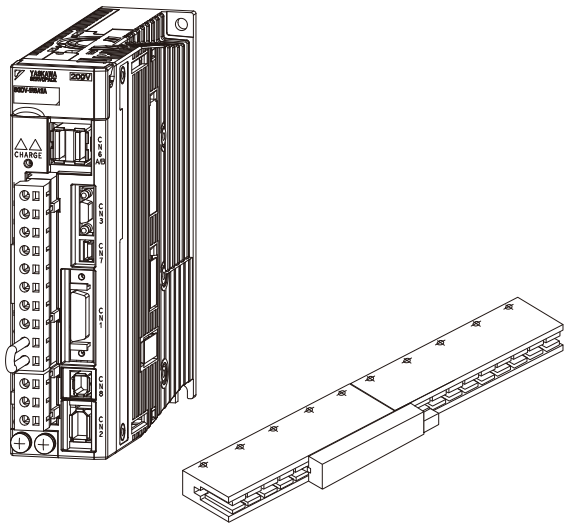
YASKAWA

AC Servodrive

Σ-V Series
USER'S MANUAL
Design and Maintenance

Linear Motor
MECHATROLINK-II Communications Reference

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



MANUAL NO. SIEP S800000 48B

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
Servodrive	A set including a servomotor and SERVOPACK (i.e., a servo amplifier)
Servo System	A servo control system that includes the combination of a servodrive with a host controller and peripheral devices
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.

- 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 (SIEPS80000044)				✓	✓		
Σ-V Series User's Manual Design and Maintenance Rotational Motor MECHATROLINK-II Communications Reference (SIEPS80000046)		✓	✓	✓		✓	✓
Σ-V Series Product Catalog (KAEPS80000042)	✓	✓					
Σ-V Series User's Manual Operation of Digital Operator (SIEPS80000055)					✓	✓	✓
Σ-V Series AC SERVOPACK SGDV Safety Precautions (TOBPC71080010)							✓
Σ Series Digital Operator Safety Precautions (TOBPC73080000)							✓
AC SERVOMOTOR Safety Precautions (TOBPC23020000)							✓

■ Safety Information

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

⚠ 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 series 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.
  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

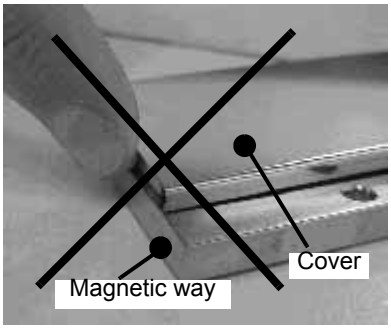
⚠ CAUTION

- 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 30 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 circuit cable 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.

■ 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 electric shock or injury.
- Do not attempt to change wiring while the power is ON.
  Failure to observe this caution may result in damage to the product.
- Do not disassemble or repair the linear servomotor.
  Failure to observe this caution may result in electric shock or injury.

■ Disposal

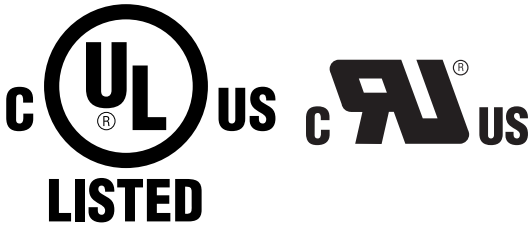
⚠ CAUTION
• When disposing of the products, treat them as ordinary industrial waste.

■ 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 class A group 1	EN61800-3	EN954

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

Contents

1

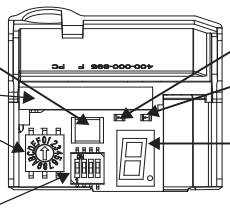
Outline

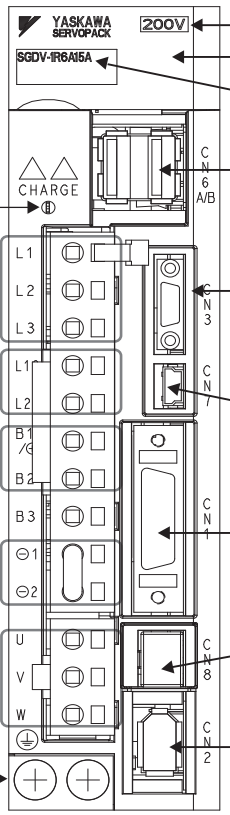
1.1 Σ-V Series SERVOPACKs

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 MECHATROLINK-II communications reference.





CN5 Analog monitor connector
Used to monitor motor speed, force reference, and other values through a special cable (option).
Refer to *5.1.3 Monitoring Analog Signals*.

Serial number

Rotary switch (SW 1)
Used to set the MECHATROLINK-II station address.
Refer to *4.1.1 Setting Switches SW1 and SW2*.

DIP switch (SW 2)
Used to set MECHATROLINK-II communications.
Refer to *4.1.1 Setting Switches SW1 and SW2*.

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.

DC reactor terminals for harmonic suppression
Connects DC reactor for harmonic suppression.
Refer to *3.8.3 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*.

Power LED indicator (POWER)
Indicates that the control power is being supplied.

Communications LED indicator (COM)
Indicates that data is being transmitted between the SERVOPACK and the MECHATROLINK-II system.

Panel display
Indicates the servo status with a seven-segment LED display.
Refer to *2.1.1 Status Display*.

Input voltage

Front cover

SERVOPACK model
Refer to *1.5 SERVOPACK Model Designation*.

MECHATROLINK-II communications connectors
Connects MECHATROLINK-II -supported devices.
Refer to *3.5 Wiring MECHATROLINK-II Communications*.

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 refer to *3.2.3 Safety Function Signal (CN8) Names and Functions*.
Refer to *4.6 Safety Function*.

CN2 Encoder connector
Connects a serial converter unit or a linear scale.
Refer to *3.6 Examples of Encoder 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
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
Max. Output Current [Arms]	2.1	2.9	5.8	9.3	11.0	16.9	17	28	42	56	84
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
Continuos Output Current [Arms]	1.9	3.5	5.4	8.4	11.9	16.5
Max. Output Current [Arms]	5.5	8.5	14	20	28	42
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
	Surrounding Air/Storage Humidity			90% RH or less (with no condensation)
	Vibration/Shock Resistance			4.9 m/s^2 / 19.8 m/s^2
	Protection Class/ Pollution Degree			Protection class: 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 group1 classA, EN61800-3, EN61800-5
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	Input Signals which can be allocated	Number of Channels	7 ch
			Functions	The signal allocation and positive/negative logic can be modified. Homing deceleration switch signal (/DEC), external latch signals (/EXT 1 to 3), forward run prohibited (P-OT), reverse run prohibited (N-OT), forward current limit (/P-CL), reverse current limit (/N-CL)
	Sequence Output	Fixed Output		Servo alarm (ALM), alarm code (AL01, AL02, AL03) outputs
		Output Signals which can be allocated	Number of Channels	4 ch
			Functions	The signal allocation and positive/negative logic can be modified. Positioning completion (/COIN), speed coincidence detection (/V-CMP), movement detection (/TGON), servo ready (/S-RDY), force limit detection (/CLT), speed limit detection (/VLT), brake (/BK), warning (/WARN), near (/NEAR)

Communications Function	RS422A Communications (CN3)	Interface	Digital operator (JUSP-OP05A-1-E), personal computer (can be connected with SigmaWin+), etc.
		1:N Communications	N = Up to 15 stations possible at RS422A
		Axis Address Setting	Set by parameter
	USB Communications (CN7)	Interface	Personal computer (can be connected with SigmaWin+.)
		Communications Standard	Complies with standard USB1.1. (12 Mbps)
LED Display			Panel display (seven-segment), CHARGE, POWER, and COM indicators
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 overtravel
Regenerative Processing			Built-in or external regenerative resistor (option)
Overtravel Prevention (OT)			Dynamic brake stop at P-OT or N-OT, deceleration to a stop, or free run to a stop
Protection Function			Overcurrent, overvoltage, insufficient voltage, overload, 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:

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

1.3.3 MECHATROLINK-II Function Specifications

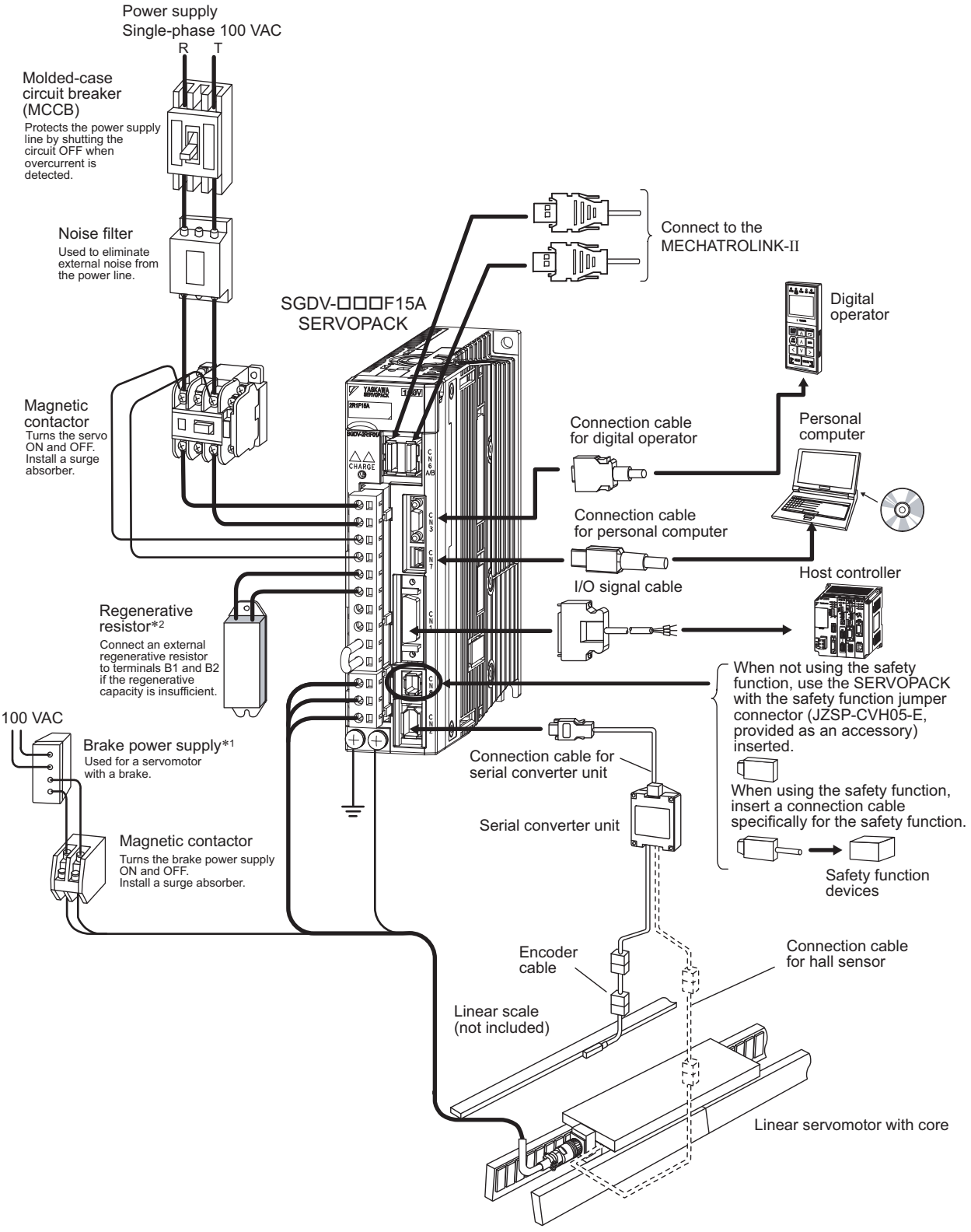
The following table shows the basic specifications of MECHATROLINK-II.

Function		Specifications
MECHATROLINK-II Communication	Communication Protocol	MECHATROLINK-II
	Station Address	41H to 5FH (Max. number of stations: 30)
	Baud Rate	10 Mbps, 4 Mbps
	Transmission Cycle	250 μs, 0.5 ms to 4.0 ms (Multiples of 0.5 ms)
	Number of Words in Link Communication	Selections: 17 byte per station or 32 byte per station DIP switch (SW2)
Reference Method	Control Method	Position, speed, or force control with MECHATROLINK-II communication
	Reference Input	MECHATROLINK, MECHATROLINK-II commands (sequence, motion, data setting/reference, monitoring, or adjustment)

1.4 Examples of Servo System Configurations

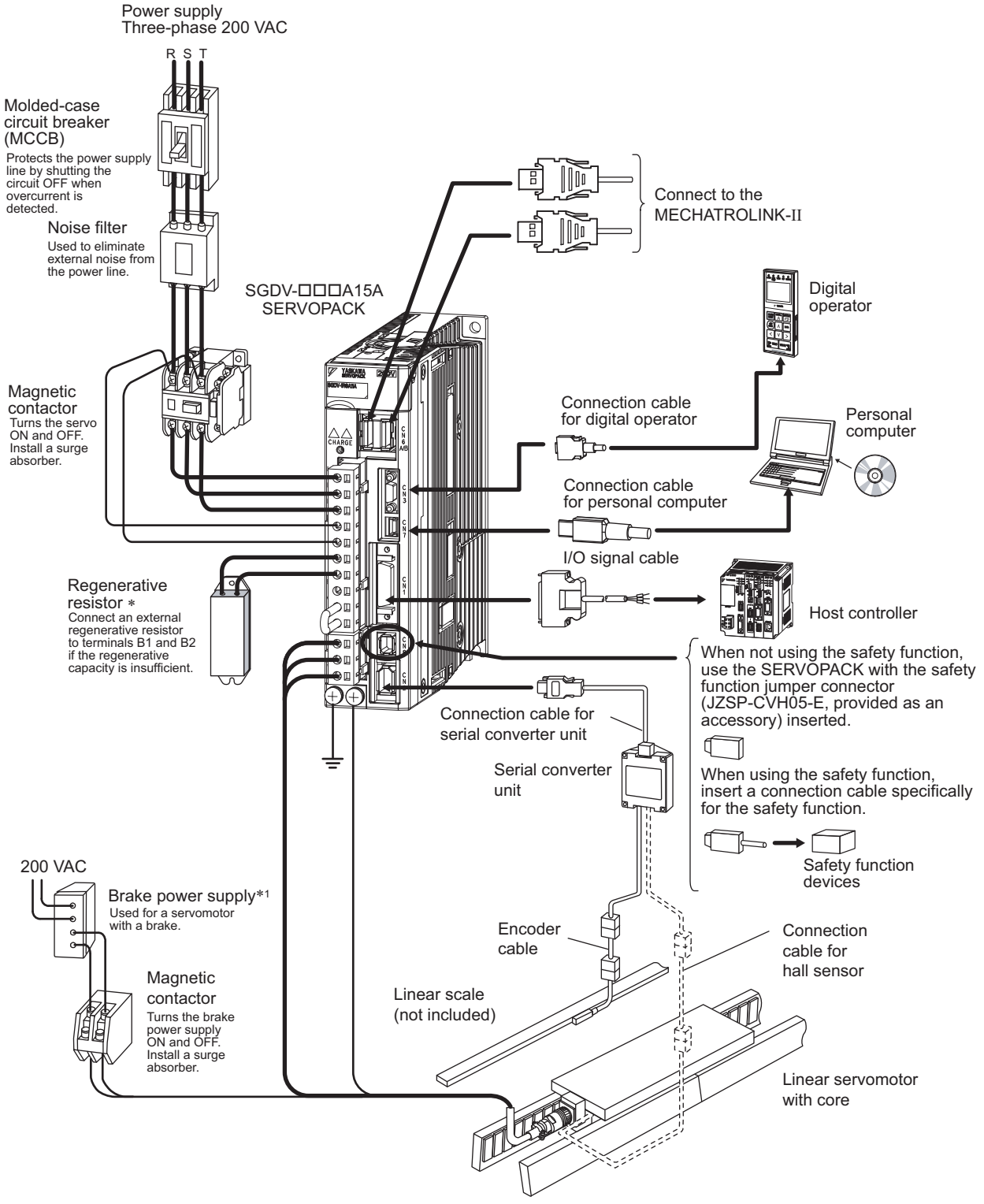
This section describes examples of basic servo system configuration.

1.4.1 Connecting to SGDV-□□□F15A SERVOPACK



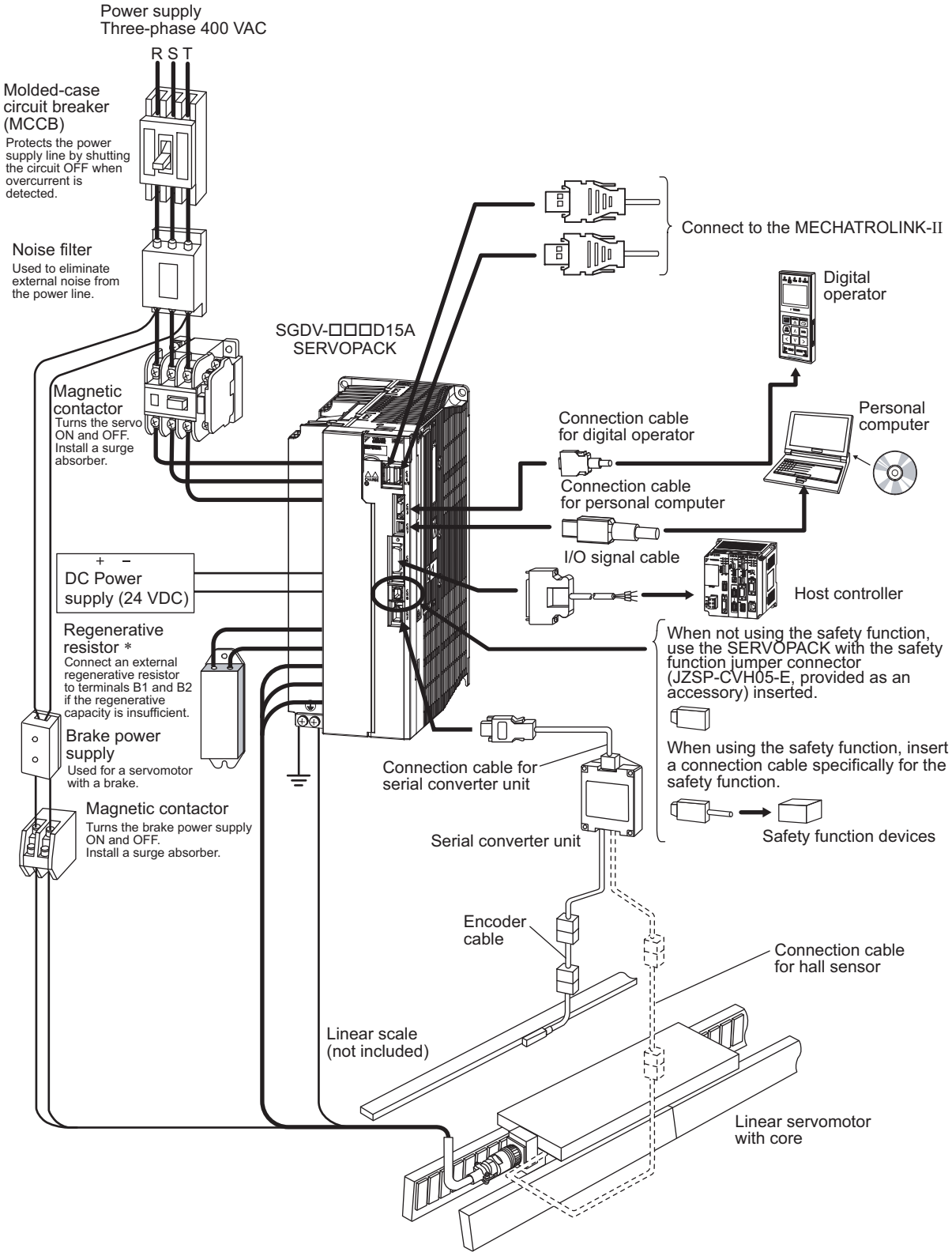
∗1. Use a 24 VDC power supply. (not included)
∗2. If terminals B2 and B3 are connected with a lead wire, remove the wire between the terminals on the SERVOPACK before connecting an external regenerative resistor to the SERVOPACK.

1.4.2 Connecting to SGDV-□□□A15A SERVOPACK



*1. Use a 24 VDC power supply. (not included)
*2. If terminals B2 and B3 are connected with a lead wire, remove the wire between the terminals on the SERVOPACK before connecting an external regenerative resistor to the SERVOPACK.

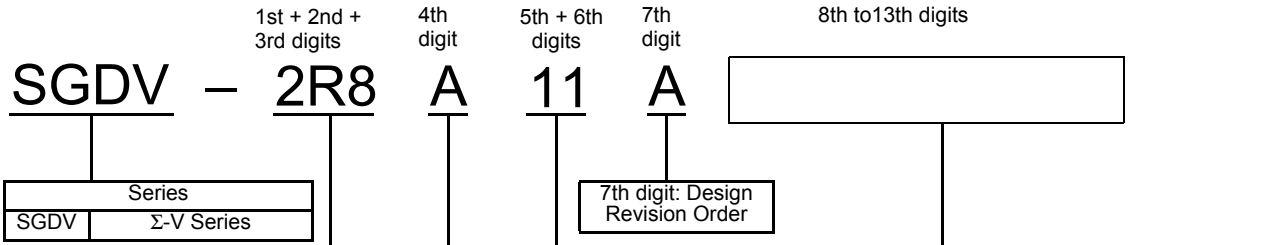
1.4.3 Connecting to SGDV-□□□D15A SERVOPACK



∗1. Use a 24 VDC power supply. (not included)
∗2. If terminals B2 and B3 are connected with a lead wire, remove the wire between the terminals on the SERVOPACK before connecting an external regenerative resistor to the SERVOPACK.
∗3. Use a following power supply for 90 V brake. For details, refer to *Σ-V series Product Catalog* (KAEPS80000042).
- For 200 V input voltage: LPSE-2H01-E
- For 100 V input voltage: LPDE-1H01-E

1.5 SERVOPACK Model Designation

Select the SERVOPACK according to the applied servomotor.



Series	
SGDV	Σ-V Series

7th digit: Design Revision Order

8th to 13th digits: Option	
Blank	Base-mounted type (standard)
001000	Rack-mounted 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
400 V	1R9	0.5
	3R5	1
	5R4	1.5
	8R4	2
	120	3
	170	5

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

1.6 Inspection and Maintenance

This section describes the inspection and maintenance of SERVOPACK.

(1) SERVOPACK Inspection

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

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

(2) SERVOPACK's Parts Replacement Schedule

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

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

IMPORTANT

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.

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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 Display and Operation of Digital Operator

2.1 Panel Display

The servo status can be checked on the panel display of the SERVOPACK.
Also, if an alarm or warning occurs, its alarm or warning number is displayed.

2.1.1 Status Display

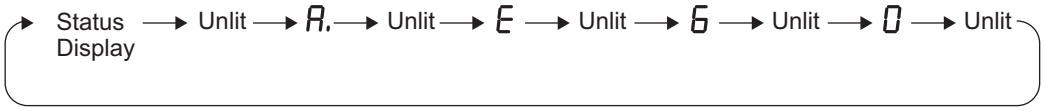
The display shows the following status.

Display	Meaning
	Baseblock Light for baseblock. Does not light when servo is ON.
	Movement Detection (/TGON) Light if motor speed exceeds the value set in Pn522. (Factory setting: 7 reference units)
	Reference Input Lights when a reference is being input.
	CONNECT Lights during connection.

2.1.2 Alarm and Warning Display

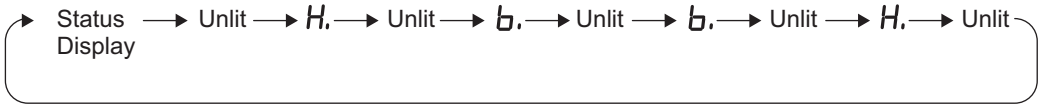
If an alarm or warning occurs, the display will change in the following order.

Example: Alarm A.E60



2.1.3 Mode Test without Motor Display

The display will change in the following order if a test is being done without a motor.



2.2 Utility Function Mode (Fn□□□), Parameter Setting Mode (Pn□□□), Monitor Mode (Un□□□)

Operation examples of Utility Function Mode (Fn□□□), Parameter Setting Mode (Pn□□□) and Monitor Mode (Un□□□) are in the following table.

For the Utility Function Mode, refer to 2.3 Utility Function Mode (Fn□□□).
For the Parameter Setting Mode, refer to 2.4 Parameter Setting Mode (Pn□□□).
For the Monitor Mode, refer to 2.5 Monitor Mode (Un□□□).

Operations are performed with a digital operator or SigmaWin+.

The following procedures are described for cases in which the digital operator is used.

For more information on the usage of the digital operator, refer to *Σ-V Series USER'S MANUAL Operation of Digital Operator* (manual no.: SIEP S800000 55).

2.3 Utility Function Mode (Fn□□□)

The setup and adjustment functions of the SERVOPACK are executed in this mode.

The digital operator displays numbers beginning with Fn.

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

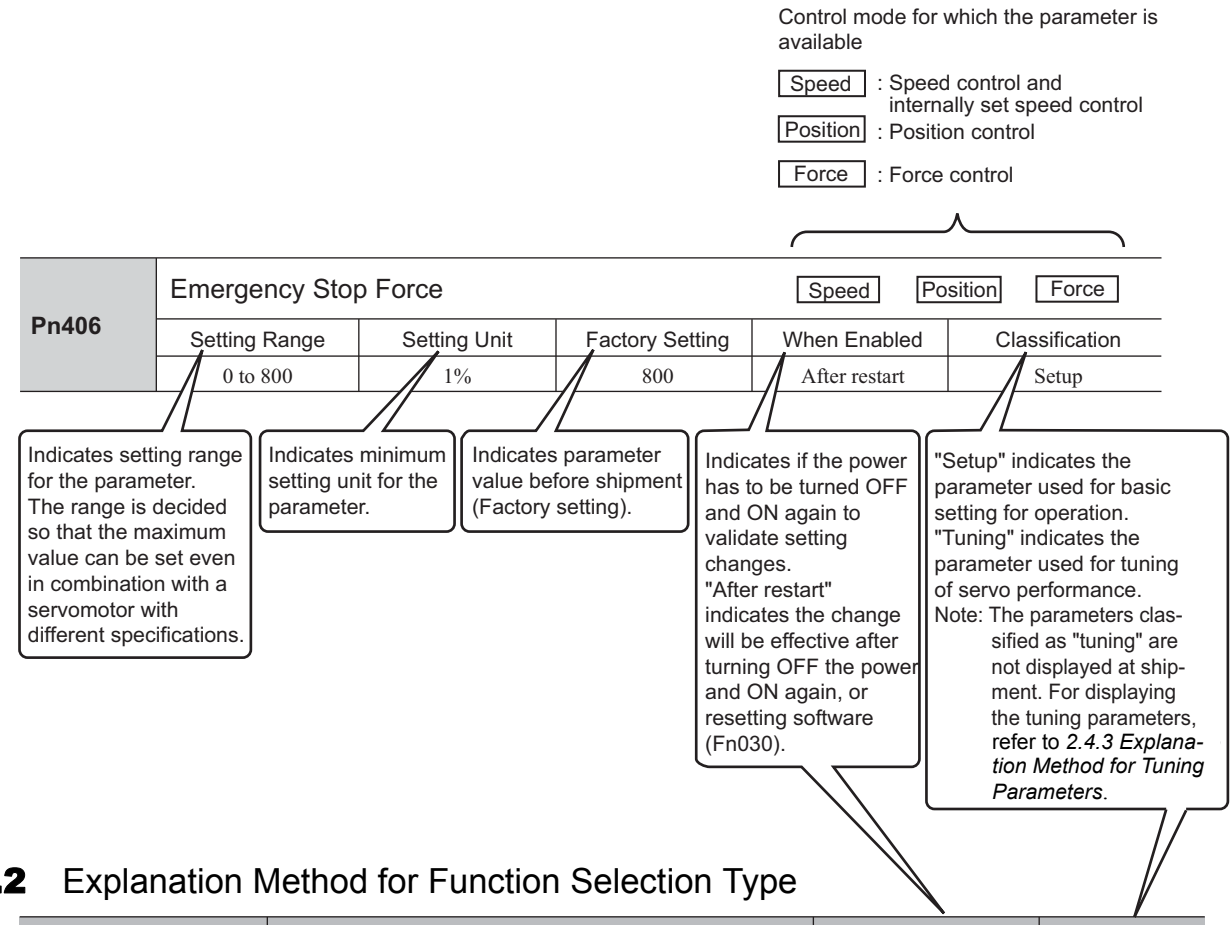
Step	Display on the Digital Operator	Keys	Description
1	BB —FUNCTION— Fn002:JOG Fn003:Z-Search Fn004:Program JOG Fn005:Prm Init	MODE/SET ∧ ∨	Open the Utility Function Mode main menu and select Fn003.
2	BB —Z-Search— Un000= 00000 Un002= 00000 Un003=00774 Un00D=00000000	DATA	Press the DATA Key. The display is switched to the execution display of Fn003. If the display is not switched and "NO-OP" is displayed in the status display, change the following settings. • If Write Prohibited is set: → Cancel the Write Prohibited setting. • If the servo is ON: → Send SV_OFF command.
3	RUN —Z-Search— Un000= 00000 Un002= 00000 Un003=00774 Un00D=00000000	JOG SVON	Press the JOG SVON Key. "RUN" is displayed in the status display, and the servomotor becomes servo ON status. Note: If the servomotor is already at the zero position, "-Complete-" is displayed.
4	RUN —Complete— Un000= 00000 Un002= 00000 Un003=00000 Un00D=00001D58	∧ ∨	When the parameter is set to Pn000.0 = 0 (default), pressing the ∧ Key will run the motor in the forward direction. Pressing the ∨ 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. Press the ∧ or ∨ Key until the motor stops. If the origin search completed normally, "-Complete-" is displayed on the right top on the screen.
5	BB —Z-Search— Un000= 00000 Un002= 00000 Un003=00774 Un00D=00001D58	JOG SVON	When the origin search is completed, press the JOG SVON Key. "BB" is displayed in the status display, and the servomotor becomes servo OFF status. The display "-Complete-" changes to "-Z-Search-."

Step	Display on the Digital Operator	Keys	Description
6	BB —FUNCTION— Fn002:JOG Fn003:Z-Search Fn004:Program JOG Fn005:Prm Init		Press the MODE/SET Key. The display returns to the Utility Function Mode main menu. This completes the operation.

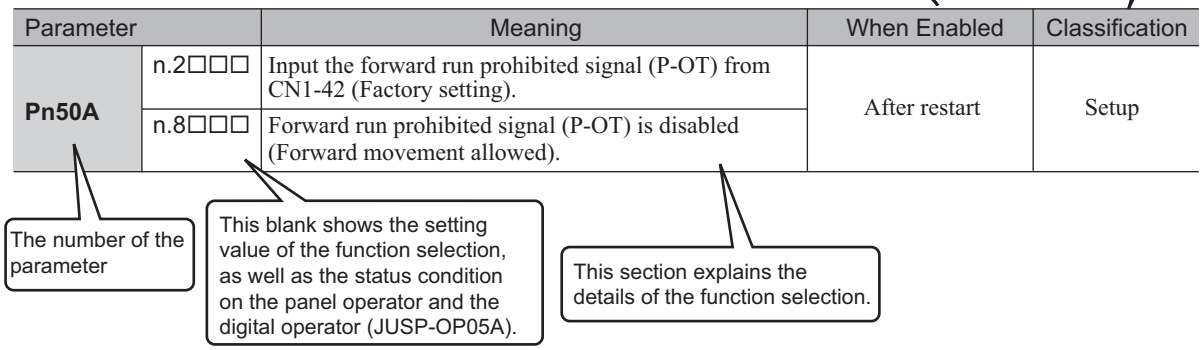
2.4 How to Read a Parameter Explanation

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

2.4.1 Explanation Method for Parameter Setting Type



2.4.2 Explanation Method for Function Selection Type



2.4.3 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.	After restart	Setup
	n.□□□1	Displays all parameters.		

2.5 Parameter Setting Mode (Pn□□□)

Parameters related to the SERVOPACK are set in this mode.

The digital operator displays numbers beginning with Pn.

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 *2.5.1*.
As for the operation method of function selection type, refer to *2.5.2*.

2.5.1 Parameter Setting Mode for Parameter Setting Type

The following example shows how to change the setting of parameter Pn304 (JOG speed) to 1000 mm/s.

Step	Display on the Digital Operator	Keys	Description
1	BB −PRM/MON− Un000= 00000 Un002= 00000 Un008= 00000 Un00D=00000000	MODE/SET	Press the MODE/SET Key to select the Parameter/Monitor Mode.
2	BB −PRM/MON− Un000= 00000 Un002= 00000 Un008= 00000 Un00D=00000000	< >	Press the < or > Key to move the cursor to "Un."
3	BB −PRM/MON− Pn000=n.0010 Un002= 00000 Un008= 00000 Un00D=00000000	∧ ∨	Press the ∧ or ∨ Key to change "Un" to "Pn."
4	BB −PRM/MON− Pn000=n.1011 Un002= 00000 Un008= 00000pulse Un00D=00000000	>	Press the > Key to move the cursor to the column on the right of "Pn."
5	BB −PRM/MON− Pn304=00500 Un002= 00000 Un008= 00000 Un00D=00000000	< > ∧ ∨	Press the arrow keys to display "Pn304". To move the cursor to different columns: <, > Key To change the settings: ∧, ∨ Key
6	BB −PRM/MON− Pn304=00500 Un002= 00000 Un008= 00000 Un00D=00000000	DATA	Press the DATA Key to move the cursor to the one's place of Pn304.
7	BB −PRM/MON− Pn304=00500 Un002= 00000 Un008= 00000 Un00D=00000000	<	Press the < Key twice to move the cursor to the hundred's place of Pn304.
8	BB −PRM/MON− Pn304=01000 Un002= 00000 Un008= 00000 Un00D=00000000	∧	Press the ∧ Key five times to change the setting to "1000."

Step	Display on the Digital Operator	Keys	Description
9	BB −PRM/MON− Pn304=01000 Un002= 00000 Un008= 00000 Un00D=00000000	DATA	Press the DATA Key to write the settings.

2.5.2 Parameter Setting Mode for Function Selection Type

The following example shows how to set the clear signal form (Pn200.1) of the position control reference form selection switch (Pn200) to 0 "clearing position error pulse if the signal is at H level."

Step	Display on the Digital Operator	Keys	Description
1	BB −PRM/MON− Un000= 00000 Un002= 00000 Un008= 00000 Un00D=00000000	MODE/SET	Press the MODE/SET Key to select the Parameter/Monitor Mode.
2	BB −PRM/MON− Un000= 00000 Un002= 00000 Un008= 00000 Un00D=00000000	< >	Press the < or > Key to move the cursor to "Un."
3	BB −PRM/MON− Pn000=n.0000 Un002= 00000 Un008= 00000 Un00D=00000000	∧ ∨	Press the ∧ or ∨ Key to change "Un" to "Pn."
4	BB −PRM/MON− Pn000=n.0000 Un002= 00000 Un008= 00000 Un00D=00000000	>	Press the > Key to move the cursor to the column on the right of "Pn."
5	BB −PRM/MON− Pn200=n.0000 Un002= 00000 Un008= 00000 Un00D=00000000	∧	Press the ∧ Key twice to display "Pn200."
6	BB −PRM/MON− Pn200=n.0000 Un002= 00000 Un008= 00000 Un00D=00000000	DATA	Press the DATA Key to move the cursor to "Pn200.0."
7	BB −PRM/MON− Pn200=n.0000 Un002= 00000 Un008= 00000 Un00D=00000000	<	Press the < Key to move the cursor to "Pn200.1."
8	BB −PRM/MON− Pn200=n.0010 Un002= 00000 Un008= 00000 Un00D=00000000	∧	Press the ∧ Key to change the setting of "Pn200.1" to "1."
9	A.941 −PRM/MON− Pn200=n.0010 Un002= 00000 Un008= 00000 Un00D=00000000	DATA	Press the DATA Key to write the settings. If the setting of Pn200 is changed, the new setting must be validated. If not, the warning "A.941" will be displayed.
10	The new setting must be validated. After the setting has been validated, the status display showing the "A.941" warning will change to "BB."		

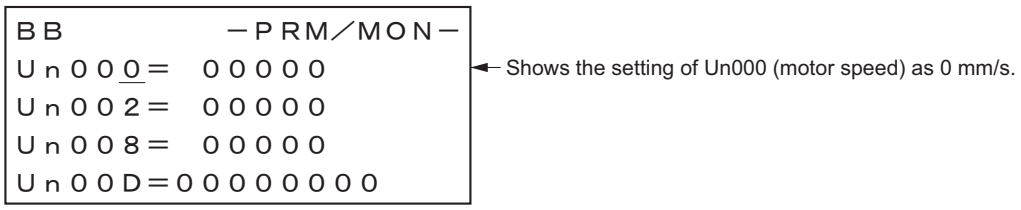
2.6 Monitor Mode (Un□□□)

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

For details, refer to *7.2 Monitor Mode Display*

The digital operator display numbers beginning with Un.

The following four settings are the factory settings.



3

Wiring and Connection

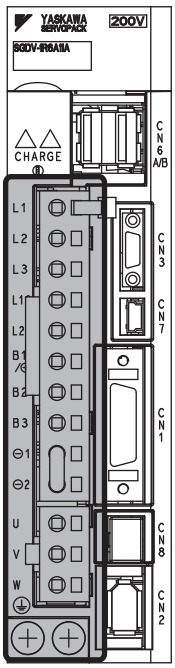
3.1 Main Circuit Wiring

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.
DC reactor connection terminal for power supply harmonic suppression	⊖ 1, ⊖ 2	□□□F □□□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	□□□A □□□D	
Servomotor connection terminals	U, V, W	Use for connecting to the servomotor.	
Ground terminals (× 2)	⏚	Use for connecting the power supply ground terminal and servomotor ground terminal.	

3.1.2 SERVOPACK Main Circuit Wire Size

This section describes the SERVOPACK Main Circuit Wire Size.

IMPORTANT

1. Wire sizes are selected for three cables per bundle at 40°C ambient temperature with the rated current.
2. Use a 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 Heat-resistant Vinyl Cable (HIV)

AWG Size	Nominal Cross Section Diameter (mm^2)	Configuration (Number of Wires/mm^2)	Conductive Resistance (Ω/km)	Allowable Current at 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

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

(2) Single-phase, 100 V

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

(3) Three-phase, 200 V

External Terminal Name	Terminal Symbols	SERVOPACK Model SGDV-									
		R70	R90	1R6	2R8	3R8	5R5	7R6	120	180	200	330
Main circuit power input terminals	L1, L2, L3	HIV1.25			HIV2.0					HIV3.5		HIV 5.5
Control power input terminals	L1C, L2C	HIV1.25										
Servomotor connection terminals	U, V, W	HIV1.25				HIV2.0				HIV 3.5	HIV 5.5	HIV 8.0
External regenerative resistor connection terminals	B1/⊕, B2	HIV1.25								HIV 2.0	HIV 3.5	HIV 5.5
Ground terminal	⏚	HIV2.0 or higher										

(4) Three-phase, 400 V

External Terminal Name	Terminal Symbols	SERVOPACK Model SGDV-					
		1R9	3R5	5R4	8R4	120	170
Main circuit power input terminals	L1, L2, L3	HIV1.25			HIV2.0		HIV3.5
Control power input terminals	24V, 0V	HIV1.25					
Servomotor connection terminals	U, V, W	HIV1.25			HIV2.0		HIV3.5
External regenerative resistor connection terminals	B1/⊕, B2 (B1, B2)	HIV1.25					HIV2.0
Ground terminal	⏚	HIV2.0 or higher					

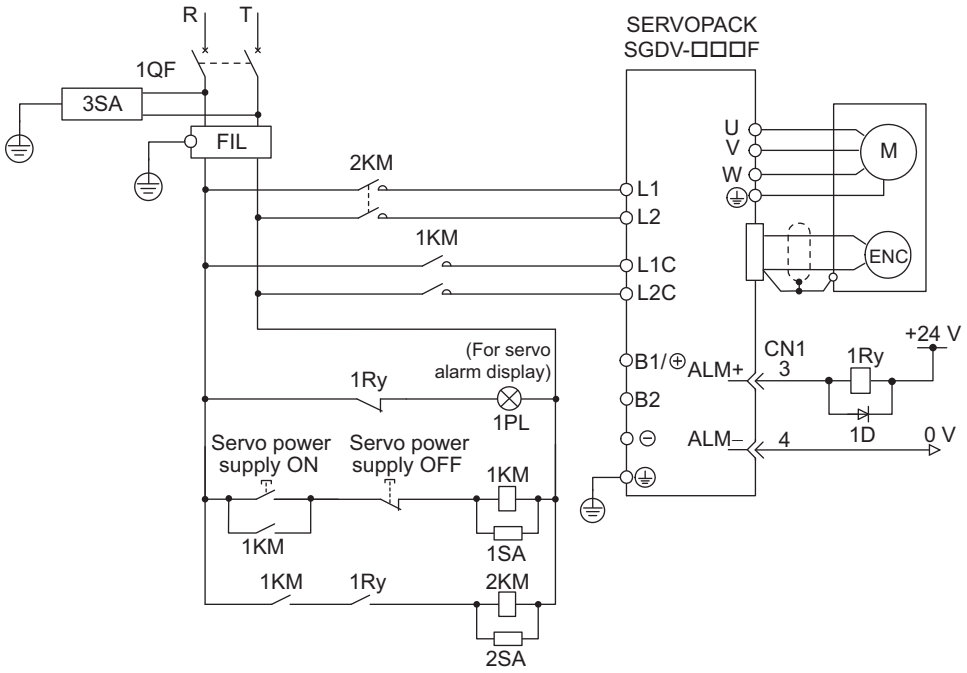
3.1.3 Typical Main Circuit Wiring Examples

This section describes the typical main circuit wiring examples.

⚠ WARNING

- Do not touch the power terminals 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.

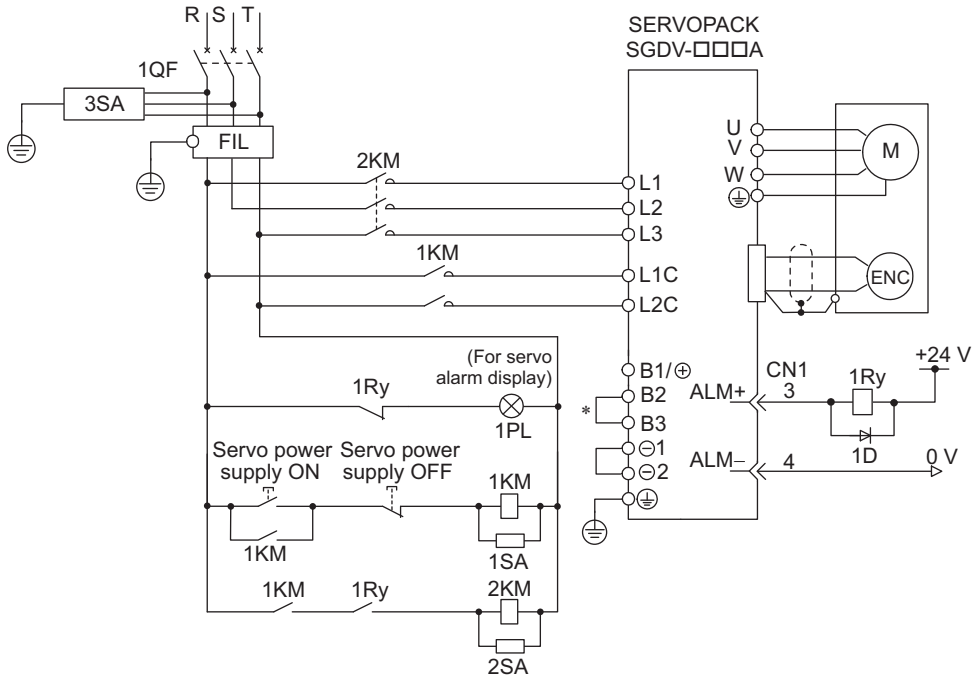
■ Single-phase 100 V, SGDV-□□□F



1QF: Molded-case circuit breaker
FIL: 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

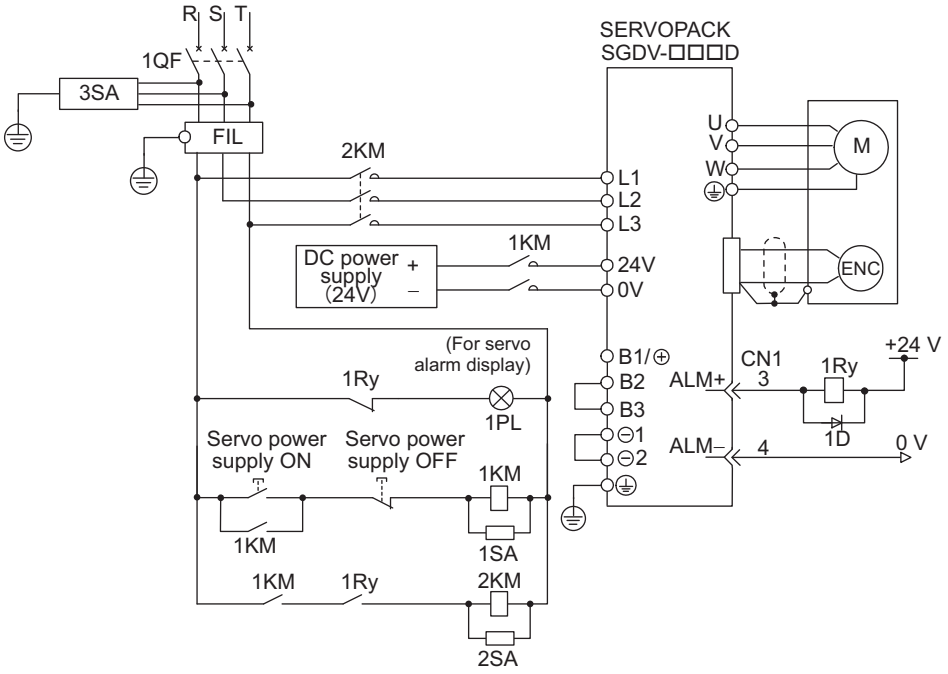


1QF: Molded-case circuit breaker
FIL: Noise filter
1KM: Magnetic contactor (for control power supply)
2KM: Magnetic contactor (for main power supply)
1Ry: Relay

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

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

■ Three-phase 400 V, SGDV-□□□D



1QF: Molded-case circuit breaker
FIL: 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 an earth leakage breaker.

- 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. Do not turn power ON or OFF more than once per minute.

- 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* (KAEPS80000042). Design and arrange the system so that each cable will be as short as possible.

Observe the following precautions when wiring the main circuit.

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

Observe the following precautions when wiring the ground.

- Use a cable as thick as possible (at least 2.0 mm^2)
- Grounding to a resistance of 100Ω or less is recommended. For 400 VAC SERVOPACKs, a grounding resistance of 10Ω 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.

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

■ Three-phase, 200 V

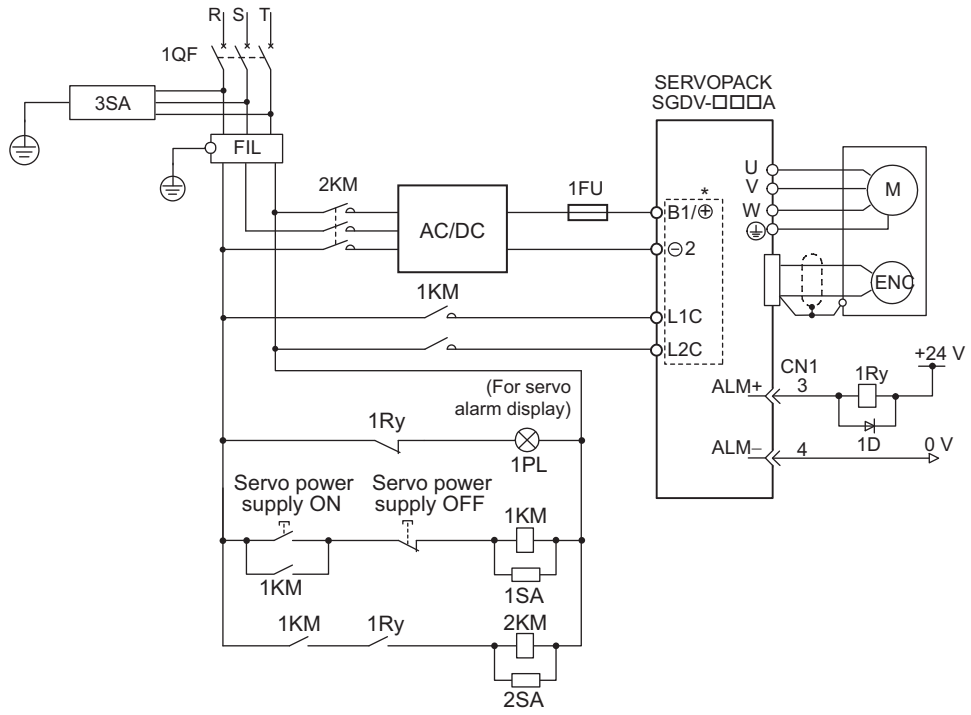
SERVOPACK model SGDV	Terminal Name and Description		
	Main circuit plus terminal	Main circuit minus terminal	Control power supply input terminal
	270 to 320 VDC	0 VDC	200 to 230 VAC
SGDV-□□□A	B1/ ⊕	⊖ 2	L1C, L2C

■ 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	24VDC (± 15%)
-1R9D, -3R5D, -5R4D, -8R4D,-120D	B1/ ⊕	⊖ 2	24 V, 0 V
-170D	⊕	⊖ 2	24 V, 0 V

(2) Wiring Example with DC Power Supply Input

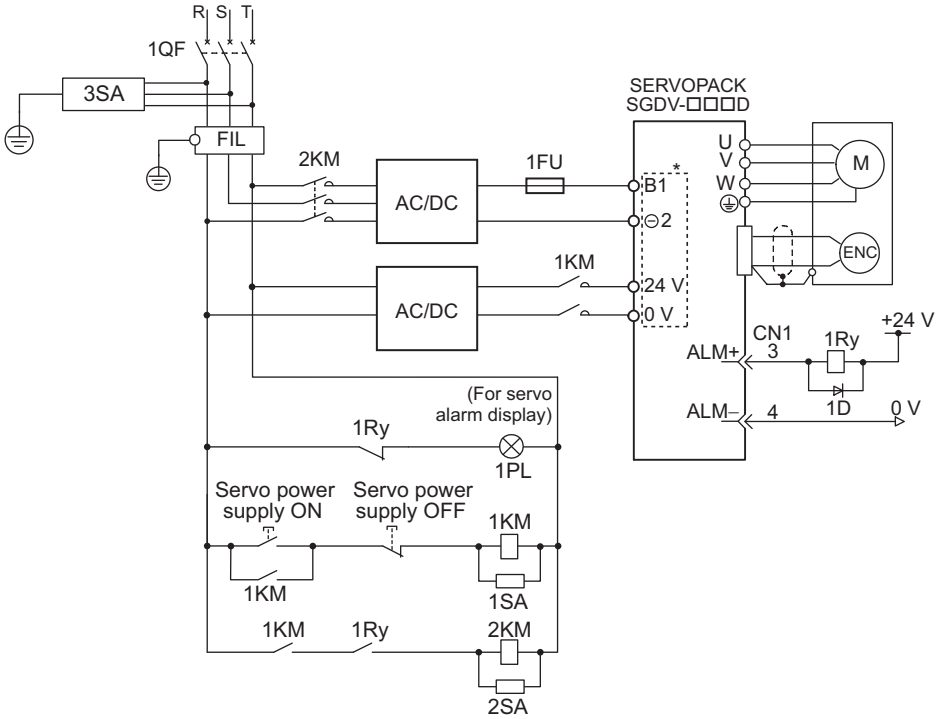
■ 200 V SERVOPACK SGDV-□□□A



1QF: Molded-case circuit breaker
FIL: 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
FIL: 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.

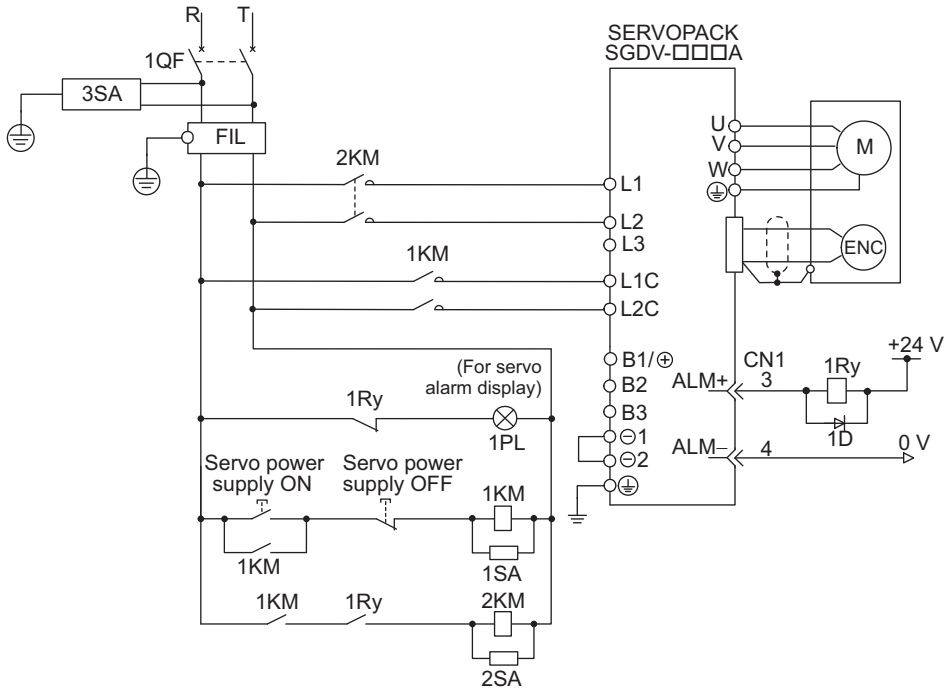
The specifications of the power supplies other than the main circuit power supply are the same as for three-phase power supply input.

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%, -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



(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 or molded-case circuit breaker to the input side. Select the fuse or molded-case circuit breaker 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 of the table for 5 s.
- Inrush current: No breaking at the same current values of the table for 20 ms.

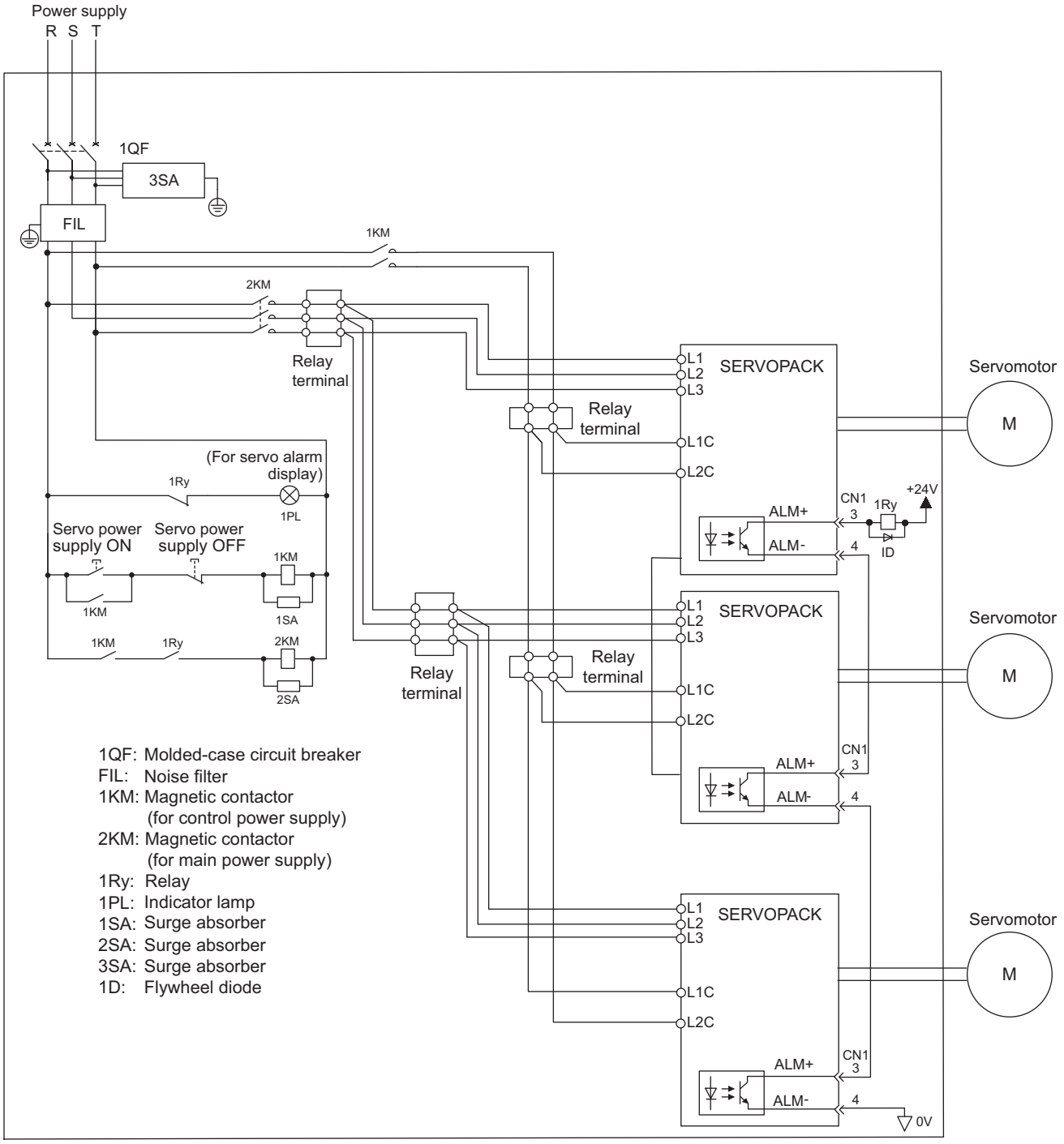
3.1.7 Precautions When Using More Than One SERVOPACK

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.



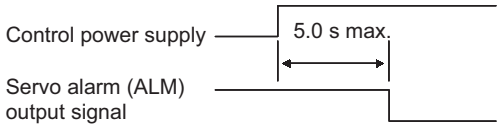
(2) Precautions

Multiple servos can share a single molded-cable 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.

- 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, turn them OFF at the same time or first turn OFF the power for the main circuit.

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

Signal	Pin No.	Name	Function	Reference Section
/DEC	9	Homing deceleration limit switch	Connects the deceleration limit switch for homing.	–
P-OT N-OT	7 8	Forward run prohibited, Reverse run prohibited	Overtravel prohibited: Stops servomotor when movable part travels beyond the allowable range of motion.	4.3.2
/EXT 1 /EXT 2 /EXT 3	10 11 12	External latch signal 1 External latch signal 2 External latch signal 3	Connects the external signals that latch the current feedback pulse counter.	–
+24VIN	6	Control power supply for sequence signal	Control power supply input for sequence signals: The 24 VDC power supply is not included. Allowable voltage fluctuation range: 11 to 25 V	3.4.2
BAT (+) BAT (-)	21 22	Battery (+) input signal Battery (–) input signal	Connecting pin for the absolute encoder backup battery.	–
/SI0	13	General-purpose input signal	General-purpose input signal: Monitored in the I/O monitor field of MECHATROLINK-II.	–

Note 1. The functions allocated to /DEC, P-OT, N-OT, /EXT1, /EXT2, and /EXT3 input signals can be changed by using the parameters. Refer to *3.3.1 Input Signal Allocation*.

2. If the Forward run prohibited/ Reverse run prohibited function is used, the software can be used to stop the SERVOPACK. If the application does not satisfy the safety requirements, add an external circuit for safety reasons as required.

(2) Output Signals

Signal	Pin No.	Name	Function	Reference Section
ALM+ ALM-	3 4	Servo alarm output signal	Turns OFF when an error is detected.	–
/BK+ (/SO1+) /BK- (/SO1-)	1 2	Brake signal	Controls the brake. The brake is released when the signal turns ON. Allocation can be changed to general-purpose output signals (/SO1+, /SO1-).	4.3.3
/SO2+ /SO2- /SO3+ /SO3-	23 24 25 26	General-purpose output signal	General-purpose output signal Note: Set the parameter to allocate a function.	
FG	16	Signal ground	Connected to frame ground if the shield wire of the I/O signal cable is connected to the connector shell.	–

Note: For more information on the allocation of /SO1, /SO2, and /SO3, refer to *3.3.2 Output Signal Allocation.*

3.2.2 I/O Signal Connector (CN1) Terminal Layout

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

1	/BK+ (/SO1+)	Brake output	2	/BK- (/SO1-)	Brake output	14	BAT(+)	Battery (+) input	15	BAT(-)	Battery (-) input
3	ALM+	Servo alarm output	4	ALM-	Servo alarm output	16	SG	Signal ground	17	PAO	PG dividing pulse (Phase-A) output
5			6	+24VIN	Control power supply for sequence signal input	18	/PAO	PG dividing pulse (Phase-A) output	19	PBO	PG dividing pulse (Phase-B) output
7	P-OT (/SI1)	Forward run prohibited input	8	N-OT (/SI2)	Reverse run prohibited input	20	/PBO	PG dividing pulse (Phase-B) output	21	PCO	PG dividing pulse (Phase-C) output
9	/DEC (/SI3)	Zero-point return deceleration switch input	10	/EXT1 (/SI4)	External latch signal 1 input	22	/PCO	PG dividing pulse (Phase-C) output	23	/SO2+	General-purpose input
11	/EXT2 (/SI5)	External latch signal 2 input	12	/EXT3 (/SI6)	External latch signal 3 input	24	/SO2-	General-purpose input	25	/SO3+	General-purpose input
13	/SI0	General-purpose input				26	/SO3-	General-purpose input			

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 signals can be changed by using the parameters.
Input signals: /DEC, P-OT, N-OT, /EXT1, /EXT2, /EXT3
4. The output signals /SO1, /SO2, and /SO3 can be used as the output signal /COIN, /V-CMP, /TGON, /S-RDY, /CLT, /VLT, /BK, /WARN, or /NEAR by setting the parameter Pn50E, Pn50F, or Pn510. For details, refer to *3.3.2 Output Signal Allocation*.

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

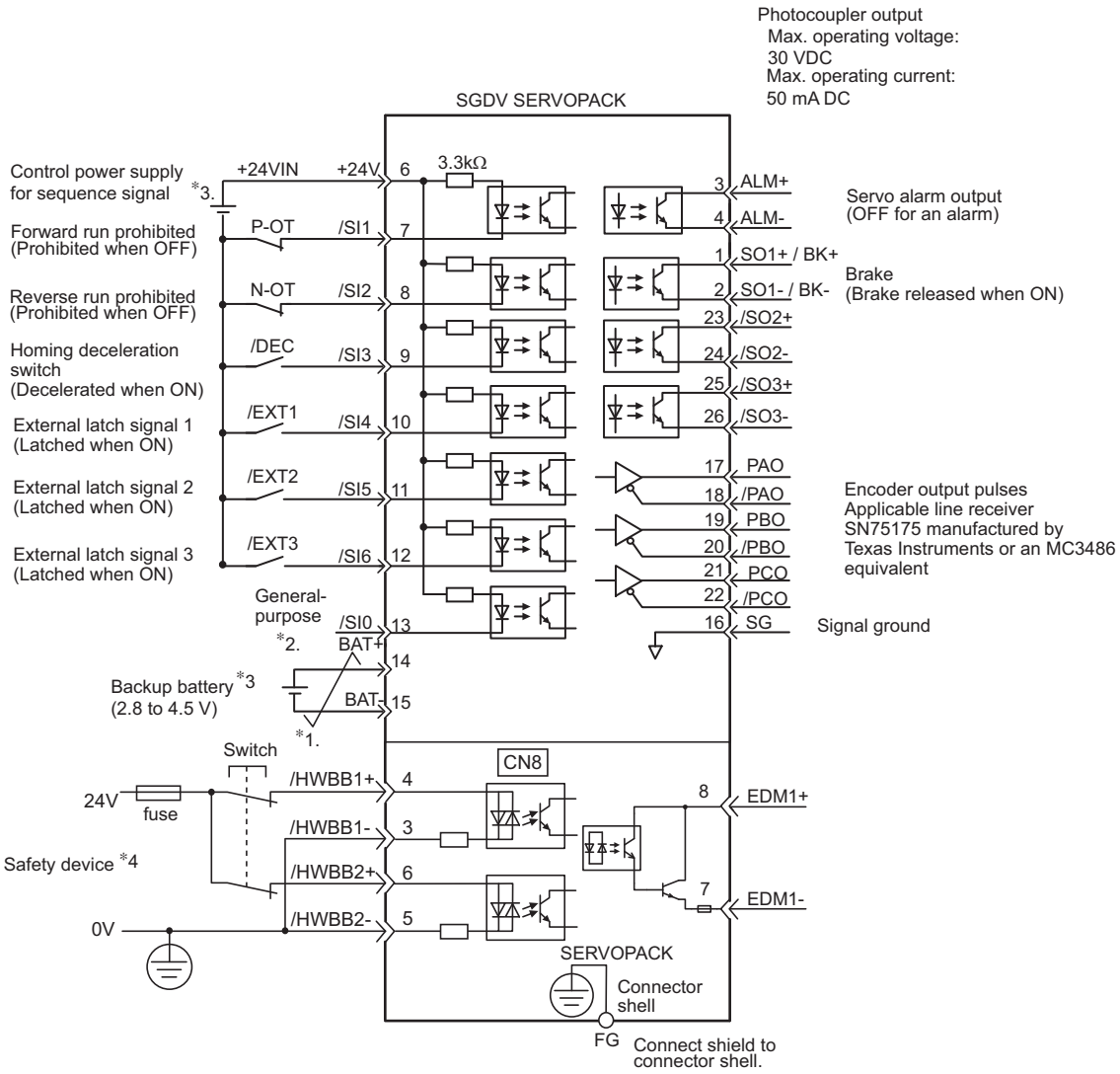
The following table shows the terminal layout of safety function signals (CN8).

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

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

3.2.5 Example of I/O Signal Connections

The following diagram shows a typical connection example.



∗1. represents twisted-pair wires.

∗2. Connect when using an absolute encoder. When the encoder cable for the battery case is connected, do not connect a backup battery.

∗3. The 24 VDC power supply is not included. Use a power supply with a double-shielded enclosure.

∗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 /DEC, P-OT, N-OT, /EXT1, /EXT2, and /EXT3 and the output signals /SO1, /SO2, and /SO3 can be changed by using the parameters. Refer to *3.3.1 Input Signal Allocation* and *3.3.2 Output Signal Allocation*.

3.3 I/O Signal Allocation

This section describes the I/O signal allocation.

3.3.1 Input Signal Allocation

Input signals are allocated as shown in the following table.

□ means factory setting.

Signal Name	Validity Level	Input Signal	CN1 Pin Numbers							Connection Not required (SERVOPACK judges the connection)	
Parameter Setting Allocation			13 (SI0)	7 (SI1)	8 (SI2)	9 (SI3)	10 (SI4)	11 (SI5)	12 (SI6)	Always ON	Always OFF
Forward Run Prohibited **Pn50A.3 setting**	H	P-OT	0	**1**	2	3	4	5	6	7	8
	L	/P-OT	9	A	B	C	D	E	F		
Reverse Run Prohibited **Pn50B.0 setting**	H	N-OT	0	1	**2**	3	4	5	6	7	8
	L	/N-OT	0	A	B	C	D	E	F		
Forward External Force Limit **Pn50B.2 setting**	L	/P-CL	0	1	2	3	4	5	6	7	**8**
	H	P-CL	9	A	B	C	D	E	F		
Reserve External Force Limit **Pn50B.3 setting**	L	/N-CL	0	1	2	3	4	5	6	7	**8**
	H	N-CL	9	A	B	C	D	E	F		
Homing Deceleration LS **Pn511.0 setting**	L	/DEC	0	1	2	**3**	4	5	6	7	8
	H	DEC	9	A	B	C	D	E	F		
External Latch Signal 1 **Pn511.1 setting**	L	EXT1	*	*	*	*	**4**	5	6	7	8
	H	/EXT1	*	*	*	*	D	E	F		
External Latch Signal 2 **Pn511.2 setting**	L	EXT2	*	*	*	*	4	**5**	6	7	8
	H	/EXT2	*	*	*	*	D	E	F		
External Latch Signal 3 **Pn511.3 setting**	L	EXT3	*	*	*	*	4	5	**6**	7	8
	H	/EXT3	*	*	*	*	D	E	F		

* Always set to "Invalid."

IMPORTANT

1. When using 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.

3.3.2 Output Signal Allocation

Output signals are allocated as shown in the following table.

□ means factory setting.

CN1 Pin No.		1/(2)		23/(24)		25/(26)		Remark
Parameter Setting Allocation		Signal Output Polarity Setting						
		Pn512.0 setting		Pn512.1 setting		Pn512.2 setting		
		0	1 (Reverse)	0	1 (Reverse)	0	1 (Reverse)	
Positioning Completion (/COIN) **Pn50E.0 setting**	0	Invalid						L: Output signal is L level when the parameter is valid. H: Output signal is H level when the parameter is valid. Invalid: Not use the output signal.
	1	□ L	H					
	2			L	H			
	3					L	H	
Speed Coincidence Detection (/V-CMP) **Pn50E.1 setting**	0	Invalid						
	1	□ L	H					
	2			L	H			
	3					L	H	
Movement Detection (/TGON) **Pn50E.2 setting**	0	Invalid						
	1	L	H					
	2			□ L	H			
	3					L	H	
Servo Ready (/S-RDY) **Pn50E.3 setting**	0	Invalid						
	1	L	H					
	2			L	H			
	3					□ L	H	
Force Limit Detection (/CLT) **Pn50F.0 setting**	0	□ Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Speed Limit Detection (/VLT) **Pn50F.1 setting**	0	□ Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Brake (/BK) **Pn50F.2 setting**	0	□ Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Warning (/WARN) **Pn50F.3 setting**	0	□ Invalid						
	1	L	H					
	2			L	H			
	3					L	H	
Near (/NEAR) **Pn510.0 setting**	0	□ Invalid						
	1	L	H					
	2			L	H			
	3					L	H	

IMPORTANT

- The signals not detected are considered as "Invalid."
- When two or more signals are allocated to the same output circuit, a signal is output with OR logic circuit.

3.4 Examples of Connection to Host Controller

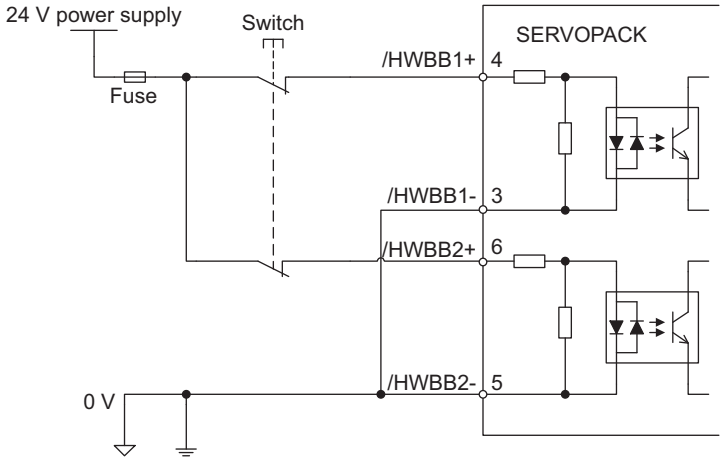
This section shows examples of SERVOPACK I/O signal connection to the host controller.

3.4.1 Connection Examples of Input Circuits to SERVOPACK

(1) 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.

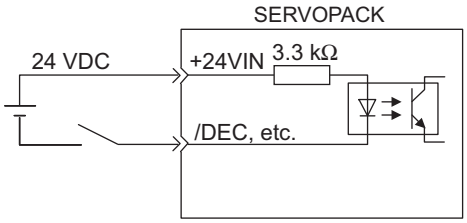
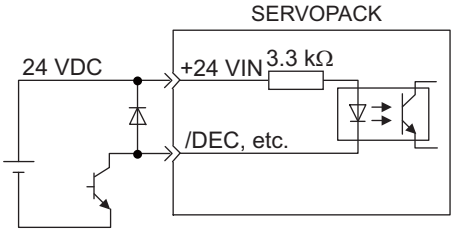
Input Signal Connection Example



3.4.2 Connection Examples of Sequence Input Circuits to SERVOPACK

CN1 connector terminals 6 to 13 are explained below.

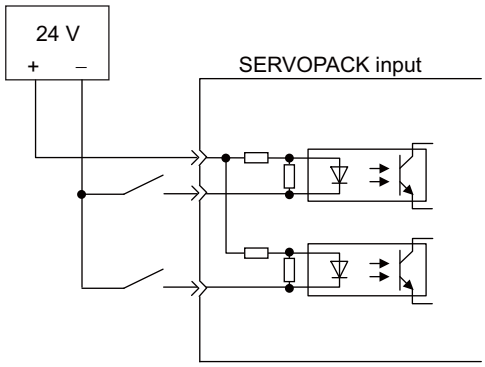
The sequence input circuit interface connects through a relay or open-collector transistor circuit. Select a low-current relay otherwise a faulty contact will result.

Relay Circuit Example	Open-collector Circuit Example
	

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

Use the sink circuit for the input circuit to the SERVOPACK.

Sink Circuit



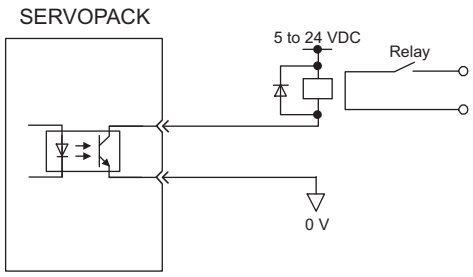
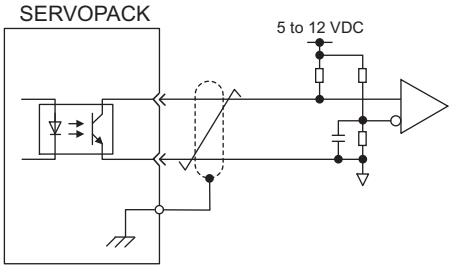
Input Signal Polarities			
Signal	Level	Voltage Level	Contact
ON	Low (L) level	0 V	Close
OFF	High (H) level	24 V	Open

3.4.3 Connection Examples of Output Circuits to SERVOPACK

The following diagrams show examples of how output circuits can be connected the SERVOPACK.

(1) 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
	

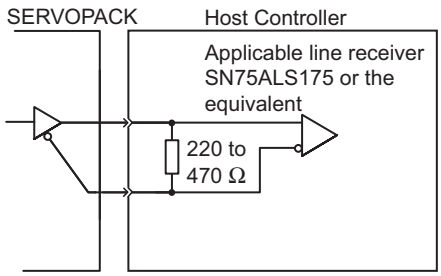
Note: The maximum allowable voltage and current capacities for photocoupler output circuits are as follows.
- Voltage: 30 VDC
- Current: 5 to 50 mA DC

(2) Line Driver Output Circuit

CN1 connector terminals, 17-18 (phase-A signal), 19-20 (phase-B signal), and 21-22 (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



(3) 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

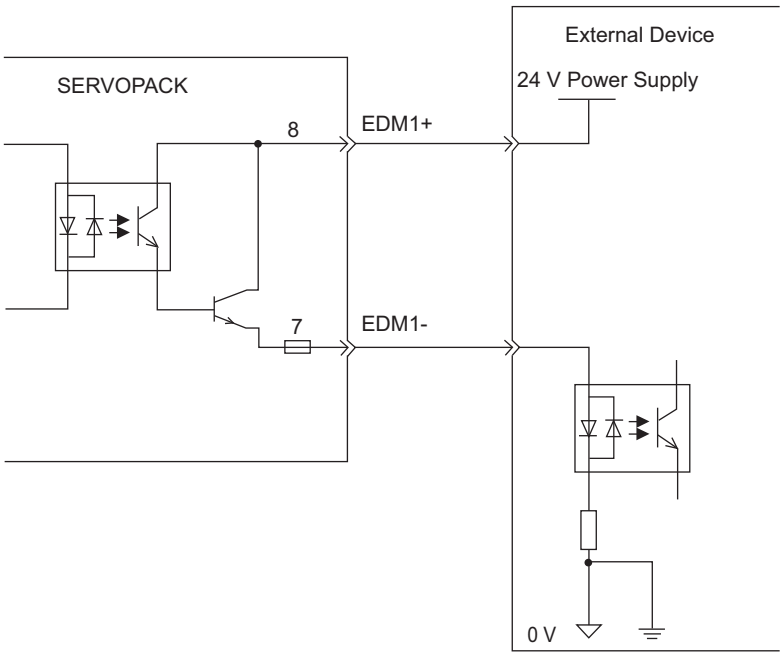
The EDM1 signal is not a safety output. Use it only for monitoring a failure.

(4) 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

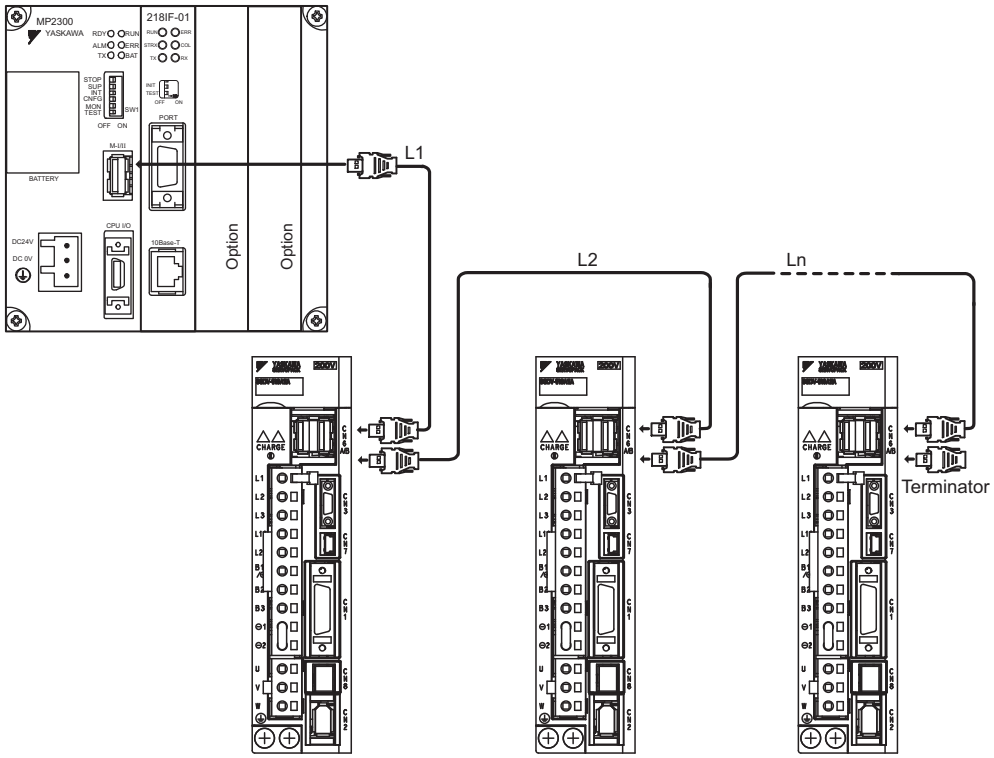
Type	Signal Name	Pin No.	Input Status	Meaning
Output	EDM1	CN8-8 CN8-7	ON	Both baseblocks by /HWBB1 signal and /HWBB2 signal normally activate.
			OFF	–

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 Wiring MECHATROLINK-II Communications

The following diagram shows an example of connections between a host controller and a SERVOPACK using MECHATROLINK-II communications cables (CN6A, CN6B).



Note 1. The length of the cable between stations (L1, L2 ... Ln) must be 0.5 m or more.
2. The total cable length must be L1 + L2 ... + Ln ≤ 50.
3. When multiple SERVOPACKs are connected by MECHATROLINK-II communications cable, a terminator must be installed at the final SERVOPACK.

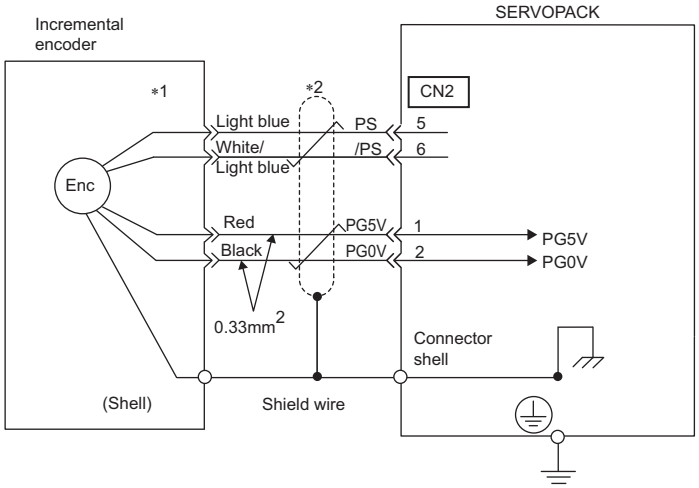
3.6 Examples of Encoder Connection

This section describes the connection example between encoder and SERVOPACK.
CN2 encoder connector terminal layout is also described.

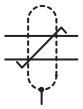
3.6.1 Connection Example of an Encoder

The following diagram shows the example of connecting encoder.

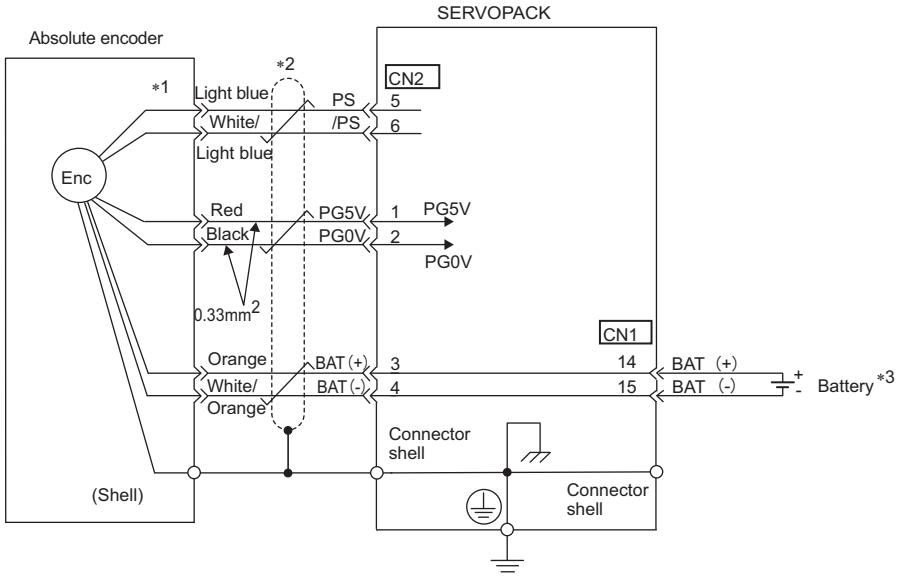
(1) Incremental Encoder



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

*2.  : represents twisted-pair wires.

(2) Absolute Encoders



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

*2.  : represents twisted-pair wires.

*3. When using an absolute encoder, install a battery in a battery case (JZSP-BA01) of encoder cable, or install a battery on the host controller side to supply power.

3.6.2 CN2 Encoder Connector Terminal Layout

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

3.7 Connecting Regenerative Resistors

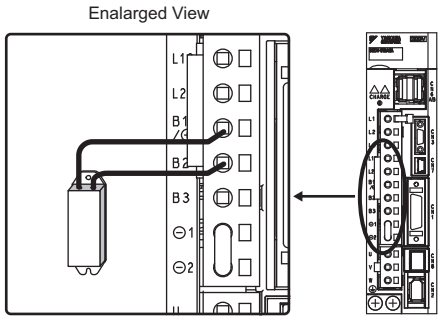
This section describes how to connect the regenerative resistor and set the regenerative resistor capacity. As for precautions on selecting a regenerative resistor and its specifications, refer to *Σ-V series Product Catalog* (KAEPS80000042).

3.7.1 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

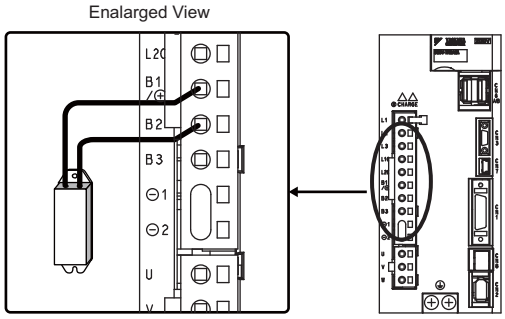
Connect an external regenerative resistor between B1/⊕ and B2 terminals.



(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.

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



⚠ WARNING

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

3.7.2 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.

3.8 Noise Control and Measures for Harmonic Suppression

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

3.8.1 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.

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.

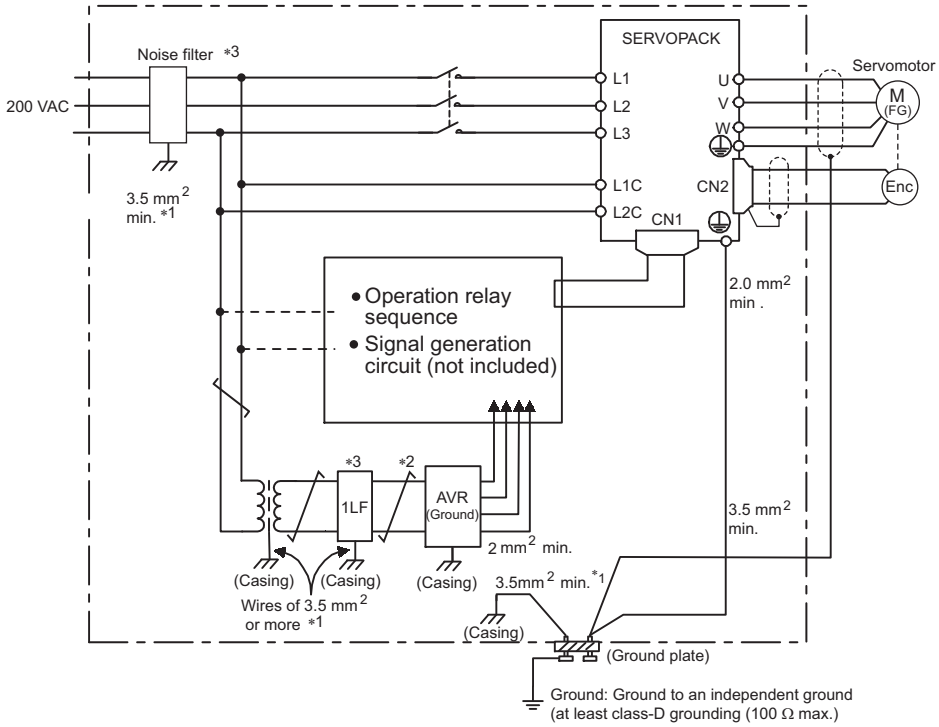
To prevent malfunction due to noise, take the following actions:

- 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. ⩘ should be twisted-pair wires.

∗3. When using a noise filter, follow the precautions in *3.8.2 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 ⏚.

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.

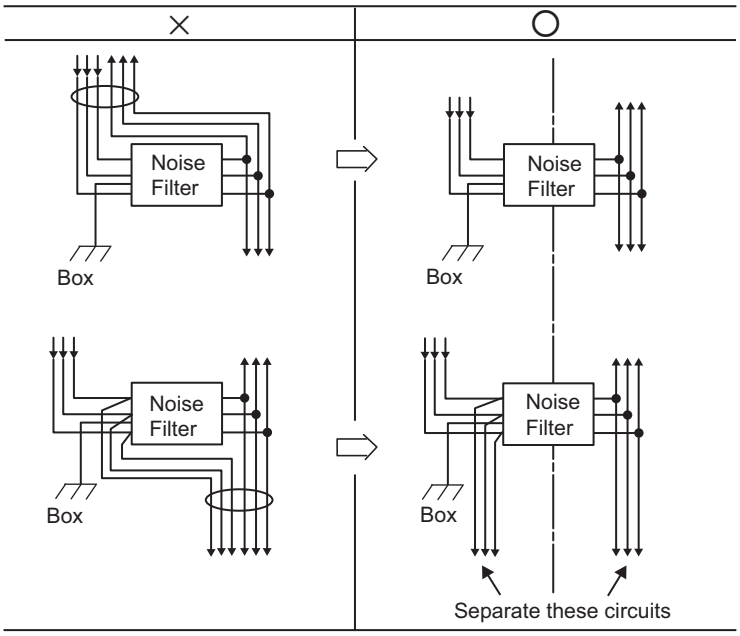
3.8.2 Precautions on Connecting Noise Filter

This section describes the precautions on installing a noise filter.

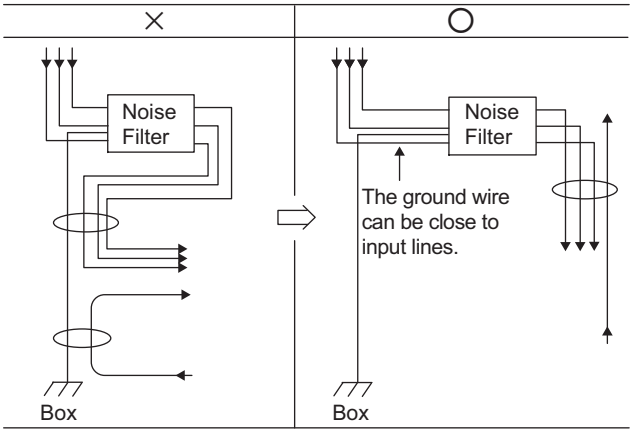
(1) Precautions on Using Noise Filters

Always observe the following installation and wiring instructions.

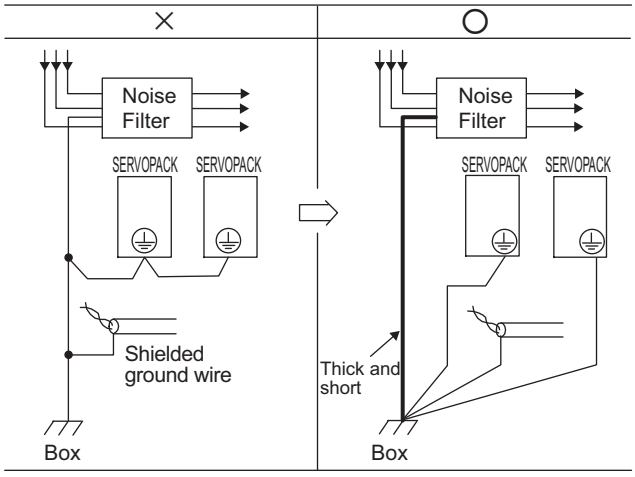
Do not put the input and output lines in the same duct or bundle them together.



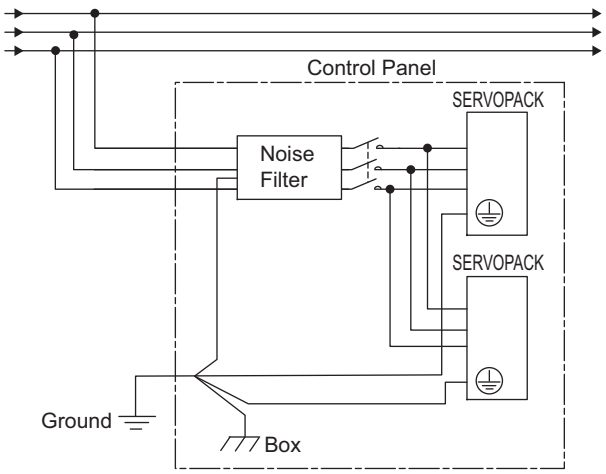
Separate the noise filter ground wire from the output lines.
Do not accommodate the noise filter ground wire, output lines and other signal lines in the same duct or bundle them together.



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



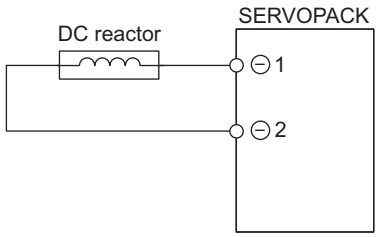
If a noise filter is located inside a control panel, connect the noise filter ground wire and the ground wires from other devices inside the control panel to the ground plate for the control panel first, then ground these wires.



3.8.3 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* (KAEPS80000042).
Connect a reactor as shown in the following diagram.

DC Reactor
Three-phase input



4

Operation

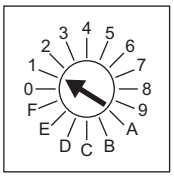
4.1 MECHATROLINK-II Communications Settings

This section describes the switch settings necessary for MECHATROLINK-II communications.

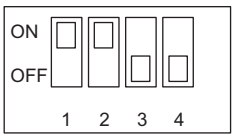
4.1.1 Setting Switches SW1 and SW2

The SW2 DIP switch is used to make the settings for MECHATROLINK-II communications.

The station address is set using the rotary switch (SW1) and bit 3 on the DIP switch (SW2).



SW1 (factory setting)



SW2 (factory settings)

(1) Settings for the SW2 DIP Switch

The following table shows the settings of the DIP switch (SW2).

SW2	Function	Setting	Description	Factory setting
Pin 1	Sets the baud rate.	OFF	4 Mbps (MECHATROLINK-I)	ON
		ON	10 Mbps (MECHATROLINK-II)	
Pin 2	Sets the number of transmission bytes.	OFF	17 bytes	ON
		ON	32 bytes	
Pin 3	Sets the station address.	OFF	Station address = 40H + SW1	OFF
		ON	Station address = 50H + SW1	
Pin 4	Reserved. (Do not change.)	OFF	–	OFF

IMPORTANT

- When connecting to a MECHATROLINK-I network, turn OFF pins 1 and 2.
- The following combination cannot be used:
  Baud rate: 4 Mbps; Transmission bytes: 32 (pin 1: OFF, pin 2: ON)

(2) Setting the Station Address

The following table lists the possible settings of the rotary switch (SW1) and bit3 of the DIP switch (SW2) that can be combined to form a station address.

The factory setting for the station address is 41H (SW2 bit 3 = OFF, SW1 = 1).

Station Address	Bit 3 of SW2	SW1	Station Address	Bit 3 of SW2	SW1
Disabled	OFF	0	50H	ON	0
41H	OFF	1	51H	ON	1
42H	OFF	2	52H	ON	2
43H	OFF	3	53H	ON	3
44H	OFF	4	54H	ON	4
45H	OFF	5	55H	ON	5
46H	OFF	6	56H	ON	6
47H	OFF	7	57H	ON	7
48H	OFF	8	58H	ON	8
49H	OFF	9	59H	ON	9
4AH	OFF	A	5AH	ON	A
4BH	OFF	B	5BH	ON	B
4CH	OFF	C	5CH	ON	C
4DH	OFF	D	5DH	ON	D
4EH	OFF	E	5EH	ON	E
4FH	OFF	F	5FH	ON	F

IMPORTANT

- Turn the power OFF and then ON again to validate the new settings.

4.2 MECHATROLINK-II Commands

For information on the MECHATROLINK-II commands, refer to *Σ-V series User's Manual MECHATROLINK-II Command* (manual number: SIEP S800000 54).

4.3 Setting Common Basic Functions

This section explains the settings for the common basic functions.

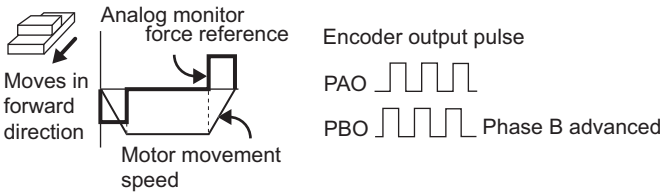
4.3.1 Servomotor Movement Direction

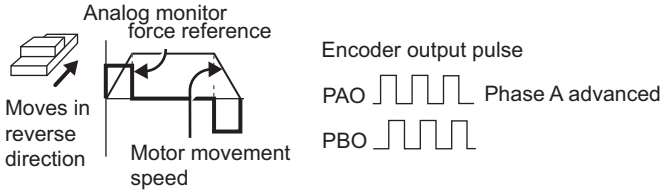
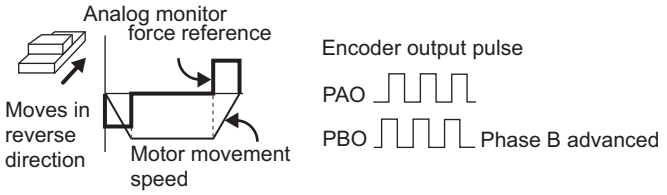
The servomotor movement direction can be reversed with parameter Pn000.

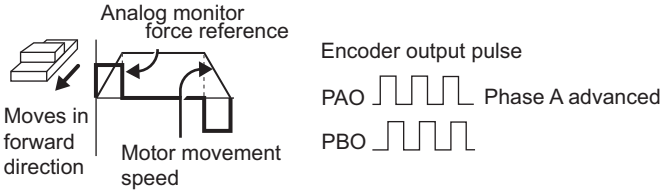
This causes the travel direction (+, -) of the shaft reverse, but the encoder pulse output and analog monitor signal polarity do not change.

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>

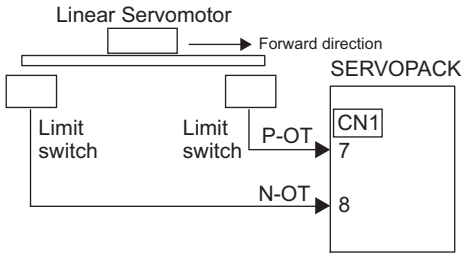
Note 1. The count of linear scale can be checked with Feedback Pulse Counter (Un00D).
2. According to the change of motor movement direction, the direction of overtravel forward/reverse is also switched.
For Pn000 = n.□□□0: The linear scale counting up direction is forward movement (P-OT).
For Pn000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

4.3.2 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 munute current applied to prevent the oxidization of the contacts.



(1) Signal Setting

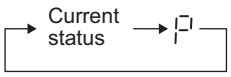
Type	Name	Connector Pin Number	Setting	Meaning
Input	P-OT	CN1-7	ON	Forward run allowed. Normal operation status.
			OFF	Forward run prohibited. Forward overtravel.
	N-OT	CN1-8	ON	Reverse run allowed. Normal operation status.
			OFF	Reverse run prohibited. Reverse overtravel.

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

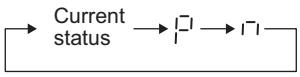
(2) Display when Overtravel Occurs

If overtravelling occurs, the panel display on the front of the SERVOPACK will change in the following order.

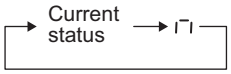
① Overtravel at forward direction (P-OT)



③ Overtravel at forward/reverse direction



② Overtravel at reverse direction (N-OT)



(3) 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 CN1-7. (Factory setting)	After restart	Setup
	n.8□□□	Disables the Forward Run Prohibited (P-OT) signal. (Allows constant forward direction.)		
Pn50B	n.□□□3	Inputs the Reverse Run Prohibited (N-OT) signal from CN1-8. (Factory setting)		
	n.□□□8	Disables the Reverse Run Prohibited (N-OT) signal. (Allows constant reverse direction.)		

- 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 Allocation*.

(4) 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 *4.3.3 Stopping Method for Servomotor after Servo OFF or Alarm Occurrence*.

(5) Emergency Stop Force for Overtravel

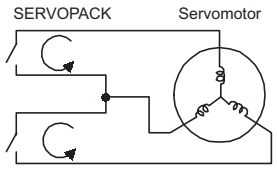
Pn406	Emergency Stop Force		Speed Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup

- 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.

(6) 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.

4.3.3 Stopping Method for Servomotor after Servo OFF or Alarm Occurrence

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

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

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

Parameter		Stop Mode	Mode After Stopping	Meaning	When Enabled	Classification
Pn001	n.□□□0	Stop by dynamic brake	Dynamic Brake	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.

(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 *8.1.1 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.

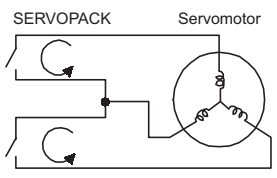
IMPORTANT

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

<Terms>

Dynamic brake (DB)

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

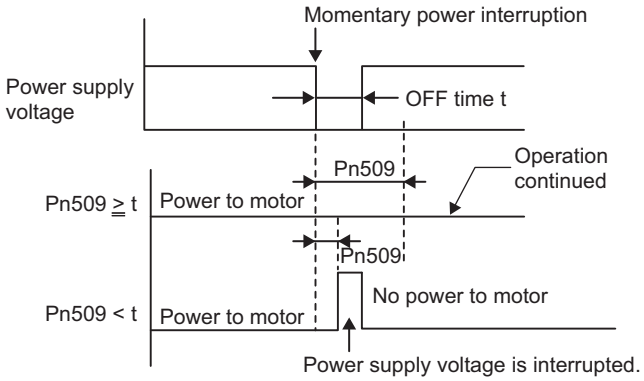


4.3.4 Power Loss Settings

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 SERVOPACK 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.

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.

4.3.5 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)

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

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

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

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

IMPORTANT

The following environment is required to use this function.

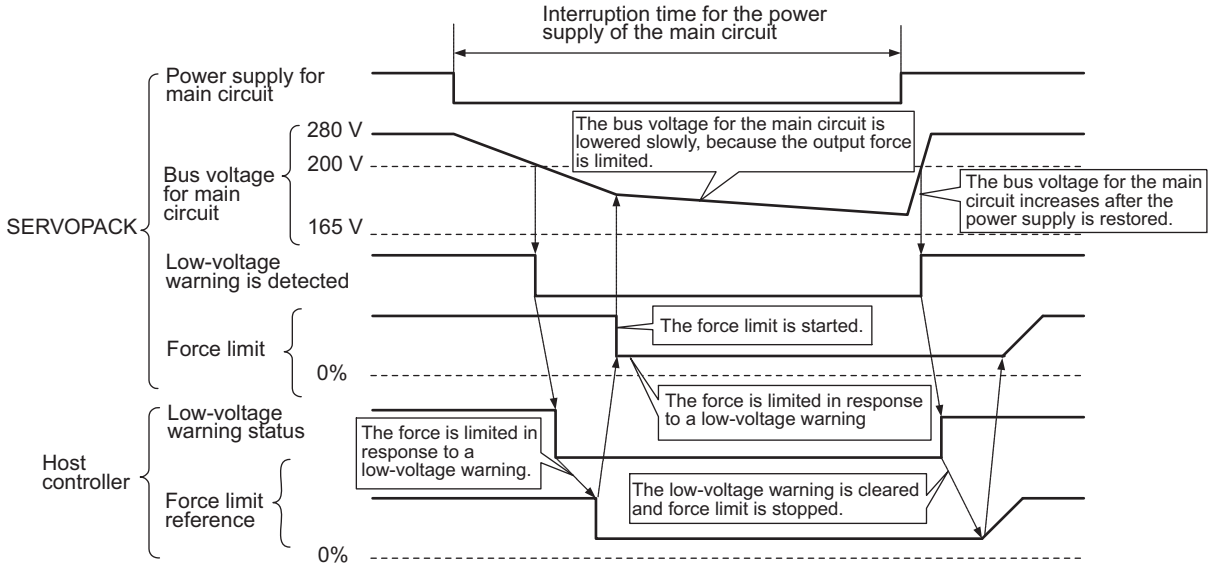
- Provide the control power supply from an uninterruptible power supply (UPS).
- Set the host controller and servo set time so that no force reference that exceeds the specified acceleration will be output when the power supply for the main circuit is restored.

(1) Execution Method

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

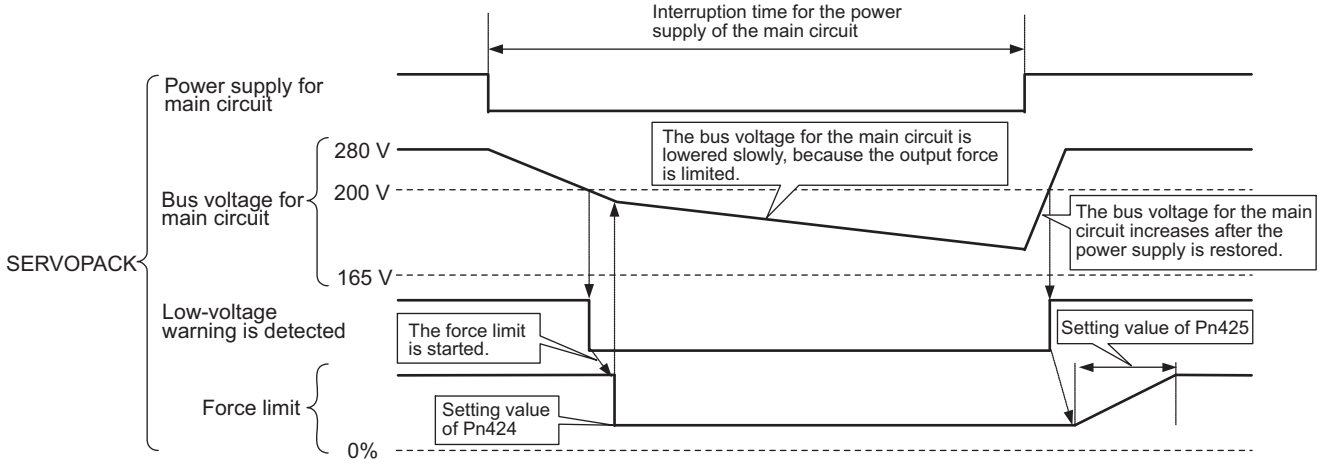
■ Execution with Host Controller

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.



■ 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.



(2) Related Parameters

Parameter		Meaning	When Enabled	Classification
Pn008	n.☐☐0☐	A main circuit low voltage warning is not detected. [Factory setting].	After restart	Setup
	n.☐☐1☐	A main circuit low voltage warning is detected, and the host controller limits the force.		
	n.☐☐2☐	A main circuit low voltage warning 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

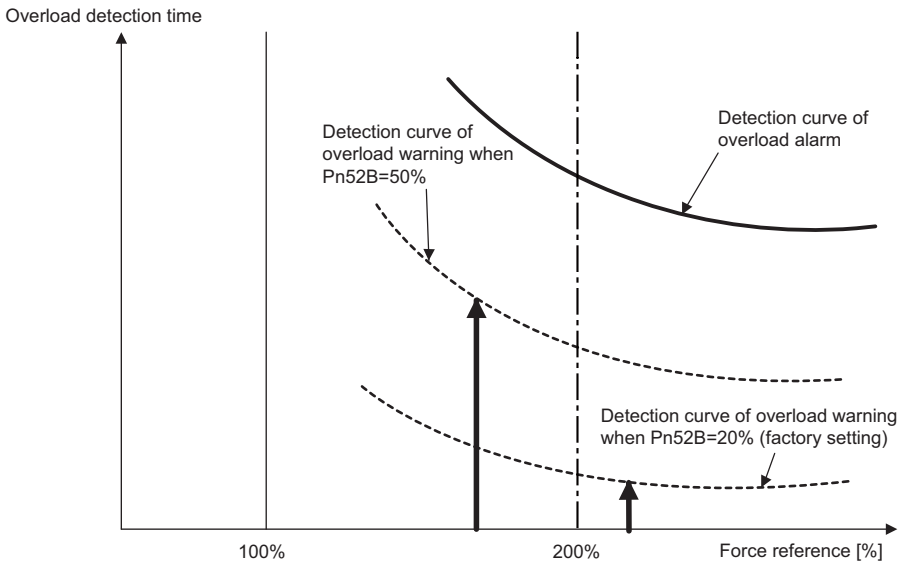
* The setting unit is a percentage of the rated force.

4.3.7 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

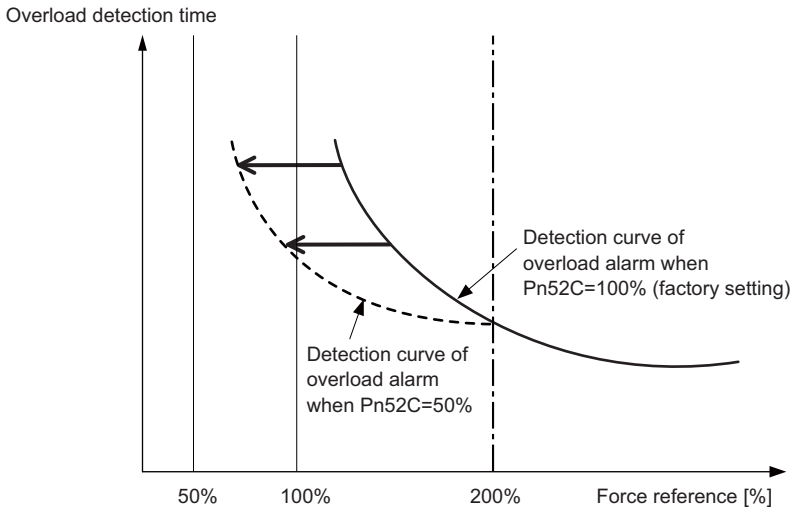
(2) Changing Detection Timing of Overload Alarm (A.720)

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

4.4 Trial Operation

To check the movement of a linear servomotor, refer to *Σ-V Series User's Manual, Setup, Linear Motor* (SIEPS80000044).
This section describes a trial operation using MECHATROLINK-II communications.

4.4.1 Inspection and Checking before Trial Operation

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

(1) Servomotors

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

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

(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?

4.4.2 Trial Operation via MECHATROLINK-II

The following table provides the procedures for trial operation via MECHATROLINK-II.

Step	Description	Reference
1	Confirm that the wiring is correct, and then connect the I/O signal connector (CN1 connector).	*Chapter 3 Wiring and Connection*
2	Turn ON the power to the SERVOPACK. If the SERVOPACK is receiving power, the CHARGE, the POWER, and the COM LED indicators on the SERVOPACK will light up. Note: If the COM LED does not turn ON, recheck the settings of MECHATROLINK-II setting switches (SW1, SW2) and then turn the power OFF and ON again.	
3	Send the CONNECT Command. In the response data from the SERVOPACK, the alarm code "00" is cleared to show normal operation. The response data from the SERVOPACK may be confirmed with the SMON command.	*Σ-V Series User's Manual MECHATROLINK-II Command* (Manual No: SIEP S80000054)
4	Check the product type using an ID_RD command. A reply showing the product type, such as SGDV-R90A 11A, is received from the SERVOPACK.	
5	Set the following items to the necessary settings for a trial operation. • Electronic gear settings • Movement direction of motor • Overtravel	*4.4.3 Electronic Gear* *4.3.1 Servomotor Movement Direction* *4.3.2 Overtravel*
6	Save these settings (step 5). If saving the settings in the controller, use the PRM_WR command. If saving settings in the SERVOPACK, use the PPRM_WR command.	*Σ-V Series User's Manual MECHATROLINK-II Command* (Manual No: SIEP S80000054)
7	Send the SV_ON command. A reply showing that the servomotor has switched to Drive status and that SVON=1 (Conductivity to motor being made) is received.	
8	Run the servomotor at low speed. <Example using a positioning command> Command used: POSING Command setting: Option = 0, Positioning position =10000 (If using the absolute encoder, add 1000 to the present position), rapid traverse speed= 400	
9	Check the following points while running the servomotor at low speed (step 8). • Confirm that the movement direction of the servomotor correctly coincides with the forward movement or reverse movement command. If they do not coincide, reset the direction. • Confirm that no unusual vibrations, noises, or temperature rises occur. If any abnormalities are seen, correct the conditions. Note: Because the running-in of the load machine is not sufficient at the time of the trial operation, the servomotor may become overloaded.	*4.3.1 Servomotor Movement Direction* *8.3 Troubleshooting Malfunction Based on Operation and Conditions of the Servomotor*

4.4.3 Electronic Gear

(1) Scale Feedback Resolution

- Incremental Encoder

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

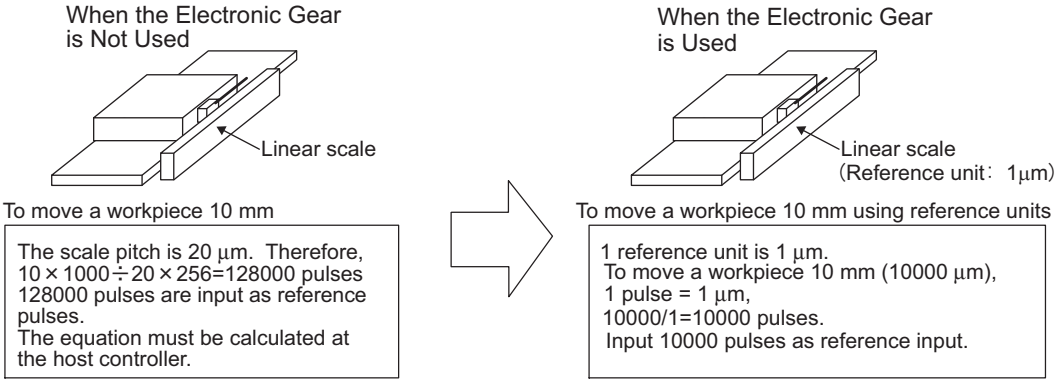
Scale Pitch	Pulse Resolution
40 μm	0.156 μm
20 μm	0.078 μm
4 μm	0.016 μm

- 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.



(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:

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

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.

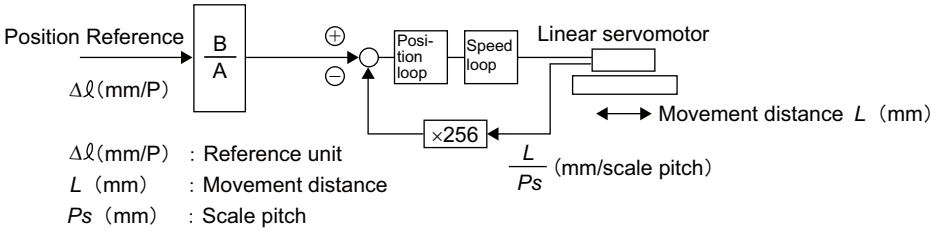
(4) Procedure for Setting the Electronic Gear Ratio

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.

A: Pn210 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

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 during performing 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	×	○
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 card	○	○
Fn01B	Initialize vibration detection level	×	×
Fn01E	SERVOPACK and servomotor ID display	○	○
Fn01F	Display of servomotor ID for feedback option	○	○
Fn200	Tuning-less level setting	×	×
Fn201	Advanced autotuning	×	×
Fn202	Advanced autotuning by reference	×	×
Fn203	One-parameter tuning	×	×
Fn204	Anti-resonance control adjustment function	×	×

Fn No.	Contents	Can be used or not	
		Motor not connect-ed	Motor connect-ed
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 Related Parameters

The following parameters are used for the test without motor.

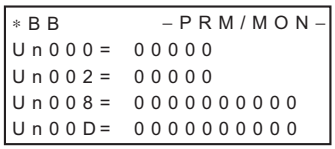
(1) Application Function Select Switch C

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

4.5.3 Digital Operator Display during Testing without Motor



(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 movement 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.

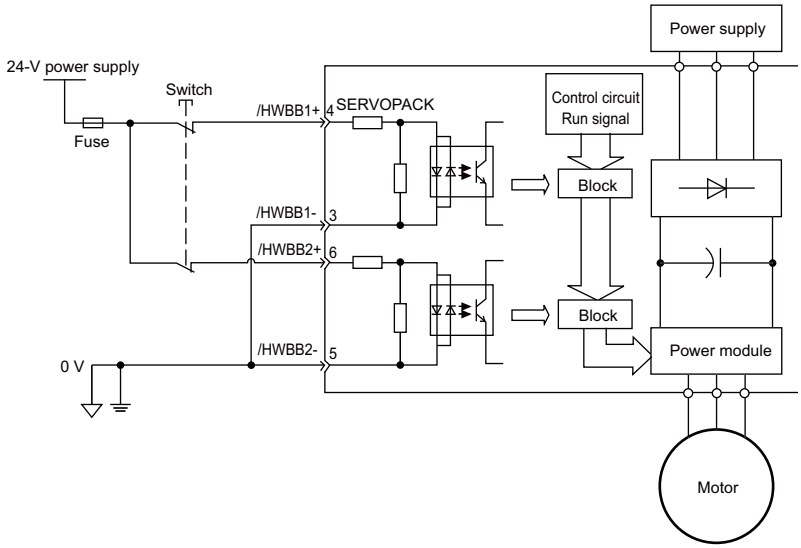
Display	Status
A.□□□	Alarm occurs.
AdJ (Blinks)	Executing advanced autotuning (Fn201).
NO_OP (Blinks one second)	Utility function disabled.
ERROR (Blinks one second)	Error occurs during executing the utility function.
doNE (Blinks one second)	Utility function executed correctly.
END (Blinks one second)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

4.6 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.

4.6.1 Hard Wire Base Block (HWBB) Function

The Hard Wire Base Block function (hereinafter referred to as HWBB function) is a safety function designed to baseblock the motor (shut off the motor current) by using the hardwired circuits: Each circuit for two channel input signals blocks the run signal to turn off the power module, and the motor current is shut off. (Refer to the diagram below.)



(1) Risk Assessment

Perform risk assessment for the system and confirm that the safety requirements with the following standards are fulfilled before using the HWBB function.

EN954 Category3
IEC61508 SIL2

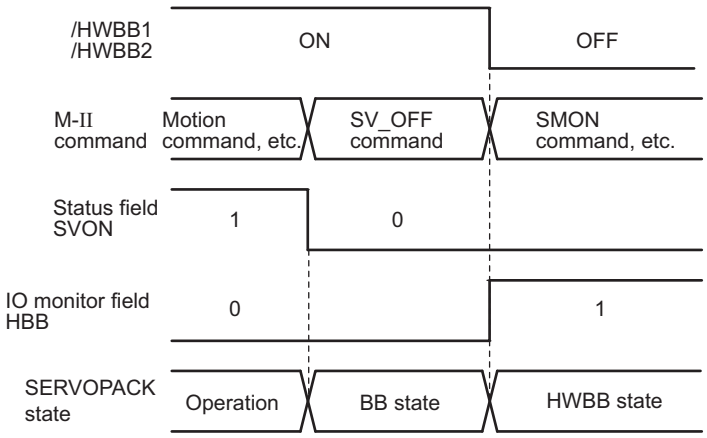
The following risks can be estimated even if the HWBB function is used. These risks must be included in the risk assessment.

- The motor will rotate in an application where external force is applied to the motor (for example, gravity on the vertical axis). Take measures to secure the motor, such as installing a mechanical brake.
- The motor may move within the electric angle of 180 degrees in case of the power module failure, etc. The number of rotations or movement distance depends on the motor type as shown below.
  Rotary motor: 1/6 rotation max. (rotation angle at the motor shaft)
  Direct-drive motor:1/20 rotation max. (rotation angle at the motor shaft)
  Linear motor: 30 mm max.
- The HWBB function does not shut off the power to the servodrive or electrically isolates it. Take measures to shut off the power to the servodrive when performing maintenance on it, etc.

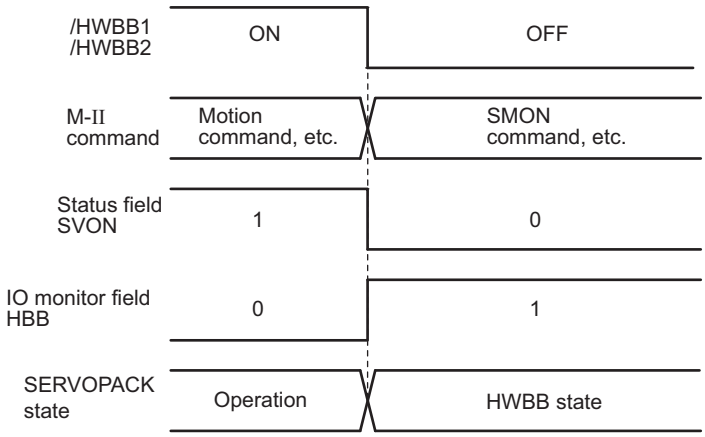
(2) Hard Wire Base Block (HWBB) State

The SERVOPACK will be in the following state if the HWBB function operates. If the /HWBB1 or /HWBB2 signal is OFF, the HWBB function will operate and the SERVOPACK will enter a hard wire baseblock (HWBB) state.

[HWBB function operates after Servo is turned OFF (No power to motor)]



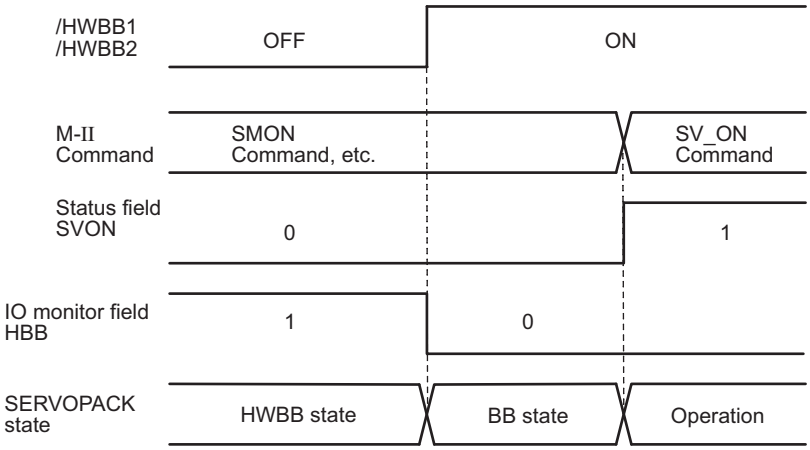
[HWBB function operates while power is applied to the motor]



(3) Resetting the HWBB State

By receiving a servo ON command (SV_ON: 31 H) again after both /HWBB1 and /HWBB2 signals are turned ON, the SERVOPACK returns to normal operation status.

If a servo ON command (SV_ON: 13 H) is sent while the SERVOPACK is in the HWBB status, the SERVOPACK can be returned to normal operational status by sending commands other than servo ON commands (SV_ON: 31) such as a servo OFF command (SV_OFF: 32H) after both /HWBB1 and /HWBB2 signals are turned ON and by resending a servo ON command (SV_ON: 31 H).



Note: Even if the Servo turns OFF after turning OFF the main circuit power, the HWBB status remains until a servo OFF command (SV_OFF: 32 H) is received.

(4) Related Commands

If the HWBB function is working with the /HWBB1 or /HWBB2 signal turned OFF, the setting of IO monitoring field D10 (HBB) changes to 1, so the status of the upper level apparatus can be known by looking at the setting of this bit.

If the status becomes HWBB status during the execution of the next command, a command warning is issued. If a warning is given, clear the alarm to return to normal operational status. After stopping or canceling the action command, using the sequence of commands to return to the HWBB status is recommended.

Object Action Commands
Servo ON (SV_ON)
Interpolating (INTERPORATE)
Positioning (POSING)
Constant speed feed (FEED)
Interpolating with position detection function (LATCH)
External input positioning (EX_POSING)
Homing (ZRET)

(5) 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.

(6) Connection Example and Specifications of Input Signals (HWBB Signals)

The input signals must be redundant. A connection example and specifications of input signals (HWBB signals) are shown below.

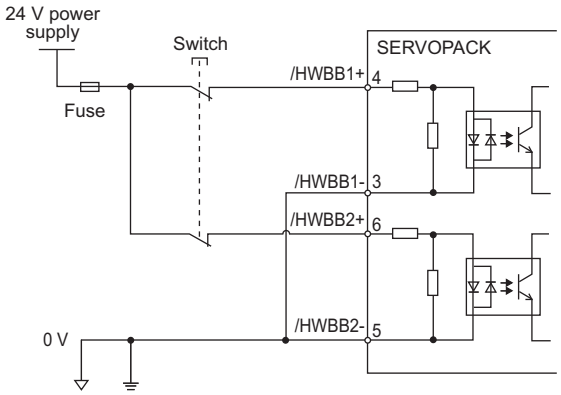
IMPORTANT

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

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

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

■ Connection Example for Input Signals (HWBB Signals)



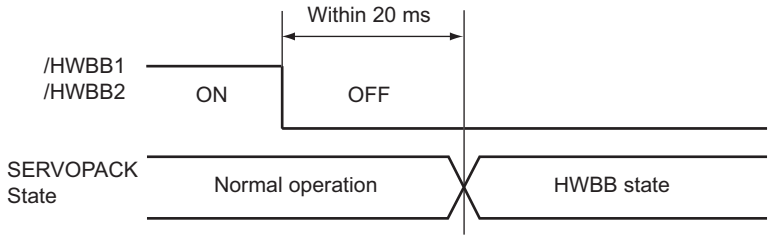
■ Specifications of Input Signals (HWBB Signals)

Type	Signal Name	Pin Number	State	Meaning
Input	/HWBB1	CN8-4	ON	Normal operation
		CN8-3	OFF	Requires the HWBB function by using the hardwired circuits.
	/HWBB2	CN8-6	ON	Normal operation
		CN8-5	OFF	Requires the HWBB function by using the hardwired circuits.

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

Items	Characteristics	Remarks
Internal impedance	3.3 kΩ	
Operation movable voltage range	+11 V to + 25 V	
Maximum delay time	20 ms	Time from the /HWBB1 and /HWBB2 signals are OFF to the HWBB function operates.

Note: Use a relay or switch that has micro-current contacts.
If the HWBB function is requested by turning OFF the /HWBB1 and /HWBB2 input signals on the two channels, power supply to the motor will be turned OFF within 20 ms (see below).



Note: The OFF status is not recognized if the /HWBB1 and /HWBB2 signals are 0.5 ms or shorter.

(7) 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)

(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.

4.6.2 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

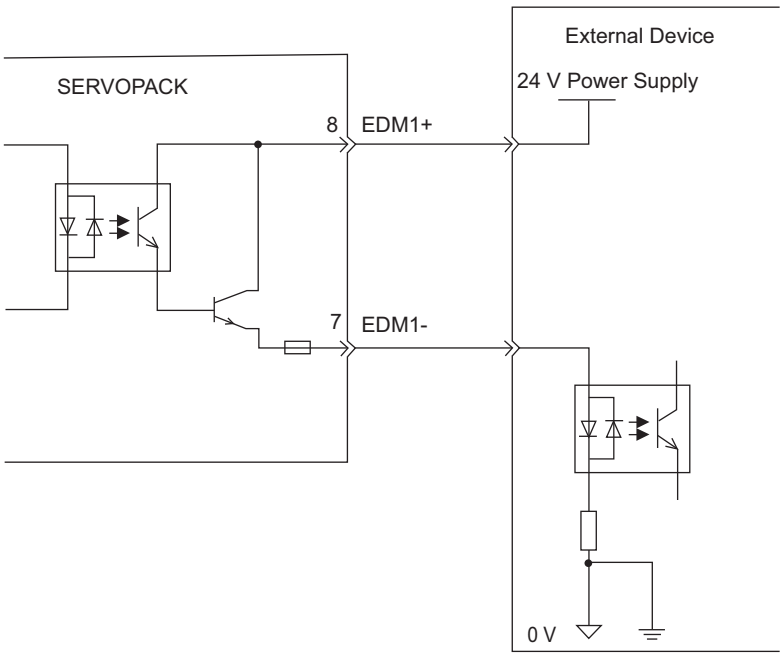
The EDM1 signal is not a safety output. Use it only for monitoring a failure.

(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.

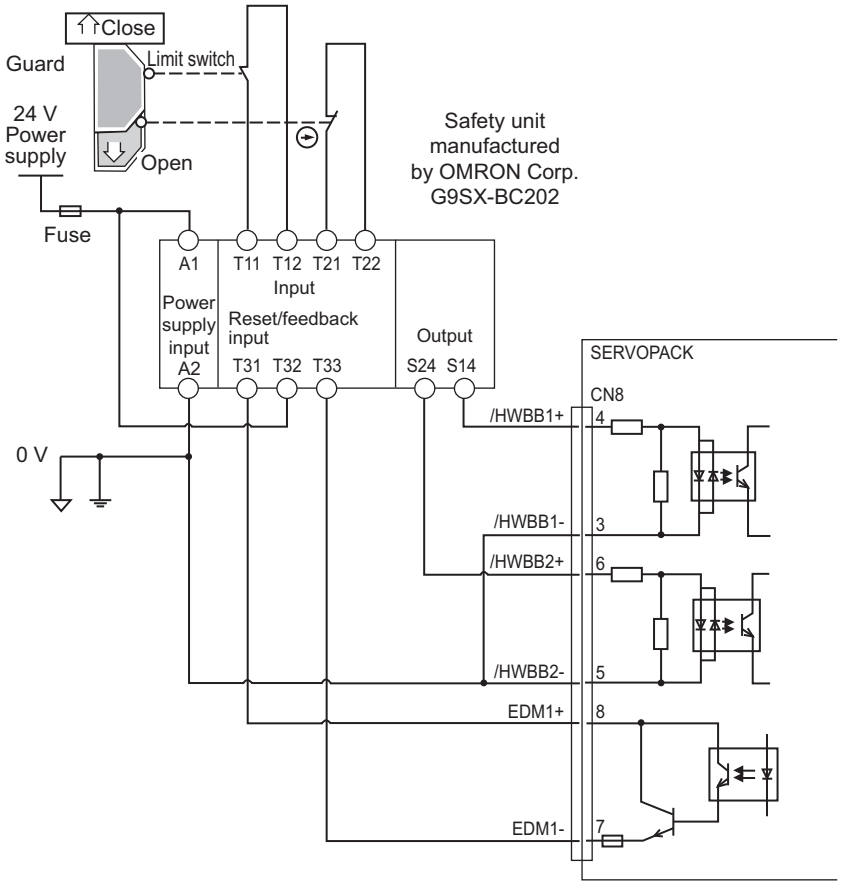
Items	Characteristics	Remarks
Maximum Allowable Voltage	30 VDC	–
Maximum Current	50 m ADC	–
Maximum Voltage Drop at ON	1.0 V	Voltage between EDM1+ to EDM1- at current is 50 mA.
Maximum Delay Time	20 ms	Time from change of /HWBB1, /HWBB2 to change of EDM1

4.6.3 Application Example of Safety Functions

An example of using safety functions is shown below.

(1) Connection Example

In the following example, a safety unit is used and the HWBB function operates when the guard opens.



When a guard opens, both of signals, the /HWBB1 and the /HWBB2, turn OFF, and the EDM1 signal is ON. Since the feedback is ON when the guard closes, the safety unit is reseted, and the /HWBB1 and the /HWBB2 signals turn ON, and the operation becomes possible.

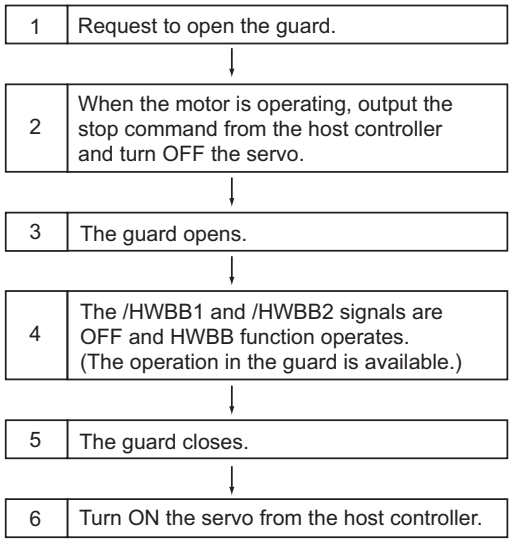
Note: Connect the EDM1 as the direction of current flows from EMD1+ to EMD1-, because the EMD1 has polarity with a transistor output.

(2) Failure Detection Method

In case of a failure such as the /HWBB1 or the /HWBB2 signal remains ON, the safety unit is not reseted because the EDM1 signal keeps OFF. Therefore starting is impossible, then the failure is detected.

An error in the external device, disconnection or short-circuiting of the external wiring, or a failure in the SERVOPACK must be considered. Find the cause and correct the problem.

(3) Usage Example



4.6.4 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/the 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.

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

5

Adjustments

5.1 Adjustments and Basic Adjustment Procedure

This section describes adjustments and the basic adjustment procedure.

5.1.1 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.

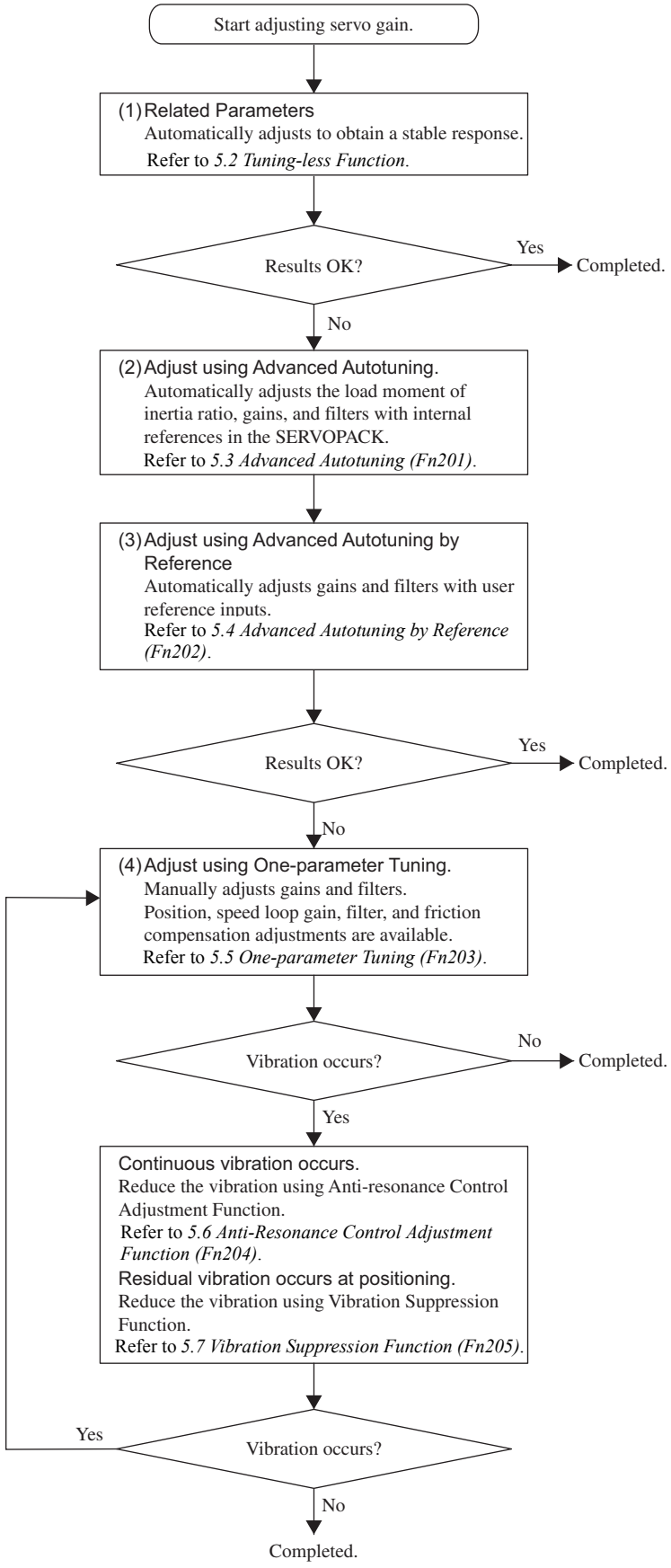
This section describes the following utility adjustment functions.

Use the Digital Operator or SigmaWin+ to make adjustments with these functions.

Utility Function for Adjustment	Outline	Applicable Control Mode
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
Advanced Autotuning (Fn201)	Advanced autotuning automatically adjusts the mass ratio, gains, and filters with internal references in the SERVOPACK.	Speed and Position
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
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
Anti-Resonance Control Adjustment Function (Fn204)	This function effectively suppresses vibration between 100 and 1000 Hz.	Speed and Position
Vibration Suppression Function (Fn205)	This function effectively suppresses residual vibration if it occurs when positioning.	Position

5.1.2 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.



5.1.3 Monitoring Analog Signals

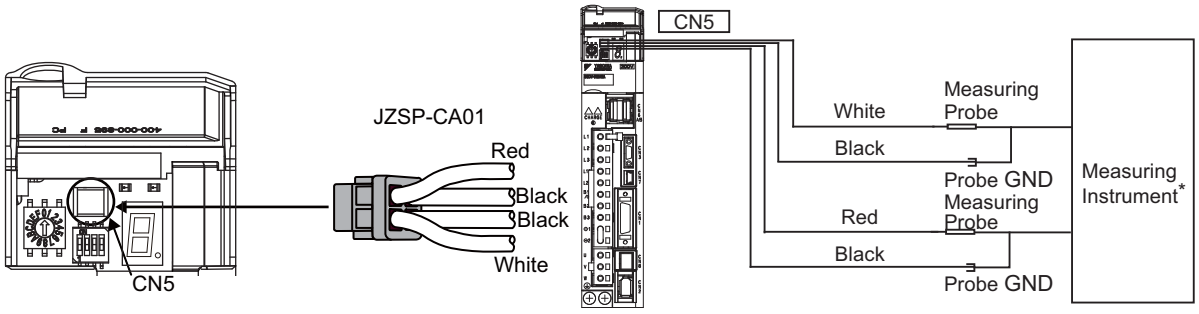
The servo gain adjustments must be made while checking the signal status. Connect a measuring instrument, such as a memory recorder, to connector CN5 on the SERVOPACK to monitor analog signals.

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.

$$\text{Analog monitor 1 output voltage} = (-1) \times \left(\underset{(\text{Pn006=n.00}\square\square)}{\text{Signal selection}} \times \underset{(\text{Pn552})}{\text{Multiplier}} + \underset{(\text{Pn550})}{\text{Offset voltage [V]}} \right)$$

$$\text{Analog monitor 2 output voltage} = (-1) \times \left(\underset{(\text{Pn007=n.00}\square\square)}{\text{Signal selection}} \times \underset{(\text{Pn553})}{\text{Multiplier}} + \underset{(\text{Pn551})}{\text{Offset voltage [V]}} \right)$$

(3) Related Parameters

The monitor factor can be changed by setting following parameters.

Pn006.0, Pn006.1	Analog Monitor 1 Signal Selection		Speed Position 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

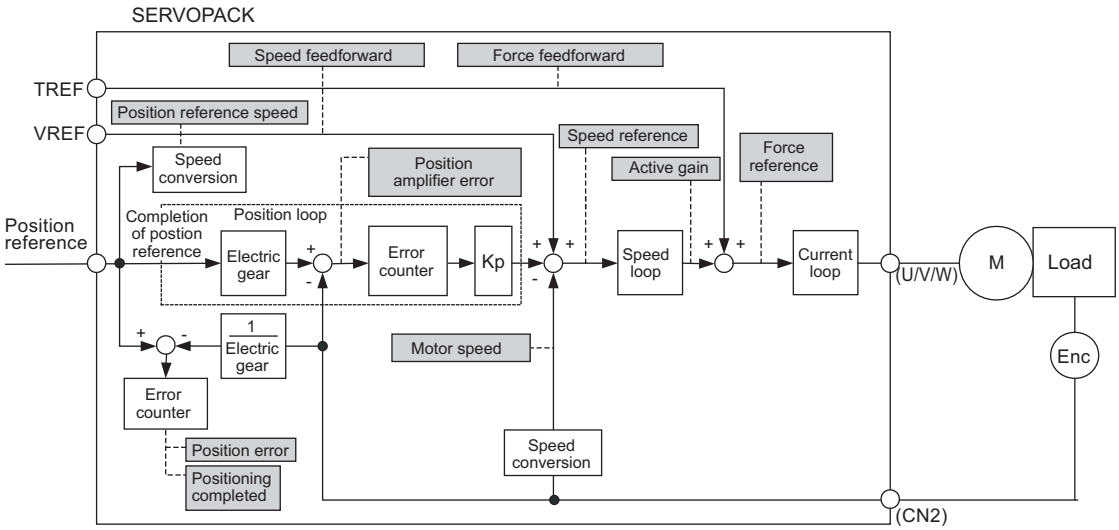
(4) Monitor Signals

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	

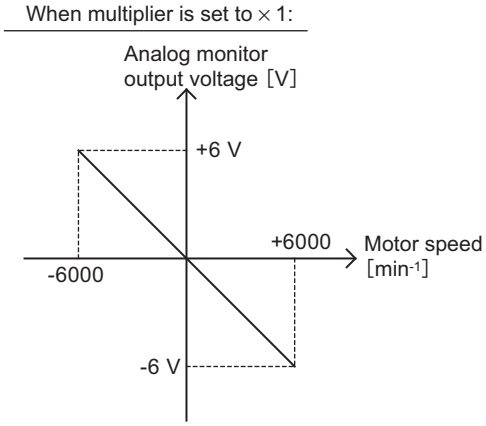
* When using speed control, the position error monitor signal is 0.

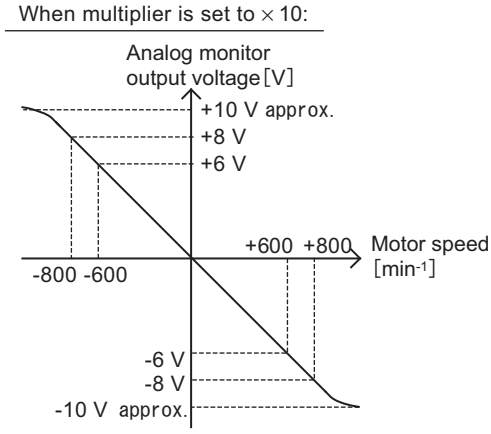
The following diagram shows the analog monitor output at position control.



<Example>

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





Note: Linear effective range: within ± 8V

5.1.4 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 *4.3.2 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 [%]

(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.

$$\text{Position Error} = \frac{\text{Motor Speed [min}^{-1}\text{]}}{60} \times \frac{\text{Number of Pulses per Motor Rotation [reference unit]}}{\text{Pn102 / 10}}$$

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

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

$$\text{Pn520} > \frac{\text{Max. Motor Speed [min}^{-1}\text{]}}{60} \times \frac{\text{Number of Pulses per Motor Rotation [reference unit]}}{\text{Pn102 / 10}} \times \underline{\underline{(1.2 \text{ to } 2)}}$$

Set the level to a value that satisfies these equations, and no alarm will be generated during normal operation. The servomotor will be stopped, however, if the servomotor runs unpredictably after a reference is input or if a position error in accordance with the value set in Pn520 occurs. At the end of the equation, a coefficient is shown as "× (1.2 to 2)." This coefficient is used to add a margin that prevents a faulty alarm from occurring in actual operation of the servomotor.

If the acceleration/deceleration of the position reference exceeds the capacity of the servomotor, the servomotor cannot perform at the requested speed, and the allowable level for position error will be increased as not to satisfy these equations. If so, lower the level of the acceleration/deceleration for the position reference so that the servomotor can perform at the requested speed or raise the allowable level of the position errors.

■ Related Parameter

	Excessive Position Error Alarm Level		Position		Classification
Pn520	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 position reference 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 *8 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 *6.16 Vibration Detection Level Initialization (Fn01B)*

(5) Excessive Position Error Alarm Level at Servo ON

If Pn200.2 (Clear Operation) is set to value other than zero, the position error pulses will remain at the base-block. If the servomotor is moved by an external force while it is being baseblocked, the servomotor will return to the original position so that the position error pulses are cleared and reset to zero after the servo is turned ON. This setting is used to limit such motions and to detect any errors.

■ Related Parameters

Pn520	Excessive Position Error Alarm Level [Position]				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741823 (2^{30}-1)	1 reference unit	5242880	Immediately	Setup

Pn526	Excessive Position Error Alarm Level at Servo ON [Position]				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 107374183 (2^{30}-1)	1 reference unit	5242880	Immediately	Setup

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 position reference 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 *8 Troubleshooting* and take the corrective actions.

5.2 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.

5.2.1 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.

5.2.2 Tuning-less Operating Procedure

The procedure to use the tuning-less function is given below.

(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 on the Digital Operator	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) 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.

(4) 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]		

5.3 Advanced Autotuning (Fn201)

This section describes the adjustment using advanced autotuning.

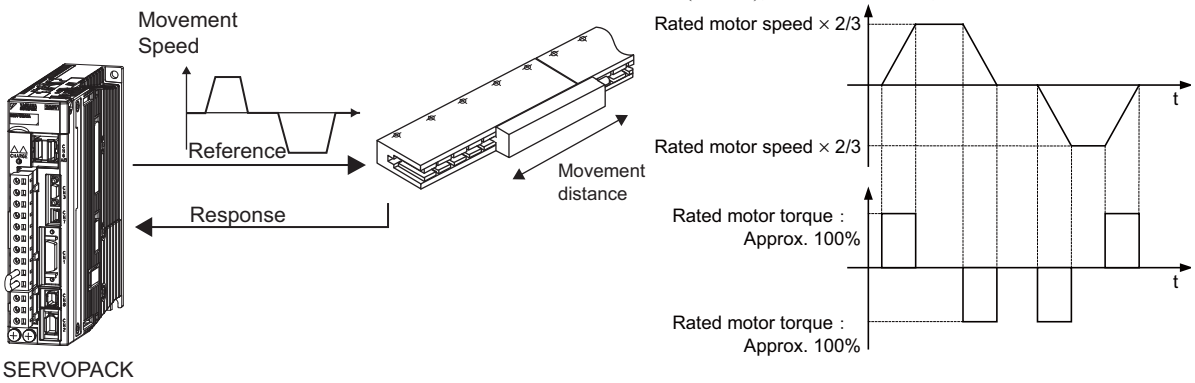
5.3.1 Advanced Autotuning

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 (Refer to *(7) Friction Compensation*.)
- Anti-resonance control (Refer to *(5) Anti-Resonance Control Adjustment Function*.)
- Vibration suppression (Mode = 2 or 3) (Refer to *(6) Model Following Control with Vibration Suppression*.)

Refer to *5.3.3 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 *5.4 Advanced Autotuning by Reference (Fn202)* and *5.5 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 *5.4 Advanced Autotuning by Reference (Fn202)* and *5.5 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.

- 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

- 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 *5.6 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.

Tuning Level / Friction Compensation Setting		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) will be ignored because model following control will be enabled.

The following settings are required if model following control is used together with the external speed/force feedforward.

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.		

5.3.2 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* (SIEPS80000055) for basic key operations of the Digital Operator.

(1) Operating Procedure

Step	Display on the Digital Operator	Keys	Operation
1	BB —FUNCTION— Fn200:TuneLvl Set Fn201:AAT Fn202:Ref-AAT Fn203:OnePrmTun	MODE/SET ∧ ∨	Display the main menu of the utility function mode, and select Fn201.
2	BB Advanced AT Jcalc=ON Mode=2 Type=2 Stroke=+00288000 (0090.0)rev	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 Jcalc=ON Mode=2 Type=2 Stroke=+00288000 (0090.0)rev	∧ ∨ SCROLL	Press the ∧, ∨ or SCROLL Key and set the items in steps 3-1 to 3-4.
3-1	■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.		
3-2	■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.		
3-3	■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.		
3-4	■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 Notes: • 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.		

Step	Display on the Digital Operator	Keys	Operation
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.
5	RUN ADVANCED AT Pn103=00000 Pn100=0040.0 Pn101=0020.00 Pn141=0050.0	JOG SVON	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."
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.

Step	Display on the Digital Operator	Keys	Operation
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
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.
An error occurred during the calculation of the mass ratio.	Refer to *(3) Errors during Calculation of Mass Ratio*.	
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.
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.

(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).
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.

5.3.3 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

5.4 Advanced Autotuning by Reference (Fn202)

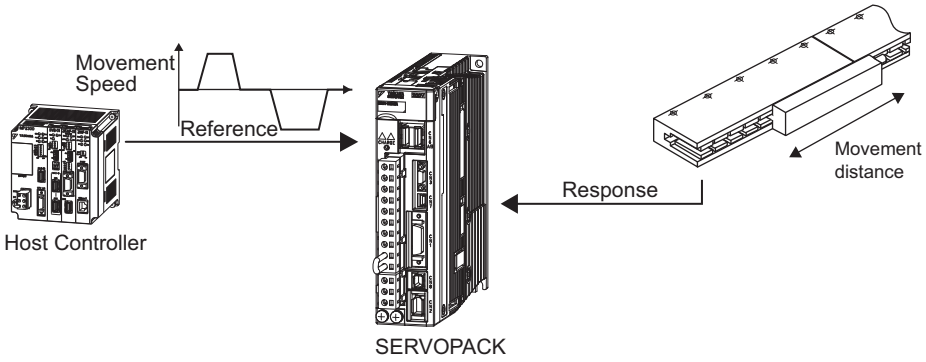
Adjustments with advanced autotuning by reference are described below.

5.4.1 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 (Refer to *(7) Friction Compensation*.)
- Anti-resonance control (Refer to *(5) Anti-Resonance Control Adjustment Function*.)
- Vibration suppression (Refer to *(6) Model Following Control with Vibration Suppression*.)

Refer to *5.4.3 Related Parameters* for parameters used for adjustments.

Tuning level can be set to select an adjustment type.
When using a 13-bit encoder, select Mode 1.

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 *5.5 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 *5.6 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.

Tuning Level / Friction Compensation Setting		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) will be ignored because model following control will be enabled.

The following settings are required if model following control is used together with the external speed/force feedforward .

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.		

5.4.2 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.

(1) Operating Procedure

Step	Display on the Digital Operator	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.		

Step	Display on the Digital Operator	Keys	Operation
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 the SV_ON command, 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.
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.

5.4.3 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

5.5 One-parameter Tuning (Fn203)

Adjustments with one-parameter tuning are described below.

5.5.1 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 (Refer to *(4) Friction Compensation*.)
- Anti-resonance control (Refer to *(3) Anti-Resonance Control Adjustment Function*.)

Refer to *5.5.4 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 *5.8 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 *5.6 Anti-Resonance Control Adjustment Function (Fn204)*

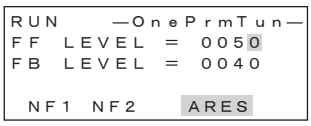
Parameter		Function	When Enabled	Classification
Pn160	n.□□0□	Does not use the anti-resonance control automatically.	Immediately	Tuning
	n.□□1□	Uses the anti-resonance control automatically. [Factory setting]		

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.



(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) will be ignored because model following control will be enabled.

The following settings are required if model following control is used together with the external speed/force feedforward.

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.		

5.5.2 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.

(1) Operating Procedure 1

Step	Display on the Digital Operator	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]

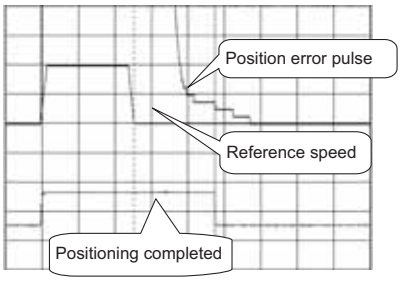
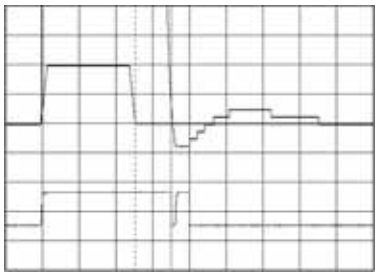
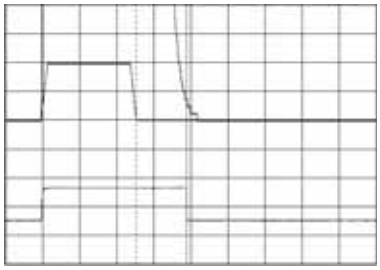
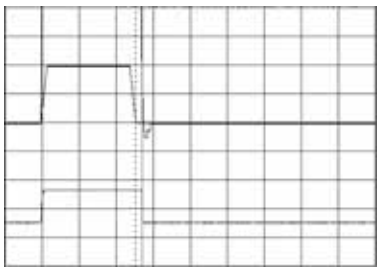
Step	Display on the Digital Operator	Keys	Operation
1			Input the SV_ON command. The display will change from "BB" to "RUN." Input a reference from the host controller.
2	RUN —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn141=0050.0	DATA	The set value will be displayed. Press the DATA Key after checking the 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 on the Digital Operator	Keys	Operation
1			Input the SV_ON command. 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.

5.5.3 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 LB 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.

5.5.4 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

5.6 Anti-Resonance Control Adjustment Function (Fn204)

This section describes the anti-resonance control adjustment function.

5.6.1 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.

5.6.2 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.

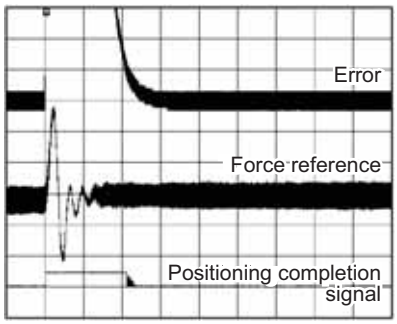
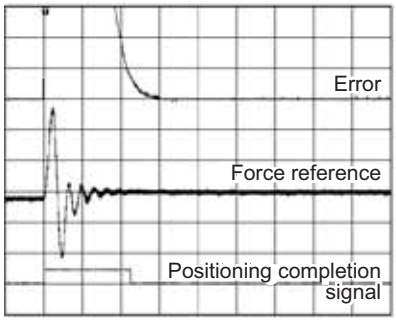
Note: Use this function if vibration is generated when a control reference is input.

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 5-40.
2. Starting Execution without Vibration Suppression When the Anti-resonance Control Adjustment Function Has Not Been Used → See page 5-42.
3. Starting Execution for Fine-tuning When the Anti-resonance Control Adjustment Function Has Been Used → See page 5-44.

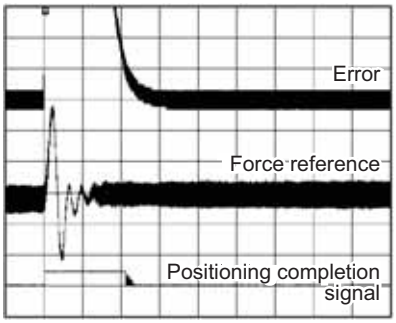
(1) Starting Execution with Vibration Suppression When the Anti-Resonance Control Adjustment Function Has Not Been Used

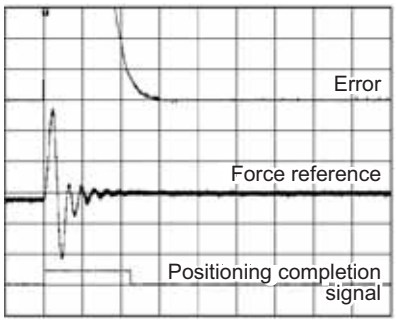
Step	Display on the Digital Operator	Keys	Operation
1	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET ∧ ∨	Display the main menu of the utility function mode, and select Fn204.
2	RUN — Vib Sup— Tuning Mode = 0	DATA	Press the DATA Key to display the initial setting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

Step	Display on the Digital Operator	Keys	Operation
10	RUN — Vib Sup— freq = 0420 Hz damp = 00120	DATA	Press [DATA] Key to save the settings.
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 on the Digital Operator	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 —Z-Search— Un000= 00000 Un002= 00000 Un003=00774 Un00D=00000000	SCROLL	Press the [SCROLL] Key. The cursor will move to "damp".

Step	Display on the Digital Operator	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.

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

Step	Display on the Digital Operator	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.

5.6.3 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

5.7 Vibration Suppression Function (Fn205)

The vibration suppression function is described in this section.

5.7.1 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) will be ignored because model following control will be enabled.

The following settings are required if model following control is used together with the external speed/force feedforward.

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.		

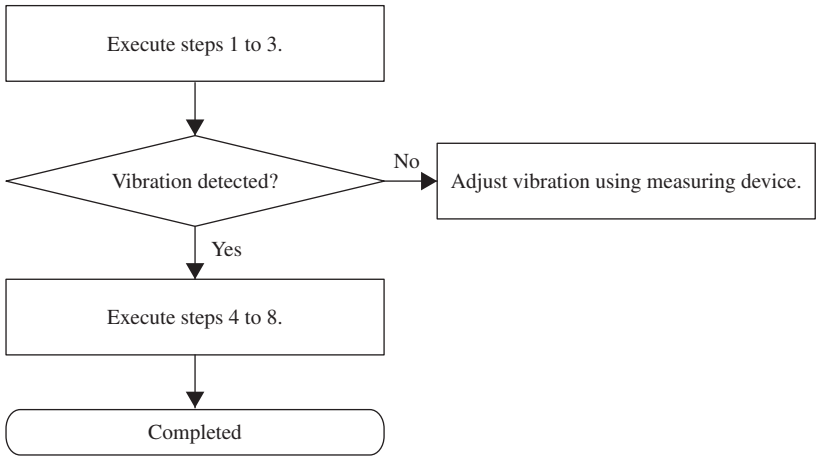
5.7.2 Vibration Suppression Function Operating Procedure

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.

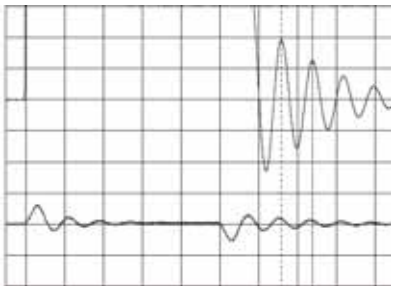
Note: If this function is aborted by pressing the MODE/SET Key, the SERVOPACK will continue operating until the motor comes to a stop. After the motor stops, the set value will return to the previous value.

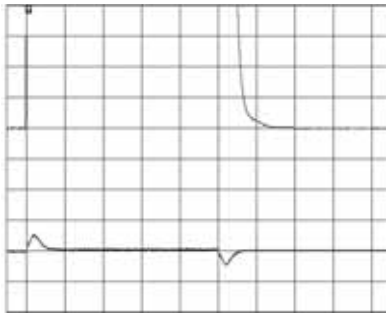
The operating flow of the vibration suppression function is shown below.

(1) Operating Flow



(2) Operating Procedure

Step	Display on the Digital Operator	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.

Step	Display on the Digital Operator	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.

5.7.3 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

5.8 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	*5.8.1*
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	*5.8.2*
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 SEROVOPACK. The user must select the switching conditions.	Speed Position	*5.8.3*

(2) Adjustment Functions to Reduce Vibration

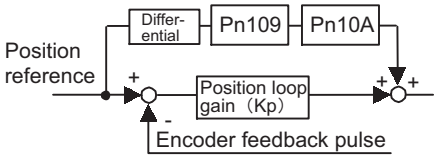
Adjustment Functions and Related Parameters	Description	Characteristics	Applicable Control Mode	Reference
Force Reference Filter Pn401	Sets a filter time constant with the first order lag filter and a notch filter arranged in series to the force reference.	Effective in almost all frequency bands. If a large value (low frequency) is set, the responsiveness will decrease.	Speed Position Force	*5.8.4*
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	*5.8.4*

(3) Other Adjustment Functions

Adjustment Functions and Related Parameters	Description	Applicable Control Mode	Reference
Position Integral Time Constant	This function adds an integral control operation to the position loop.	Position	*5.8.5*
Friction Compensation Pn408	This function rectifies the viscous friction change and regular load change.	Speed Position	*5.8.6*

5.8.1 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

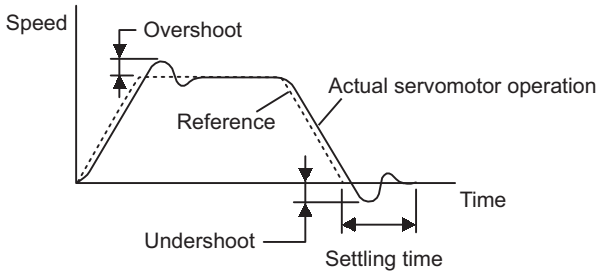
Note: Too high value may cause the machine to vibrate. For ordinary machines, set 80% or less in this parameter.

5.8.2 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) Other Adjustment Functions*.

<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.	–		

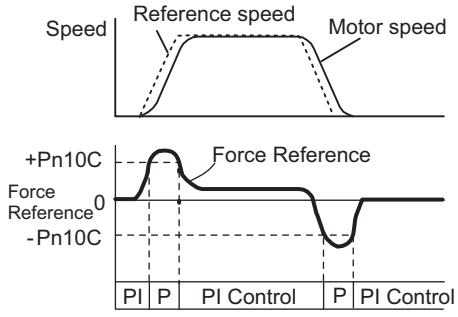
■ Parameters to set the detection point

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

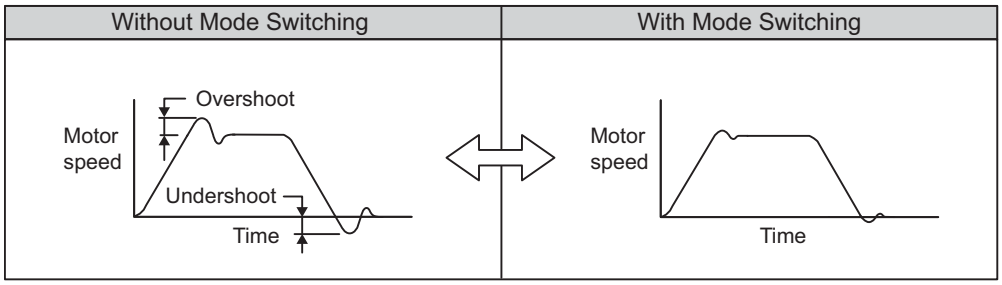
Mode switch functions according to the detection point are as follows.

■ 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.

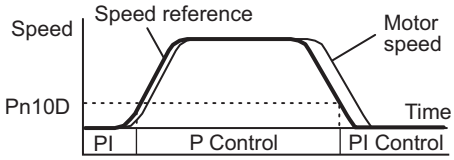


<Example>
If the mode switch function is not being used and the SERVOPACK is always operated with PI control, the speed of the motor may overshoot or undershoot due to force saturation during acceleration or deceleration. The mode switch function suppresses force saturation and eliminates the overshooting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

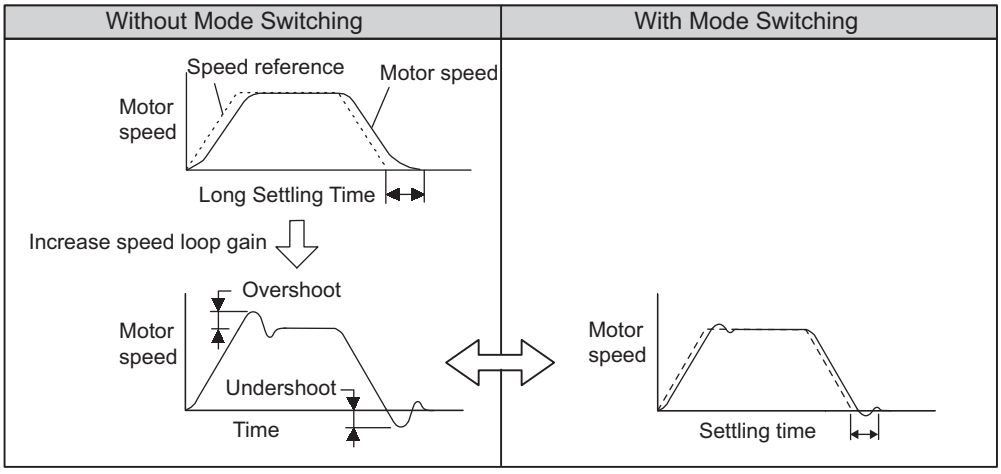


■ Using the Speed Reference Level to Switch Modes

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

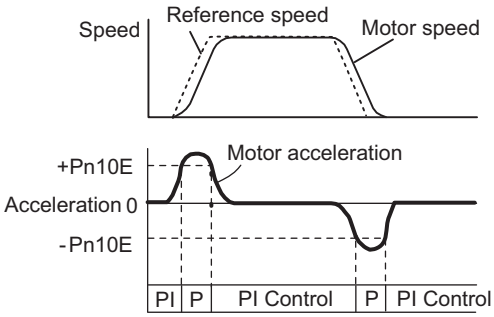


<Example>
In this example, the mode switch is used to reduce the settling time. It is necessary to increase the speed loop gain to reduce the settling time. Using the mode switch suppresses overshooting and undershooting when speed loop gain is increased.



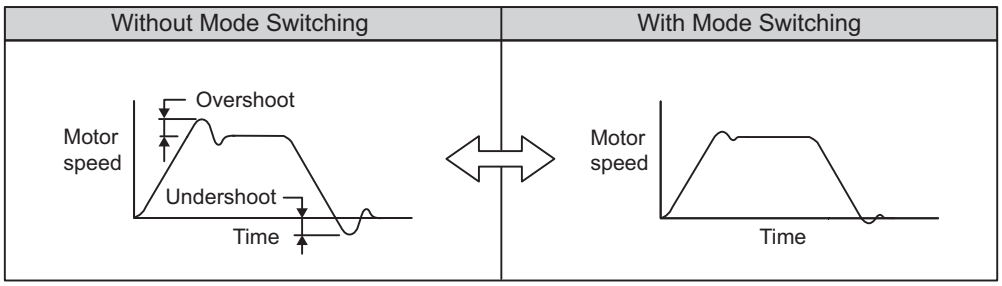
■ Using the Acceleration Level to Switch Modes

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



<Example>

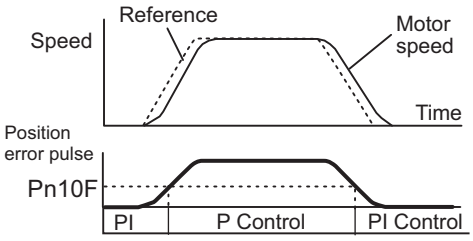
If the mode switch function is not being used and the SERVOPACK is always operated with PI control, the speed of the motor may overshoot or undershoot due to force saturation during acceleration or deceleration. The mode switch function suppresses force saturation and eliminates the overshooting or undershooting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



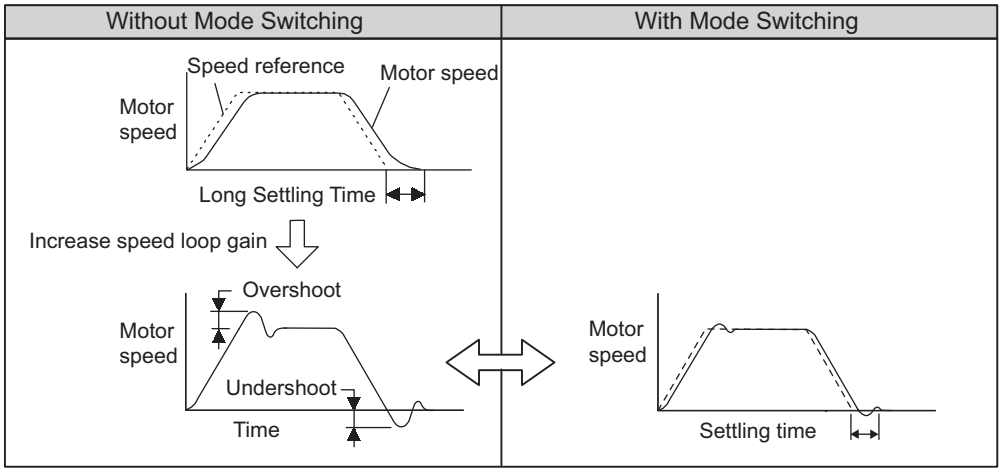
■ Using the Position Error Pulse Level to Switch Modes

This setting is effective with position control only.

With this setting, the speed loop is switched to P control when the position error pulse exceeds the value set in Pn10F.



<Example>
In this example, the mode switch is used to reduce the settling time. It is necessary to increase the speed loop gain to reduce the settling time. Using the mode switch suppresses overshooting and undershooting when speed loop gain is increased.



5.8.3 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

Note: The model following control gain and model following control compensation gain can be changed only manually.

* 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.

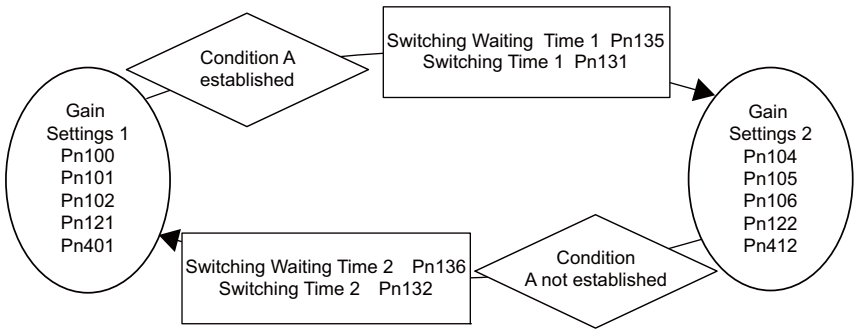
Parameter Setting	Switching Setting	Setting
Pn139=n.□□□0 Manual Gain Switching	OFF (H level)	Gain Setting 1
	ON (L level)	Gain Setting 2

(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

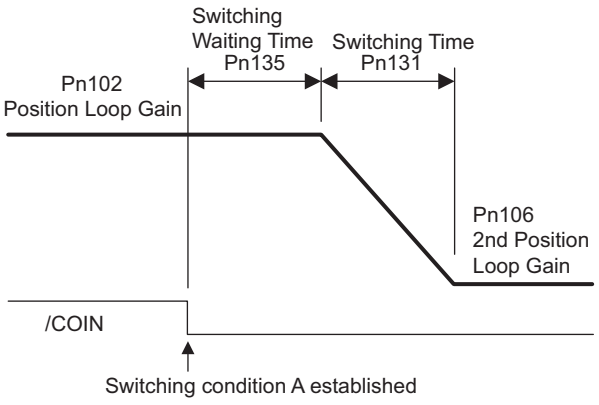
Automatic switching pattern 1 (Pn139.0 = 2)



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

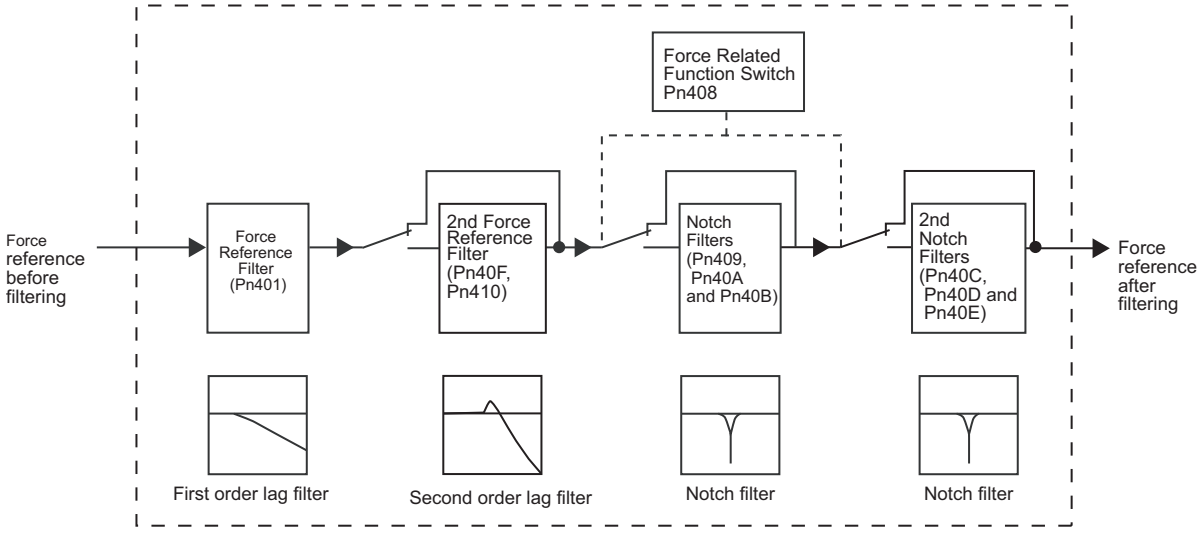
(5) Parameters for Automatic Gain Switching

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 input OFF	Fixed in gain setting 1		
	n.□□5□		Position reference input ON	Fixed in gain setting 2		

5.8.4 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.



(1) Force Reference Filter

If you suspect that machine vibration is being caused by the servodrive, try adjusting the filter time constants. This may stop the vibration. The lower the value, the better the speed control response will be, but there is a lower limit that depends on the machine conditions.

Pn401	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

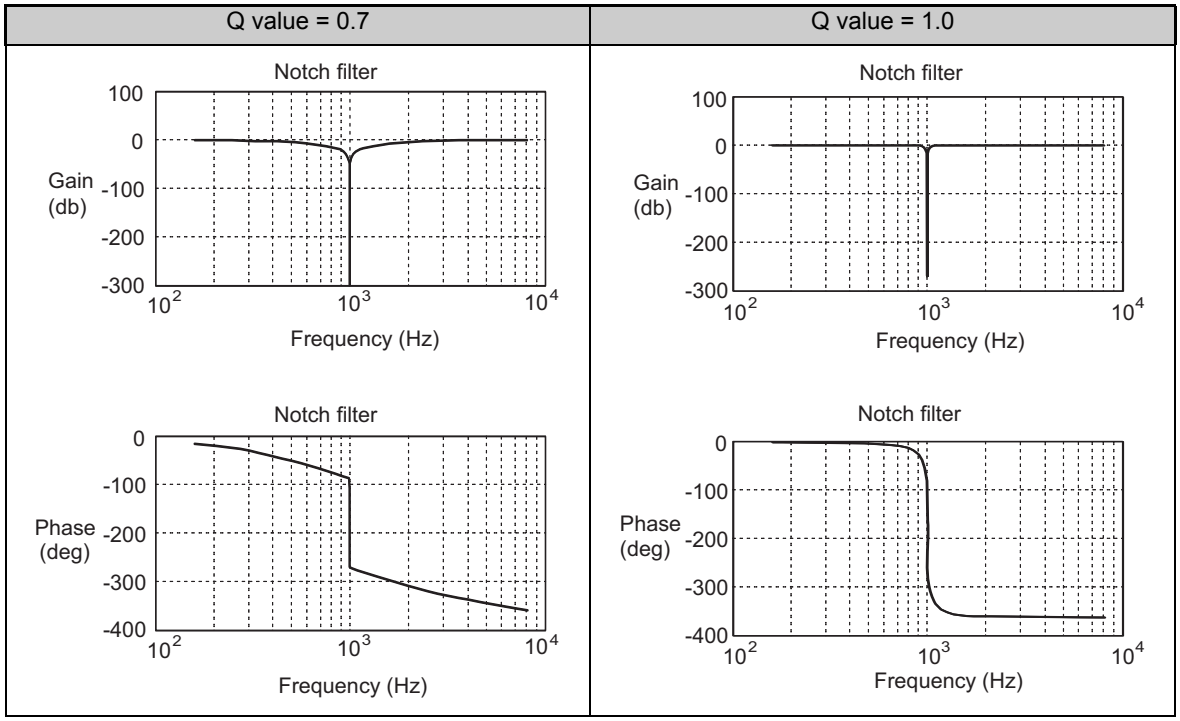
• Speed Loop Gain (Pn100) and Force Reference Filter Time Constant (Pn401)

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

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

(2) Notch Filter

The notch filter can eliminate specific frequency vibration generated by sources such as resonances of ball screw axes. The notch filter puts a notch in the gain curve at the specific vibration frequency. The frequency components near the notch frequency can be eliminated with this characteristic. A higher notch filter Q value produces a sharper notch and phase delay.



Set the notch filter enabled/disabled with Pn408.

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

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

Pn409	1st Notch Filter Frequency		Speed Position 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.

5.8.5 Position Integral Time Constant

This function adds an integral control operation to the position loop. It is effective for electronic cam or electronic shaft applications.

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

5.8.6 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
Pn123	Friction Compensation Coefficient	Speed	Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled
	0 to 100	1 %	0	Immediately
Pn124	Friction Compensation Frequency Correction	Speed	Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled
	-10000 to 10000	0.1 Hz	0	Immediately
Pn125	Friction Compensation Gain Correction	Speed	Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled
	1 to 1000	1 %	100	Immediately

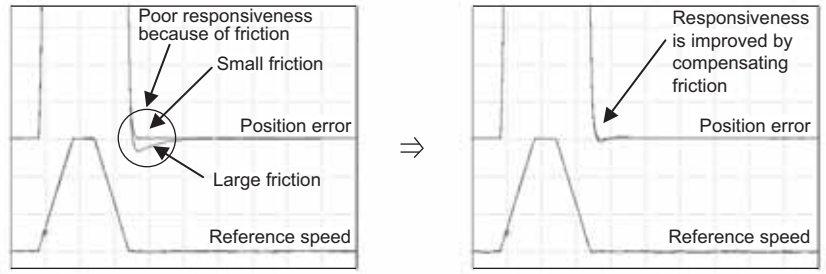
				Tuning

(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).
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.

5.8.7 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
400 V	3R5D□□A, 5R4D□□A, 8R4D□□A, 120D□□A, 170D□□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.

5.8.8 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).

	Current Gain Level		Speed Position		Classification
Pn13D	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.

5.8.9 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.

6

Utility Functions (Fn□□□)

6.1 List of Utility Functions

Utility functions are used to execute parameters related to servomotor operation and adjustment. The digital operator displays numbers beginning with Fn.

The following table shows the parameters in the utility mode and reference section.

Function No.	Function	Reference Section
Fn000	Alarm traceback data display	6.2
Fn002	JOG operation	6.3
Fn003	Origin search	6.4
Fn004	Program JOG operation	6.5
Fn005	Initializes parameter settings	6.6
Fn006	Clears alarm traceback data	6.7
Fn00C	Manual zero-adjustment of analog monitor output	6.8
Fn00D	Manual gain-adjustment of analog monitor output	6.9
Fn00E	Automatic offset-adjustment of motor current detection signal	6.10
Fn00F	Manual offset-adjustment of motor current detection signal	6.11
Fn010	Write prohibited setting	6.12
Fn011	Checks servomotor models	6.13
Fn012	Software version display	6.14
Fn014	Resets configuration error of option card	6.15
Fn01B	Initializes vibration detection level	6.16
Fn01E	Display of SERVOPACK and Servomotor ID	6.17
Fn200	Tuning-less level setting	5.2.2
Fn201	Advanced autotuning	5.3.3
Fn202	Advanced autotuning by reference	5.4.2
Fn203	One-parameter tuning	5.5.2
Fn204	Anti-resonance control adjustment function	5.6.2
Fn205	Vibration suppression function	5.7.2
Fn206	EasyFFT	6.18
Fn207	Online vibration monitor	6.19
Fn020	Origin setting*	–
Fn030	Software reset	6.20
Fn080	Polarity Detection*	–

* For details, refer to *Σ-V Series User's Manual Setup Linear Motor* (SIEPS80000044).

Note: If the write prohibited setting (Fn010) is enabled, "NO-OP" is displayed on the status display of the Digital Operator if the user attempts to execute the above utility functions. For details, refer to *6.12 Write Prohibited Setting (Fn010)*.

6.2 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 total number of operating hours is 1.

Follow the steps below to confirm the alarm histories.

Step	Display Example	Keys	Description
1	BB −FUNCTION− Fn207:V−Monitor Fn000:Alm History Fn002:JOG Fn003:Z-Search	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn000.
2	0:D00 00001207196 1:720 00000032651 2:511 00000009043 3:−−− Alarm History No. "0" is the latest; "9" is the oldest. Alarm. Time stamps	DATA	Press the DATA Key. Then, the alarm history will appear.
3	A.D00 −ALARM− 0:D00 00001207196 1:720 00000032651 2:511 00000009043 3:−−− A.D00 −ALARM− 1:720 00000032651 2:511 00000009043 3:−−− 4:−−− A.D00 −ALARM− 2:511 00000009043 3:−−− 4:−−− 5:−−−	∧ ∨	Press the ∧ or ∨ Key to scroll through the alarm history.
4	BB −FUNCTION− Fn207:V−Monitor Fn000:Alm History Fn002:JOG Fn003:Z-Search	MODE/SET	Press the MODE/SET Key to return to the Utility Function Mode main menu.

<Notes>

- If the same alarm occurs more than one hour later, this alarm is also saved.
- 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.

6.3 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.

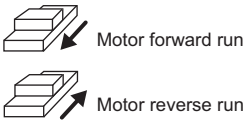
- If the servo is ON, send an SV_OFF command.
- Considering the operating range of the machine, set the JOG operation speed in Pn383.

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 Example	Keys	Description
1	BB −FUNCTION− Fn000:Alm History Fn002:JOG Fn003:Z−Search Fn004:Program JOG	MODE/SET	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn002.
2	BB −JOG− Pn383=00500 Un000= 00000 Un002= 00000 Un00D=00000000	DATA	Press the DATA Key. The display is switched to the execution display of Fn002. Note: If the display is not switched and "NO-OP" is displayed in the status display, change the following settings. • If Write Prohibited is set: → Cancel the Write Prohibited setting. • If the servo is ON, → Send an SV_OFF command.
3	BB −JOG− Pn383=00500 Un000= 00000 Un002= 00000 Un00D=00000000	∧ ∨	Press the DATA Key. The cursor moves to the setting side (the right side) of Pn383 (JOG mode operation).
4	BB −JOG− Pn383=01000 Un000= 00000 Un002= 00000 Un00D=00000000	< > ∧ ∨	Press the < or > Key and the ∧ or ∨ Key to set the JOG speed to 1000 mm/s.
5	BB −JOG− Pn383=01000 Un000= 00000 Un002= 00000 Un00D=00000000	DATA	Press the DATA Key. The setting value is entered, and the cursor moves to the parameter number side (the left side).
6	RUN −JOG− Pn383=01000 Un000= 00000 Un002= 00000 Un00D=00000000	JOG SVON	Press the JOG SVON Key. "RUN" is displayed in the status display, and the servo turns ON.

Step	Display Example	Keys	Description
7	RUN −JOG− Pn383=01000 Un000= 00000 Un002= 00000 Un00D=00000000	∧ ∨	The servomotor will move at the present speed set in Pn304 while the ∧ Key (for forward run) or ∨ Key (for reverse run) is pressed.  Motor forward run Motor reverse run
8	BB −JOG− Pn383=01000 Un000= 00000 Un002= 00000 Un00D=00000000	JOG SVON	After having confirmed the correct motion of servomotor, press the JOG SVON Key. "BB" is displayed in the status display, and the servo turns OFF.
9	BB −FUNCTION− Fn000:Alm History Fn002:JOG Fn003:Z−Search Fn004:Program JOG	MODE/SET	Press the MODE/SET Key to return to the Utility Function Mode main menu.

6.4 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 servo is ON, send an SV_OFF command.

(2) Operating Procedure

Follow the steps below to execute the origin search.

Step	Display Example	Keys	Description
1	BB —FUNCTION— Fn002:JOG Fn003:Z-Search Fn004:Program JOG Fn005:Prm Init	MODE/SET ∧ ∨	Open the Utility Function Mode main menu and select Fn003.
2	BB —Z-Search— Un000= 00000 Un002= 00000 Un003=00774 Un00D=000000000	DATA	Press the DATA Key. The display is switched to the execution display of Fn003. Note: If the display is not switched and "NO-OP" is displayed in the status display, change the following settings. • If Write Prohibited is set: → Cancel the Write Prohibited setting. • If the servo is ON, → Send an SV_OFF command.
3	BB —Z-Search— Un000= 00000 Un002= 00000 Un003=00774 Un00D=000000000	JOG SVON	Press the JOG SVON Key. "RUN" is displayed in the status display, and the servomotor becomes servo ON status. Note: If the servomotor is already at the zero position, "-Complete-" is displayed.
4	RUN —Complete— Un000= 00000 Un002= 00000 Un003=00000 Un00D=00001D58	∧ ∨	When the parameter is set to Pn000.0 = 0 (default), pressing the ∧ Key will run the motor in the forward direction. Pressing the ∨ 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. Press the ∧ or ∨ Key until the motor stops. If the origin search completed normally, "-Complete-" is displayed on the right top on the screen.
5	BB —Z-Search— Un000= 00000 Un002= 00000 Un003=00774 Un00D=00001D58	JOG SVON	When the origin search is completed, press the JOG SVON Key. "BB" is displayed in the status display, and the servomotor becomes servo OFF status. The display "-Complete-" changes to "-Z-Search-."

Step	Display Example	Keys	Description
6	BB —FUNCTION— Fn002:JOG Fn003:Z-Search Fn004:Program JOG Fn005:Prm Init	MODE/SET	Press the MODE/SET Key to return to the Utility Function Mode main menu. This completes the operation.

6.5 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 is ON, send an SV_OFF command.

(2) Precautions

- The overtravel function is enabled in this function.
- When an absolute encoder is used, input is not necessary since SEN signal is always enabled.

(3) Related Parameters

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

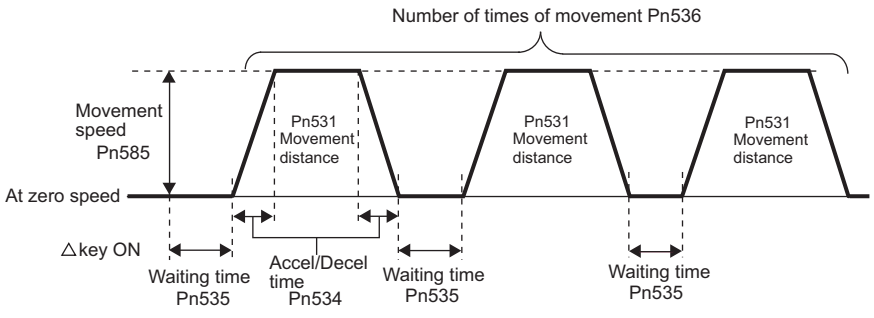
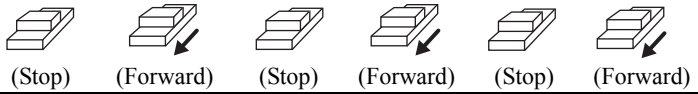
(4) Setting Infinite Time Operation

- 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 JOG/SVON Key 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

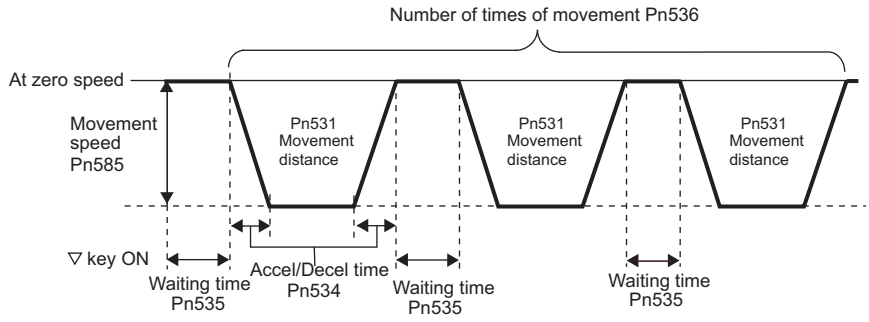
The following example is given when the movement direction of the Servomotor is set as Pn000.0 = 1 (linear scale counting up direction is regarded as the forward run).

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

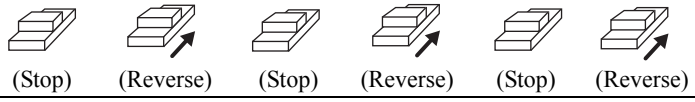
Pn530.0 = 1

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

Speed Diagram



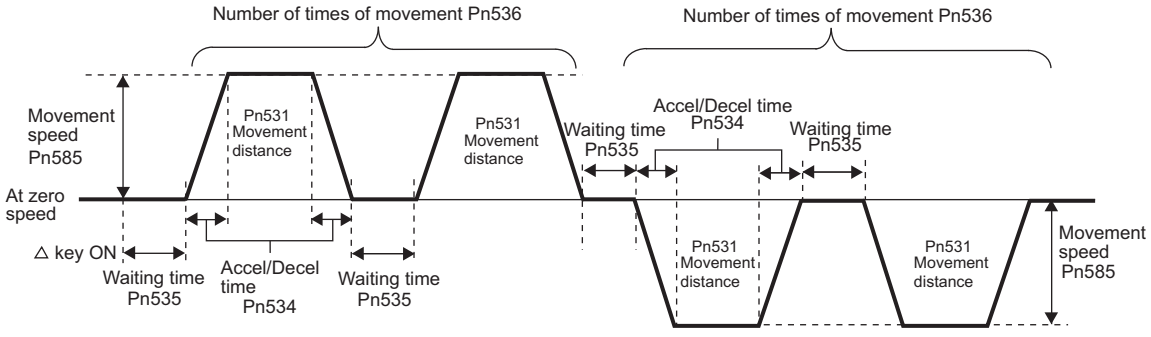
Servomotor Run Status



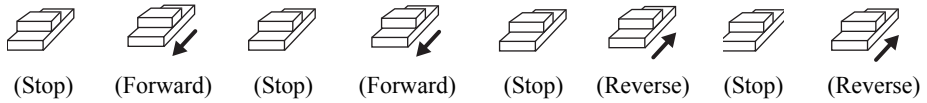
Pn530.0 = 2

(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



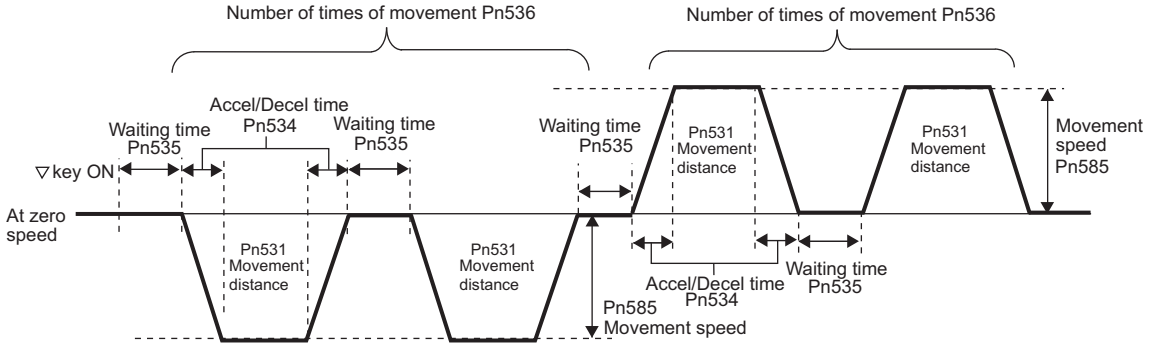
Servomotor Run Status



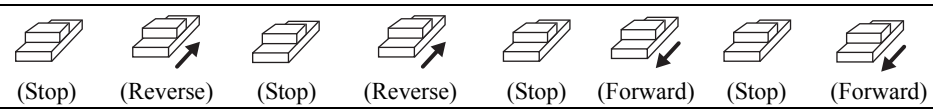
Pn530.0 = 3

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

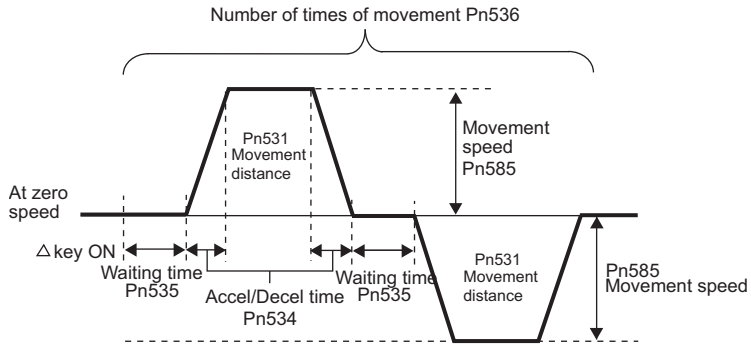
Speed Diagram

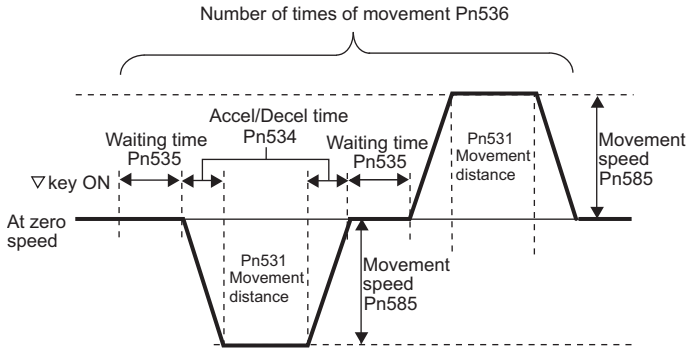
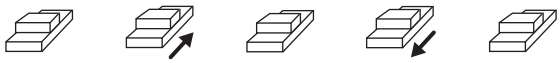


Servomotor Run Status



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	

(6) Operating Procedure

Follow the steps below to perform the program JOG operation.

Step	Display Example	Keys	Description
1	BB −FUNCTION− Fn003:Z-Search Fn004:Program JOG Fn005:Prm Init Fn006:AlmHist Clr	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn004.
2	BB −PRG JOG− Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00001	DATA	Press the DATA Key. The display is switched to the execution display of Fn004. Note: If the display is not switched and "NO-OP" is displayed in the status display, change the following settings. • If Write Prohibited is set: → Cancel the Write Prohibited setting. • If the servo is ON, → Send an SV_OFF command.
3	BB −PRG JOG− Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00001	SCROLL	Press the SCROLL Key to select a parameter to be set. In this example, Pn536 has been selected.
4	BB −PRG JOG− Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00001	< >	Press the < or > Key to select a digit to be edited in the Pn536 setting.
5	BB −PRG JOG− Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00010	∧ ∨	Press the ∨ or ∧ Key to change "1" to "10."
6	RUN −PRG JOG− Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00010	JOG SVON ∧ ∨	Press the JOG SVON Key to turn the servo ON. The main circuit power supply is turned ON, and if neither in Servo ON or OT status, the servo turns ON. The display "BB" is changed to "RUN." Press the ∧ (forward movement start) or ∨ (reverse movement start) Key according to the first movement direction of the preset operation pattern for one second, the servomotor starts moving after the preset waiting time in Pn535. Note: Pressing the JOG SVON Key again changes the status to "BB" (Servo OFF) and stops movement even during operation.
7	END −PRG JOG− Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00010	MODE/SET	When the set program JOG operation movement is completed, "END" is displayed for one second, and then "RUN" is displayed. Press the MODE/SET Key. The servomotor becomes base-blocked status and the Utility Function Mode main menu reappears.

6.6 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 Example	Keys	Description
1	BB −FUNCTION− Fn004:Program JOG Fn005:Prm Init Fn006:AlmHist Clr Fn008:Mturn Clr	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn005.
2	BB Parameter Init Start :[DATA] Return:[SET]	DATA	Press the DATA Key. The display is switched to the execution display of Fn005. Note: If the display is not switched and "NO-OP" is displayed in the status display, change the following settings. • If Write Prohibited is set: → Cancel the Write Prohibited setting. • If the servo is ON, → Send an SV_OFF command.
3	BB Parameter Init Start :[DATA] Return:[SET]	DATA	Press the DATA Key to initialize parameters. During initialization, "Parameter Init" is blinking in the display. After the initialization is completed, "Parameter Init" stops blinking and the status display changes as follows: "BB" to "Done" to "A.941.*" ∗ "A.941" means that setting validation is required to validate the new settings. Note: Press the MODE/SET Key not to initialize parameters. The display returns to the Utility Function Mode main menu.
4	Turn OFF the power and then turn it ON again to validate the new setting.		

6.7 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.

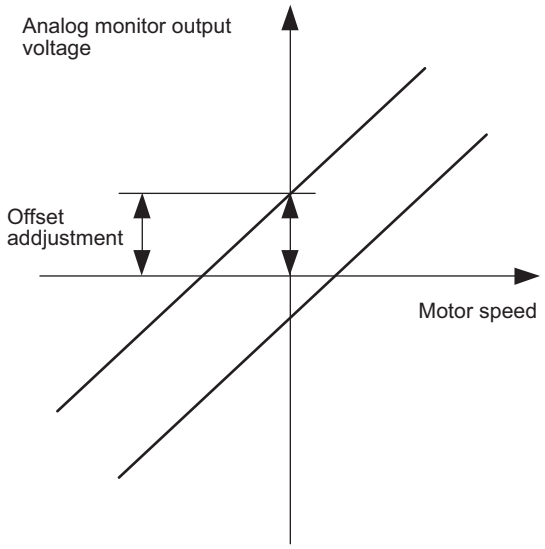
Step	Display Example	Keys	Description
1	BB −FUNCTION− Fn005:Prm Init Fn006:AlmHist Clr Fn008:Mturn Clr Fn009:Ref Adj	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn006.
2	BB Alarm History Data Clear Start :[DATA] Return:[SET]	DATA	Press the DATA Key. The display is switched to the execution display of Fn006. Note: If the display is not switched and "NO-OP" is displayed in the status display, the Write Prohibited Setting (Fn010 = 0001) is set. Check the setting and reset.
3	Done Alarm History Data Clear Start :[DATA] Return:[SET]	DATA	Press the DATA Key to clear the alarm traceback data. While clearing the data, "Done" is displayed in the status display. After the data has been successfully cleared, "BB" is displayed. Note: Press the MODE/SET Key not to clear the alarm history. The display returns to the Utility Function Mode main menu.

6.8 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 Example	Keys	Description
1	BB −FUNCTION− Fn00B:Trq Adj Fn00C:MonZero Adj Fn00D:MonGain Adj Fn00E:Cur AutoAdj	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn00C.
2	BB −Zero ADJ− CH1=−00002 CH2= 00001 Un002= 00000 Un000= 00000	DATA	Press the DATA Key. The display is switched to the execution display of Fn00C. Note: If the display is not switched and "NO-OP" is displayed in the status display, the Write Prohibited Setting (Fn010 = 0001) is set. Check the setting and reset.

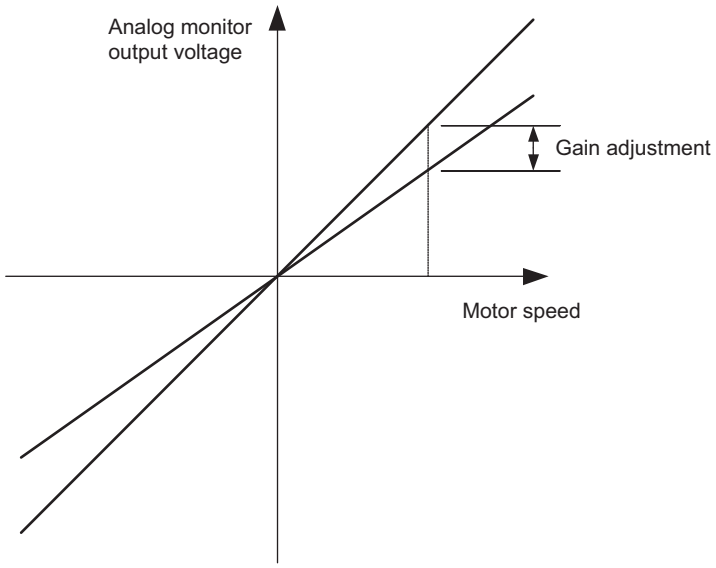
Step	Display Example	Keys	Description
3	BB −Zero ADJ− CH1=−00005 CH2= 00001 Un002= 00000 Un000= 00000		Press the [∧] or [∨] Key to adjust the offset of CH1 (force reference monitor). Adjust the offset so that the measurement instrument reading is as close to 0 V as possible.
4	BB −Zero ADJ− CH1=−00005 CH2= 00001 Un002= 00000		After the offset adjustment of CH1 has completed, adjust the offset of CH2 (motor speed monitor). Press the [SCROLL] Key. The cursor moves to CH2 side.
5	BB −Zero ADJ− CH1=−00005 CH2= 00006 Un002= 00000 Un000= 00000		Adjust the offset of CH2 in the same way as for CH1. Press the [∧] or [∨] Key to adjust the offset of CH2. Adjust the offset so that the measurement instrument reading is as close to 0 V as possible.
6	Done −Zero ADJ− CH1=−00005 CH2= 00006 Un002= 00000 Un000= 00000		After having completed the offset adjustment both for CH1 and CH2, press the [DATA] Key. The adjustment results are saved in the SERVO-PACK. "Done" is displayed in the status display after saving is completed.
7	BB −FUNCTION− Fn00B:Trq Adj Fn00C:MonZero Adj Fn00D:MonGain Adj Fn00E:Cur AutoAdj		Press the [MODE/SET] Key to return to the Utility Function Mode main menu.

6.9 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 Example	Keys	Description
1	BB −FUNCTION− Fn00C:MonZero Adj Fn00D:MonGain Adj Fn00E:Cur AutoAdj Fn00F:Cur ManuAdj	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn00D.
2	BB −Gain ADJ− CH1=−00001 CH2=−00001 Un002= 00000 Un000= 00000	DATA	Press the DATA Key. The display is switched to the execution display of Fn00D. • If the display is not switched and "NO-OP" is displayed in the status display, the Write Prohibited Setting (Fn010 = 0001) is set. Check the setting and reset.
3	BB −Gain ADJ− CH1= 00125 CH2=−00001 Un002= 00000 Un000= 00000	∧ ∨	Press the ∨ or ∧ Key to adjust the gain adjustment width.
4	BB −Gain ADJ− CH1= 00125 CH2=−00001 Un002= 00000 Un000= 00000	SCROLL	After the gain adjustment of CH1, adjust the gain adjustment width of CH2 (motor speed monitor). Press the SCROLL Key. The cursor moves to CH2 side.
5	BB −Gain ADJ− CH1= 00125 CH2=−00125 Un002= 00000 Un000= 00000	∧ ∨	Press the ∧ or ∨ Key to adjust the gain adjustment width of CH2 (motor speed monitor).
6	Done −Gain ADJ− CH1= 00125 CH2=−00125 Un002= 00000 Un000= 00000	DATA	After having completed the adjustment both for CH1 and CH2, press the DATA Key. The adjustment results are saved in the SERVOPACK. After the saving is completed, "Done" is displayed in the status display.
7	BB −FUNCTION− Fn00C:MonZero Adj Fn00D:MonGain Adj Fn00E:Cur AutoAdj Fn00F:Cur ManuAdj	MODE/SET	Press the MODE/SET Key to return to the Utility Function Mode main menu.

6.10 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 Example	Keys	Description
1	BB −FUNCTION− Fn00D:MonGain Adj Fn00E:Cur AutoAdj Fn00F:Cur ManuAdj Fn010:Prm Protect	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn00E.
2	BB Auto Offset−ADJ of Motor Current Start :[DATA] Return:[SET]	DATA	Press the DATA Key. The display is switched to the execution display of Fn00E. Note: If the display is not switched and "NO-OP" is displayed in the status display, change the following settings. • If Write Prohibited is set: → Cancel the Write Prohibited setting. • If the servo is ON, → Send an SV_OFF command.
3	Done Auto Offset−ADJ of Motor Current Start :[DATA] Return:[SET]	∧ ∨	Press the DATA Key to start the automatic offset-signal adjustment of motor current detection. When the adjustment is completed, "Done" is displayed in the status display. Note: Press the MODE/SET Key to cancel the automatic adjustment. The display returns to the Utility Function Mode main menu.

6.11 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).

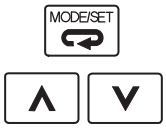
IMPORTANT

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 Example	Keys	Description
1	RUN −FUNCTION− Fn00F:Cur ManuAdj Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver		Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn00F.
2	RUN Manual Offset−ADJ of Motor Current ZADJIU= 00009 ZADJIV= 00006		Press the DATA Key. The display is switched to the execution display of Fn00F. Note: If the display is not switched and "NO-OP" is displayed in the status display, the Write Prohibited Setting (Fn010 = 0001) is set. Check the setting and reset.
3	RUN Manual Offset−ADJ of Motor Current ZADJIU= 00019 ZADJIV= 00006		Adjust the phase-U offset. Press the ∨ or ∧ Key to adjust the offset amount. Adjust the offset amount by 10 in the direction that the force ripple is reduced. Adjustment range: -512 to +511
4	RUN Manual Offset−ADJ of Motor Current ZADJIU= 00019 ZADJIV= 00006		Adjust the phase-V offset. Press the SCROLL Key. The cursor moves to the phase-V side.
5	RUN Manual Offset−ADJ of Motor Current ZADJIU= 00019 ZADJIV= 00016		Press the ∨ or ∧ Key to adjust the offset amount. Adjust the offset amount by 10 in the direction that the force ripple is reduced. Adjustment range: -512 to +511
6	Repeat the above operations (phase-U and-V alternately) until adjusting the offset amounts both for phase-U and -V in both directions cannot reduce the force ripple any more. Then, perform the same operation by adjusting by smaller amount.		
7	Done Manual Offset−ADJ of Motor Current ZADJIU= 00019 ZADJIV= 00016		Press the DATA Key to save the result of adjustment in the SERVOPACK. When the saving is completed, "Done" is displayed in the status display.
8	RUN −FUNCTION− Fn00F:Cur ManuAdj Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver		Press the MODE/SET Key to return to the Utility Function Mode main menu.

6.12 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	6.3
Fn003	Origin search	6.4
Fn004	Program JOG operation	6.5
Fn005	Initialize parameter settings	6.6
Fn006	Clear alarm traceback data	6.7
Fn00C	Manual zero-adjustment of analog monitor output	6.8
Fn00D	Manual gain-adjustment of analog monitor output	6.9
Fn00E	Automatic offset-adjustment of motor current detection signal	6.10
Fn00F	Manual offset-adjustment of motor current detection signal	6.11
Fn014	Resets configuration error of option module	6.15
Fn01B	Initializes vibration detection level	6.16
Fn200	Tuning-less level setting	5.2.2
Fn201	Advanced autotuning	5.3.2
Fn202	Advanced autotuning by reference	5.4.2
Fn203	One-parameter tuning	5.5.2
Fn204	Anti-resonance control adjustment function	5.6.2
Fn205	Vibration suppression function	5.7.2
Fn206	EasyFFT	6.18
Fn207	Online vibration monitor	6.19

Note: If the write prohibited setting (Fn010) is enabled, "NO-OP" is displayed on the status display of the Digital Operator if the user attempts to execute the above utility functions. To execute these utility functions, set Fn010 to write permitted.

(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 Example	Keys	Description
1	BB –FUNCTION– Fn00F:Cur ManuAdj Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn010.
2	BB Parameter Write Protect P. 0000	DATA	Press the DATA Key. The display switches to the execution display of Fn010.
3	BB Parameter Write Protect P. 0001	∧ ∨	Press the DATA Key to select one of the following settings. 0000: Write permitted 0001: Write prohibited
4	Done Parameter Write Protect P. 0001	DATA	Press the DATA Key. The setting value is written into the SERVOPACK, and the status display changes as follows: "BB" to "Done" to "A.941.*" * "A.941" means that setting validation is required to validate the new settings.
5	BB –FUNCTION– Fn00F:Cur ManuAdj Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver	MODE/SET	Press the MODE/SET Key to return to the Utility Function Mode main menu.
6	Turn OFF the power and then turn it ON again to validate the new setting.		

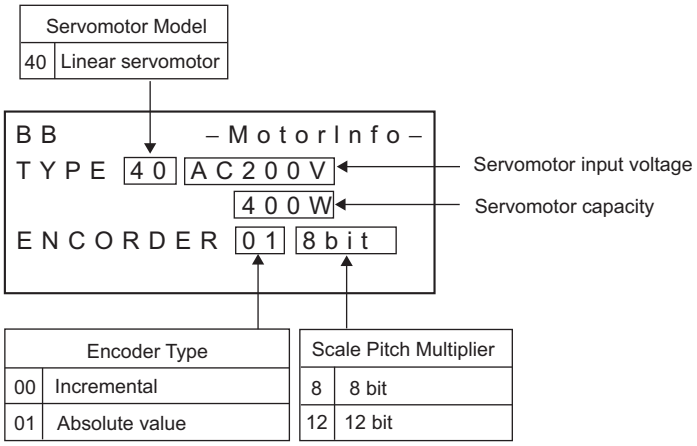
6.13 Servomotor Model Display (Fn011)

This function is used to check the servomotor model, voltage, capacity, encoder type, and encoder resolution. If the SERVOPACK has been custom-made, you can also check the specification codes of SERVOPACKs.

Follow the steps below.

Step	Display Example	Keys	Description
1	RUN −FUNCTION− Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver Fn013:MturnLmSet	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn011.
2	BB −MotorInfo− TYPE 40 AC200V 400W ENCORDER 01 8bit	DATA	Press the DATA Key to switch to the basic display of Fn011.
3	RUN −FUNCTION− Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver Fn013:MturnLmSet	MODE/SET	Press the MODE/SET Key to return to the Utility Function Mode main menu.

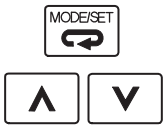
■ Display Designation



6.14 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 Example	Keys	Description
1	BB −FUNCTION− Fn011:Motor Info Fn012:Soft Ver Fn013:MturnLmSet Fn014:Opt Init		Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn012.
2	BB −Soft Ver− DRIVER Ver.=0001 ENCODER Ver.=0003		The software versions of the SERVOPACK and the connected encoder will appear. Note: If the servomotor is not connected, "Not connect" is displayed under "ENCODER" instead of the version number.
3	BB −FUNCTION− Fn011:Motor Info Fn012:Soft Ver Fn013:MturnLmSet Fn014:Opt Init		Press the MODE/SET Key to return to the Utility Function Mode main menu

6.15 Resetting Configuration Error of Option Module (Fn014)

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

This function resets these alarms.

For alarm types and corrective actions, refer to *8 Troubleshooting*.

Note 1. Alarms related to option cards can be cleared only this function. These alarms cannot be cleared by alarm reset or turning OFF the main circuit power supply.
2. Before clearing the alarm, perform corrective action for the alarm.

(1) Operating Procedure

Follow the steps below.

Step	Display Example	Keys	Description
1	RUN –FUNCTION– Fn013:MturnLmSet Fn014:Opt Init Fn01B:Vibl_vl Init Fn01E:SvMotOp ID	MODE/SET ∧ ∨	Press the ∨ or ∧ Key to select Fn014. Then, press the MODE/SET key.
2	BB –Opt Init– Command Opt Initialize Start :[DATA] Return:[SET]	DATA	Press the DATA Key to select an option card to be cleared. Note: If the display is not switched and "NO-OP" is displayed in the status display, the Write Prohibited Setting (Fn010 = 0001) is set. Check the setting and reset.
3	DONE –Opt Init– Command Opt Initialize Start :[DATA] Return:[SET]	DATA	Press the DATA Key to clear the configuration error of the option card.
5	RUN –FUNCTION– Fn013:MturnLmSet Fn014:Opt Init Fn01B:Vibl_vl Init Fn01E:SvMotOp ID	MODE/SET	Press the MODE/SET key to return to the Utility Function Mode main menu.
6	Turn OFF the power and then turn it ON again to validate the new setting.		

6.16 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 Pn384.

Step	Display Example	Keys	Description
1	RUN –FUNCTION– Fn014:Opt Init Fn01B:Vibl_vl Init Fn01E:SvMotOp ID Fn01F:FBOpMot ID	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn01B.
2	RUN Vibration Detect Level Init Start : [DATA] Return: [SET]	DATA	Press the DATA Key. The display is switched to the execution display of Fn01B. Note: If the display is not switched and "NO-OP" is displayed in the status display, the Write Prohibited Setting (Fn010 = 0001) is set. Check the setting and reset.
3	RUN Vibration Detect Level Init Init	DATA	Press the DATA Key. "Init" is displayed blinking, and the vibration level is detected and initialized. Continues initialization until the DATA Key is pressed again. Note: • Use the actual reference for this operation. • If the servomotor turns at 10% or less of the maximum number of movements, the vibrations cannot be detected correctly and an error will occur.

Step	Display Example	Keys	Description
4	Done Vibration Detect Level Init Done	DATA	Press the DATA Key. The display changes from "Init" to "Done," and the setting becomes enabled.
5	RUN –FUNCTION– Fn014:Opt Init Fn01B:Vibl_vl Init Fn01E:SvMotOp ID Fn01F:FBOpMot ID	MODE/SET	Press the MODE/SET key to return to the Utility Function Mode main menu.

(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.		

6.17 Display of SERVOPACK and Servomotor ID (Fn01E)

This function displays ID information for SERVOPACK, servomotor, encoder and option card connected to the SERVOPACK.

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.

6.18 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.

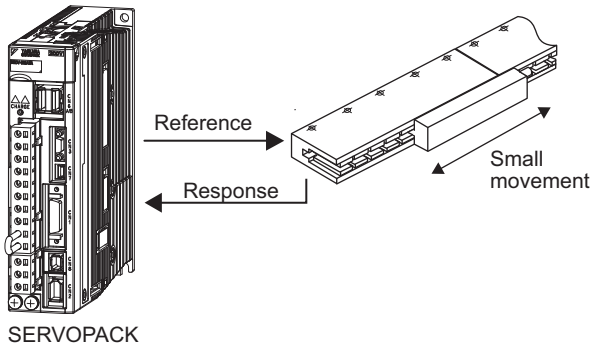
⚠ CAUTION

- 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.

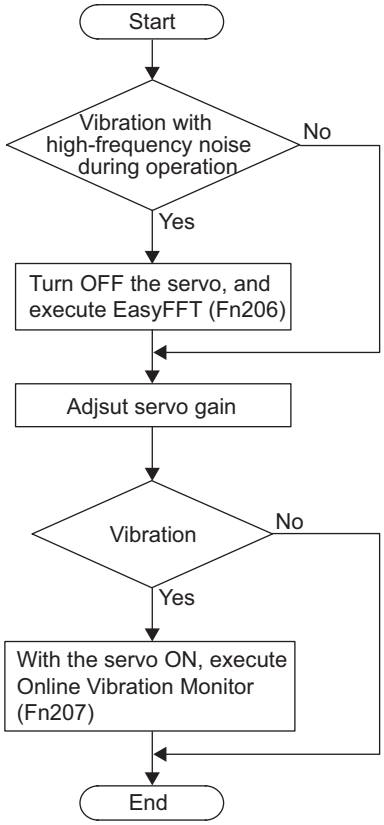
This function detects and sets the frequency as a parameter for the notch filter according to the machine characteristics. This setting function is called EasyFFT.

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 Example	Keys	Description
1	BB −FUNCTION− Fn205:Vib Sup Fn206:Easy FFT Fn207:V-Monitor Fn000:Alm History	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn206.
2	BB −Easy FFT− Setting Input = 015%	DATA	Press the DATA Key. The display is switched to the execution display of Fn206. Note: If the display is not switched and "NO-OP" is displayed in the status display, change the following settings. •If Write Prohibited is set: → Cancel the Write Prohibited setting. •If the servo is ON, → Send an SV_OFF command.

Step	Display Example	Keys	Description
3	BB −Easy FFT− Setting Input = 015%	∧ ∨	The cursor is on the setting of "Input." Press the ∧ or ∨ Key to set the sweep force reference amplitude (Pn456) Setting range: 1 to 800. Note: When making the initial settings for EasyFFT, do not change the setting for the reference amplitude. Start with the original value of 15. Increasing reference amplitude increases the detection accuracy, but the vibration and noise from the machine will increase. Increase the amplitude value little by little.
4	RUN −Easy FFT− Ready Input = 015%	JOG SVON	Press the JOG SVON Key to turn ON the power to the servomotor. The display "BB" and "Setting" changes to "RUN" and "Ready."
5	RUN −Easy FFT− Measure Input = 015%	∧ ∨	Press the ∧ (forward run start) Key or ∨ (reverse run start) Key to run the servomotor and start the frequency measurement. "Measure" is displayed during the measurement. Within 10 mm, the servomotor will move forward and then in reverse several times. The total operation time is between 1 and 45 seconds. Note: The actions of the servomotor are very minute in this operation. Also at the same time, the servomotor emits a noise. To ensure safety, do not enter the working envelope of the motor.
6	RUN −Easy FFT− Result Input = 015 % Res = 1250 Hz Filter1 1375 Hz	JOG SVON	When the detection processing has completed normally, the result and the notch filter value to be set are displayed. Press the JOG SVON Key after the detection to turn OFF the power to the servomotor. < Important > If two seconds or more are required for the operation although detection was successfully completed, the detection accuracy might be insufficient. Increasing reference amplitude more than 15 increases the detection accuracy, but the vibration and noise from the machine will increase. Increase the amplitude value little by little. Notes: • If a notch filter has been set and is being used, "*" is displayed on the second line. • If the first stage notch filter has been set, the second stage notch filter value is displayed. If the first and second stage notch filters have been set, only the result of frequency detection is displayed. • If the JOG SVON Key is pressed while the servomotor is running, the servomotor will stop, and the frequency detection will be canceled. • If the detection processing is not completed normally, "No Measure" is displayed.
7	RUN −Easy FFT− Ready Input = 015%	MODE/SET >	Press the MODE/SET Key to exit the EasyFFT function at this stage. The power to the servomotor is turned OFF and the display returns to the Utility Function Mode main menu. Press the > Key to return to "Ready" display.

Step	Display Example	Keys	Description
8	Done −Easy FFT− Result Input = 015 % Res = 1250 Hz Filter1 1375 Hz	DATA	Press the DATA Key after the normal completion of frequency detection. The notch filter frequencies are updated to the optimum values. If the first stage notch filter frequency has been set, set the second stage notch filter frequency (Pn 40C) to Pn 408 = n.□□□1 . Notes: • If the second stage notch filter frequency has already been set, the notch filter frequency cannot be set in Pn408 = n.□1□□. • If the frequency detected by this function is not used, set the notch filter to be invalid (Pn408 = n.□□□0).
9	BB −FUNCTION− Fn205:Vib Sup Fn206:Easy FFT Fn207:V-Monitor Fn000:Alm History	MODE/SET	Press the MODE/SET Key to return to the Utility Function Mode main menu.

(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

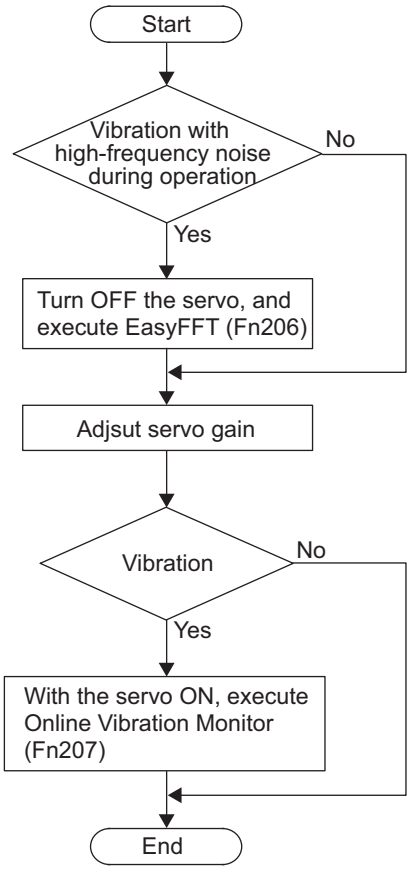
Pn40C	2nd Notch Filter Frequency	Speed	Position	Force	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning

6.19 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 Example	Keys	Description
1	RUN −FUNCTION− Fn206:Easy FFT Fn207:V-Monitor Fn000:Alm History Fn001:JOG	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn207.
2	RUN −V−MONITOR− Measure F1=−−−− F2=−−−− F3=−−−−	DATA	Press the DATA Key. The display is switched to the execution display of Fn207. Note: If the display is not switched and "NO-OP" is displayed in the status display, the Write Prohibited Setting (Fn010 = 0001) is set. Check the setting and reset.
3	RUN −V−MONITOR− Measure F1=−−−− F2=−−−− F3=−−−−	DATA	Press the DATA Key for one second. The message, "Measure," blinks, and vibration detection will start.
4	RUN −V−MONITOR− Measure F1= 0850 [Hz] F2= 1600 [Hz] F3= 0225 [Hz]		When the vibration detection has completed, "Measure" stops blinking and the detection processing ends automatically. When the detection processing has completed normally, the vibrations with three largest peak values in vibration frequency are displayed as F1, F2, and F3. Notes: • Press the MODE/SET Key to exit the online vibration monitor function. The display returns to the Utility Function Mode main menu. • Up to three detected frequency is displayed. For the vibration with undetectable peak frequency, "----" is displayed. If no frequency was detected, "----" is displayed for F1, F2, and F3. • If the detection could not be completed normally, "NO MONITOR" is displayed.
5	Done −V−MONITOR− SETTING DONE F1= 0850 [Hz] F2= 1600 [Hz] F3= 0225 [Hz]	DATA	After the detection has normally completed, press the DATA Key. The optimum frequency (time constant) of notch filter or force reference filter for F1 is set automatically. At the same time, the parameter Pn409 is updated for a notch filter, or the parameter Pn401 is updated for a force reference filter.
6	RUN −FUNCTION− Fn206:Easy FFT Fn207:V-Monitor Fn000:Alm History Fn001:JOG	MODE/SET	Press the MODE/SET Key to return to the Utility Function Mode main menu.

(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

6.20 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 Example	Keys	Description
1	BB –FUNCTION– Fn020:S–Orig Set Fn030:Soft Reset Fn080:Pole Detect Fn200:TuneLvl Set	MODE/SET ∧ ∨	Press the MODE/SET Key to open the Utility Function Mode main menu and select Fn030.
2	BB Software Reset RESET1	DATA	Press the DATA Key. The display switches to the execution display of Fn030.
3	BB Software Reset RESET5	∧ ∨	Press the ∧ or ∨ Key to select RESET5.
4	BB Software Reset	DATA	Press the DATA Key to execute the software reset. "RESET5" is no longer displayed.
5	File First Loading Please Wait...		After the reset has been successfully completed, the screen which appears when the power is turned ON will be displayed. Then, the mode changes to the parameter/monitor display mode.
6	BB –FUNCTION– Fn020:S–Orig Set Fn030:Soft Reset Fn080:Pole Detect Fn200:TuneLvl Set	MODE/SET	Press the MODE/SET Key to return to the Utility Function Mode main menu.

7

Monitor Modes (Un□□□)

7.1 List of Monitor Modes

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

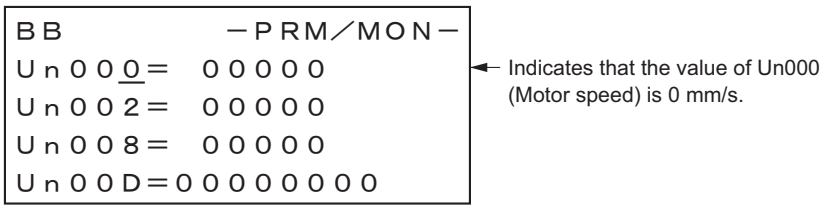
Refer to the following table.

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)	pulses from the origin
Un004	Electric angle 2 (Electric angle from the origin)	deg
Un005	Input signal monitor	–
Un006	Output signal monitor	–
Un007	Input reference 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	Input reference counter (decimal, 10-digit display)	reference unit
Un00D	Feedback pulse counter (encoder pulses × 4 (multiplier): 32-bit decimal code)	encoder pulse
Un011	Hall sensor signal monitor	–
Un012	Total operation time	100 ms
Un013	Feedback pulse counter (decimal, 10-digit display)	reference unit
Un014	Effective gain monitor	–
Un015	Safety I/O signal monitor	–
Un020	Motor rated speed	mm/s
Un021	Motor maximum speed	mm/s
Un084	Linear scale pitch	pm
Un085	Linear scale pitch index	exponential in decimal

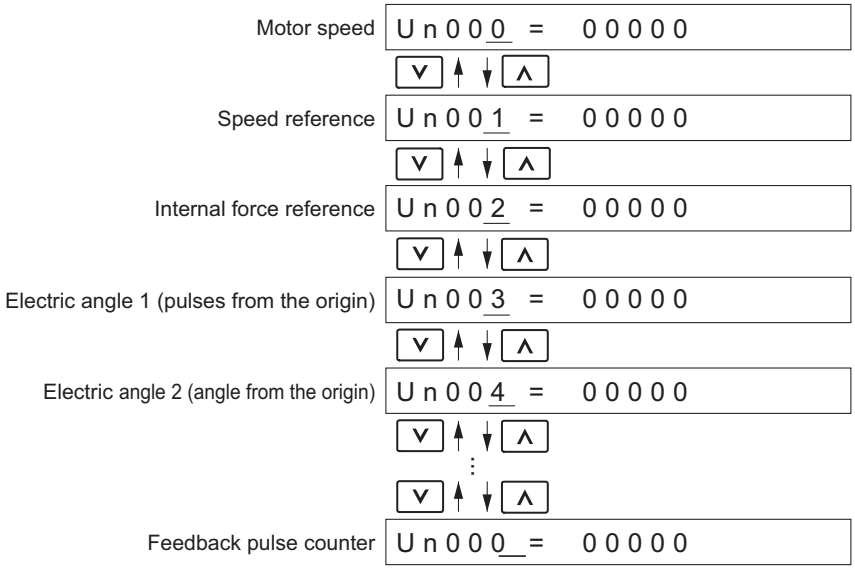
7.2 Monitor Mode Display

Monitor mode can be checked in the Parameter/Monitor Mode (-PRM/MON-) window.

The following figure shows four factory settings that are first displayed if using monitor mode.



To view any items that are not shown, press the [∧] or [∨] Key to scroll through the list in monitor mode.



8

Troubleshooting

8.1 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 *8.1.1 List of Alarms*.

The causes of alarms and troubleshooting methods are provided in *8.1.2 Troubleshooting of Alarms*.

8.1.1 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.

Alarm Display	Alarm Name	Meaning	Servo-motor Stop Method	Alarm Reset
A.020	Parameter Checksum Error 1	The data of the parameter in the SERVO-PACK is incorrect.	Gr.1	N/A
A.021	Parameter Format Error 1	The data of the parameter in the SERVO-PACK is incorrect.	Gr.1	N/A
A.022	System Checksum Error 1	The data of the parameter in the SERVO-PACK is incorrect.	Gr.1	N/A
A.023	Parameter Password Error 1	The data of the parameter in the SERVO-PACK is incorrect.	Gr.1	N/A
A.030	Main Circuit Detector Error	Detection data for power circuit is incorrect.	Gr.1	Available
A.040	Parameter Setting Error 1	The parameter setting is outside the allowable setting range.	Gr.1	N/A
A.041	Encoder Output Pulse Setting Error	The encoder output pulse setting (pulse unit) (Pn212) is outside the allowable setting range or not satisfies the setting conditions.	Gr.1	N/A
A.042	Parameter Combination Error	Combination of some parameters exceeds the setting range.	Gr.1	N/A
A.044	Fully-closed Loop Control Parameter Setting Error	The settings of the option card and Pn00B.3, Pn002.3 do not match.	Gr.1	N/A
A.04A	Parameter Setting Error 2	Bank member/bank data setting is incorrect.	Gr.1	N/A
A.050	Combination Error	The SERVOPACK and the servomotor capac-ities do not match each other.	Gr.1	Available
A.051	Unsupported Device Alarm	The device unit unsupported was connected.	Gr.1	N/A
A.080	Linear Scale Pitch Setting Error	The setting of the linear scale pitch (Pn282) has not been changed from the default setting.	Gr.1	N/A
A.0b0	Cancelled Servo ON Command Alarm	The Host controller reference was sent to turn the Servo ON after the Servo ON function was used with the utility function.	Gr.1	Available
A.100	Overcurrent or Heat Sink Overheated	An overcurrent flowed through the IGBT. Heat sink of the SERVOPACK was over-heated.	Gr.1	N/A
A.300	Regeneration Error	Regenerative circuit or regenerative resistor is faulty.	Gr.1	Available
A.320	Regenerative Overload	Regenerative energy exceeds regenerative resistor capacity.	Gr.2	Available

Alarm Display	Alarm Name	Meaning	Servo-motor Stop Method	Alarm Reset
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
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
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
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
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	Available
A.891	Encoder Module Error	Encoder module is faulty.	Gr.1	N/A
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.b6A	MECHATROLINK Communications ASIC Error 1	ASIC error occurred in the MECHATROLINK communications.	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

Alarm Display	Alarm Name	Meaning	Servo-motor Stop Method	Alarm Reset
A.bF3	System Alarm 3	"Internal program error 3" of the SERVO-PACK occurred.	Gr.1	N/A
A.bF4	System Alarm 4	"Internal program error 4" of the SERVO-PACK occurred.	Gr.1	N/A
A.C10	Servo Overrun Detected	The servomotor ran out of control.	Gr.1	Available
A.C20	Phase Detection Error	The detection of the phase is incorrect.	Gr.1	N/A
A.C21	Hall Sensor Error	The hall sensor is faulty.	Gr.1	N/A
A.C22	Phase Information Disagreement	The phase information does not match.	Gr.1	N/A
A.C50	Polarity Detection Error	The polarity detection failed.	Gr.1	N/A
A.C51	Overtravel Detection at Polarity Detection	The overtravel signal was detected at polarity detection.	Gr.1	N/A
A.C52	Polarity Detection Uncompleted	The servo was turned ON under the condition of polarity detection uncompleted.	Gr.1	N/A
A.C53	Out of Range for Polarity Detection	The moving distance exceeded the set value of Pn48E during polarity detection.	Gr.1	N/A
A.C54	Polarity Detection Error 2	The polarity detection failed.	Gr.1	N/A
A.C80	Absolute Encoder Clear Error	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
A.d00	Position Error Pulse Overflow	Position error pulses exceeded parameter (Pn520).	Gr.1	Available
A.d01	Position Error Pulse Overflow Alarm at Servo ON	Position error pulses accumulated too much.	Gr.1	Available
A.d02	Position Error Pulse Overflow Alarm by Speed Limit at Servo ON	If the servo turns ON with position error pulses accumulated, the speed is limited by Pn529. In this state, the reference was input without resetting the speed limit, and the position error pulses exceeds the value set for the parameter Pn520.	Gr.2	Available
A.d30	Position Data Overflow	The position data exceeded ±1879048192.	Gr.1	N/A
A.E02	MECHATROLINK-II Internal Synchronization Error 1	Synchronization error during MECHA-TROLINK-II communications with the SER-VOPACK.	Gr.1	Available
A.E40	MECHATROLINK-II Transmission Cycle Setting Error	The setting of the MECHATROLINK-II transmission cycle is out of the allowable range.	Gr.2	Available
A.E50	MECHATROLINK-II Synchronization Error	A synchronization error occurs during MECHATROLINK-II communications.	Gr.2	Available
A.E51	MECHATROLINK-II Synchronization Failed	A synchronization failure occurs in MECHA-TROLINK-II communications.	Gr.2	Available
A.E60	MECHATROLINK-II Communications Error (Reception error)	A communications error occurs continuously during MECHATROLINK-II communica-tions.	Gr.2	Available

Alarm Display	Alarm Name	Meaning	Servo-motor Stop Method	Alarm Reset
A.E61	MECHATROLINK-II Transmission Cycle Error (Synchronization interval error)	The transmission cycle fluctuates during MECHATROLINK-II communications.	Gr.2	Available
A.EA2	DRV Alarm 2 (SERVOPACK WDT error)	A SERVOPACK DRV alarm 0 occurs.	Gr.2	Available
A.Eb1	Safety Function Signal Input Timing Error	The safety function signal input timing is faulty.	Gr.1	N/A
A.ED1	Command Execution Timeout	A timeout error occurred when using a MECHATROLINK command.	Gr.1	N/A
A.F10	Main Circuit Cable Open Phase	With the main power supply ON, voltage was low for more than 1 second in phase-R, -S or -T.	Gr.2	Available
CPF00	Digital Operator Transmission Error 1	Digital operator (JUSP-OP05A) fails to communicate with the SERVOPACK (e.g., CPU error).	–	N/A
CPF01	Digital Operator Transmission Error 2		–	N/A
A.– –	Not an error	Normal operation status	–	–

8.1.2 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 Pn585 "Program JOG Movement Speed."	Check that the detection conditions is satisfied.*1	Increase the setting for Pn585 "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 card does not match with those of Pn00B.3 and Pn002.3.	Check the settings of the option card, Pn00B.3, and Pn002.3.	The setting of option card must be compatible with the settings of Pn00B.3 and Pn002.3. Mount an option card or replace the mounted option card with an appropriate model. Or change the parameter setting.
A.04A: Parameter Setting Error 2	The bank member settings for Pn902 to Pn910 are incorrect.	–	Change the settings for bank members to an appropriate value.
	The total amount of bank data exceeds 64. (Pn900 × Pn901 > 64)	–	Reduce the total amount of bank data to 64 or less.
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.

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

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

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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.
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 *3.7 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 servodrive specifications.	Reduce the load applied to the servomotor or increase the operation speed.
	Malfunction caused by noise interference.	Improve the wiring or installation environment, such as by reducing noise, and check to see if the alarm recurs.	Take countermeasures for noise, such as correct wiring of the FG. Use an FG wire size equivalent to the SERVOPACK main circuit wire size.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.100: Overcurrent or Heat Sink Overheated (An overcurrent flowed through the IGBT or heat sink of SERVOPACK overheated.) (cont'd)	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.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 SigmaSize+, etc.	Change the regenerative resistance, regenerative resistor capacity, or SERVOPACK capacity. Reconsider the operation conditions using the capacity selection software SigmaSize+, etc.
	Regenerative power continuously flowed back because negative load was continuously applied.	Check the load to the servomotor during operation.	Reconsider the system including servo, machine, and operation conditions.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.320: Regenerative Overload (cont'd)	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.
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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.400: Overvoltage (Detected when the SERVOPACK's main circuit DC voltage is one of the values below. 100 and 200 VAC SERVOPACKs: 410 VDC or more 400 VAC SERVOPACKs: 820 VDC or more) (Detected when the power to the main circuit is turned ON) (cont'd)	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.
A.410: Undervoltage (Detected when the SERVOPACK's main circuit DC voltage is one of the values below. 100 VAC SERVOPACKs: 146 VDC or less 200 VAC SERVOPACKs: 170 VDC or less 400 VAC SERVOPACKs: 340 VDC or less.) (Detected when the power to the main circuit is turned ON.)	For 200 VAC SERVOPACKs: The power supply is 120 V or less. For 400 VAC SERVOPACKs: The power supply is 240 V or less.	Measure the power supply voltage.	Set the power supply voltage within the specified range.
	The power supply voltage dropped during operation.	Measure the power supply voltage.	Increase the power supply capacity.
	Occurrence of instantaneous power interruption.	Measure the power supply voltage.	Set the power supply voltage within the specified range. When the instantaneous power cut hold time Pn509 is set, decrease the setting.
	The SERVOPACK fuse is blown out.	–	Repair or replace the 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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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.
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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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.
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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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.
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.b6A: MECHATROLINK Communications ASIC Error 1	SERVOPACK MECHATROLINK communication section fault.	–	Replace the SERVOPACK.
A.bF0: System Alarm 0	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. • An absolute linear scale is being used. • The polarity detection selection for the absolute linear scale was set to not execute. (Pn587.0 = 0) • Polarity was not yet detected.	–	When using an absolute linear scale, set the parameter Pn587.0 to 1 to execute polarity detection.
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).

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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.
A.C80: Absolute Encoder Clear Error (Multi-turn Limit Setting Error)	An encoder fault occurred.	–	Turn the power supply OFF and then ON again. If the alarm still occurs, the servomotor may be faulty. Repair or replace the servomotor.
	A SERVOPACK fault occurred.	–	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
	Origin setting (Fn020) was not executed correctly.	–	Turn the power supply OFF and then ON again. Then execute origin setting (Fn020).
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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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.
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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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.
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 counter (Un00C).	Reconsider the operating specifications.
A.E02: MECHATROLINK-II Internal Synchronization Error 1	MECHATROLINK-II transmission cycle fluctuated.	–	Remove the cause of transmission cycle fluctuation at host controller.
	A SERVOPACK fault occurred.	–	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.E40: MECHATROLINK-II Transmission Cycle Setting Error	Setting of MECHATROLINK-II transmission cycle is out of specifications range.	Check the MECHATROLINK-II transmission cycle setting.	Set the transmission cycle to the proper value.
A.E50: MECHATROLINK-II Synchronization Error	WDT data of host controller was not updated correctly.	Check the WDT data updating for the host controller.	Update the WDT data at the host controller correctly.
A.E51: MECHATROLINK-II Synchronization Failed	WDT data of host controller was not updated correctly at the synchronization communications start, and synchronization communications could not start.	Check the WDT data updating for the host controller.	Update the WDT data at the host controller correctly.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
A.E60: MECHATROLINK-II Communications error	MECHATROLINK-II wiring is incorrect.	Check the MECHATROLINK-II wirings.	Correct the MECHATROLINK-II wiring. Connect the terminator correctly.
	MECHATROLINK-II data reception error occurred due to noise interference.	–	Take measures against noise. Check the MECHATROLINK-II communications cable and FG wiring and take measures such as adding ferrite core on the MECHATROLINK-II communications cable.
	A SERVOPACK fault occurred.	–	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.E61: MECHATROLINK-II Transmission Cycle Error	MECHATROLINK-II transmission cycle fluctuated.	Check the MECHATROLINK-II transmission cycle setting.	Remove the cause of transmission cycle fluctuation at host controller.
	A SERVOPACK fault occurred.	–	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.EA2: DRV Alarm 2	A parameter was changed by the digital operator or the personal computer during MECHATROLINK-II communications.	Confirm the way the parameters are edited.	Stop changing parameters using digital operator or personal computer during MECHATROLINK-II communications.
	MECHATROLINK-II transmission cycle fluctuated.	Check the MECHATROLINK-II transmission cycle setting.	Remove the cause of transmission cycle fluctuation at host controller.
	A SERVOPACK fault occurred.	–	Turn the power supply OFF and then ON again. If the alarm still occurs, the SERVOPACK may be faulty. Repair or replace the SERVOPACK.
A.Eb1: 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.ED1: Command Execution Timeout	A timeout error occurred when using an MECHATROLINK command.	Check the motor status when the command is executed.	Execute the SV_ON or SENS_ON command only when the motor is not running.
		Check the linear scale status when the command is executed.	Execute the SENS_ON command only when an external scale is connected.
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.

Alarm: Alarm Name	Cause	Investigative Actions	Corrective Actions
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.

8.2 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 *8.2.1 List of Warnings*.

The causes of alarms and troubleshooting methods are provided in *8.2.2 Troubleshooting of Warnings*.

8.2.1 List of Warnings

The relation between warning displays and warning code outputs are shown below.

Warning Display	Warning Name	Meaning
A.900	Position Error Pulse Overflow	Position error pulse exceeded the parameter settings (Pn520×Pn51E/100).
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).
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.
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.
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.
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.
A.94A	Data Setting Warning 1 (Parameter Number Error)	Incorrect command parameter number was set.
A.94B	Data Setting Warning 2 (Out of Range)	Command input data is out of range.
A.94C	Data Setting Warning 3 (Calculation Error)	Calculation error was detected.
A.94D	Data Setting Warning 4 (Parameter Size)	Data size does not match.
A.94E	Data Setting Warning 5 (Latch Mode Error)	Latch mode error is detected.
A.95A	Command Warning 1 (Unsatisfying Command)	Command was sent although the conditions for sending a command were not satisfied.
A.95B	Command Warning 2 (Non-supported Command)	Unsupported command was sent.
A.95D	Command Warning 4 (Command Interference)	Command, especially latch command, interferes.
A.95E	Command Warning 5 (Subcommand Disable)	Subcommand and main command interfere.
A.95F	Command Warning 6 (Undefined Command)	Undefined command was sent.
A.960	MECHATROLINK Communications Warning	Communications error occurred during MECHATROLINK communications.
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.

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.

8.2.2 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 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.94A	Data Setting Warning 1 (Parameter Number Error)	Disabled parameter number was used.	–	Use the correct parameter number.
A.94B	Data Setting Warning 2 (Out of Range)	Attempted to send values outside the range to the command data.	–	Set the value of the parameter within the allowable range.
A.94C	Data Setting Warning 3 (Calculation Error)	Calculation result of set value is incorrect.	–	Set the value of the parameter within the allowable range.
A.94D	Data Setting Warning 4 (Parameter Size)	Parameter size set in command is incorrect.	–	Use the correct parameter size.
A.94E	Data Setting Warning 5 (Latch mode error)	Latch mode error is detected.	–	Change the setting value of Pn850 or the LT_MOD data for the LTMOD_ON command sent by the host controller to the proper value.
A.95A	Command Warning 1	Command sending condition is not satisfied.	–	Send a command after command sending condition is satisfied.
A.95B	Command Warning 2	SERVOPACK received unsupported command.	–	Do not sent an unsupported command.
A.95D	Command Warning 4	Command sending condition for latch-related commands is not satisfied.	–	Send a command after command sending condition is satisfied.
A.95E	Command Warning 5	Subcommand sending condition is not satisfied.	–	Send a command after command sending condition is satisfied.
A.95F	Command Warning 6 (Undefined Command)	Undefined command was sent.	–	Do not use an undefined command.

Warning Display	Warning Name	Situation at Warning Occurrence	Cause	Corrective Actions
A.960	MECHATROLINK Communications Warning	MECHATROLINK-II wiring is incorrect.	Confirm the wiring.	Correct the MECHATROLINK-II wiring. Or, connect a terminal to the terminal station.
		MECHATROLINK-II data reception error occurred due to noise interference.	Confirm the installation conditions.	Take measures against noise. Check the MECHATROLINK-II communications cable and FG wiring and take measures such as adding ferrite core on the MECHATROLINK-II communications cable.
		A SERVOPACK fault occurred.	–	A fault occurred in the SERVOPACK. Repair or replace the SERVOPACK.
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.

8.3 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.
	The SERVOPACK enters a hard wire baseblock state.	Check if the connector CN8 is properly inserted and connected.	Correct the connector CN8 connection.
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."
	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.
	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.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Linear Servomotor Moves Without Reference Input	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.
	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.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Abnormal Noise from Servomotor (cont'd)	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 frequency is too high.	Check Un00C (Input Reference Counter.)	Reduce the reference 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.

9

Appendix

9.1 List of Parameters

9.1.1 Utility Functions

The following list shows the available utility functions.

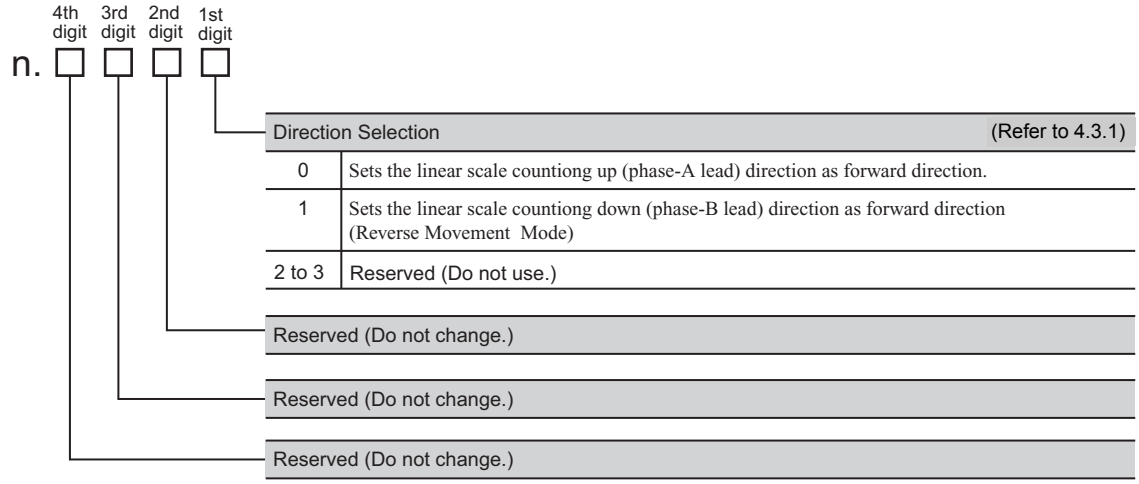
Function No.	Function	Reference Section
Fn000	Alarm traceback data display	6.2
Fn002	JOG operation	6.3
Fn003	Origin search	6.4
Fn004	Program JOG operation	6.5
Fn005	Initializes parameter settings	6.6
Fn006	Clears alarm traceback data	6.7
Fn00C	Manual zero-adjustment of analog monitor output	6.8
Fn00D	Manual gain-adjustment of analog monitor output	6.9
Fn00E	Automatic offset-adjustment of motor current detection signal	6.10
Fn00F	Manual offset-adjustment of motor current detection signal	6.11
Fn010	Write prohibited setting	6.12
Fn011	Checks servomotor models	6.13
Fn012	Software version display	6.14
Fn014	Resets configuration error of option module	6.15
Fn01B	Initializes vibration detection level	6.16
Fn01E	Display of SERVOPACK and Servomotor ID	6.17
Fn200	Tuning-less level setting	5.2.2
Fn201	Advanced autotuning	5.3.2
Fn202	Advanced autotuning by reference	5.4.2
Fn203	One-parameter tuning	5.5.2
Fn204	Anti-resonance control adjustment function	5.6.2
Fn205	Vibration suppression function	5.7.2
Fn206	EasyFFT	6.18
Fn207	Online vibration monitor	6.19
Fn020	Origin setting*	–
Fn030	Software reset	6.20
Fn080	Polarity Detection*	–

* For details, refer to *Σ-V Series User's Manual Setup Linear Motor* (SIEPS80000044).

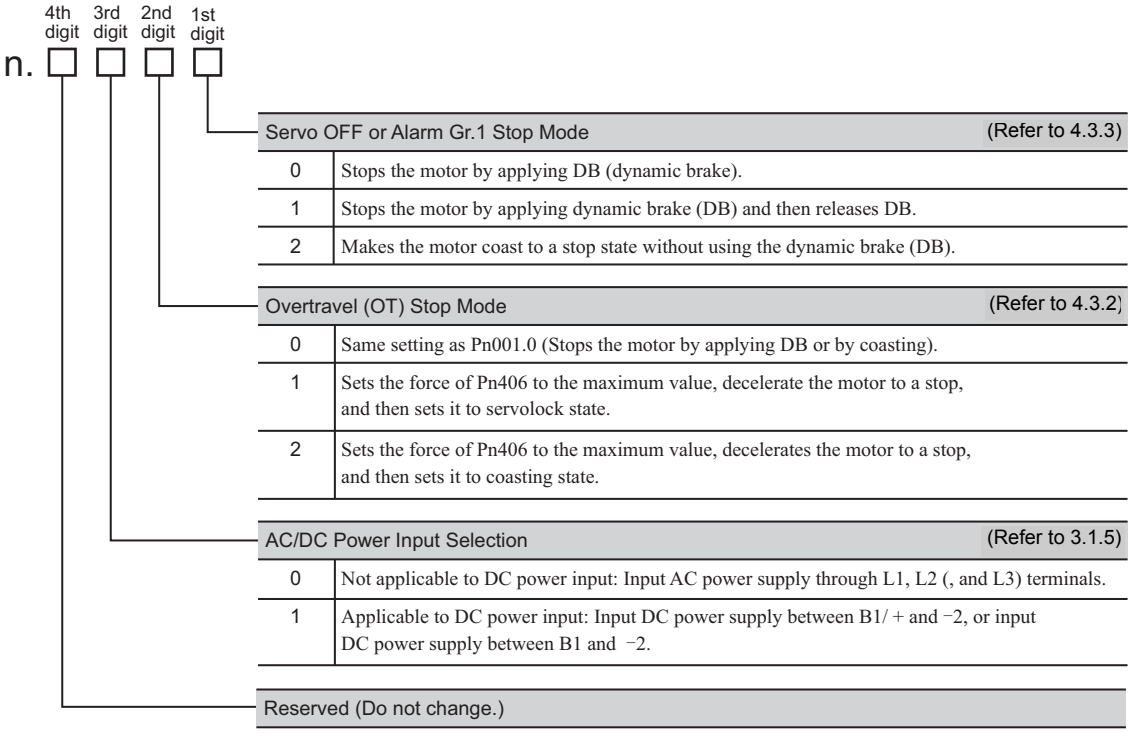
Note: If the write prohibited setting (Fn010) is enabled, "NO-OP" is displayed on the status display of the Digital Operator if the user attempts to execute the above utility functions. For details, refer to *6.12 Write Prohibited Setting (Fn010)*.

9.1.2 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	–



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	–



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: MECHATROLINK Command Position and Speed Control Option

0	The set value of P_TLIM, NTLIM, and TFF are ignored.
1	P_TLIM and NTLIM operate as the force limit values.
2	TFF operates as the force feed forward.
3	When P-CL and N-CL are available, P_TLIM and NTLIM operate as the force limit value.

2nd digit: Force Control Option

0	V_LIM is not available.
1	V_LIM operates as the speed limit value.

3rd digit: Absolute Encoder Usage

0	Uses absolute encoder as an absolute encoder.
1	Uses absolute encoder as an incremental encoder.

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)

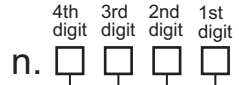
1st and 2nd digits: Analog Monitor 1 Signal Selection (Refer to 5.1.3)

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)

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	–



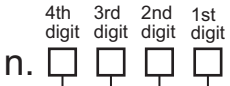
Analog Monitor 1 Signal Selection (Refer to 5.1.3)

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)

Reserved (Do not change.)

Reserved (Do not change.)

Pn008	Application Function Select Switch 8	0000 to 7121	–	4000	After restart	Setup	–



Reserved (Do not change.)

Function Selection at Main Circuit Voltage Drop (Refer to 4.3.6)

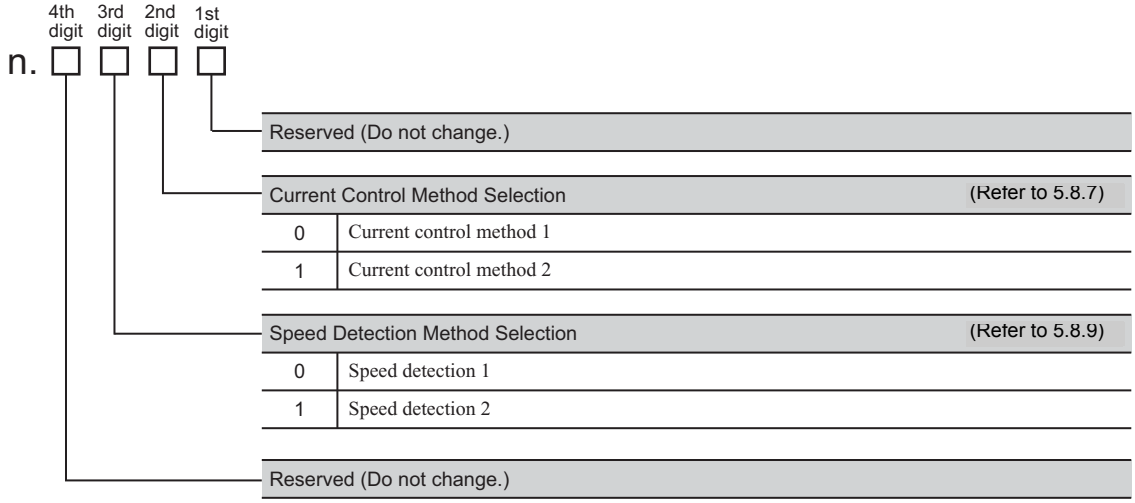
0	Disables detection of the main circuit voltage drop.
1	Detects warning and limits force by host controller.
2	Detects warning and limits force by Pn424 and Pn425.

Warning Detection Selection (Refer to 8.2.1)

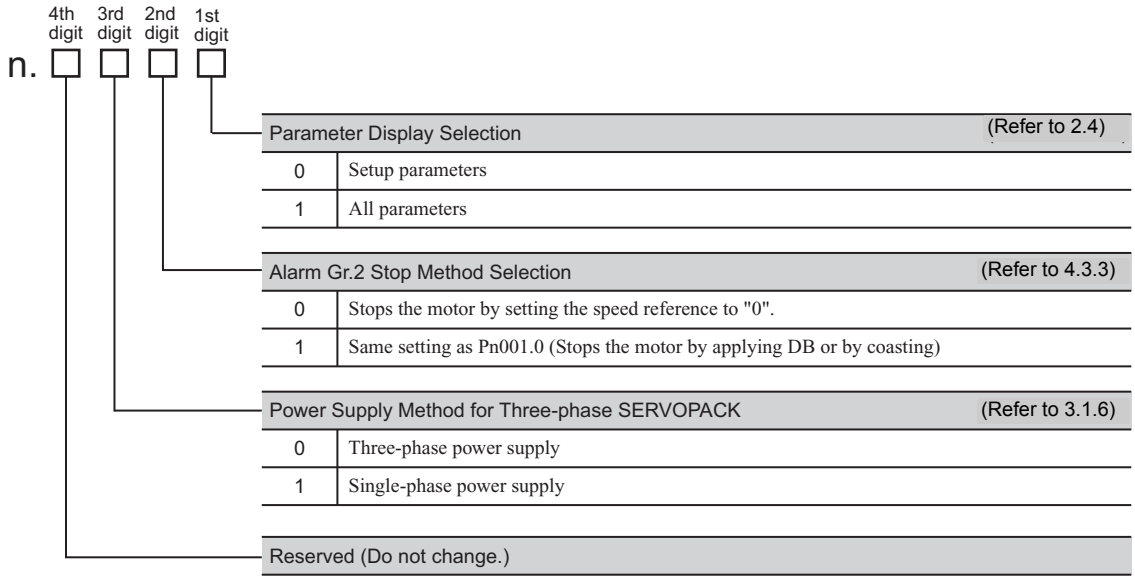
0	Detects warning.
1	Does not detect warning.

Reserved (Do not change.)

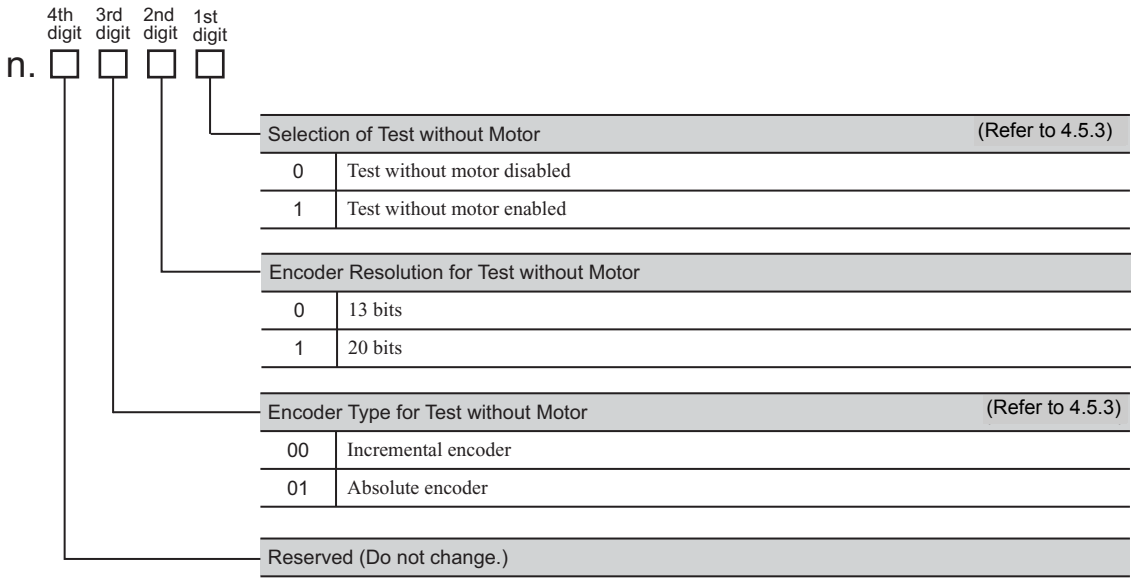
Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn009	Application Function Select Switch 9	0000 to 0111	–	0010	After restart	Tuning	–



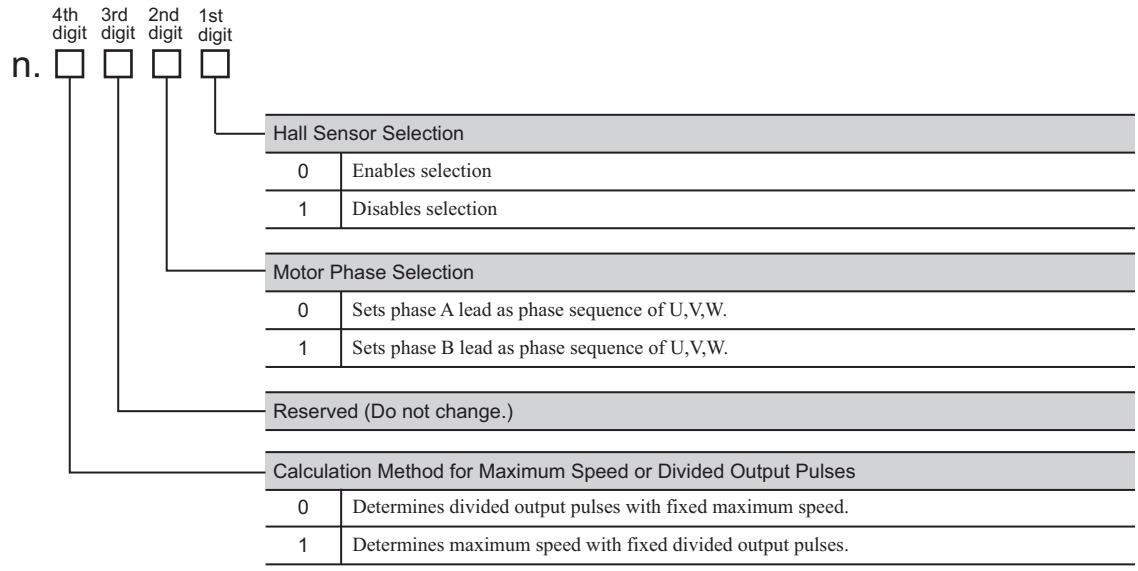
Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn00B	Application Function Select Switch B	0000 to 1111	–	0000	After restart	Setup	–



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	–

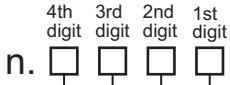


Pn080	Application Function Select Switch 80	0000 to 1111	–	0000	After restart	Setup	–



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	5.8.3
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	5.8.1
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	–



Mode Switch Selection (Refer to 5.8.2) — When Enabled: Immediately

0	Uses internal force reference as the condition (Level setting: Pn10C)
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

Speed Loop Control Method — When Enabled: After restart

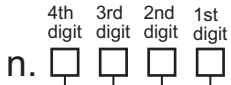
0	PI control
1	I-P control
2 and 3	Reserved (Do not change.)

Reserved (Do not change.)

Reserved (Do not change.)

Pn10C	Mode Switch (force reference)	0 to 800	1%	200	Immediately	Tuning	5.8.2
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	5.8.5
Pn121	Friction Compensation Gain	10 to 1000	1%	100	Immediately	Tuning	5.8.6
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	5.8.3
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	–



Gain Switching Selection Switch (Refer to 5.8.3)

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.

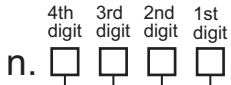
Gain Switching Condition A (Refer to 5.8.3)

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 input OFF
5	Position reference input ON

Reserved (Do not change.)

Reserved (Do not change.)

Pn13D	Current Gain Level	100 to 2000	1%	2000	Immediately	Tuning	5.8.8
Pn140	Model Following Control Related Switch	0000 to 1121	–	0100	Immediately	Tuning	–



Model Following Control Selection

0	Does not use model following control.
1	Uses model following control.

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.

Vibration Suppression Adjustment Selection (Refer to 5.3.1, 5.4.1, 5.5.1 and 5.7.1)

0	Does not adjust vibration suppression automatically using utility function.
1	Adjusts vibration suppression automatically using utility function.

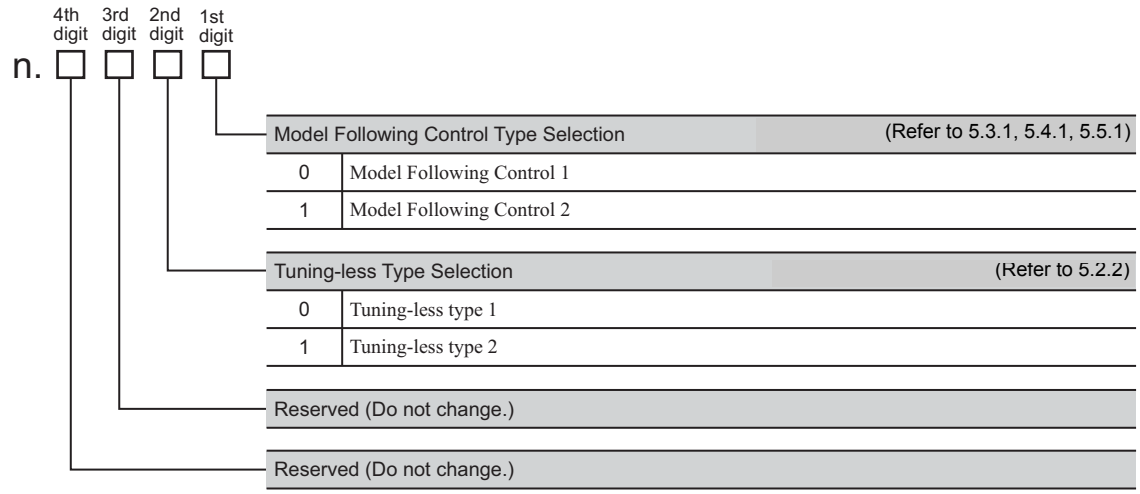
Selection of Speed Feedforward (VFF) / Force Feedforward (TFF) (Refer to 5.3.1, 5.4.1)

0	Does not use model following control and external speed/force feedforward together.
1	Uses model following control and external speed/force feedforward together.

Pn141	Model Following Control Gain	10 to 20000	0.1/s	500	Immediately	Tuning	–
Pn142	Model Following Control Gain Compensation	500 to 2000	0.1%	1000	Immediately	Tuning	–

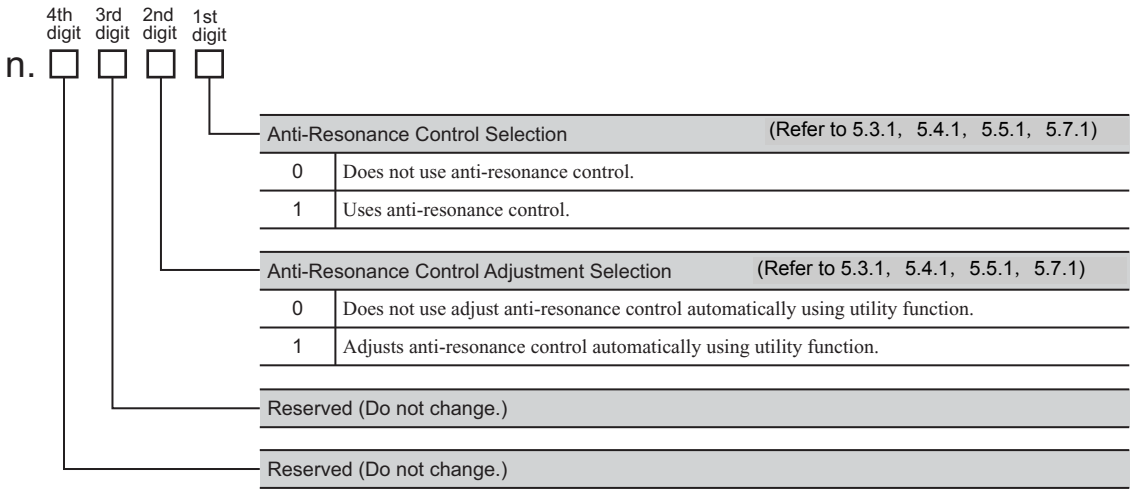
Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn143	Model Following Control Bias (Forward Direction)	0 to 10000	0.1%	1000	Immediately	Tuning	–
Pn144	Model Following Control Bias (Reverse Direction)	0 to 10000	0.1%	1000	Immediately	Tuning	–
Pn145	Vibration Suppression 1 Frequency A	10 to 2500	0.1 Hz	500	Immediately	Tuning	–
Pn146	Vibration Suppression 1 Frequency B	10 to 2500	0.1 Hz	700	Immediately	Tuning	–
Pn147	Model Following Control Speed Feedforward Compensation	0 to 10000	0.1%	1000	Immediately	Tuning	–
Pn148	2nd Model Following Control Gain	10 to 20000	0.1/s	500	Immediately	Tuning	–
Pn149	2nd Model Following Control Gain Compensation	500 to 2000	0.1%	1000	Immediately	Tuning	–
Pn14A	Vibration Suppression 2 Frequency	10 to 2000	0.1 Hz	800	Immediately	Tuning	–
Pn14B	Vibration Suppression 2 Compensation	10 to 1000	1%	100	Immediately	Tuning	–
Pn14F	Control Related Switch	0000 to 0011	–	0011	After restart	Tuning	–

Pn14F



Pn160	Anti-Resonance Control Related Switch	0000 to 0011	–	0010	Immediately	Tuning	–

Pn160



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	–

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn165	Anti-Resonance Filter Time Constant 2 Compensation	-1000 to 1000	0.01 ms	0	Immediately	Tuning	–
Pn170	Tuning-less Function Rated Switch	0000 to 2411	–	1401	–	Setup	5.2

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

Tuning-less Function Selection		When Enabled
0	Tuning-less function disabled	After restart
1	Tuning-less function enabled	

Control Method during Speed Control		When Enabled
0	Uses as speed control.	After restart
1	Uses as position control at host controller.	

Tuning-less Level		When Enabled
0 to 4	Sets tuning-less level.	Immediaately

Tuning-less Load Level		When Enabled
0 to 2	Sets tuning-less load level.	Immediaately

Pn181	Mode Switch (Speed Reference)	0 to 10000	1mm/s	0	Immediately	Tuning	5.8.2
Pn182	Mode Switch (Acceleration)	0 to 30000	1mm/s^2	0	Immediately	Tuning	5.8.2
Pn207	Position Control Function Switch	0000 to 2210	–	0010	After restart	Setup	–

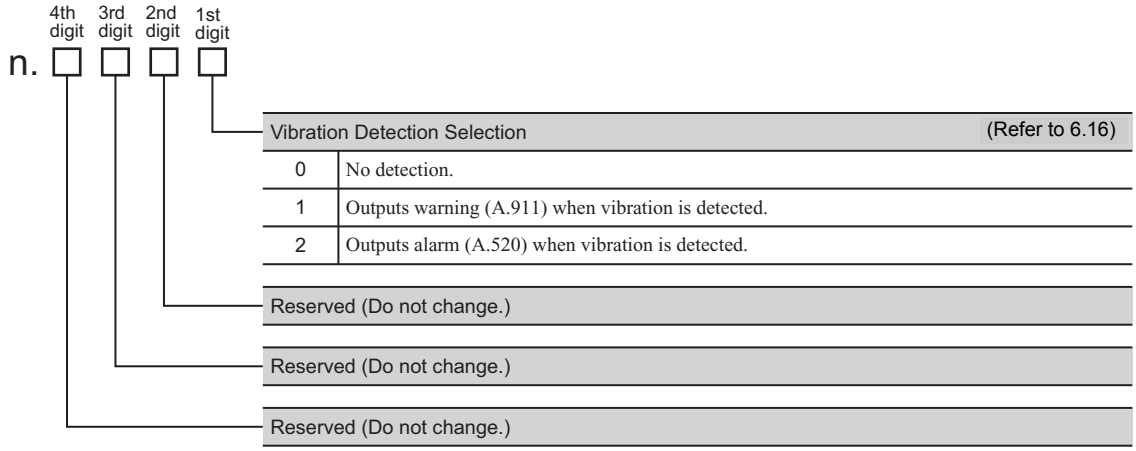
n. □ (4th digit) □ (3rd digit) □ (2nd digit) □ (1st digit)

Reserved (Do not change.)	
Reserved (Do not change.)	
Reserved (Do not change.)	
/COIN Output Timing	
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.

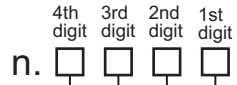
Pn20E	Electronic Gear Ratio (Numerator)	1 to 1073741824 (2^{30})	-	4	After restart	Setup	4.4.3
Pn210	Electronic Gear Ratio (Denominator)	1 to 1073741824 (2^{30})	-	1	After restart	Setup	
Pn281	Encoder Output Resolution	1 to 4096	1 P/pitch	20	After restart	Setup	–
Pn282	Linear Scale Pitch	0 to 65536	0.01 µm	0	After restart	Setup	–

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn305	Soft Start Acceleration Time	0 to 10000	1 ms	0	Immediately	Setup	–
Pn306	Soft Start Deceleration Time	0 to 10000	1 ms	0	Immediately	Setup	
Pn310	Vibration Detection Switch	0000 to 0002	–	0000	Immediately	Setup	–
Pn311	Vibration Detection Sensibility	50 to 500	1%	100	Immediately	Tuning	6.16
Pn324	Mass Calculating Start Level	0 to 20000	1%	300	Immediately	Setup	–
Pn383	JOG Speed	0 to 10000	1mm/s	50	Immediately	Setup	6.3
Pn384	Vibration Detection Level	0 to 5000	1mm/s	10	Immediately	Tuning	6.16
Pn385	Motor Max.Speed	1 to 100	100 mm/s	50	After restart	Setup	4.3.5
Pn401	Force Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	Tuning	5.8.4
Pn404	Forward External Force Limit	0 to 800	1%	100	Immediately	Setup	–
Pn405	Reverse External Force Limit	0 to 800	1%	100	Immediately	Setup	
Pn406	Emergency Stop Force	0 to 800	1%	800	Immediately	Setup	4.3.2

Pn310



Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn408	Force Related Function Switch	0000 to 1111	–	0000	–	Setup	–



1st Step Notch Filter Selection (Refer to 5.8.4) — When Enabled

0	N/A
1	Uses 1st step notch filter for torque reference.

When Enabled: Immediately

Speed Limit Selection — When Enabled

0	Uses the smaller value between motor max. speed and parameter Pn407 as speed limit value.
1	Uses the smaller value between overspeed detection speed and parameter Pn407 as speed limit value.

When Enabled: After restart

2nd Step Notch Filter Selection (Refer to 5.8.4) — When Enabled

0	N/A
1	Uses 2nd step notch filter for torque reference.

When Enabled: Immediately

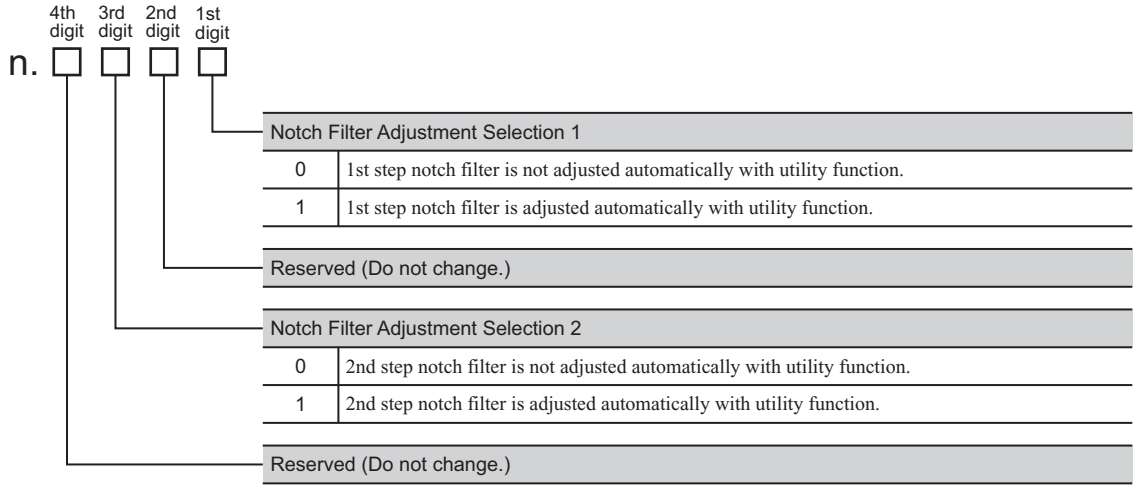
Friction Compensation Function Selection (Refer to 5.8.6) — When Enabled

0	Disables use friction compesation function.
1	Enables friction compsation function.

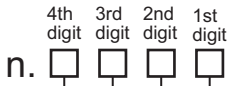
When Enabled: Immediately

Pn409	1st Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning	5.8.4
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	
Pn424	Force Limit at Main Circuit Voltage Drop	0 to 100	1%	50	Immediately	Setup	4.3.6
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	6.18

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn460	Notch Filter Adjustment Switch	0000 to 0101	–	0101	Immediately	Tuning	5.2.1 5.3.1 5.5.1
Pn480	Speed Limit during Force Control	0 to 10000	1 mm/s	10000	Immediately	Setup	–
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	–
Pn484	Reverse Force Limit	0 to 800	1%	30	Immediately	Setup	–
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	4.3.4



Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50A	Input Signal Selection 1	0000 to FFF1	–	1881	After restart	Setup	–



Reserved (Do not change.)

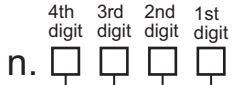
Reserved (Do not change.)

Reserved (Do not change.)

P-OT Signal Mapping (Refer to 4.3.2)

0	Forward run allowed when CN1-13 input signal is ON (L-level)
1	Forward run allowed when CN1-7 input signal is ON (L-level)
2	Forward run allowed when CN1-8 input signal is ON (L-level)
3	Forward run allowed when CN1-9 input signal is ON (L-level)
4	Forward run allowed when CN1-10 input signal is ON (L-level)
5	Forward run allowed when CN1-11 input signal is ON (L-level)
6	Forward run allowed when CN1-12 input signal is ON (L-level)
7	Forward run prohibited
8	Forward run allowed
9	Forward run allowed when CN1-13 input signal is OFF (H-level)
A	Forward run allowed when CN1-7 input signal is OFF (H-level)
B	Forward run allowed when CN1-8 input signal is OFF (H-level)
C	Forward run allowed when CN1-9 input signal is OFF (H-level)
D	Forward run allowed when CN1-10 input signal is OFF (H-level)
E	Forward run allowed when CN1-11 input signal is OFF (H-level)
F	Forward run allowed when CN1-12 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	–	8882	After restart	Setup	



N-OT Signal Mapping (Overtravel when OFF (H-level)) (Refer to 4.3.2)

0	Reverse run allowed when CN1-13 input signal is ON (L-level).
1	Reverse run allowed when CN1-7 input signal is ON (L-level).
2	Reverse run allowed when CN1-8 input signal is ON (L-level).
3	Reverse run allowed when CN1-9 input signal is ON (L-level) .
4	Reverse run allowed when CN1-10 input signal is ON (L-level).
5	Reverse run allowed when CN1-11 input signal is ON (L-level).
6	Reverse run allowed when CN1-12 input signal is ON (L-level).
7	Reverse run prohibited.
8	Reverse run allowed.
9	Reverse run allowed when CN1-13 input signal is OFF (H-level).
A	Reverse run allowed when CN1-7 input signal is OFF (H-level).
B	Reverse run allowed when CN1-8 input signal is OFF (H-level).
C	Reverse run allowed when CN1-9 input signal is OFF (H-level).
D	Reverse run allowed when CN1-10 input signal is OFF (H-level).
E	Reverse run allowed when CN1-11 input signal is OFF (H-level).
F	Reverse run allowed when CN1-12 input signal is OFF (H-level).

Reserved (Do not change.)

/P-CL Signal Mapping

Same as /N-OT

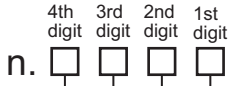
/N-CL Signal Mapping

Same as /N-OT

■ 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
Pn50E	Output Signal Selection 1	0000 to 3333	–	0000	After restart	Setup	3.3.2



Positioning Completion Signal Mapping (/COIN)

0	Disabled (the above signal is not used.)
1	Outputs the signal from CN1-1, 2 output terminal.
2	Outputs the signal from CN1-23, 24 output terminal.
3	Outputs the signal from CN1-25, 26 output terminal.

Speed Coincidence Detection Signal Mapping (/V-CMP)

0 to 3	Same as /COIN

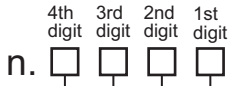
Servomotor Movement Detection Signal Mapping (/TGON)

0 to 3	Same as /COIN

Servo Ready Signal Mapping (/S-RDY)

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	–	0100	After restart	Setup	3.3.2



Force Limit Detection Signal Mapping (/CLT)

0	Disabled (the above signal is not used.)
1	Outputs the signal from CN1-1, 2 output terminal.
2	Outputs the signal from CN1-23, 24 output terminal.
3	Outputs the signal from CN1-25, 26 output terminal.

Speed Limit Detection Signal Mapping (/VLT)

0 to 3	Same as /CLT

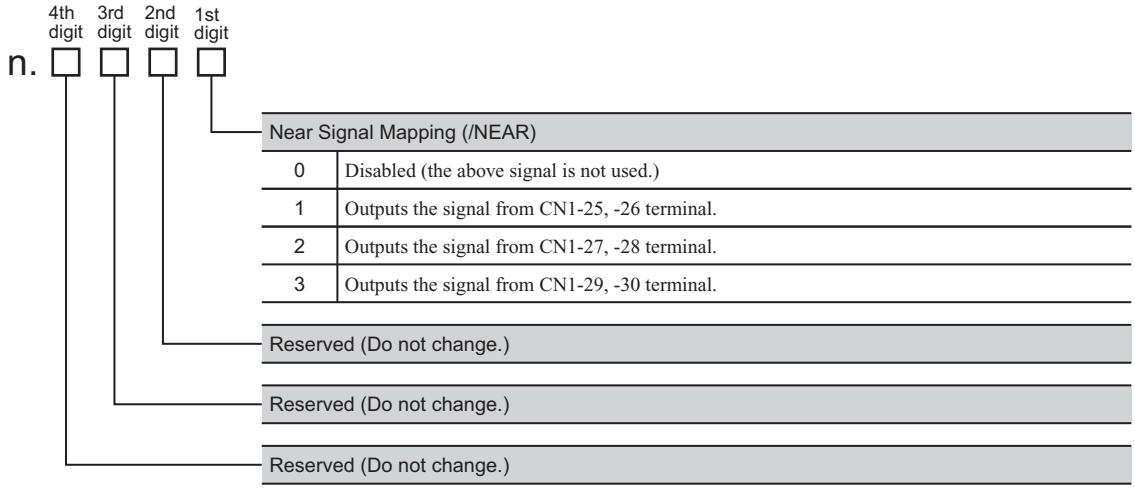
Brake Signal Mapping (/BK)

0 to 3	Same as /CLT

Warning Signal Mapping (/WARN)

0 to 3	Same as /CLT

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn510	Output Signal Selection 3	0000 to 0033	–	0000	After restart	Setup	–



Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn511	Input Signal Selection 5	0000 to FFFF	–	6543	After restart	Setup	–

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

/DEC (Deceleration limit switch for homing) Signal Mapping

0	Inputs the signal from CN1-13 input terminal.
1	Inputs the signal from CN1-7 input terminal.
2	Inputs the signal from CN1-8 input terminal.
3	Inputs the signal from CN1-9 input terminal.
4	Inputs the signal from CN1-10 input terminal.
5	Inputs the signal from CN1-11 input terminal.
6	Inputs the signal from CN1-12 input terminal.
7	Sets signal ON.
8	Sets signal OFF.
9	Inputs the reversal signal from CN1-13 input terminal.
A	Inputs the reversal signal from CN1-7 input terminal.
B	Inputs the reversal signal from CN1-8 input terminal.
C	Inputs the reversal signal from CN1-9 input terminal.
D	Inputs the reversal signal from CN1-10 input terminal.
E	Inputs the reversal signal from CN1-11 input terminal.
F	Inputs the reversal signal from CN1-12 input terminal.

/EXT1 (External latch) Signal Mapping

4	Inputs the signal from CN1-10 input terminal.
5	Inputs the signal from CN1-11 input terminal.
6	Inputs the signal from CN1-12 input terminal.
7	Sets signal ON.
8	Sets signal OFF.
D	Inputs the reversal signal from CN1-10 input terminal.
E	Inputs the reversal signal from CN1-11 input terminal.
F	Inputs the reversal signal from CN1-12 input terminal.
0 to 3 9 to F	Sets signal OFF.

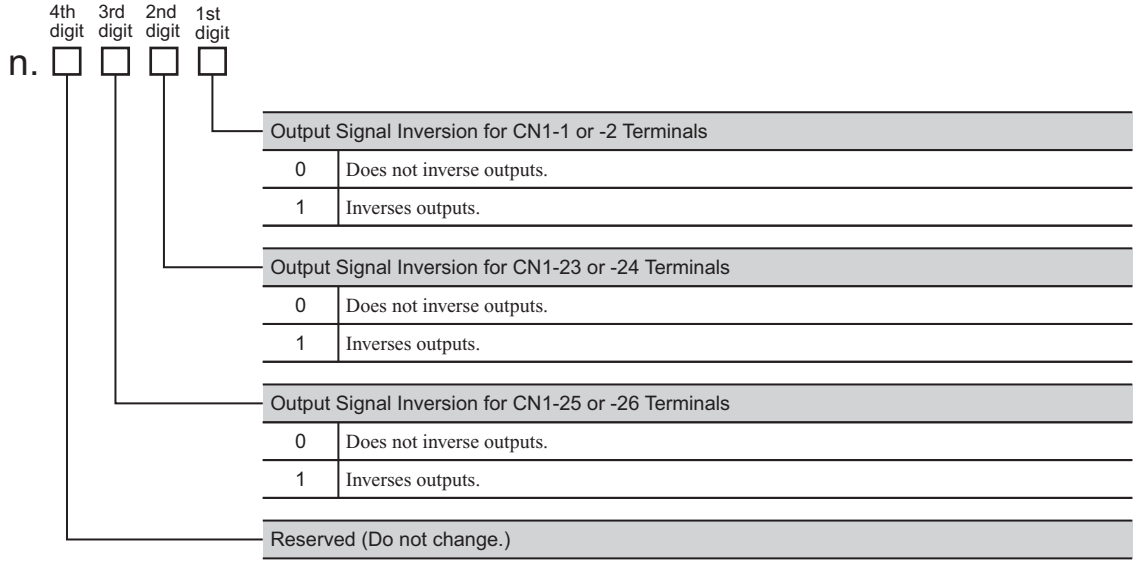
/EXT2 (External latch 2) Signal Mapping

0 to F	Refer to /EXT1 signal mapping.

/EXT3 (External latch 3) Signal Mapping

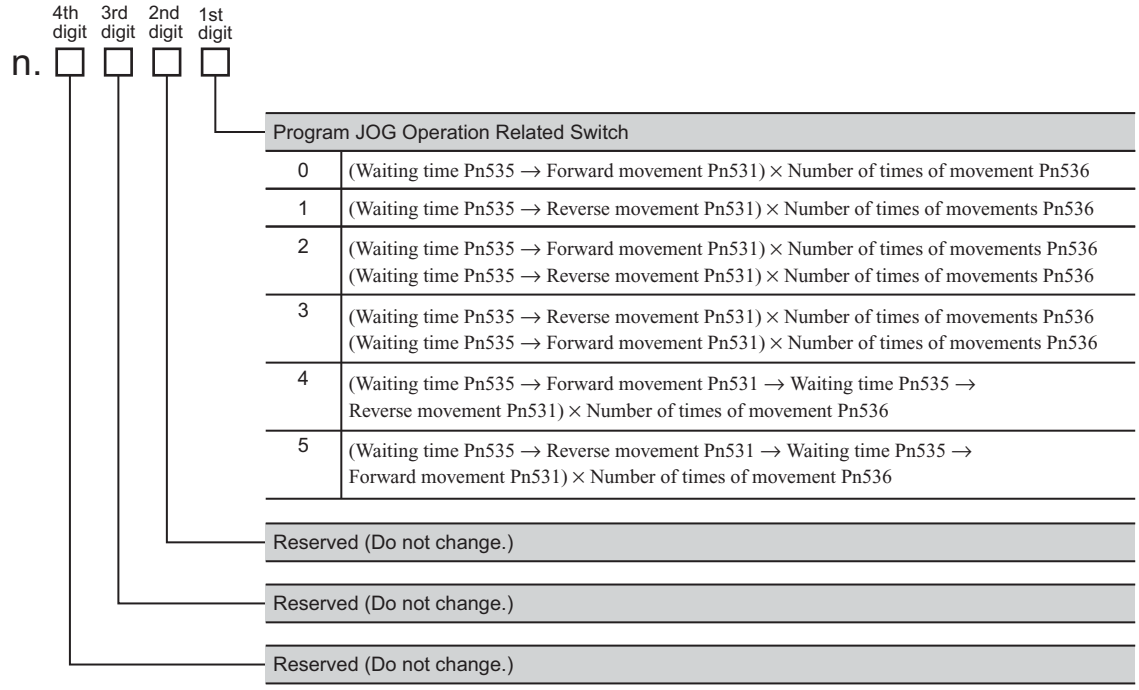
0 to F	Refer to /EXT1 signal mapping.

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



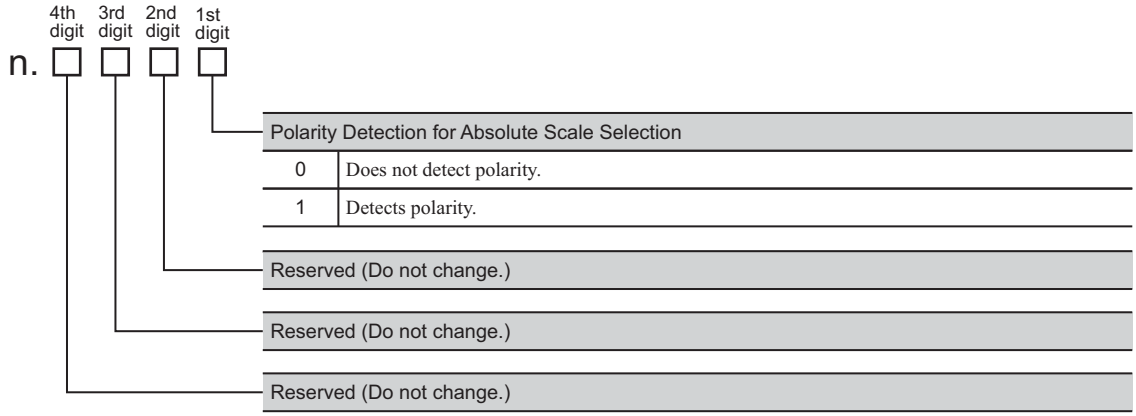
Pn51E	Excessive Position Error Warning Level	10 to 100	1%	100	Immediately	Setup	8.2.1
Pn520	Excessive Position Error Alarm Level	1 to 1073741823 (2^{30}-1)	1 reference unit	5242880	Immediately	Setup	5.1.4
Pn522	Positioning Completed Width	0 to 1073741824 (2^{30})	1 reference unit	7	Immediately	Setup	–
Pn524	NEAR Signal Width	1 to 1073741824 (2^{30})	1 reference unit	1073741824	Immediately	Setup	–
Pn526	Excessive Position Error Alarm Level at Servo ON	1 to 1073741823 (2^{30}-1)	1 reference unit	5242880	Immediately	Setup	8.1.1
Pn528	Excessive Position Error Warning Level at Servo ON	10 to 100	1%	100	Immediately	Setup	8.2.1
Pn52B	Overload Warning Level	1 to 100	1%	20	Immediately	Setup	4.3.7
Pn52C	Derating of Base Current at Detecting Overload of Motor	10 to 100	1%	100	After restart	Setup	
Pn52F	Monitor Display at Power ON	0000 to 0FFF	–	0FFF	Immediately	Setup	–

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	6.5



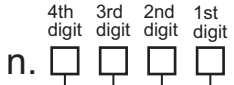
Pn531	Program JOG Movement Distance	1 to 1073741824 (2^{30})	1 reference unit	32768	Immediately	Setup	6.5
Pn534	Program JOG Acceleration/Deceleration Time	2 to 10000	1 ms	100	Immediately	Setup	
Pn535	Program JOG Waiting Time	0 to 10000	1 ms	100	Immediately	Setup	
Pn536	Number of Times of Program JOG 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	5.1.3
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	5.7.1
Pn561	Overshoot Detection Level	0 to 100	1%	100	Immediately	Setup	5.3.1 5.4.1
Pn580	Zero Clamp Level	0 to 10000	1 mm/s	10	Immediately	Setup	–
Pn581	Zero Speed Level	1 to 10000	1 mm/s	20	Immediately	Setup	–
Pn582	Speed Coincidence Signal Output Width	0 to 100	1 mm/s	10	Immediately	Setup	–
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	8.1.1
Pn585	Program JOG Movement Speed	0 to 10000	1 mm/s	50	Immediately	Setup	6.5
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	–	0000	Immediately	Setup	–
Pn600	Regenerative Resistor Capacity *1	Depends on SERVOPACK Capacity *2	10 W	0	Immediately	Setup	3.7.2
Pn601	Reserved (Do not change.)	–	–	0	–	–	–



∗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.

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn800	Communications Control	–	–	0040	Immediately	Setup	–



MECHATROLINK Communications Check Mask (for debug)

0	No mask
1	Ignores MECHATROLINK communications error (A.E60).
2	Ignores WDT error (A.E50).
3	Ignores both MECHATROLINK communications error (A.E60) and WDT error (A.E50).

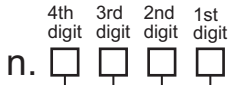
Warning Check Mask

0	No mask
1	Ignores data setting warning (A.94☐).
2	Ignores command warning (A.95☐).
3	Ignores both data setting warning (A.94☐) and command warning (A.95☐).
4	Ignores communications warning (A.96☐).
5	Ignores both data setting warning (A.94☐) and communications warning (A.96☐).
6	Ignores both command warning (A.95☐) and communications warning (A.96☐).
7	Ignores data setting warning (A.94☐), command warning (A.95☐) and communications warning (A.96☐).

Reserved (Do not change.)

Reserved (Do not change.)

Pn801	Application Function Select 6 (Software LS)	–	–	0003	Immediately	Setup	–



Software Limit Function

0	Enables forward and reverse software limit.
1	Disables forward software limit.
2	Disables reverse software limit.
3	Disables software limit in both directions.

Reserved (Do not change.)

Software Limit for Reference

0	Disables software limit for reference.
1	Enables software limit for reference.

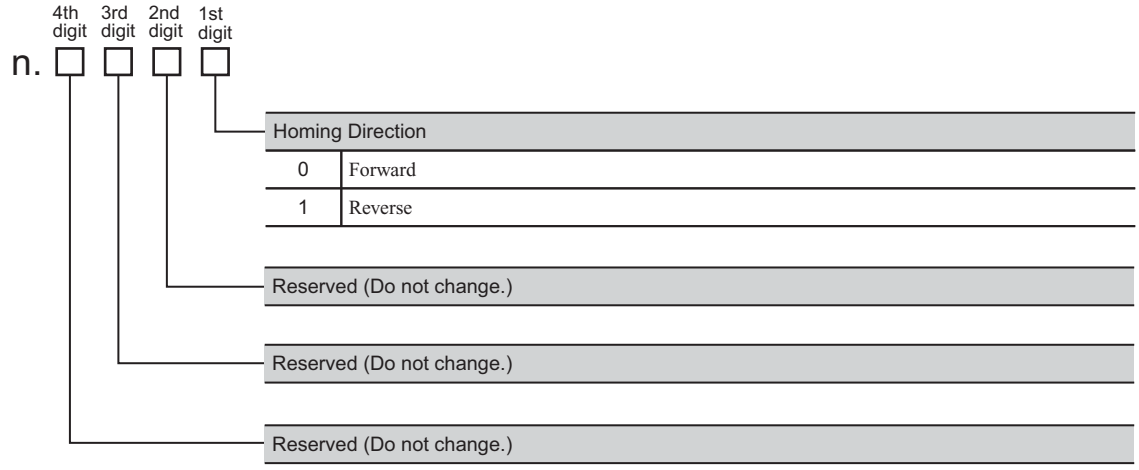
Reserved (Do not change.)

Pn803	Origin Range	0 to 250	1 reference unit	10	Immediately	Setup	–

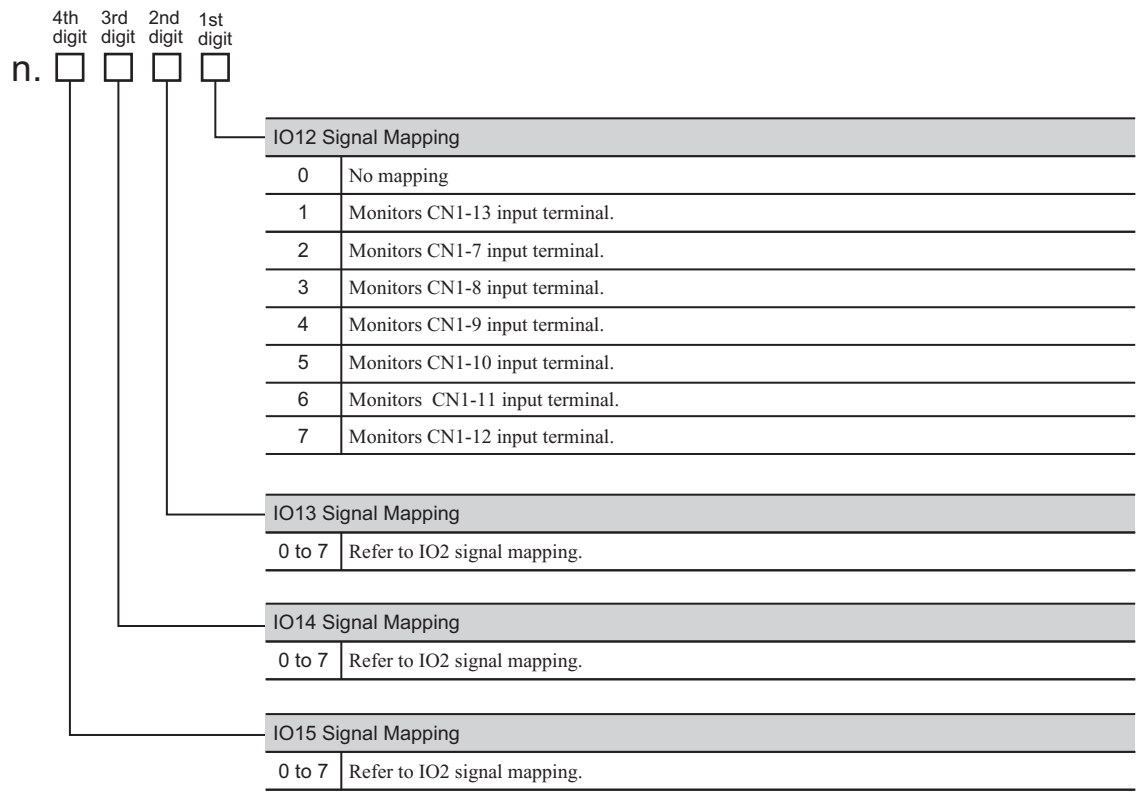
Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn804	Forward Software Limit	-1073741823 to 1073741823	1 reference unit	1073741823	Immediately	Setup	–
Pn806	Reverse Software Limit	-1073741823 to 1073741823	1 reference unit	-1073741823	Immediately	Setup	
Pn808	Absolute Encoder Origin Offset	-1073741823 to 1073741823	1 reference unit	0	Immediately*3	Setup	–
Pn80A	1st Linear Acceleration Constant	1 to 65535	10000 reference unit/s^2	100	Immediately*4	Setup	–
Pn80B	2nd Linear Acceleration Constant	1 to 65535	10000 reference unit/s^2	100	Immediately*4	Setup	–
Pn80C	Acceleration Constant Switching Speed	0 to 65535	100 reference unit/s	0	Immediately*4	Setup	–
Pn80D	1st Linear Deceleration Constant	1 to 65535	10000 reference unit/s^2	100	Immediately*4	Setup	–
Pn80E	2nd Linear Deceleration Constant	1 to 65535	10000 reference unit/s^2	100	Immediately*4	Setup	–
Pn80F	Deceleration Constant Switching Speed	0 to 65535	100 reference unit/s	0	Immediately*4	Setup	–
Pn810	Exponential Function Acceleration/ Deceleration Bias	0 to 65535	100 reference unit/s	0	Immediately*5	Setup	–
Pn811	Exponential Function Acceleration/ Deceleration Time Constant	0 to 5100	0.1 ms	0	Immediately*5	Setup	–
Pn812	Movement Average Time	0 to 5100	0.1 ms	0	Immediately*5	Setup	–
Pn814	Final Travel Distance for External Positioning	-1073741823 to 1073741823	1 reference unit	100	Immediately	Setup	–

∗3. Available after the SENS_ON command is input.
∗4. Change the setting when the reference is stopped (DEN is set to 1), because the change will affect the output during operation.
∗5. The settings are updated only if the sending of the reference has been stopped (DEN is set to 1).

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn816	Homing Mode Setting	–	–	0000	Immediately	Setup	–

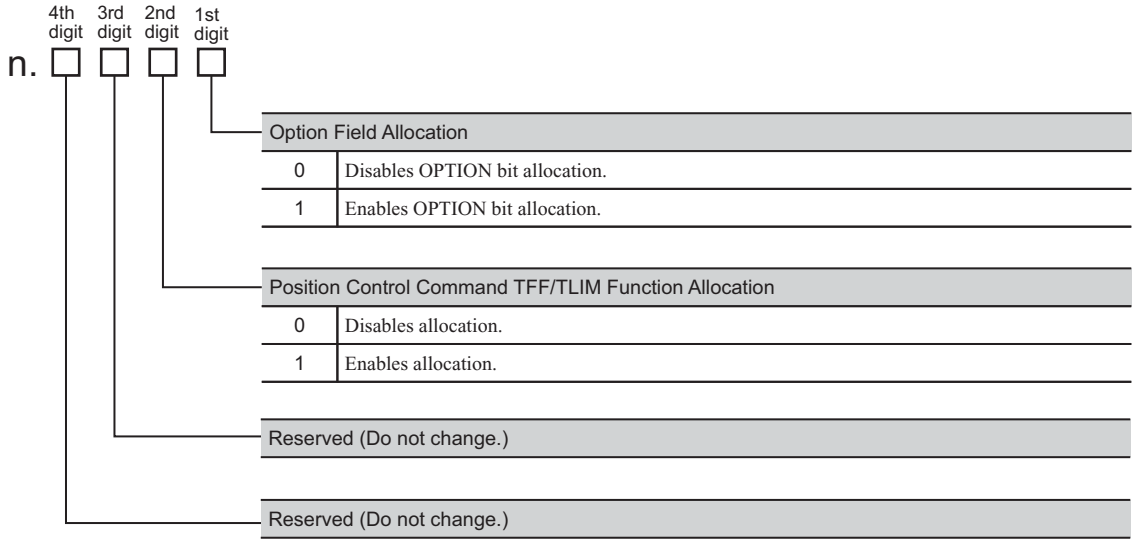


Pn817	Homing Approach Speed 1	0 to 65535	100 reference unit/s	50	Immediately*4	Setup	–
Pn818	Homing Approach Speed 2	0 to 65535	100 reference unit/s	5	Immediately*4	Setup	–
Pn819	Final Travel Distance for Homing	-1073741823 to 1073741823	1 reference unit	100	Immediately	Setup	–
Pn81E	Input Signal Monitor Selection	–	–	0000	Immediately	Setup	–



*4. Change the setting when the reference is stopped (DEN is set to 1), because the change will affect the output during operation.

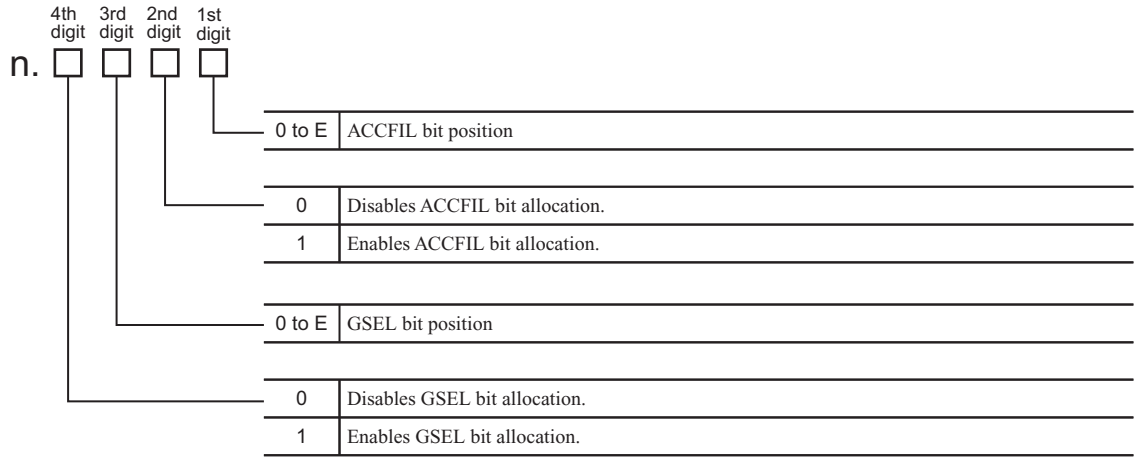
Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn81F	Command Data Allocation	–	–	0000	After restart	Setup	–



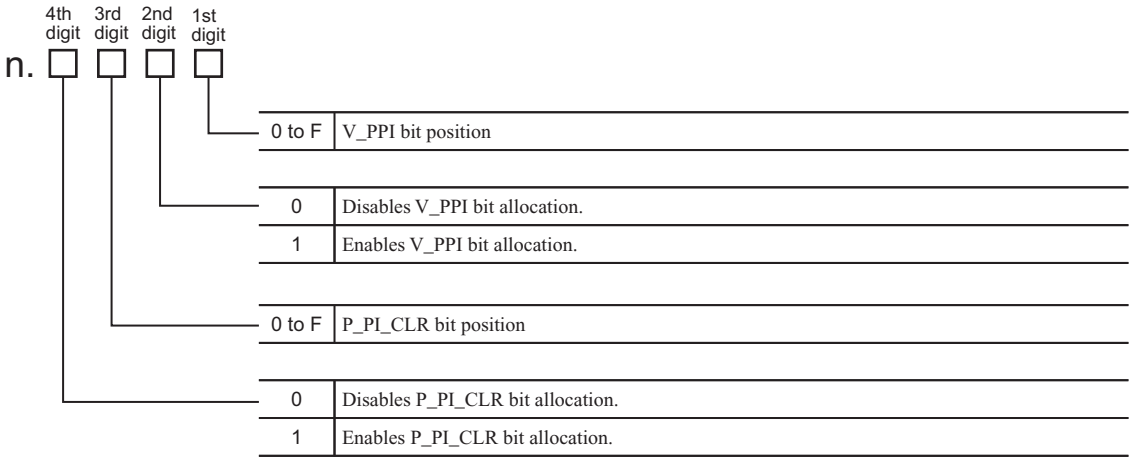
Pn820	Forward Latching Allowable Area	-2147483648 to 2147483647	1 reference unit	0	Immediately	Setup	–
Pn822	Reverse Latching Allowable Area	-2147483648 to 2147483647	1 reference unit	0	Immediately	Setup	–

Parameter No.	Name		Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn824	Option Monitor 1 Selection		–	–	0000	Immediately	Setup	–
	0000H	Motor movement speed [1000000H/overspeed detection position]		–				
	0001H	Speed reference [1000000H/overspeed detection position]		–				
	0002H	Force [1000000H/max. force]		–				
	0003H	Position error (lower 32 bits) [reference unit]		–				
	0004H	Position error (upper 32 bits) [reference unit]		–				
	0005H	System reserved		–				
	0006H	System reserved		–				
	000AH	Encoder count (lower 32 bits) [reference unit]		–				
	000BH	Encoder count (upper 32 bits) [reference unit]		–				
	000CH	FPG count (lower 32 bits) [reference unit]		–				
	000DH	FPG count (upper 32 bits) [reference unit]		–				
	0010H	Un000: Motor movement speed [mm/s]		–				
	0011H	Un001: Speed reference [mm/s]		–				
	0012H	Un002: Force reference [%]		–				
	0013H	Un003: Electric angle 1 [pulse]		–				
	0014H	Un004: Electric angle 2 [deg]		–				
	0015H	Un005: Input signal monitor						
	0016H	Un006: Output signal monitor						
	0017H	Un007: Input position reference speed [mm/s]		–				
	0018H	Un008: Position error [reference unit]		–				
	0019H	Un009: Accumulated load ratio [%]		–				
	001AH	Un00A: Regenerative load ratio [%]		–				
	001BH	Un00B: DB resistance consumption power [%]		–				
	001CH	Un00C: Input reference counter [pulse]		–				
	001DH	Un00D: Feedback pulse counter [pulse]		–				
	001EH	Un00E: Fully-closed loop feedback pulse counter [pulse]		–				
	001FH	System reserved		–				
	0025H	Primary absolute position data (lower 32 bits) [pulse]		–				
	0026H	Primary absolute position data (upper 32 bits) [pulse]		–				
	0080H	Previous value of latched feedback position (LPOS)						
Pn825	Option Monitor 2 Selection		–	–	0000	Immediately	Setup	–
	0000H to 0080H	Refer to Option Monitor 1 Selection.					–	–

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn827	Linear Deceleration Constant 1 for Stopping	1 to 65535	10000 reference unit/s	100	Immediately*4	Setup	–
Pn829	SVOFF Waiting Time (SVOFF at deceleration to stop)	0 to 65535	10 ms	0	Immediately*4	Setup	–
Pn82A	Option Field Allocation 1	0000 to 1E1E	–	1813	After restart	Setup	–



Pn82B	Option Field Allocation 2	0000 to 1F1F	–	1D1C	After restart	Setup	–



*4. Change the setting when the reference is stopped (DEN is set to 1), because the change will affect the output during operation.

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn82C	Option Field Allocation 3	0000 to 1F1F	–	1F1E	After restart	Setup	–

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

0 to F	P_CL bit position
0	Disables P_CL bit allocation.
1	Enables P_CL bit allocation.
0 to F	N_CL bit position
0	Disables N_CL bit allocation.
1	Enables N_CL bit allocation.

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn82D	Option Field Allocation 4	0000 to 1F1C	–	0000	After restart	Setup	–

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

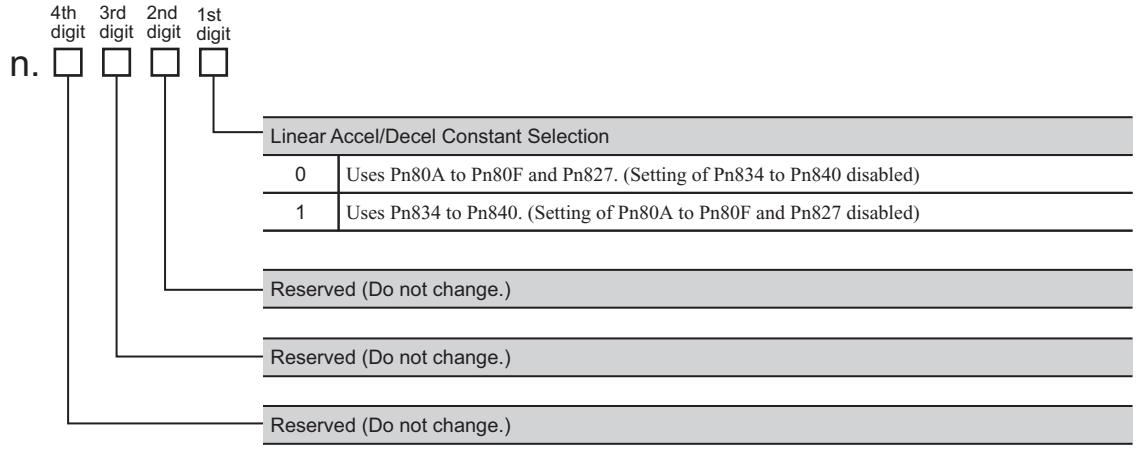
0 to C	BANK_SEL1 bit position
0	Disables BANK_SEL1 bit allocation.
1	Enables BANK_SEL1 bit allocation.
0 to F	LT_DISABLE bit position
0	Disables LT_DISABLE bit allocation.
1	Enables LT_DISABLE bit allocation.

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn82E	Option Field Allocation 5	0000 to 1F1C	–	0000	After restart	Setup	–

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

Reserved (Do not change.)	
Reserved (Do not change.)	
0 to D	OUT_SIGNAL bit position
0	Disables OUT_SIGNAL bit allocation.
1	Enables OUT_SIGNAL bit allocation.

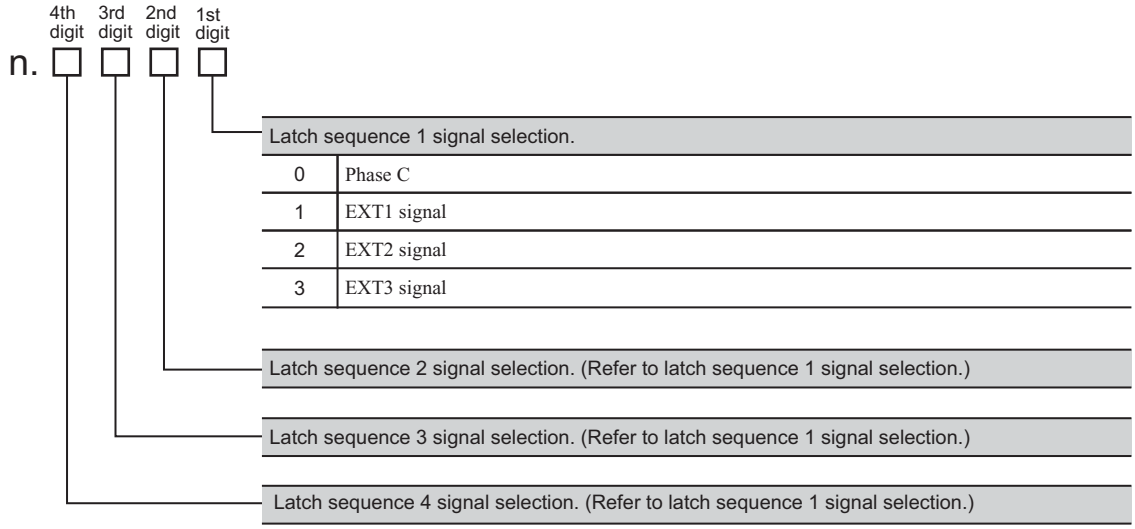
Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn833	Motion Setting	0000 to 0001	–	0000	After restart	Setup	–



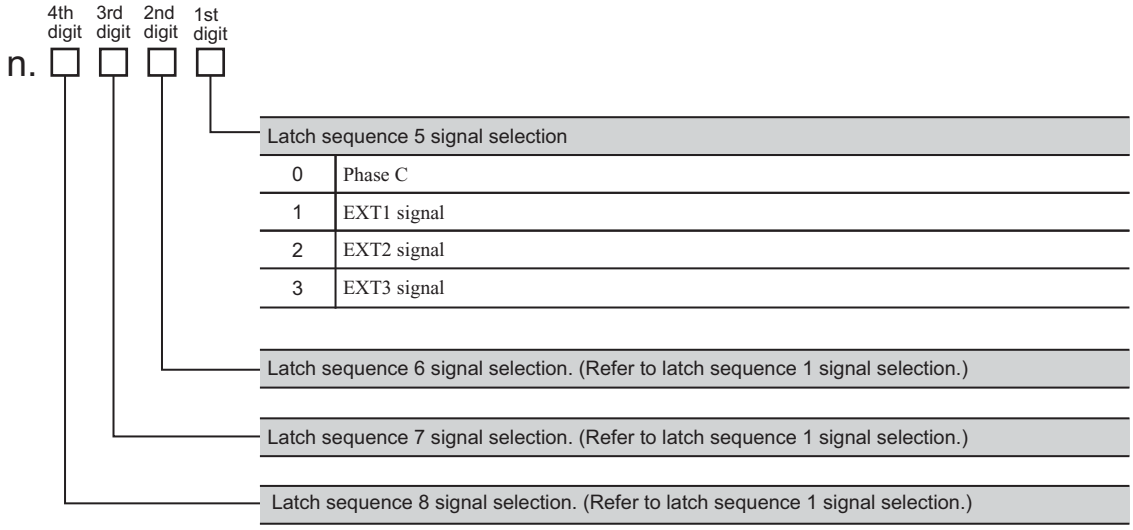
Pn834	1st Linear Acceleration Constant 2	1 to 20971520	10000 Reference unit/s^2	100	Immediately *4	Setup	–
Pn836	2nd Linear Acceleration Constant 2	1 to 20971520	10000 Reference unit/s^2	100	Immediately *4	Setup	–
Pn838	Acceleration Constant Switching Speed 2	0 to 2097152000	Reference unit/s	0	Immediately *4	Setup	–
Pn83A	1st Linear Deceleration Constant 2	1 to 20971520	10000 Reference unit/s^2	100	Immediately *4	Setup	–
Pn83C	2nd Linear Deceleration Constant 2	1 to 20971520	10000 Reference unit/s^2	100	Immediately *4	Setup	–
Pn83E	Deceleration Constant Switching Speed 2	0 to 2097152000	Reference unit/s	0	Immediately *4	Setup	–
Pn840	Linear Deceleration Constant 2 for Stopping	1 to 20971520	10000 Reference unit/s^2	100	Immediately *4	Setup	–
Pn850	Latch Sequence Number	0 to 8	–	0	Immediately	Setup	–
Pn851	Continuous Latch Count	0 to 255	–	0	Immediately	Setup	–

*4. Change the setting when the reference is stopped (DEN is set to 1), because the change will affect the output during operation.

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn852	Latch Sequence Signal 1 to 4 Setting	0000 to 3333	–	0000	Immediately	Setup	–



Pn853	Latch Sequence Signal 5 to 8 Setting	0000 to 3333	–	0000	Immediately	Setup	–



Pn880	Station Address Monitor (for maintenance, read only)	40 to 5FH	–	0	Immediately	Setup	–
Pn881	Setting Transmission Byte Monitor [byte] (for maintenance, read only)	17, 32	–	0	Immediately	Setup	–
Pn882	Transmission Cycle Setting Monitor [0.25 µs] (for maintenance, read only)	0 to FFFFH	–	0	Immediately	Setup	–
Pn883	Communications Cycle Setting Monitor [x transmission cycle] (for maintenance, read only)	0 to 32	–	0	Immediately	Setup	–
Pn88A	MECHATROLINK-II Receive Error Counter Monitor (for maintenance, read only)	0 to 65535	–	0	Immediately	Setup	–
Pn890 to Pn89E	Command Data Monitor at Alarm/ Warning Occurs (for maintenance, read only)	0 to FFFFFFFFH	–	0	Immediately	Setup	–

Parameter No.	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn8A0 to Pn8AE	Response Data Monitor at Alarm/ Warning Occurs (for maintenance, read only)	0 to FFFFFFFFH	–	0	Immediately	Setup	–
Pn900	Parameter Bank Number	0 to 16	–	0	After restart	Setup	–
Pn901	Parameter Bank Member Number	0 to 15	–	0	After restart	Setup	–
Pn902 to Pn910	Parameter Bank Member Definition	0000H to 08FFH	–	0	After restart	Setup	–
Pn920 to Pn95F	Parameter Bank Data (nonvolatile memory save disabled)	0000H to FFFFH	–	0	Immediately	Setup	–

9.2 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)	pulses from the origin
Un004	Electric angle 2 (Electric angle from the origin)	deg
Un005	Input signal monitor	–
Un006	Output signal monitor	–
Un007	Input reference 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	Input reference counter (decimal, 10-digit display)	reference unit
Un00D	Feedback pulse counter (encoder pulses × 4 (multiplier): 32-bit decimal code)	encoder pulse
Un011	Hall sensor signal monitor	–
Un012	Total operation time	100 ms
Un013	Feedback pulse counter (decimal, 10-digit display)	reference unit
Un014	Effective gain monitor	–
Un015	Safety I/O signal monitor	–
Un020	Motor rated speed	mm/s
Un021	Motor maximum speed	mm/s
Un084	Linear scale pitch	pm
Un085	Linear scale pitch index	exponential in decimal

9.3 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	4000						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
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
Pn140	0100						Model Following Control Related Switch	Immediately

Parame-ter	Factory Setting						Name	When Enabled
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
Pn207	0010						Position Control Function Switch	After restart
Pn20E	4						Electronic Gear Ratio (Numerator)	After restart
Pn210	1						Electronic Gear Ratio (Denominator)	After restart
Pn281	20 P/Pitch						Encoder Output Resolution	After restart
Pn282	0.00 µm						Linear Scale Pitch	After restart
Pn305	0 ms						Soft Start Acceleration Time	Immediately
Pn306	0 ms						Soft Start Deceleration Time	Immediately
Pn310	0000						Vibration Detection Switch	Immediately
Pn311	100%						Vibration Detection Sensibility	Immediately
Pn324	300%						Mass Calculating Start Level	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
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	–

Parame-ter	Factory Setting						Name	When Enabled
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
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	4.0 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
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	1881						Input Signal Selection 1	After restart
Pn50B	8882						Input Signal Selection 2	After restart
Pn50E	0000						Output Signal Selection 1	After restart
Pn50F	0100						Output Signal Selection 2	After restart
Pn510	0000						Output Signal Selection 3	After restart
Pn511	6543						Input Signal Selection 5	After restart
Pn512	0000						Output Signal Reversal Setting	After restart
Pn51E	100%						Excessive Position Error Warning Level	Immediately

Parame-ter	Factory Setting						Name	When Enabled
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/Decelera-tion 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
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.)	–
Pn800	0040						Communications Control	Immediately
Pn801	0003						Application Function Select 6 (Software LS)	Immediately
Pn803	10 reference unit						Origin Range	Immediately

Parame-ter	Factory Setting						Name	When Enabled
Pn804	1073741823 reference unit						Forward Software Limit	Immediately
Pn806	-1073741823 reference unit						Reverse Software Limit	Immediately
Pn808	0 reference unit						Absolute Encoder Origin Offset	Immediately *1
Pn80A	10000 reference unit/s^2						1st Linear Acceleration Constant	Immediately *2
Pn80B	10000 reference unit/s^2						2nd Linear Acceleration Constant	Immediately *2
Pn80C	0 reference unit						Acceleration Constant Switching Speed	Immediately *2
Pn80D	10000 reference unit/s^2						1st Linear Deceleration Constant	Immediately *2
Pn80E	10000 reference unit/s^2						2nd Linear Deceleration Constant	Immediately *2
Pn80F	0 reference unit						Deceleration Constant Switching Speed	Immediately *2
Pn810	0 reference unit						Exponential Function Acceleration/ Deceleration Bias	Immediately *2
Pn811	0.0 ms						Exponential Function Acceleration/ Deceleration Time Constant	Immediately *2
Pn812	0.0 ms						Movement Average Time	Immediately *2
Pn814	100 reference unit						Final Travel Distance for External Positioning	Immediately *2
Pn816	0000						Homing Mode Setting	Immediately *2
Pn817	5000 reference unit/s						Homing Approach Speed 1	Immediately *2
Pn818	500 reference unit/s						Homing Approach Speed 2	Immediately *2
Pn819	100 reference unit						Final Travel Distance for Homing	Immediately *2
Pn81E	0000						Input Signal Monitor Selection	Immediately
Pn81F	0000						Command Data Allocation	After restart
Pn820	0 reference unit						Forward Latching Allowable Area	Immediately
Pn822	0 reference unit						Reverse Latching Allowable Area	Immediately
Pn824	0000						Option Monitor 1 Selection	Immediately

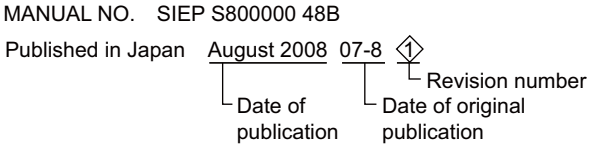
Parameter	Factory Setting						Name	When Enabled
Pn825	0000						Option Monitor 2 Selection	Immediately
Pn827	100000 reference unit/s						Linear Deceleration Constant 1 for Stopping	Immediately *2
Pn829	0 ms						SVOFF Waiting Time (SVOFF at deceleration to stop)	Immediately
Pn82A	1813						Option Field Allocation 1	After restart
Pn82B	1D1C						Option Field Allocation 2	After restart
Pn82C	1F1E						Option Field Allocation 3	After restart
Pn82D	0000						Option Field Allocation 4	After restart
Pn82E	0000						Option Field Allocation 5	After restart
Pn833	0000						Motion Setting	After restart
Pn834	1000000 reference unit/s^2						1st Linear Acceleration Constant 2	Immediately *2
Pn836	1000000 reference unit/s^2						2nd Linear Acceleration Constant 2	Immediately *2
Pn838	0 reference unit/s						Acceleration Constant Switching Speed 2	Immediately *2
Pn83A	1000000 reference unit/s^2						1st Linear Deceleration Constant 2	Immediately *2
Pn83C	1000000 reference unit/s^2						2nd Linear Deceleration Constant 2	Immediately *2
Pn83E	0 reference unit/s						Deceleration Constant Switching Speed 2	Immediately *2
Pn840	1000000 reference unit/s^2						Linear Deceleration Constant 2 for Stopping	Immediately *2
Pn850	0						Latch Sequence Number	Immediately
Pn851	0						Continuous Latch Count	Immediately
Pn852	0000						Latch Sequence Signal 1 to 4 Setting	Immediately
Pn853	0000						Latch Sequence Signal 5 to 8 Setting	Immediately
Pn880	0						Station Address Monitor (for maintenance, read only)	Immediately
Pn881	0						Setting Transmission Byte Monitor [byte] (for maintenance, read only)	Immediately
Pn882	0						Transmission Cycle Setting Monitor [0.25 µs] (for maintenance, read only)	Immediately
Pn883	0						Communications Cycle Setting Monitor [x transmission cycle] (for maintenance, read only)	Immediately
Pn88A	0						MECHATROLINK-II Receive Error Counter Monitor (for maintenance, read only)	Immediately
Pn890 to Pn89E	0						Command Data Monitor at Alarm/ Warning Occurs (for maintenance, read only)	Immediately

Parame-ter	Factory Setting						Name	When Enabled
Pn8A0 to Pn8AE	0						Response Data Monitor at Alarm/ Warning Occurs (for maintenance, read only)	Immediately
Pn900	0						Parameter Bank Number	After restart
Pn901	0						Parameter Bank Member Number	After restart
Pn902 to Pn910	0						Parameter Bank Member Definition	After restart
Pn920 to Pn95F	0						Parameter Bank Data (nonvolatile memory save disabled)	Immediately

∗1. Enabled after the SENS_ON is entered.
∗2. Change the setting when the reference is stopped (DEN is set to 1), because the change will affect the output during operation.

Revision History

The revision dates and numbers of the revised manuals are given on the bottom of the back cover.



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AC Servodrive

Σ-V Series

USER'S MANUAL
Design and Maintenance

Linear Motor
MECHATROLINK-II Communications Reference

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