting of Pn080.1 (Motor Phase Selection). Match the linear scale direction and servomotor direction.
	Polarity detection is not performed correctly.	Check if the value of Un004 (Electrical Angle 2, angle from 0 (zero) degree of phase-U) at an arbitrary position is between ±10 degrees.	Correct the settings for the polarity detection related parameter.
DB (dynamic brake) Does Not Operate	Improper parameter setting	Check the setting of parameter Pn001.0 (Servo OFF or Alarm Gr.1 Stop Mode).	Correct the setting of parameter Pn001.0.
	DB resistor disconnected	Check if excessive mass, motor overspeed, or DB frequent activation has occurred.	Replace the SERVOPACK, and reconsider the load.
	DB drive circuit fault	Check if DB circuit parts are faulty.	Replace the SERVOPACK.
Abnormal Noise from Servomotor	Mounting not secured	Check if there are any loosen mounting screws.	Tighten the mounting screws.
	Vibration source on the driven machine	Check the machine movable section for foreign matter, damage or deformity.	Contact the machine manufacturer.
	Noise interference due to incorrect I/O signal cable specifications	The specifications of input signal wires must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 min. and tinned annealed copper twisted wire.	Use the specified I/O signal cables.
	Noise interference due to long distance of I/O signal cable	The wiring distance must be 3 m max. and the impedance a few hundreds ohm max.	Shorten the wiring distance for I/O signal cable to the specified value.
	Noise interference due to incorrect serial converter unit connection cable specifications	The specifications of encoder cable must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 min. and tinned annealed copper twisted wire.	Use the specified serial converter unit connection cable.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Abnormal Noise from Servomotor (cont'd)	Noise interference due to long serial converter unit connection cable wiring distance	The wiring distance must be 20 m max.	Shorten the serial converter unit connection cable wiring distance to the specified value.
	Noise due to damaged serial converter unit connection cable	Check if the serial converter unit connection cable is not damaged or bent.	Modify the serial converter unit connection cable layout.
	Excessive noise to the serial converter unit connection cable	Check if the serial converter unit connection cable is bundled with high-current line or near the high-current line.	Install a surge absorber to the serial converter unit connection cable.
	FG electrical potential varies by influence of such machines on the servomotor side as welders.	Check if the machine is correctly grounded.	Ground the machine separately from PG side FG.
	SERVOPACK pulse counting error due to noise	Check if there is noise interference on the I/O signal cable from the encoder.	Take measure against noise for the serial converter unit wiring.
	Excessive vibration and shock to the serial converter unit	Check if vibration from the machine occurred or serial converter unit installation is incorrect. (Mounting surface accuracy, or fixing.)	Reduce vibration from the machine, or correct the serial converter unit installation.
	Serial converter unit fault	–	Replace the serial converter unit.
	Linear scale fault	–	Replace the linear scale.
Servomotor Vibrates at about 200 to 400 Hz	Speed loop gain value (Pn100) is too high.	Check the setting of Pn100 (Speed Loop Gain).	Reduce speed loop gain (Pn100) preset value.
	Position loop gain value (Pn102) is too high.	Check the setting of Pn102 (Position Loop Gain).	Reduce position loop gain (Pn102) preset value.
	Incorrect speed loop integral time constant (Pn101) setting	Check the setting of Pn101 (Speed Loop Integral Time Constant).	Correct the speed loop integral time constant (Pn101) setting.
	Mass ratio data is incorrect.	Check the setting of Pn103 (Mass Ratio).	Correct the setting of Pn103 (Mass Ratio).
	When the autotuning is used: Incorrect mass ratio data setting	Check the setting of Pn103 (Mass Ratio).	Correct the setting of Pn103 (Mass Ratio).
High Speed Overshoot on Starting and Stopping.	Speed loop gain value (Pn100) is too low.	Check the setting of Pn100 (Speed Loop Gain).	Reduce the speed loop gain (Pn100) preset value.
	Position loop gain value (Pn102) is too high.	Check the setting of Pn102 (Position Loop Gain).	Reduce the position loop gain (Pn102) preset value.
	Incorrect speed loop integral time constant (Pn101) setting	Check the setting of Pn101 (Speed Loop Integral Time Constant).	Correct the speed loop integral time constant (Pn101) setting.
	Mass ratio data is incorrect.	Check the setting of Pn103 (Mass Ratio).	Correct the setting of Pn103 (Mass Ratio).
	When the autotuning is used: Mass ratio data is incorrect.	Check the setting of Pn103 (Mass Ratio).	Correct the setting of Pn103 (Mass Ratio).
	The force reference is saturated.	Check the force reference wave form.	Use the mode switch function.
	The force limit (Pn483, Pn484) is set to the initial value.	Initial value of force limit: Pn483 = 30% Pn484 = 30%	Set a appropriate value for Pn483 and Pn484 (Force Limit).

Problem	Probable Cause	Investigative Actions	Corrective Actions
Overtravel (OT) (Movement over the zone specified by the host controller)	An overtravel signal is output (P-OT (CN1-42) or N-OT (CN1-43)) is at H.	Check if the voltage of input signal external power supply (+24 V) is correct.	Connect to the external +24 V power supply.
		Check if the overtravel limit switch (SW) operates properly.	Correct the overtravel limit SW.
		Check if the overtravel limit switch (SW) is connected correctly.	Correct the overtravel limit SW wiring.
	The overtravel signal does not operate normally (P-OT or N-OT signal sometimes changes).	Check the fluctuation of the input signal external power supply (+24 V) voltage.	Stabilize the external +24 V power supply voltage.
		Check if the overtravel limit switch (SW) activate correctly.	Adjust the overtravel limit SW so that it operates correctly.
		Check if the overtravel limit switch wiring is correct. (check for damaged cables or loosen screws.)	Correct the overtravel limit SW wiring.
	Incorrect P-OT/N-OT signal selection	Check the P-OT signal mapping (Pn50A.3).	Correct the setting of P-OT signal mapping (Pn50A.3).
		Check the N-OT signal mapping (Pn50B.0).	Correct the setting of N-OT signal mapping (Pn50B.0).
	Incorrect servomotor stop method selection	Check if "coast to stop" in servo OFF status is selected.	Check Pn001.0 and Pn001.1.
		Check if "coast to stop" in force control mode is selected.	Check Pn001.0 and Pn001.1.
	Improper overtravel position setting	Check if the distance to the position of OT (overtravel) is too short considering the coasting distance.	Correct the OT position.
	Noise interference due to improper serial converter unit connection cable specifications	The serial converter unit connection cable specifications must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 min. and tinned annealed copper twisted wire.	Use serial converter unit connection cable with the specified specifications.
	Noise interference because the serial converter unit connection cable distance is too long.	The wiring distance must be 20 m max.	The serial converter unit connection cable distance must be within the specified range.
	Noise influence due to damaged serial converter unit connection cable	Check if the serial converter unit connection cable is bent or its sheath is damaged.	Correct the serial converter unit connection cable layout.
	Excessive noise interference to serial converter unit connection cable	Check if the serial converter unit connection cable is bundled with a high-current line or near high-current line.	Change the serial converter unit connection cable layout so that no surge voltage is applied.
	FG electrical potential varies by influence of such machines on the servomotor side as welders.	Check if the machine is correctly grounded.	Ground the machine separately from encoder side FG.
	SERVOPACK pulse count error due to noise	Check if the I/O signal cable from the serial converter unit is influenced by noise.	Take a measure against noise for the serial converter unit wiring.
	Excessive vibration and shock to the serial converter unit	Check if machine vibration occurred or serial converter unit mounting such as mounting surface precision, fixing is incorrect.	Reduce the machine vibration or mount the serial converter unit securely.
	Serial converter unit fault	–	Replace the serial converter unit.
	SERVOPACK fault	–	Replace the SERVOPACK.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Position error (without alarm)	Noise interference due to improper I/O signal cable specifications	The input signal cable specifications must be: Twisted-pair or twisted-pair shielded wire with core 0.12 mm^2 min. and tinned annealed copper twisted wire.	Use I/O signal cable with the specified specifications.
	Noise interference because the I/O signal cable distance is too long.	The wiring distance must be 3 m max. and the impedance several hundreds ohm max.	The I/O signal cable distance must be within the specified range.
	Reference pulse frequency is too high.	Check Un00C (Input Reference Pulse Counter.)	Reduce the reference pulse frequency to a value within the specification.
	Serial converter unit fault (pulse count does not change)	–	Replace the serial converter unit.
Servomotor Overheated	Surrounding air temperature is too high.	Measure the servomotor surrounding air temperature.	Reduce the surrounding air temperature to 40°C max.
	Servomotor surface is dirty.	Check visually.	Clean dust and oil from servomotor surface.
	Overloaded	Run under no load.	Reconsider load and operation conditions or replace with larger capacity servomotor.
	Polarity detection is not performed correctly.	Check if the value of Un004 (Electrical Angle 2, angle from 0 (zero) degree of phase-U) at an arbitrary position is between ±10 degrees.	Correct the settings for the polarity detection related parameter.

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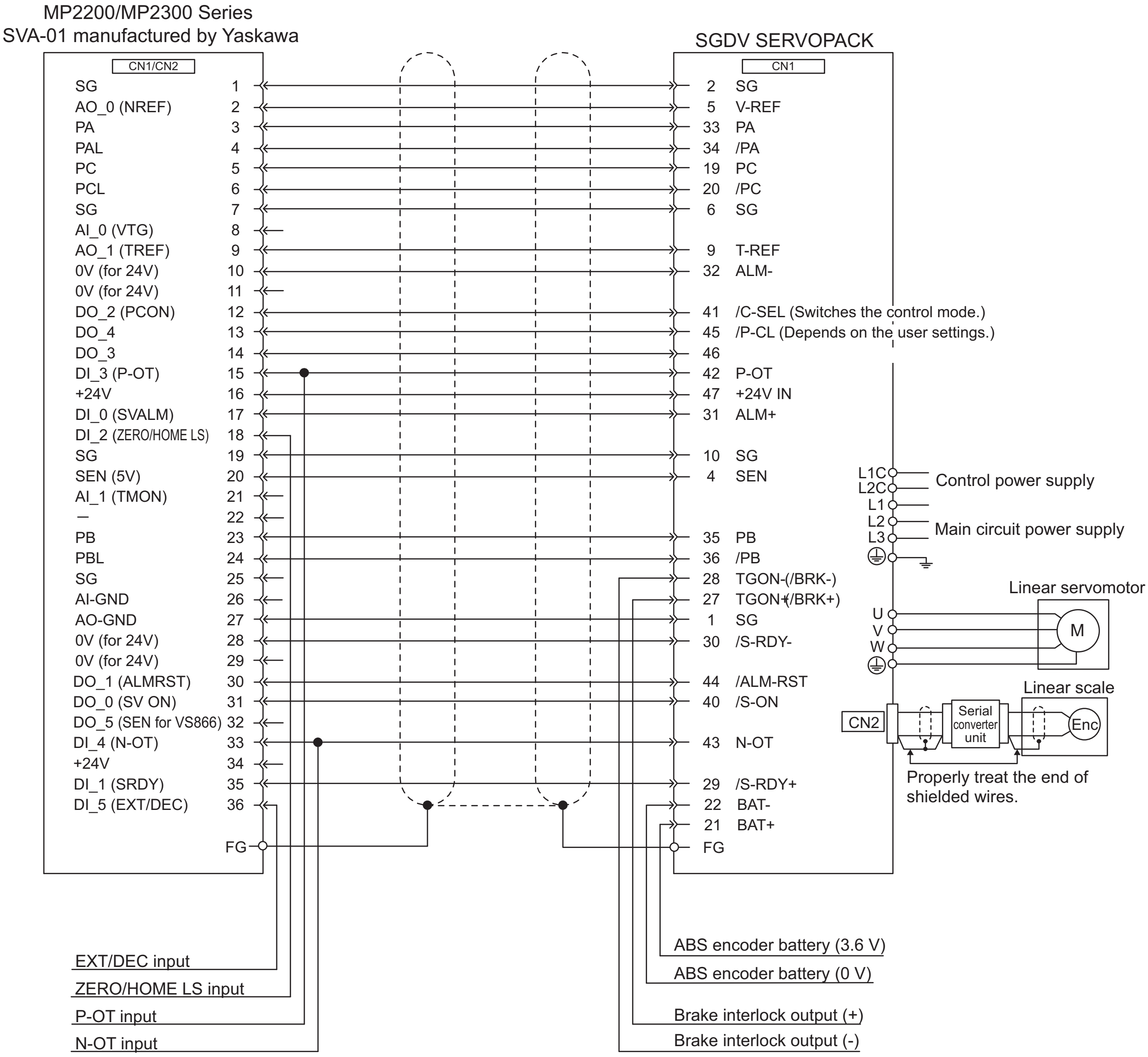
Appendix

10.1 Connection to Host Controller

The following figures show the connection examples to host controllers.

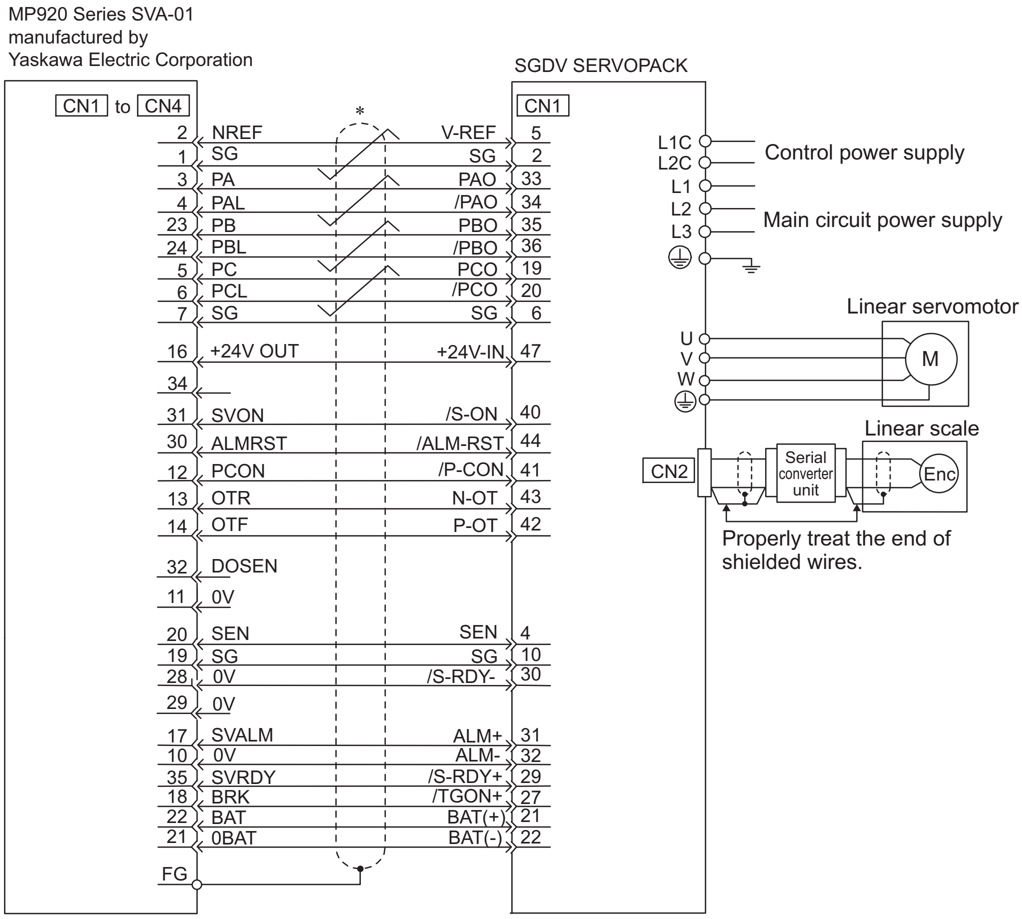
10.1.1 Example of Connection to MP2200/MP2300 Motion Module SVA-01



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.*

10.1.2 Example of Connection to MP920 4-axes Analog Module SVA-01

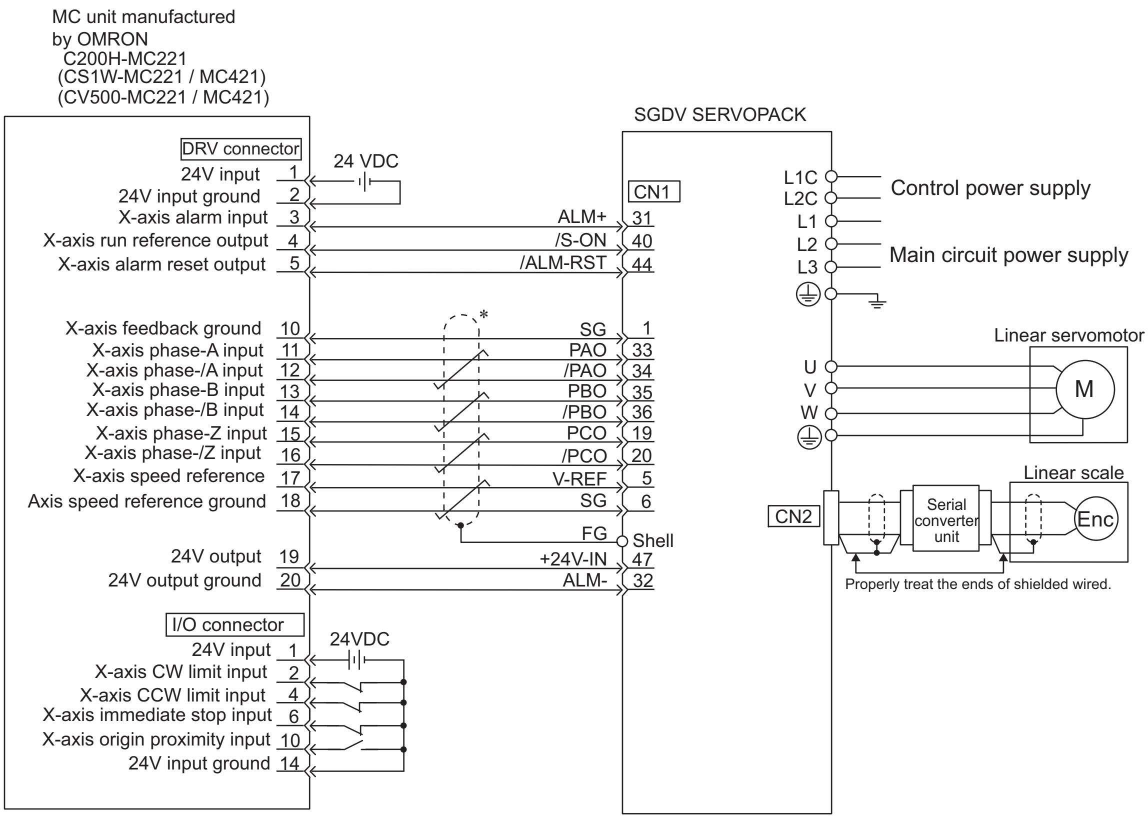


*  represents twisted-pair wires.

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.*

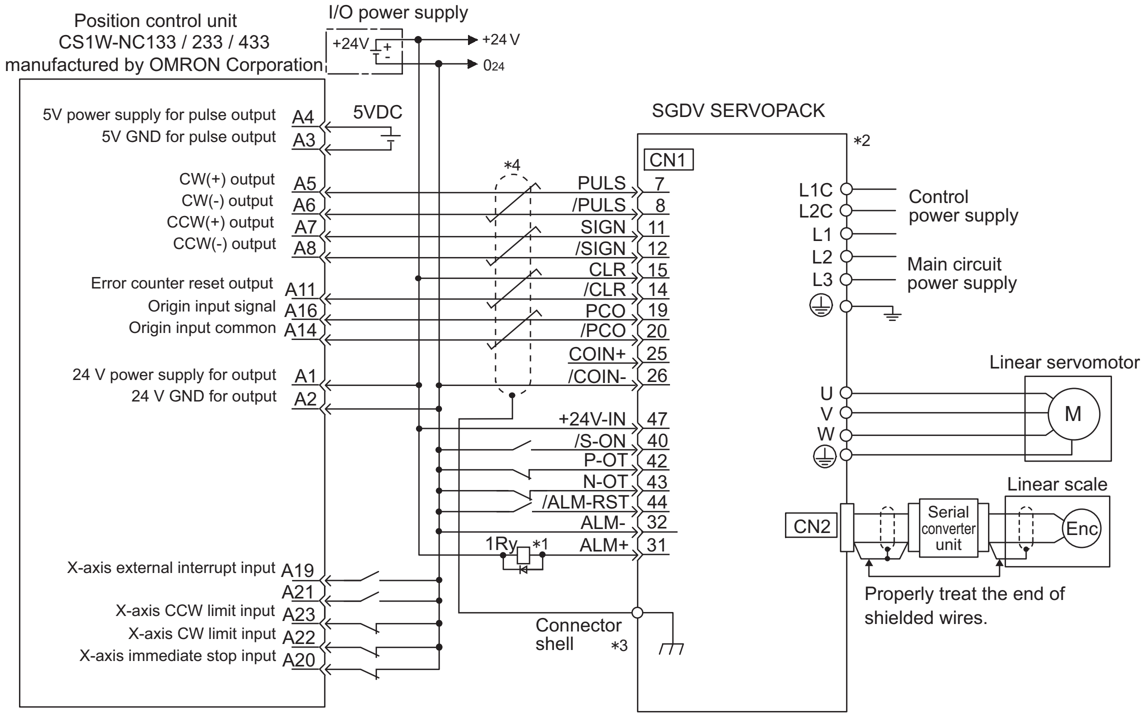
10.1.3 Example of Connection to OMRON’s Motion Control Unit



* represents twisted-pair wires.

Note 1. Only signals applicable to Yaskawa’s SGDV 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.*

10.1.4 Example of Connection to OMRON's Position Control Unit

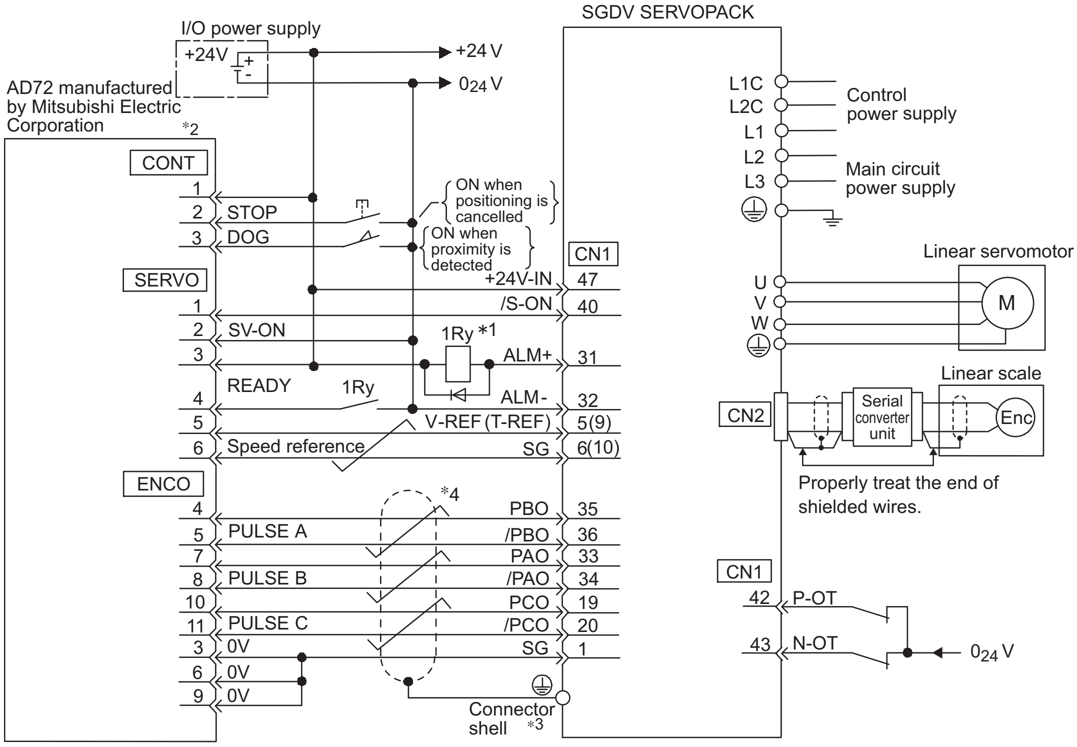


*1. The ALM signal is output for about five seconds after the control power is turned ON. Take this into consideration when designing the power ON sequence. The ALM signal actuates the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK.
*2. Set parameter Pn200.0 to "1."
*3. Connect the shield wire to the connector shell.

*4. represents twisted-pair wires.

Note 1. Only signals applicable to Yaskawa's SGDV 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*.

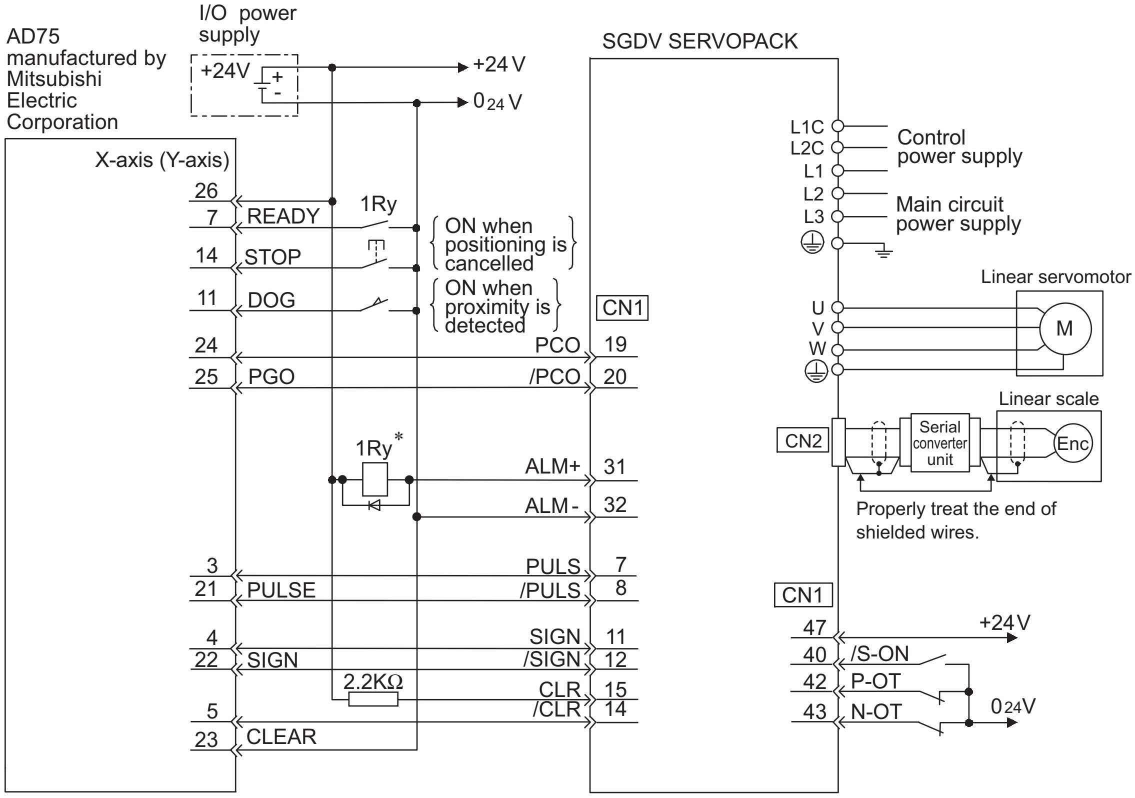
10.1.5 Connection to MITSUBISHI's AD72 Positioning Unit (SERVOPACK in Speed Control Mode)



*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 SGDV 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*.

10.1.6 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 SGDV SERVOPACK and Mitsubishi's AD75 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*.

10.2 List of Parameters

10.2.1 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
Fn009	Automatic tuning of analog (speed, force) reference offset	○	○	5.3.2 5.5.2
Fn00A	Manual servo tuning of speed reference offset	○	○	5.3.2
Fn00B	Manual servo tuning of force 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
Fn014	Reset configuration error of option module	○	○	7.15
Fn01B	Initialize vibration detection level	○	○	7.16
Fn01E	SERVOPACK and servomotor ID display	×	○	7.17
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	○	○	7.18
Fn207	Online vibration monitor	○	○	7.19
Fn080	Polarity Detection	○	○	5.9.4
Fn020	Origin setting	○	○	5.9.5
Fn030	Software reset	○	○	7.20

○: Avaiable ×: 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.

10.2.2 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	–

n. □ □ □ □ (digit digit digit digit)

Direction Selection (Refer to 5.2.2)

0	Sets the linear scale countiong up (phase-A lead) direction as forward direction.
1	Sets the linear scale countiong down (phase-B lead) direction as forward direction (Reverse Movement 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	Force 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) ↔ Force control (analog reference)
7	Position control (pulse train reference) ↔ Speed control (analog reference)
8	Position control (pulse train reference) ↔ Force control (analog reference)
9	Force 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	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Servo OFF or Alarm Gr.1 Stop Mode (Refer to 5.2.2)

0	Stops the motor by applying DB (dynamic brake).
1	Stops the motor by applying dynamic brake (DB) and then releases DB.
2	Makes the motor coast to a stop state without using the dynamic brake (DB).

2nd digit: Overtravel (OT) Stop Mode (Refer to 5.2.3)

0	Same setting as Pn001.0 (Stops the motor by applying DB or by coasting).
1	Sets the force of Pn406 to the maximum value, decelerate the motor to a stop, and then sets it to servolock state.
2	Sets the force of Pn406 to the maximum value, decelerates the motor to a stop, and then sets it to coasting state.

3rd digit: AC/DC Power Input Selection (Refer to 3.1.5)

0	Not applicable to DC power input: Input AC power supply through L1, L2 (, and L3) terminals.
1	Applicable to DC power input: Input DC power supply between B1/ + and −2, or input DC power supply between B1/ and −2

4th digit: Warning Code Output Selection (Refer to 5.10.2)

0	ALO1, ALO2, and ALO3 output only alarm codes.
1	ALO1, ALO2, and ALO3 output both alarm codes and warning codes. While warning codes are output, ALM signal output remains ON (normal state).

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	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Speed Control Option (T-REF Terminal Allocation)

0	N/A	
1	Uses T-REF as an external force limit input.	(Refer to 5.8.3)
2	Uses T-REF as a force feedforward input.	(Refer to 6.8.2)
3	Uses T-REF as an external force limit input when P-CL and N-CL are ON.	(Refer to 5.8.4)

2nd digit: Force Control Option (V-REF Terminal Allocation) (Refer to 5.5.3)

0	N/A
1	Uses V-REF as an external speed limit input.

3rd digit: Absolute Linear Scale Usage

0	Uses absolute linear scale as an absolute linear scale.
1	Uses absolute linear scale as an incremental linear scale.

4th digit: Reserved (Do not change.)

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn006	Application Function Select Switch 6	0000 to 005F	–	0002	Immediately	Setup	–

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st and 2nd digits: Analog Monitor 1 Signal Selection (Refer to 6.1.3)

00	Motor speed (1 V/1000 mm/s)
01	Speed reference (1 V/1000 mm/s)
02	Force 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 mm/s)
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 mm/s)
0A	Force 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	Linear scale speed (1 V/1000 mm/s)

3rd digit: Reserved (Do not change.)

4th digit: 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	–

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st and 2nd digits: Analog Monitor 1 Signal Selection (Refer to 6.1.3)

00	Motor speed (1 V/1000 mm/s)
01	Speed reference (1 V/1000 mm/s)
02	Force 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 mm/s)
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 mm/s)
0A	Force 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	Linear scale speed (1 V/1000 mm/s)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn008	Application Function Select Switch 8	0000 to 7121	–	0000	After restart	Setup	–

Pn008: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Reserved (Do not change.)

2nd digit: Function Selection for Insufficient Voltage (Refer to 5.2.7)

0	Disables detection of insufficient voltage.
1	Detects warning and limits force by host controller.
2	Detects warning and limits force by Pn424 and Pn425.

3rd digit: Warning Detection Selection (Refer to 9.2.1)

0	Detects warning.
1	Does not detect warning.

4th digit: 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	–

Pn009: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Reserved (Do not change.)

2nd digit: Current Control Method Selection (Refer to 6.8.10)

0	Current control method 1
1	Current control method 2

3rd digit: Speed Detection Method Selection (Refer to 6.8.12)

0	Speed detection 1
1	Speed detection 2

4th digit: Reserved (Do not change.)

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn00B	Application Function Select Switch B	0000 to 1111	–	0000	After restart	Setup	–

Pn00B: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Parameter Display Selection (Refer to 2.5.3)

0	Setup parameters
1	All parameters

2nd digit: Alarm Gr.2 Stop Method Selection (Refer to 5.2.4)

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)

3rd digit: Power Supply Method for Three-phase SERVOPACK (Refer to 3.1.6)

0	Three-phase power supply
1	Single-phase power supply

4th digit: Reserved (Do not change.)

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn00C	Application Function Select Switch C	0000 to 0111	–	0000	After restart	Setup	–

4th digit 3rd digit 2nd digit 1st digit

n. □ □ □ □

Selection of Test without Motor	(Refer to 4.5.4)
0	Test without motor disabled
1	Test without motor enabled

Reserved (Do not change.)

Encoder Type for Test without Motor	(Refer to 4.5.4)
00	Incremental encoder
01	Absolute encoder

Reserved (Do not change.)

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn010	Axis Address Selection (for UART/ USB communication)	0000 to 007F	–	0001	After restart	Setup	–
Pn080	Application Function Select Switch 80	0000 to 1111	–	0000	After restart	Setup	–

4th digit 3rd digit 2nd digit 1st digit

n. □ □ □ □

Hall Sensor Selection	
0	Enables selection
1	Disables selection

Motor Phase Selection	
0	Sets phase A lead as phase sequence of U,V,W.
1	Sets phase B lead as phase sequence of U,V,W.

Reserved (Do not change.)

Calculation Method for Maximum Speed or Divided Output Pulses	
0	Determines divided output pulses with fixed maximum speed.
1	Determines maximum speed with fixed divided output pulses.

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn100	Speed Loop Gain	10 to 20000	0.1 Hz	400	Immediately	Tuning	–
Pn101	Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately	Tuning	–
Pn102	Position Loop Gain	10 to 20000	0.1/s	400	Immediately	Tuning	–
Pn103	Mass Ratio	0 to 20000	1%	100	Immediately	Tuning	–
Pn104	2nd Speed Loop Gain	10 to 20000	0.1 Hz	400	Immediately	Tuning	6.8.6
Pn105	2nd Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately	Tuning	
Pn106	2nd Position Loop Gain	10 to 20000	0.1/s	400	Immediately	Tuning	
Pn109	Feedforward Gain	0 to 100	1%	0	Immediately	Tuning	6.8.1
Pn10A	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 to 5334	–	0000	–	Setup	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Mode Switch Selection (Refer to 6.8.5)		When Enabled
0	Uses internal force reference as the condition (Level setting: Pn10C)	Immediately
1	Uses speed reference as the condition (Level setting: Pn181)	
2	Uses acceleration as the condition (Level setting: Pn182)	
3	Uses position error pulse as the condition (Level setting: Pn10F)	
4	No mode switch function available	

2nd digit:

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.)	

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn10C	Mode Switch (force reference)	0 to 800	1%	200	Immediately	Tuning	6.8.5
Pn10F	Mode Switch (position error pulse)	0 to 10000	1 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	1%	100	Immediately	Tuning	6.8.9
Pn122	2nd Gain for Friction Compensation	10 to 1000	1%	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 1000	1%	100	Immediately	Tuning	
Pn131	Gain Switching Time 1	0 to 65535	1 ms	0	Immediately	Tuning	6.8.6
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	Immediately	Tuning	–

Pn139: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Gain Switching Selection Switch (Refer to 6.8.6)

0	Manual gain switching Changes gain manually using external input signals (G-SEL)
1	Reserved (Do not change.)
2	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.

2nd digit: Gain Switching Condition A (Refer to 6.8.6)

0	Positioning completion signal (/COIN) ON
1	Positioning completion signal (/COIN) OFF
2	NEAR signal (/NEAR) ON
3	NEAR signal (/NEAR) OFF
4	Position reference filter output = 0 and reference pulse input OFF
5	Position reference pulse input ON

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn13D	Current Gain Level	100 to 2000	1%	2000	Immediately	Tuning	6.8.11
Pn140	Model Following Control Related Switch	0000 to 1121	–	0100	Immediately	Tuning	–

Pn140: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Model Following Control Selection

0	Does not use model following control.
1	Uses model following control.

2nd digit: Vibration Suppression Selection

0	Does not perform vibration suppression.
1	Performs vibration suppression over the specified frequency.
2	Performs vibration suppression over two different kinds of frequencies.

3rd digit: Vibration Suppression Adjustment Selection (Refer to 6.3.1, 6.4.1, 6.5.1 and 6.7.1)

0	Does not adjust vibration suppression automatically using utility function.
1	Adjusts vibration suppression automatically using utility function.

4th digit: Selection of Speed Feedforward (VFF) / Force Feedforward (TFF) (Refer to 6.3.1, 6.4.1)

0	Does not use model following control and external speed/force feedforward together.
1	Uses model following control and external speed/force feedforward together.

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
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	–
Pn143	Model Following Control Bias (Forward Direction)	0 to 10000	0.1%	1000	Immediately	Tuning	–

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
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	–
Pn14F	Control Related Switch	0000 to 0011	–	0011	After restart	Tuning	–

Pn14F

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Model Following Control Type Selection (Refer to 6.3.1, 6.4.1, 6.5.1)

0	Model Following Control 1
1	Model Following Control 2

2nd digit: Tuning-less Type Selection (Refer to 6.2.2)

0	Tuning-less type 1
1	Tuning-less type 2

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn160	Anti-Resonance Control Related Switch	0000 to 0011	–	0010	Immediately	Tuning	–

Pn160

n. □□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Anti-Resonance Control Selection (Refer to 6.3.1, 6.5.1, 6.5.1, 6.7.1)

0	Does not use anti-resonance control.
1	Uses anti-resonance control.

2nd digit: Anti-Resonance Control Adjustment Selection (Refer to 6.5.1, 6.5.1, 6.5.1, 6.5.1)

0	Does not use adjust anti-resonance control automatically using utility function.
1	Adjusts anti-resonance control automatically using utility function.

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn161	Anti-Resonance Frequency	10 to 20000	0.1 Hz	1000	Immediately	Tuning	–
Pn162	Anti-Resonance Gain Compensation	1 to 1000	1%	100	Immediately	Tuning	–
Pn163	Anti-Resonance Damping Gain	0 to 300	1%	0	Immediately	Tuning	–
Pn164	Anti-Resonance Filter Time Constant 1 Compensation	-1000 to 1000	0.01 ms	0	Immediately	Tuning	–
Pn165	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, 3rd digit, 2nd digit, 1st digit)

1st digit:

Tuning-less Function Selection		When Enabled
0	Tuning-less function disabled	After restart
1	Tuning-less function enabled	

2nd digit:

Control Method during Speed Control		When Enabled
0	Uses as speed control.	After restart
1	Uses as position control at host controller.	

3rd digit:

Tuning-less Level		When Enabled
0 to 4	Sets tuning-less level.	Immediaately

4th digit:

Tuning-less Load Level		When Enabled
0 to 2	Sets tuning-less load level.	Immediaately

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn181	Mode Switch (Speed Reference)	0 to 10000	1 mm/s	0	Immediately	Tuning	6.8.5
Pn182	Mode Switch (Acceleration)	0 to 30000	1 mm/s^2	0	Immediately	Tuning	6.8.5

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn200	Position Control Reference Form Selection Switch	0000 to 2236	–	0000	After restart	Setup	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Reference Pulse Form (Refer to 6.5.1)

0	Sign + Pulse, positive logic
1	Forward direction + Reverse direction, 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	Forward direction + Reverse direction, negative logic

2nd digit: Clear Signal Form (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.

3rd digit: Clear Operation (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.

4th digit: Filter Selection (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
Pn207	Position Control Function Switch	0000 to 2210	–	0000	After restart	Setup	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Reserved (Do not change.)

2nd digit: Position Control Option (Refer to 6.5.1)

0	N/A
1	Uses V-REF as a speed feedforward input.

3rd digit: Reserved (Do not change.)

4th digit: /COIN Output Timing (Refer to 6.5.1)

0	Outputs when the position error absolute value is the same or less than the positioning completion width (Pn522).
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.
2	When the absolute value of the position error is below the positioning completed width setting (Pn522), and the position reference input is 0.

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
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	
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	
Pn281	Encoder Output Resolution	1 to 4096	1 P/pitch	20	After restart	Setup	–
Pn282	Linear Scale Pitch	0.00 to 65536.00	0.01 μm	0	After restart	Setup	–
Pn300	Speed Reference Input Gain	150 to 3000	0.01V / rated speed	600	Immediately	Setup	5.3.1 5.5.3 6.8.3
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	–
	4th digit 3rd digit 2nd digit 1st digit n. □ □ □ □ 1st digit: Vibration Detection Selection (Refer to 7.16) 0: No detection. 1: Outputs warning (A.911) when vibration is detected. 2: Outputs alarm (A.520) when vibration is detected. 2nd digit: Reserved (Do not change.) 3rd digit: Reserved (Do not change.) 4th digit: Reserved (Do not change.)						
Pn311	Vibration Detection Sensibility	50 to 500	1%	100	Immediately	Tuning	7.16
Pn324	Mass Calculating Start Level	0 to 20000	1%	300	Immediately	Setup	–
Pn380	Internal Set Speed 1	0 to 10000	1 mm/s	10	Immediately	Setup	5.6.1
Pn381	Internal Set Speed 2	0 to 10000	1 mm/s	20	Immediately	Setup	5.6.1
Pn382	Internal Set Speed 3	0 to 10000	1 mm/s	30	Immediately	Setup	5.6.1
Pn383	JOG Speed	0 to 10000	1 mm/s	50	Immediately	Setup	7.3
Pn384	Vibration Detection Level	0 to 5000	1 mm/s	10	Immediately	Tuning	7.16
Pn385	Motor Max.Speed	1 to 100	100 mm/s	50	After restart	Setup	5.2.6
Pn400	Force Reference Input Gain	10 to100	0.1 V/ rated force	30	Immediately	Setup	5.5.1 6.8.2
Pn401	Force Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	Tuning	6.8.7
Pn404	Forward External Force Limit	0 to 800	1%	100	Immediately	Setup	5.8.2 5.8.4
Pn405	Reverse External Force Limit	0 to 800	1%	100	Immediately	Setup	
Pn406	Emergency Stop Force	0 to 800	1%	800	Immediately	Setup	5.2.3

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn408	Force Related Function Switch	0000 to 1111	–	0000	–	Setup	–

Pn408 digits: 4th digit, 3rd digit, 2nd digit, 1st digit

n. □ □ □ □

1st digit:

1st Step Notch Filter Selection (Refer to 6.8.7)		When Enabled
0	N/A	Immediately
1	Uses 1st step notch filter for torque reference.	

2nd digit:

Speed Limit Selection (Refer to 5.5.3)		When Enabled
0	Uses the smaller value between motor max. speed and parameter Pn480 as speed limit value.	After restart
1	Uses the smaller value between overspeed detection speed and parameter Pn480 as speed limit value.	

3rd digit:

2nd Step Notch Filter Selection (Refer to 6.8.7)		When Enabled
0	N/A	Immediately
1	Uses 2nd step notch filter for torque reference.	

4th digit:

Friction Compensation Function Selection (Refer to 6.8.9)		When Enabled
0	Disables use friction compesation function.	Immediately
1	Enables friction compsation function.	

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn409	1st Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning	6.8.7
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	2ndt Notch Filter Depth	0 to 1000	0.001	0	Immediately	Tuning	
Pn40F	2nd Force Reference Filter Frequency	100 to 5000	1 Hz	5000	Immediately	Tuning	
Pn410	2nd Force Reference Filter Q Value	50 to 100	0.01	50	Immediately	Tuning	
Pn412	1st Step 2nd Force Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	Tuning	6.8.6
Pn415	T-REF Filter Time Constant	0 to 65535	0.01 ms	0	Immediately	Setup	6.8.2
Pn424	Force Limit at Main Circuit Voltage Drop	0 to 100	1%	50	Immediately	Setup	5.2.7
Pn425	Release Time for Force Limit at Main Circuit Voltage Drop	0 to 1000	1 ms	100	Immediately	Setup	
Pn456	Sweep Force Reference Amplitude	1 to 800	1%	15	Immediately	Tuning	7.18

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

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Notch Filter Adjustment Selection 1	
0	1st step notch filter is not adjusted automatically with utility function.
1	1st step notch filter is adjusted automatically with utility function.

2nd digit: Reserved (Do not change.)

3rd digit:

Notch Filter Adjustment Selection 2	
0	2nd step notch filter is not adjusted automatically with utility function.
1	2nd step notch filter is adjusted automatically with utility function.

4th digit: Reserved (Do not change.)

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn480	Speed Limit during Force Control	0 to 10000	1 mm/s	10000	Immediately	Setup	5.5.3
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	–
Pn483	Forward Force Limit	0 to 800	1%	30	Immediately	Setup	5.8.1
Pn484	Reverse Force Limit	0 to 800	1%	30	Immediately	Setup	5.8.1
Pn485	Polarity Detection Reference Speed	0 to 100	1 mm/s	20	Immediately	Setup	–
Pn486	Polarity Detection Reference Accel/ Decel Time	0 to 100	1 ms	25	Immediately	Tuning	–
Pn487	Polarity Detection Constant Speed Time	0 to 300	1 ms	0	Immediately	Tuning	–
Pn488	Polarity Detection Reference Waiting Time	50 to 500	1 ms	100	Immediately	Tuning	–
Pn48E	Polarity Detection Range	1 to 65535	1 mm	10	Immediately	Tuning	–
Pn490	Polarity Detection Load Level	0 to 20000	1%	100	Immediately	Tuning	–
Pn495	Polarity Detection Confirmation Force Reference	0 to 200	1%	100	Immediately	Tuning	–
Pn498	Polarity Detection Allowable Error Range	0 to 30	1 deg	10	Immediately	Tuning	–
Pn506	Brake Reference - Servo OFF Delay Time	0 to 50	10 ms	0	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	5.2.5

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	–

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: 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.

2nd digit: /S-ON Signal Mapping
Signal Polarity: Normal; Servo ON when ON (L-level)
Signal Polarity: Reverse; Servo ON when OFF (H-level)
(Refer to 5.2.1)

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	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)

3rd digit: /P-CON Signal Mapping (P control when ON (L-level)) (Refer to 6.8.4)

0 to F	Same as /S-ON

4th digit: 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	

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: 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).

2nd digit: /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.

3rd digit: /P-CL Signal Mapping (Force Limit when ON (L-level)) (Refer to 5.8.2)

0 to F	Same as /S-ON, the setting of 2nd digit of Pn50A

4th digit: /N-CL Signal Mapping (Force 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	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: /SPD-D Signal Mapping (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).

2nd digit: /SPD-A Signal Mapping (Refer to 5.6.1)

0 to F	Same as /SPD-D

3rd digit: /SPD-B Signal Mapping (Refer to 5.6.1)

0 to F	Same as /SPD-D

4th digit: /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	–

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: /ZCLAMP Signal Mapping (Zero clamp when ON (L-level)) (Refer to 5.3.5)

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).

2nd digit: /INHIBIT Signal Mapping (Reference pulse inhibit when ON (L-level)) (Refer to 5.4.7)

0 to F	Same as /ZCLAMP

3rd digit: /G-SEL1 Signal Mapping (Gain change when ON (L-level)) (Refer to 6.8.6)

0 to F	Same as /ZCLAMP

4th digit: /P-DET Signal Mapping (Polarity detection starts when ON (L-level))

0 to F	Same as /ZCLAMP

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50E	Output Signal Selection 1	0000 to 3333	–	3211	After restart	Setup	–

n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Positioning Completion Signal Mapping (/COIN) (Refer to 5.4.5)

0	Disabled (the above signal is not used.)
1	Outputs the signal from CN1-25, 26 output terminal.
2	Outputs the signal from CN1-27, 28 output terminal.
3	Outputs the signal from CN1-29, 30 output terminal.

2nd digit: Speed Coincidence Detection Signal Mapping (/V-CMP) (Refer to 5.3.8)

0 to 3	Same as /COIN

3rd digit: Servomotor Movement Detection Signal Mapping (/TGON) (Refer to 5.10.3)

0 to 3	Same as /COIN

4th digit: Servo Ready Signal Mapping (/S-RDY) (Refer to 5.10.4)

0 to 3	Same as /COIN

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	–
Pn510	Output Signal Selection 3	0000 to 0033	–	0000	After restart	Setup	–
Pn511	Input Signal Selection 5	0000 to FFFF	–	8888	After restart	Setup	–

Pn50F

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Force Limit Detection Signal Mapping (/CLT) (Refer to 5.8.5)

0	Disabled (the above signal is not used.)
1	Outputs the signal from CN1-25, -26 output terminal.
2	Outputs the signal from CN1-27, -28 output terminal.
3	Outputs the signal from CN1-29, -30 output terminal.

2nd digit: Speed Limit Detection Signal Mapping (/VLT) (Refer to 5.5.3)

0 to 3	Same as /CLT

3rd digit: Brake Signal Mapping (/BK) (Refer to 3.3.2)

0 to 3	Same as /CLT

4th digit: Warning Signal Mapping (/WARN) (Refer to 5.10.2)

0 to 3	Same as /CLT

Pn510

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Near Signal Mapping (/NEAR) (Refer to 5.4.6)

0	Disabled (the above signal is not used.)
1	Outputs the signal from CN1-25, -26 terminal.
2	Outputs the signal from CN1-27, -28 terminal.
3	Outputs the signal from CN1-29, -30 terminal.

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Pn511

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Reserved (Do not change.)

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

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	3.3.2

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit:

Output Signal Inversion for CN1-25 or -26 Terminals	
0	Does not inverse outputs.
1	Inverses outputs.

2nd digit:

Output Signal Inversion for CN1-27 or -28 Terminals	
0	Does not inverse outputs.
1	Inverses outputs.

3rd digit:

Output Signal Inversion for CN1-29 or -30 Terminals	
0	Does not inverse outputs.
1	Inverses outputs.

4th digit: Reserved (Do not change.)

Pn513	Output Signal Selection 4	0000 to 0333	–	0000	After restart	Setup	–

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Reserved (Do not change.)

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Pn51E	Excessive Position Error Warning Level	10 to 100	1%	100	Immediately	Setup	9.2.1
Pn520	Excessive Position Error Alarm Level	1 to 1073741823 (2^{30}-1)	1 reference unit	5242880	Immediately	Setup	6.1.4 9.1.1
Pn522	Positioning Completed Width	0 to 1073741824 (2^{30})	1 reference unit	7	Immediately	Setup	5.4.5
Pn524	NEAR Signal Width	1 to 1073741824 (2^{30})	1 reference unit	1073741824	Immediately	Setup	5.4.6
Pn526	Excessive Position Error Alarm Level at Servo ON	1 to 1073741823 (2^{30}-1)	1 reference unit	5242880	Immediately	Setup	9.1.1
Pn528	Excessive Position Error Warning Level at Servo ON	10 to 100	1%	100	Immediately	Setup	9.2.1
Pn52B	Overload Warning Level	1 to 100	1%	20	Immediately	Setup	5.2.8
Pn52C	Derating of Base Current at Detecting Overload of Motor	10 to 100	1%	100	After restart	Setup	5.2.8
Pn52F	Monitor Display at Power ON	0000 to 0FFF	–	0FFF	Immediately	Setup	8.8

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn530	Program JOG Operation Related Switch	0000 to 0005	–	0000	Immediately	Setup	7.5

n. □ □ □ □ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Program JOG Operation Related Switch

0	(Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536
1	(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536
2	(Waiting time Pn535 → Forward movement Pn531) × Number of times of movements Pn536 (Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536
3	(Waiting time Pn535 → Reverse movement Pn531) × Number of times of movements Pn536 (Waiting time Pn535 → Forward movement Pn531) × Number of times of movements Pn536
4	(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of times of movement Pn536
5	(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of times of movement Pn536

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn531	Program JOG Movement Distance	1 to 1073741824 (2^{30})	1 reference unit	32768	Immediately	Setup	7.5
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%	400	Immediately	Setup	6.7.1
Pn561	Overshoot Detection Level	0 to 100	1%	100	Immediately	Setup	–
Pn580	Zero Clamp Level	0 to 10000	1 mm/s	10	Immediately	Setup	5.3.5
Pn581	Zero Speed Level	1 to 10000	1 mm/s	20	Immediately	Setup	5.10.3
Pn582	Speed Coincidence Signal Output Width	0 to 100	1 mm/s	10	Immediately	Setup	5.3.8
Pn583	Brake Reference Output Speed Level	0 to 10000	1 mm/s	10	Immediately	Setup	–
Pn584	Speed Limit Level at Servo ON	0 to 10000	1 mm/s	10000	Immediately	Setup	9.1.1
Pn585	Program JOG Movement Speed	1 to 10000	1 mm/s	50	Immediately	Setup	7.5
Pn586	Motor Running Air-cooling Ratio	0 to 100	1%/maxvel	0	Immediately	Setup	–

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn587	Polarity Detection for Absolute Scale Selection	0000h to 0001h	–	0000h	Immediately	Setup	–
Pn600	Regenerative Resistor Capacity [*1]	Depends on SERVOPACK Capacity [*2]	10 W	0	Immediately	Setup	3.6.2
Pn601	Reserved (Do not change.)	–	–	0	–	–	–

Pn587: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Polarity Detection for Absolute Scale Selection

0	Does not detect polarity.
1	Detects polarity.

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

*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.

10.3 Monitor Modes

The following list shows monitor modes available.

Parameter No.	Content of Display	Unit
Un000	Motor moving speed	mm/s
Un001	Speed reference	mm/s
Un002	Internal force reference (in percentage to the rated force)	%
Un003	Electric angle 1 (32-bit decimal code)	pulse
Un004	Electric angle 2 (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)	mm/s
Un008	Error counter (position error amount) (valid only in position control)	reference unit
Un009	Accumulated load ratio (in percentage to the rated force: effective force 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) (valid only in position control)	reference unit
Un00D*3	Feedback pulse counter (1/256 of linear scale pitch): 32-bit decimal code)	encoder pulse
Un010	Allowable maximum motor speed of Encoder output resolution	–
Un011	Hall sensor signal monitor	–
Un084	Linear scale pitch (Scale pitch = Un084 × 10^{Un085} [pm])	–
Un085	Linear scale pitch index (Scale pitch = Un084 × 10^{Un085} [pm])	–

∗1. For details, refer to *8.6 Monitoring Input Signals*.
∗2. For details, refer to *8.7 Monitoring Output Signals*.
∗3. For details, refer to *8.3 Monitor Display of Reference Pulse Counter (Un00C) and Feedback Pulse Counter (Un00D)*.

10.4 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
Pn080	0000						Application Function Select Switch 80	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 %						Mass 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	0.00 ms						Feedforward Filter Time Constant	Immediately
Pn10B	0000						Application Function for Gain Select Switch	–
Pn10C	200 %						Mode Switch (force reference)	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	0.0 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
Pn13D	2000%						Current Gain Level	Immediately

Parame-ter	Factory Setting						Name	When Enabled
Pn140	0100						Model Following Control Related Switch	Immediately
Pn141	50.0/s						Model Following Control Gain	Immediately
Pn142	100.0%						Model Following Control Gain Compensation	Immediately
Pn143	100.0%						Model Following Control Bias (Forward Direction)	Immediately
Pn144	100.0%						Model Following Control Bias (Reverse Direction)	Immediately
Pn145	50.0 Hz						Vibration Suppression 1 Frequency A	Immediately
Pn146	70.0 Hz						Vibration Suppression 1 Frequency B	Immediately
Pn147	100.0%						Model Following Control Speed Feedforward Compensation	Immediately
Pn148	50.0 /s						2nd Model Following Control Gain	Immediately
Pn149	100.0%						2nd Model Following Control Gain Compensation	Immediately
Pn14A	80.0 Hz						Vibration Suppression 2 Frequency	Immediately
Pn14B	100%						Vibration Suppression 2 Compensation	Immediately
Pn14F	0011						Control Related Switch	After restart
Pn160	0010						Anti-Resonance Control Related Switch	Immediately
Pn161	100.0 Hz						Anti-Resonance Frequency	Immediately
Pn162	100%						Anti-Resonance Gain Compensation	Immediately
Pn163	0%						Anti-Resonance Damping Gain	Immediately
Pn164	0.00 ms						Anti-Resonance Filter Time Constant 1 Compensation	Immediately
Pn165	0.00 ms						Anti-Resonance Filter Time Constant 2 Compensation	Immediately
Pn170	1401						Tuning-less Function Related Switch	–
Pn181	0 mm/s						Mode Switch (Speed Reference)	Immediately
Pn182	0 mm/s^2						Mode Switch (Acceleration)	Immediately
Pn200	0000						Position Control Reference Form Selection Switch	After restart
Pn207	0010						Position Control Function Switch	After restart
Pn20E	4						Electronic Gear Ratio (Numerator)	After restart
Pn210	1						Electronic Gear Ratio (Denominator)	After restart
Pn216	0.0 ms						Position Reference Acceleration/ Deceleration Time Constant	Immediately
Pn217	0.0 ms						Average Movement Time of Position Reference	Immediately
Pn281	20 P/Pitch						Encoder Output Resolution	After restart
Pn282	0.00 µm						Linear Scale Pitch	After restart
Pn300	6.00 V/ Rated speed						Speed Reference Input Gain	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

Parameter	Factory Setting						Name	When Enabled
Pn311	100 %						Vibration Detection Sensibility	Immediately
Pn324	300%						Mass Calculating Start Level	Immediately
Pn380	10 mm/s						Internal Set Speed 1	Immediately
Pn381	20 mm/s						Internal Set Speed 2	Immediately
Pn382	30 mm/s						Internal Set Speed 3	Immediately
Pn383	50 mm/s						JOG Speed	Immediately
Pn384	10 mm/s						Vibration Detection Level	Immediately
Pn385	5000 mm/s						Motor Max.Speed	After restart
Pn400	3.0 V/Rated force						Force Reference Input Gain	Immediately
Pn401	1.00 ms						Force Reference Filter Time Constant	Immediately
Pn404	100 %						Forward External Force Limit	Immediately
Pn405	100 %						Reverse External Force Limit	Immediately
Pn406	800 %						Emergency Stop Force	Immediately
Pn408	0000						Force 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	0.000						2nd Notch Filter Depth	Immediately
Pn40F	5000 Hz						2nd Force Reference Filter Frequency	Immediately
Pn410	0.50						2nd Force Reference Filter Q Value	Immediately
Pn412	1.00 ms						1st Step 2nd Force Reference Filter Time Constant	Immediately
Pn415	0.00 ms						T-REF Filter Time Constant	Immediately
Pn424	50%						Force Limit at Main Circuit Voltage Drop	Immediately
Pn425	100 ms						Release Time for Force Limit at Main Circuit Voltage Drop	Immediately
Pn456	15 %						Sweep Force Reference Amplitude	Immediately
Pn460	0101						Notch Filter Adjustment Switch	Immediately
Pn480	10000 mm/s						Speed Limit during Force Control	Immediately
Pn481	4.00 Hz						Polarity Detection Speed Loop Gain	Immediately
Pn482	0.30 ms						Polarity Detection Speed Loop Integral Time Constant	Immediately
Pn483	30%						Forward Force Limit	Immediately
Pn484	30%						Reverse Force Limit	Immediately
Pn485	20 mm/s						Polarity Detection Reference Speed	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
Pn48E	10 mm						Polarity Detection Range	Immediately
Pn490	100%						Polarity Detection Load Level	Immediately

Parame-ter	Factory Setting						Name	When Enabled
Pn495	100%						Polarity Detection Confirmation Force Reference	Immediately
Pn498	10 deg						Polarity Detection Allowable Error Range	Immediately
Pn506	0 ms						Brake Reference - Servo OFF Delay Time	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
Pn51E	100%						Excessive Position Error Warning Level	Immediately
Pn520	5242880 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	5242880 reference unit						Excessive Position Error Alarm Level at Servo ON	Immediately
Pn528	100%						Excessive Position Error Warning Level at Servo ON	Immediately
Pn52B	20%						Overload Warning Level	Immediately
Pn52C	100%						Derating of Base Current at Detecting Overload of Motor	After restart
Pn52F	0FFF						Monitor Display at Power ON	Immediately
Pn530	0000						Program JOG Operation Related Switch	Immediately
Pn531	32768 reference unit						Program JOG Movement Distance	Immediately
Pn534	100 ms						Program JOG Acceleration/Deceleration Time	Immediately
Pn535	100 ms						Program JOG Waiting Time	Immediately
Pn536	once						Number of Times of Program JOG Movement	Immediately
Pn550	0.0 V						Analog Monitor 1 Offset Voltage	Immediately
Pn551	0.0 V						Analog Monitor 2 Offset Voltage	Immediately
Pn552	×0.01						Analog Monitor Magnification (×1)	Immediately

Parameter	Factory Setting						Name	When Enabled
Pn553	×0.01						Analog Monitor Magnification (×2)	Immediately
Pn560	40.0%						Remained Vibration Detection Width	Immediately
Pn561	100%						Overshoot Detection Level	Immediately
Pn580	10 mm/s						Zero Clamp Level	Immediately
Pn581	20 mm/s						Zero Speed Level	Immediately
Pn582	10 mm/s						Speed Coincidence Signal Output Width	Immediately
Pn583	10 mm/s						Brake Reference Output Speed Level	Immediately
Pn584	10000 mm/s						Speed Limit Level at Servo ON	Immediately
Pn585	50 mm/s						Program JOG Movement Speed	Immediately
Pn586	0%/maxvel						Motor Running Air-cooling Ratio	Immediately
Pn587	0000h						Polarity Detection for Absolute Scale Selection	Immediately
Pn600	0 W						Regenerative Resistor Capacity	Immediately
Pn601	0						Reserved (Do not change.)	–

Revision History

The revision dates and numbers of the revised manuals are given on the bottom of the back cover.

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July 2007	–		First edition
August 2008	◇1	All chapters	Completely revised
		Back cover	Revision: Address
November 2008	◇2	Preface	Addition: EMC Directive, Safety Standards
		1.3.1 (2), (3), 1.6, 3.1.1, 3.1.2 (3), (4), 3.1.3, 3.1.5, 3.6.1, 6.8.10	Addition: SERVOPACK Models Three-phase 200 V: SGDV-470A, 550A, 590A, 780A Three-phase 400 V: SGDV-210D, 260D, 280D, 370D
		1.3.2	Revision: Applicable Standards
			Revision: Shock Resistance
		1.4	Addition: SERVOPACK Internal Block Diagrams
		1.5	Revision: Example of Servo System Configurations
		3.3	Revision: I/O Signal Allocations
		5.11.1 (11)	Addition: Servo Alarm Output Signal (ALM) and Alarm Code Output Signals (AL01, AL02, and AL03)
		6.8.7	Revision: The diagram of Force Reference Filter

AC Servo Drives

Σ-V Series

USER'S MANUAL
Design and Maintenance

Linear Motor
Analog Voltage and Pulse Train Reference

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