YASKAWA

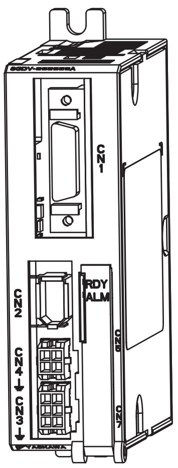
AC Servo Drives

DC Power Input Σ-V Series

USER'S MANUAL
Design and Maintenance

Rotational Motor
Analog Voltage Reference and Pulse Train Reference

SGM7M, SGMMV Servomotor
SGDV SERVOPACK



MANUAL NO. SIEP S800000 81C

About this Manual

This manual describes information required for designing, testing, adjusting, and maintaining DC Power Input Σ-V Series SERVOPACKs.

Keep this manual in a location where it can be accessed for reference whenever required. Manuals outlined on the following page must also be used as required by the application.

■ Description of Technical Terms

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

Term	Meaning
Cursor	Input position indicated by Digital Operator
Servomotor	Σ-7mini Series SGM7M servomotor Σ-Vmini Series SGMMV servomotor
SERVOPACK	DC Power Input Σ-V Series SGDV servo amplifier
Servo Drive	A set including a servomotor and SERVOPACK (i.e., a servo amplifier)
Servo System	A servo control system that includes the combination of a servo drive with a host controller and peripheral devices
Servo ON	Power to motor ON
Servo OFF	Power to motor OFF
Base Block (BB)	Power supply to motor is turned OFF by shutting off the base current to the power transistor in the current amplifier.
Servo Lock	A state in which the motor is stopped and is in position loop with a position reference of 0.
Main Circuit Cable	Cables which connect to the main circuit terminals, including power supply cables, servomotor main circuit cables, and others.

■ IMPORTANT Explanations

The following icon is displayed for explanations requiring special attention.

IMPORTANT

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

■ Notation Used in this Manual

- Notation for Reverse Signals

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

Notation Example

$\overline{\text{BK}}$ = /BK

- Notation for Parameters

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

- Parameters for Numeric Settings

Control methods for which the parameter applies.
Speed : Speed control Position : Position control Torque : Torque control

Pn311	Vibration Detection Sensitivity Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 500	1%	100	Immediately	Tuning

Parameter number

Indicates the setting range for the parameter.

Indicates the minimum setting unit for the parameter.

Indicates the parameter setting before shipment.

Indicates when a change to the parameter will be effective.

Indicates the parameter classification.

- Parameters for Selecting Functions

Parameter		Meaning	When Enabled	Classification
Pn002	n.□0□□ [Factory setting]	Uses the absolute encoder as an absolute encoder.	After restart	Setup
	n.□1□□	Uses the absolute encoder as an incremental encoder.		

Parameter number

The notation "n.□□□□" indicates a parameter for selecting functions. Each □ corresponds to the setting value of that digit. The notation shown here means that the third digit is 1.

This section explains the selections for the function.

Notation Example

(Display Example for Pn002)

n.0000

Digit	Digit Notation		Setting Notation	
	Notation	Meaning	Notation	Meaning
1st digit	Pn002.0	Indicates the value for the 1st digit of parameter Pn002.	Pn002.0 = x or n.□□□x	Indicates that the value for the 1st digit of parameter Pn002 is x.
2nd digit	Pn002.1	Indicates the value for the 2nd digit of parameter Pn002.	Pn002.1 = x or n.□□x□	Indicates that the value for the 2nd digit of parameter Pn002 is x.
3rd digit	Pn002.2	Indicates the value for the 3rd digit of parameter Pn002.	Pn002.2 = x or n.□x□□	Indicates that the value for the 3rd digit of parameter Pn002 is x.
4th digit	Pn002.3	Indicates the value for the 4th digit of parameter Pn002.	Pn002.3 = x or n.x□□□	Indicates that the value for the 4th digit of parameter Pn002 is x.

■ Manuals Related to the DC Power Input 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
DC Power Input Σ-V Series User's Manual Setup Rotational Motor (No.: SIEP S800000 80)				✓	✓		
Σ-V Series Product Catalog (No.: KAEP S800000 42)	✓	✓	✓				
DC Power Input Σ-V Series User's Manual Design and Maintenance Rotational Motor/ Analog Voltage Reference and Pulse Train Reference (this manual)			✓		✓	✓	✓
Σ-V Series User's Manual Operation of Digital Operator (No.: SIEP S800000 55)					✓	✓	✓
DC Power Input Σ-V Series AC SERVOPACK SGDV Safety Precautions (No.: TOBP C710829 06)	✓			✓			✓
Σ Series Digital Operator Safety Precautions (No.: TOBP C730800 00)							✓
AC SERVOMOTOR Safety Precautions (No.: TOBP C230200 00)				✓			✓

■ Safety Information

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

⚠ WARNING

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

⚠ CAUTION

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

⃠ PROHIBITED

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

❗ MANDATORY

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

Safety Precautions

This section describes important precautions that must be followed during storage, transportation, installation, wiring, operation, maintenance, inspection, and disposal. Be sure to always observe these precautions thoroughly.

⚠ WARNING

- Never touch any rotating servomotor parts during operation.
  Failure to observe this warning may result in injury.
- Before starting operation with a machine connected, make sure that an emergency stop can be applied at any time.
  Failure to observe this warning may result in injury or damage to the equipment.
- Never touch the inside of the SERVOPACKs.
  Failure to observe this warning may result in electric shock.
- Immediately after the power is turned OFF or after a voltage resistance test, do not touch terminals.
  Residual voltage may cause electric shock.
- Follow the procedures and instructions provided in the manuals for the products being used in the trial operation.
  Failure to do so may result not only in faulty operation and damage to equipment, but also in personal injury.
- The multiturn limit value need not be changed except for special applications.
  Changing it inappropriately or unintentionally can be dangerous.
- If the Multiturn Limit Disagreement alarm occurs, check the setting of parameter Pn205 in the SERVOPACK to be sure that it is correct.
  If Fn013 is executed when an incorrect value is set in Pn205, an incorrect value will be set in the encoder. The alarm will disappear even if an incorrect value is set, but incorrect positions will be detected, resulting in a dangerous situation where the machine will move to unexpected positions.
- Do not remove the cables or connectors from the SERVOPACK while the power is ON.
  Failure to observe this warning may result in electric shock.
- Do not damage, pull, 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, damage to the equipment, or fire.
- Provide appropriate braking devices on the machine side to ensure safety. The holding brake on a servomotor with a brake is not a braking device for ensuring safety.
  Failure to observe this warning may result in injury.
- Do not come close to the machine immediately after resetting an instantaneous power interruption 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).
  Improper grounding may result in electric shock or fire.
- Installation, disassembly, or repair must be performed only by authorized personnel.
  Failure to observe this warning may result in electric shock or injury.

■ Storage and Transportation

⚠ CAUTION

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

- Never use the product in an environment subject to water, corrosive gases, flammable 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 or malfunction.
- 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

- Be sure to wire correctly and securely.
  Failure to observe this caution may result in motor overrun, injury, or malfunction.
- 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 terminals.
  Failure to observe this caution may result in fire.
- Do not bundle or run the servomotor main circuit cables together with the I/O signal cables or the encoder cables in the same duct. Keep the servomotor main circuit cables separated from the I/O signal cables and encoder cables by at least 30 cm.
  Placing these cables too close to each other may result in malfunction.
- Use shielded twisted-pair cables or screened unshielded twisted-pair cables for I/O signal cables and the encoder cables.
- The maximum wiring length is 3 m for I/O signal cables, 50 m for servomotor main circuit cables and encoder cables, and 10 m for power supply cables.
- Install the battery in the battery unit of the encoder cable with a battery unit.
- Voltage remains in the SERVOPACK even after the power supply is turned OFF. To prevent electric shock, do not touch the input terminals for the main circuit power supply or those for the control power supply.
  Before wiring or inspections, confirm that the SERVOPACK has completely discharged.
- Be sure to observe the following precautions when wiring the SERVOPACK main circuit terminal blocks.
  - Do not turn the SERVOPACK power ON until all wiring, including the main circuit terminal blocks, has been completed.
  - Remove detachable power supply input connectors or motor connectors from the SERVOPACK before wiring.
- Make sure that the wiring for both the main circuit power supply and control power supply is correct.
  Incorrect wiring may cause damage.
- Make sure that the polarity of the input power supply is correct.
  Incorrect polarity may cause damage.
- Always use the specified power supply voltage.
  An incorrect voltage may result in fire or malfunction.
- Take appropriate measures to ensure that the input power supply is supplied within the specified voltage fluctuation range.
  An incorrect power supply may result in damage to the equipment.
- Install external breakers or other safety devices against short-circuiting in external wiring.
  Failure to observe this caution may result in fire.
- Take appropriate and sufficient countermeasures for each form of potential interference when installing systems in the following locations.
  - Locations subject to static electricity or other forms of noise
  - Locations subject to strong electromagnetic fields and magnetic fields
  - Locations subject to possible exposure to radioactivity
  - Locations close to power supplies

  Failure to observe this caution may result in damage to the equipment.
- Do not reverse the polarity of the battery when connecting it.
  Failure to observe this caution may damage the battery, the SERVOPACK or servomotor, or cause an explosion.
- Wiring or inspection must be performed by a technical expert.
- Use a 24-VDC or 48-VDC power supply with double insulation or reinforced insulation.
- Failures caused by incorrect wiring or wrong voltage application in the brake circuit may damage the equipment or cause an accident resulting in death or injury. Follow the procedures and instructions for wiring and trial operation precisely as described in this manual.
- When using a detector or a breaker for leakage current, select the appropriate one by considering the grounding conditions and the leakage current of noise filter. For details, contact the manufacturer of the noise filter.
- Incorrect wiring or incorrect voltage application to the output circuit may cause short-circuit.
  The above failures will prevent the holding brake from working, which may damage the machine or cause an accident resulting in death or injury.

⚠ CAUTION

- Inverting the polarity of the brake signal (/BK), i.e. positive logic, will prevent the holding brake from working in case of its signal line disconnection.
  If this setting is absolutely necessary, check the operation and confirm that there are no safety problems.
- Provide separate AC/DC power supplies for the main circuits and for controls.
  Failure to observe this caution may result in malfunction.
- Do not connect devices (such as motors or solenoids) that greatly change the load or devices (such as electromagnetic switches) that generate surge voltages to the controller power line.
  Failure to observe this caution may result in deterioration of the internal elements or a blown fuse.

■ Operation

⚠ CAUTION

- Always use the servomotor and SERVOPACK in one of the specified combinations.
  Failure to observe this caution may result in fire or malfunction.
- Conduct trial operation on the servomotor alone with the motor shaft disconnected from the machine to avoid accidents.
  Failure to observe this caution may result in injury.
- During trial operation, confirm that the holding brake works correctly. Furthermore, secure system safety against problems such as signal line disconnection.
- Before starting operation with a machine connected, change the parameter 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 turn the power ON and OFF more than necessary.
  Do not use the SERVOPACK for applications that require the power to turn ON and OFF frequently. Such applications will cause elements in the SERVOPACK to deteriorate.
  As a guideline, at least one hour should be allowed between the power being turned ON and OFF once actual operation has been started.
- When carrying out JOG operation (Fn002), origin search (Fn003), or EasyFFT (Fn206), forcing movable machine parts to stop does not work for forward overtravel or reverse overtravel. Take necessary precautions.
  Failure to observe this caution may result in damage to the equipment.
- When using the servomotor for a vertical axis, install safety devices to prevent workpieces from falling due to alarms or overtravels. Set the servomotor so that it will stop in the zero clamp state when overtravel occurs.
  Failure to observe this caution may cause workpieces to fall due to overtravel.
- When not using the tuning-less function, set the correct moment of inertia ratio (Pn103).
  Setting an incorrect moment of inertia ratio may cause machine vibration.
- Do not touch the SERVOPACK heat sinks 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 equipment due to unstable operation.
- When an alarm occurs, remove the cause, reset the alarm after confirming safety, and then resume operation.
  Failure to observe this caution may result in damage to the equipment, fire, or injury.
- Do not use the holding brake of the servomotor for braking.
  Failure to observe this caution may result in malfunction.
- The servomotor will decelerate to a stop if the main-circuit or the control-circuit power supply turns OFF during operation without turning servo OFF.
- An alarm or warning may occur if communications are performed with the host controller while the SigmaWin+ or Digital Operator is operating.
  If an alarm or warning occurs, it may stop the current process and stop the system.

■ Maintenance and Inspection

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

■ Disposal Precautions

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

■ 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. • 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.

Warranty

(1) Details of Warranty

■ Warranty Period

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

■ Warranty Scope

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

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

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

(2) Limitations of Liability

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

(3) Suitability for Use

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

(4) Specifications Change

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

Harmonized Standards

■ North American Safety Standards (UL)

	Model	UL Standards (UL File No.)
SERVOPACK	SGDV	UL508C (E147823)
Servomotor	• SGM7M • SGMMV	UL1004-1 UL1004-6 (E165827)

■ EU Directives

	Model	EU Directives	Harmonized Standards
SERVOPACK	SGDV	EMC Directive 2014/30/EU	EN 55011 group1 classA EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second Environment)
		Low Voltage Directive 2014/35/EU	EN 50178 EN 61800-5-1
		RoHS Directive 2011/65/EU	EN 50581
Servomotor	SGMMV	EMC Directive 2004/108/EC	EN 55011 group1 classA EN 61000-6-2 EN 61800-3 (Category C2, Second Environment)
		Low Voltage Directive 2006/95/EC	EN 60034-1 EN 60034-5
		RoHS Directive 2011/65/EU	EN 50581
	SGM7M	EMC Directive 2014/30/EU	EN 55011 group 1, class A EN 61000-6-2 EN 61000-6-4 EN 61800-3 (Category C2, Second environment)
		Low Voltage Directive 2014/35/EU	EN 60034-1 EN 60034-5
		RoHS Directive 2011/65/EU	EN 50581

Contents

1

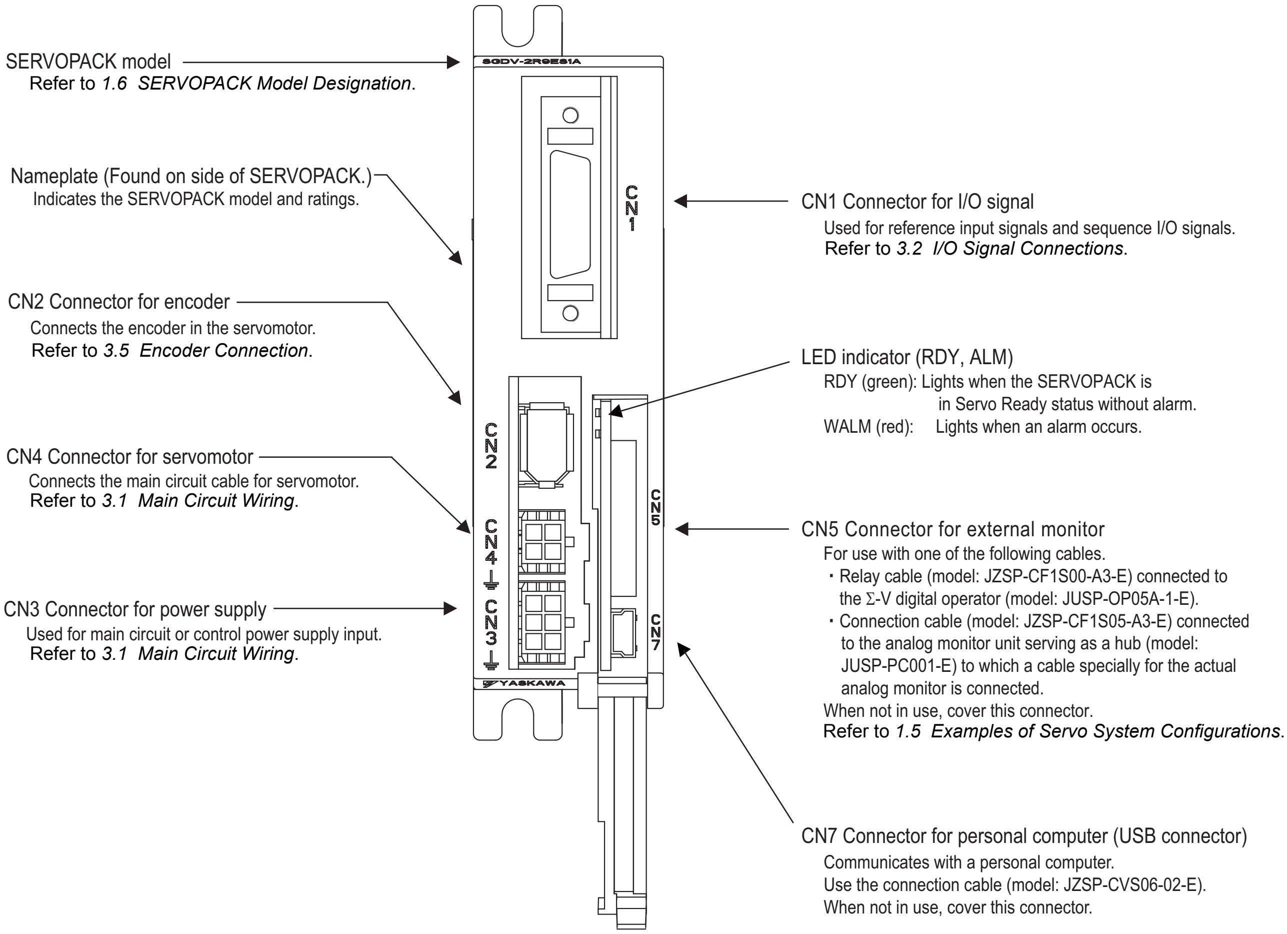
Outline

1.1 DC Power Input Σ-V Series SERVOPACKs

The DC Power Input 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 SERVOPACK for analog voltage reference and pulse train reference.



1.3 SERVOPACK Ratings and Specifications

This section describes the ratings and specifications of SERVOPACKs.

1.3.1 Ratings

Ratings of SERVOPACKs are as shown below.

SGDV	1R7		2R9	
Continuous Output Current [Arms]	1.7		2.9	
Instantaneous Max. Output Current [Arms]	4.1		8.6	
Main Circuit Power Supply	24 VDC ±15%	48 VDC ±15%	24 VDC ±15%	48 VDC ±15%
Control Power Supply	24 VDC ±15%			
Overvoltage Category	I			

* You can use either 24 or 48 VDC for the main circuit power supply. If using a 24-VDC input, the torque-motor speed characteristics of the servomotor will be less than the characteristics of a 48-VDC input. For details, refer to *Torque-Motor Speed Characteristics* of the SGMMV servomotor in *Σ-V Series Product Catalog* (Catalog No.: KAEP S800000 42) or the SGM7M servomotor in *Σ-7-Series AC Servo Drive Rotary Servomotor Product Manual* (Manual No.: SIEP S800001 36).

1.3.2 Basic Specifications

Basic specifications of SERVOPACKs are shown below.

<table>
<tr><td colspan="3">Drive Method</td><td colspan="2">Sine-wave current drive with PWM control</td></tr>
<tr><td colspan="3">Feedback</td><td colspan="2">Encoder: 17-bit (incremental/absolute)</td></tr>
<tr><td rowspan="11">Operating Conditions</td><td colspan="2">Surrounding Air Temperature</td><td colspan="2">0°C to +55°C</td></tr>
<tr><td colspan="2">Storage Temperature</td><td colspan="2">-20°C to +85°C</td></tr>
<tr><td colspan="2">Ambient Humidity</td><td>90% RH or less</td><td rowspan="2">With no freezing or condensation</td></tr>
<tr><td colspan="2">Storage Humidity</td><td>90% RH or less</td></tr>
<tr><td colspan="2">Vibration Resistance</td><td colspan="2">4.9 m/s^2</td></tr>
<tr><td colspan="2">Shock Resistance</td><td colspan="2">19.6 m/s^2</td></tr>
<tr><td colspan="2">Protection Class</td><td>IP10</td><td rowspan="2">An environment that satisfies the following conditions.
• Free of corrosive or flammable gases
• Free of exposure to water, oil, or chemicals
• Free of dust, salts, or iron dust</td></tr>
<tr><td colspan="2">Pollution Degree</td><td>2</td></tr>
<tr><td colspan="2">Altitude</td><td colspan="2">1000 m or less</td></tr>
<tr><td colspan="2">Others</td><td colspan="2">Free of static electricity, strong electromagnetic fields, magnetic fields or exposure to radioactivity</td></tr>
<tr><td colspan="3">Harmonized Standards</td><td colspan="2">Refer to Harmonized Standards in the preface for details.</td></tr>
<tr><td colspan="3">Mounting</td><td colspan="2">Base-mounted</td></tr>
<tr><td rowspan="6">Perfor-mance</td><td colspan="2">Speed Control Range</td><td colspan="2">1:5000 (The lower limit of the speed control range must be lower than the point at which the rated torque does not cause the servomotor to stop.)</td></tr>
<tr><td rowspan="3">Speed Regu-lation*</td><td>Load Regulation</td><td colspan="2">0% to 100% load: ±0.01% max. (at rated speed)</td></tr>
<tr><td>Voltage Regulation</td><td colspan="2">Rated voltage ±10%: 0% (at rated speed)</td></tr>
<tr><td>Temperature Regulation</td><td colspan="2">25 ± 25 °C: ±0.1% max. (at rated speed)</td></tr>
<tr><td colspan="2">Torque Control Tolerance (Repeatability)</td><td colspan="2">±1%</td></tr>
<tr><td colspan="2">Soft Start Time Setting</td><td colspan="2">0 to 10 s (Can be set individually for acceleration and deceleration.)</td></tr>
</table>

(cont'd)

<table>
<tr><td rowspan="6">I/O Signals
I/O Signals</td><td colspan="2">Encoder Output Pulse</td><td colspan="2">Phase A, B, C: line driver
Encoder output pulse: any setting ratio (Refer to 5.3.7.)</td></tr>
<tr><td rowspan="2">Sequence Input</td><td rowspan="2">Input Signals which can be allocated</td><td>Number of Channels</td><td>7 ch</td></tr>
<tr><td>Functions</td><td>• Servo ON (/S-ON)
• Proportional control (/P-CON)
• Forward run prohibited (P-OT), reverse run prohibited (N-OT)
• Alarm reset (/ALM-RST)
• Forward external torque limit (/P-CL), reverse external torque limit (/N-CL)
• Internal set speed selection (/SPD-D, /SPD-A, /SPD-B)
• Control selection (/C-SEL)
• SEN signal (/SEN)
• Zero clamping (/ZCLAMP)
• Reference pulse inhibit (/INHIBIT)
• Gain selection (/G-SEL)
• Reference pulse input multiplication switching (/PSEL)
Signal allocations can be performed, and positive and negative logic can be changed.</td></tr>
<tr><td rowspan="3">Sequence Output</td><td>Fixed Output</td><td colspan="2">Servo alarm (ALM)</td></tr>
<tr><td rowspan="2">Output Signals which can be allocated</td><td>Number of Channels</td><td>3 ch</td></tr>
<tr><td>Functions</td><td>• Positioning completion (/COIN)
• Speed coincidence detection (/V-CMP)
• Rotation detection (/TGON)
• Servo ready (/S-RDY)
• Torque limit detection (/CLT)
• Speed limit detection (/VLT)
• Brake (/BK)
• Warning (/WARN)
• Near (/NEAR)
• Reference pulse input multiplication switching output (/PSELA)
Signal allocations can be performed, and positive and negative logic can be changed.</td></tr>
<tr><td rowspan="2">Communi-cations Function</td><td colspan="2">Digital Operator</td><td colspan="2">Connect the Σ-V digital operator (model: JUSP-OP05A-1-E) through an applicable analog monitor unit (model: JUSP-PC001-E) and a connection cable (model: JZSP-CF1S05-A3-E), or a relay cable (model: JZSP-CF1S00-A3-E).</td></tr>
<tr><td colspan="2">Personal Computer Communications (USB)</td><td colspan="2">Supports SigmaWin+.
Based on the USB 1.1 standard (12 Mbps).</td></tr>
<tr><td colspan="3">LED Display</td><td colspan="2">ALM (red), RDY (green)</td></tr>
<tr><td colspan="3">Analog Monitor</td><td colspan="2">Number of points: 2
Output voltage: ± 10 VDC (linearity effective range ± 8 V)
Output through the analog monitor unit (model: JUSP-PC001-E), the connection cable (model: JZSP-CF1S05-A3-E), and the analog monitor cable (model: JZSP-CA01-E).</td></tr>
<tr><td colspan="3">Dynamic Brake (DB)</td><td colspan="2">Not supported.</td></tr>
<tr><td colspan="3">Regenerative Processing</td><td colspan="2">Not supported.</td></tr>
<tr><td colspan="3">Overtravel Prevention (OT)</td><td colspan="2">Deceleration to a stop or free run to a stop at P-OT or N-OT</td></tr>
<tr><td colspan="3">Protective Function</td><td colspan="2">Overcurrent, overvoltage, overload, and so on.</td></tr>
<tr><td colspan="3">Utility Function</td><td colspan="2">Gain adjustment, alarm history, JOG operation, origin search, and so on.</td></tr>
</table>

* Speed regulation by load regulation is defined as follows:

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

Outline

1

1.3.3 Control Specifications for Different Reference Type

The following list shows the control specifications for SERVOPACKs with different reference types.

(1) Analog Voltage Reference (Model: SGDV-□□□ES1A)

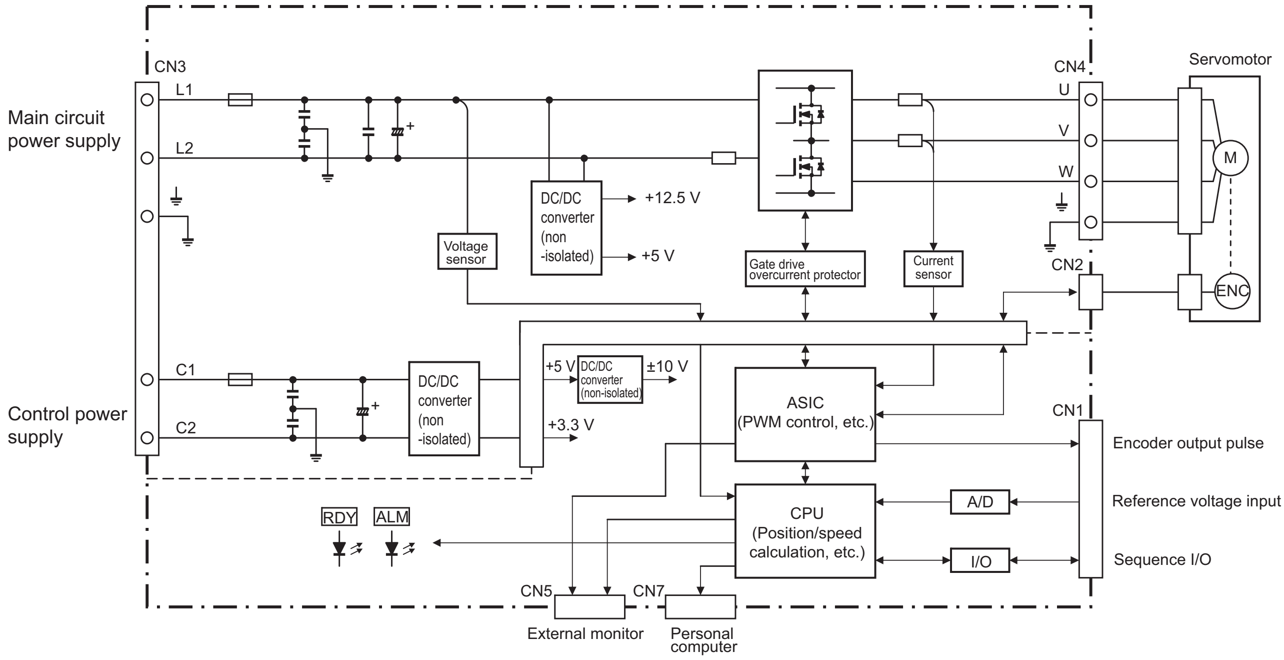
Control Method		Specifications	
Speed Control	Performance	Soft Start Time Setting	0 to 10 s (Can be set individually for acceleration and deceleration.)
	Input Signals	Reference Voltage	• Max. input voltage: ±12 V (forward speed reference with positive reference) • Factory setting: 6 VDC at rated speed Input gain setting can be varied.
		Input Impedance	Approx. 14 kΩ
		Circuit Time Constant	30 μs
	Internal Set Speed Control	Rotation Direction Selection	With P control signal
		Speed Selection	With forward/reverse external torque limit signal (speed 1 to 3 selection). Servomotor stops or another control method is used when both are OFF.
Torque Control	Input Signals	Reference Voltage	• Max. input voltage: ±12 V (forward torque reference with positive reference) • Factory setting: 3 VDC at rated torque Input gain setting can be varied.
		Input Impedance	Approx. 14 kΩ
		Circuit Time Constant	16 μs

(2) Pulse Train Reference (Model: SGDV-□□□EP1A)

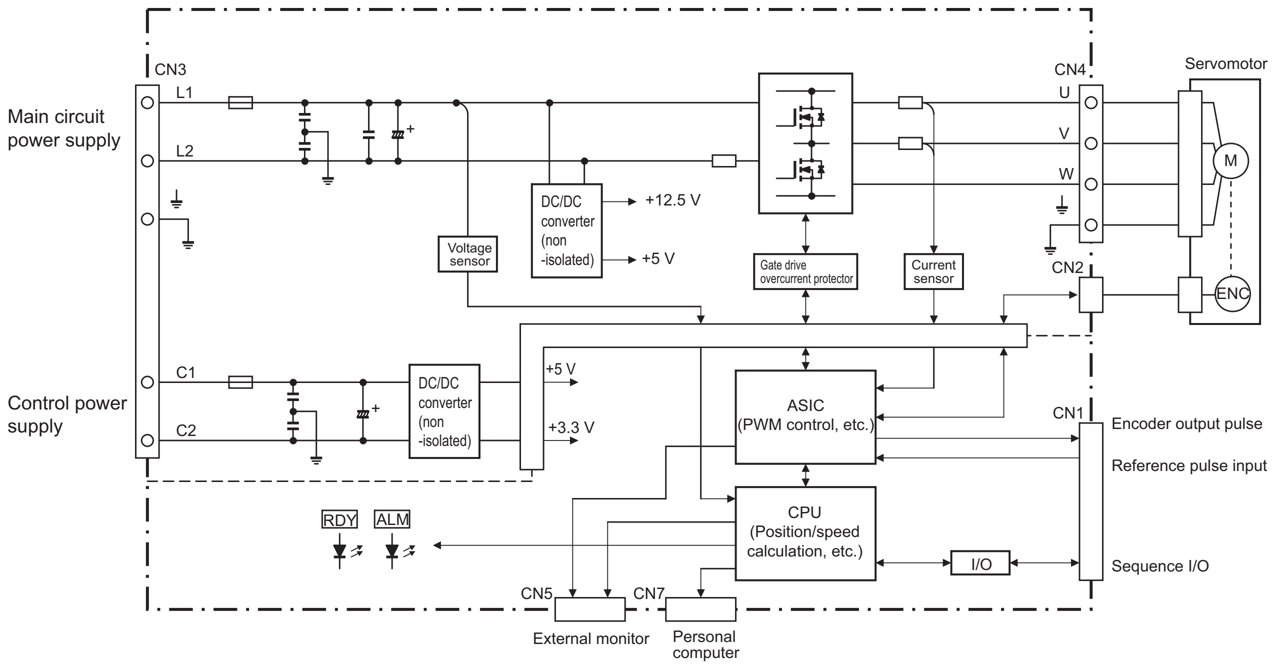
Control Method		Specifications		
Position Control	Performance	Feedforward Compensation		0% to 100%
		Positioning Completed Width Setting		0 to 1073741824 reference units
	Input Signals	Reference Pulse	Type	Select one of them: Sign + pulse train, CW + CCW pulse train, or two-phase pulse train with 90° phase differential
			Form	For line driver, open collector
			Max. Input Pulse Frequency	Line driver Sign + pulse train, CW + CCW pulse train: 4 Mpps Two-phase pulse train with 90° phase differential: 1 Mpps Open Collector Sign + pulse train, CW + CCW pulse train: 200 kpps Two-phase pulse train with 90° phase differential: 200 kpps
			Reference Pulse Input Multiplication Switching	1 to 100 times
		Clear Signal		Position error clear For line driver, open collector

1.4 SERVOPACK Internal Block Diagrams

1.4.1 Analog Voltage Reference (Model: SGDV-□□□ES1A)

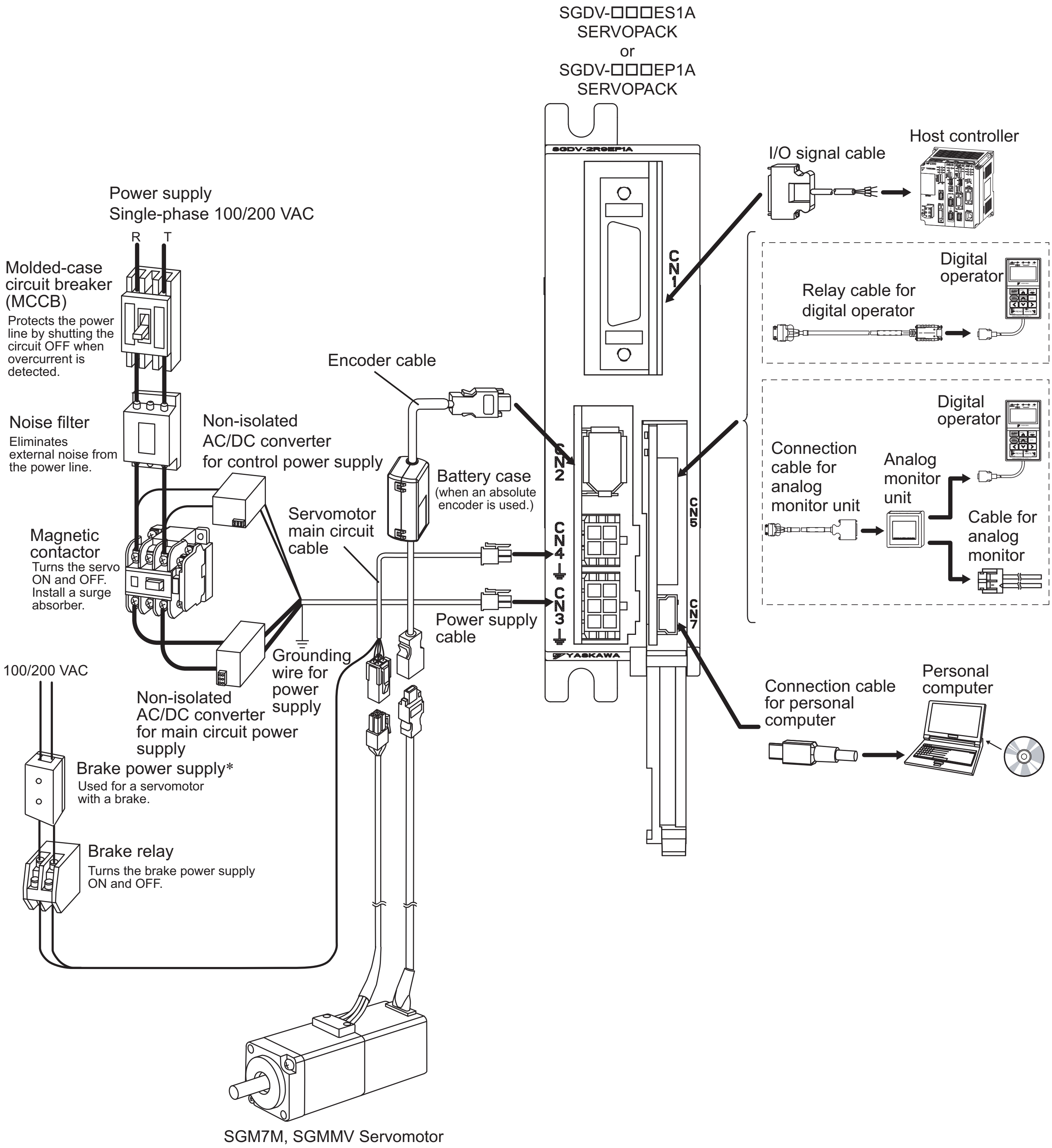


1.4.2 Pulse Train Reference (Model: SGDV-□□□EP1A)



1.5 Examples of Servo System Configurations

This section describes examples of basic servo system configuration.



* Use a 24-VDC power supply. (Not included.)

1.6 SERVOPACK Model Designation

This section shows SERVOPACK model designation.

	1st + 2nd + 3rd digits	4th digit	5th + 6th digits	7th digit	8th + 9th + 10th digits	11th + 12th digits	13th digit
SGDV –	2R9	E	S1	A	000	00	0

Series	
SGDV	Σ-V Series

1st + 2nd + 3rd digits: Current	
Code	Allowable Motor Current (Arms)
1R7	1.7
2R9	2.9

4th digit: Voltage	
Code	Voltage
E	48 VDC*

5th + 6th digits: Interface Specifications	
Code	Interface
S1	Analog voltage reference, rotational servomotor
P1	Pulse train reference, rotational servomotor
11	MECHATROLINK-II communications reference, rotational servomotor
21	MECHATROLINK-III communications reference, rotational servomotor

7th digit: Design Revision Order

8th + 9th + 10th digits: Hardware Specifications	
Code	Specifications
000	Standard

11th + 12th digits: Software Specification	
Code	Specification
00	Standard

13th digit: Parameter Specification	
Code	Specification
0	Standard

* 24 VDC for the main circuit power supply also can be used.

Note: If the option codes digits 8 to 13 are all zeros, they are omitted.

1.7 Inspection and Maintenance

This section describes the inspection and maintenance of SERVOPACK.

(1) SERVOPACK Inspection

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

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

(2) SERVOPACK's Parts Replacement Schedule

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

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

IMPORTANT

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

Part	Standard Replacement Period	Operating Conditions
Smoothing Capacitor (Aluminum Electrolytic Capacitor)	7 to 8 years	• Surrounding Air Temperature: Annual average of 30°C • Load Factor: 80% max. • Operation Rate: 20 hours/day max.

Note: If the above operating conditions are not used, replacement may be required sooner than the standard replacement period. To extend the life of the parts, reduce the ambient temperature. Contact your Yaskawa representative if you require more-detailed information.

2

Digital Operator

2.1 Digital Operator

The Digital Operator is a device that can be used to display SERVOPACK status, execute utility functions, set parameters, and monitor operation.

2.2 Digital Operator Connection

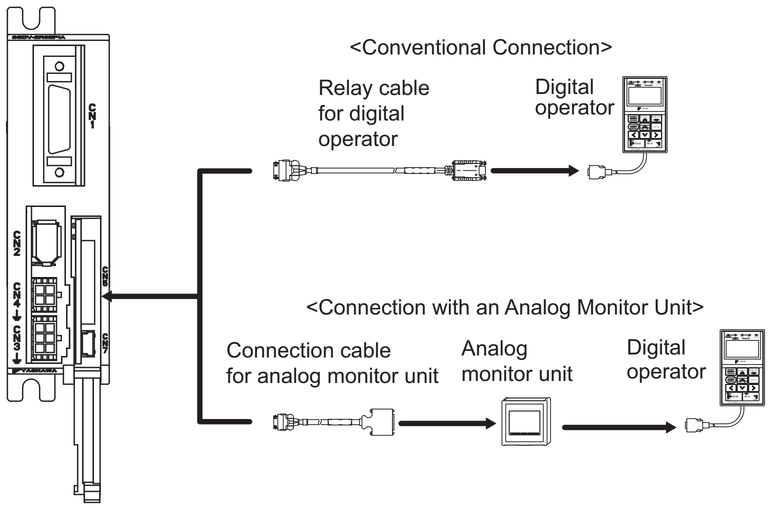
Use the external monitor connector (CN5) on the SERVOPACK to connect the digital operator. There are two ways to connect the digital operator. These are as follows:

- Conventional connection
- Connection with an analog monitor unit (If using this method, the digital operator and another device, such as a monitoring device, can be connected to the SERVOPACK at the same time).

The following table lists the devices and cables that are required for connection.

Connection Method	Required Devices and Cables
Conventional	• Digital operator relay cable (model: JZSP-CF1S00-A3-E) • Digital operator (model: JUSP-OP05A-1-E)
With an Analog Monitor Unit	• Analog monitor unit connection cable (model: JZSP-CF1S05-A3-E) • Analog monitor unit (model: JUSP-PC001-E) • Digital operator (model: JUSP-OP05A-1-E)

The connection methods are shown below.



2.3 Operation of Digital Operator

Operation examples of utility functions (Fn□□□), parameters (Pn□□□) and monitor displays (Un□□□) when using a digital operator are described in this chapter.

Operations can be also performed with SigmaWin+.

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).

2.4 Utility Functions (Fn□□□)

The utility functions are related to the setup and adjustment of the SERVOPACK.

In this case, the digital operator shows numbers beginning with Fn.

The following table outlines the procedures necessary for an origin search (Fn003).

<table>
<tr><th>Step</th><th>Display after Operation</th><th>Keys</th><th>Operation</th></tr>
<tr><td>1</td><td>BB –FUNCTION–
Fn002:JOG
Fn003:Z–Search
Fn004:Program JOG
Fn005:Prm Init</td><td>MODE/SET
∧ ∨</td><td>Press the MODE/SET Key to view the main menu for the utility function.
Use the ∧ or ∨ Key to move through the list and select Fn003.</td></tr>
<tr><td>2</td><td>BB –Z–Search–
Un000= 00000
Un002= 00000
Un003= 0000000774
Un00D= 0000000000</td><td>DATA</td><td>Press the DATA Key. The display changes to the Fn003 execution display.</td></tr>
<tr><td>3</td><td>RUN –Z–Search–
Un000= 00000
Un002= 00000
Un003= 0000000774
Un00D= 0000000000</td><td>JOG SVON</td><td>Press the JOG SVON Key.
The status display changes from "BB" to "RUN", and the servomotor power turns ON.
Note: If the servomotor is already at the zero position, "-Complete-" is displayed.</td></tr>
<tr><td>4</td><td>RUN –Complete–
Un000= 00000
Un002= 00000
Un003= 0000000000
Un00D= 0000001D58</td><td>∧ ∨</td><td>Pressing the ∧ Key will rotate the servomotor in the forward direction. Pressing the ∨ Key will rotate the servomotor in the reverse direction. The rotation direction of the servomotor changes according to the setting of Pn000.0 as shown in the following table.
<table>
<tr><th colspan="2">Parameter</th><th>∧ key</th><th>∨ key</th></tr>
<tr><td rowspan="2">Pn000</td><td>n.□□□0</td><td>CCW</td><td>CW</td></tr>
<tr><td>n.□□□1</td><td>CW</td><td>CCW</td></tr>
</table>
Note: Direction when viewed from the load of the servomotor.
Press the ∧ or ∨ Key until the servomotor stops. If the origin search completed normally, "-Complete-" is displayed on the right top on the screen.</td></tr>
<tr><td>5</td><td>BB –Z–Search–
Un000= 00000
Un002= 00000
Un003= 0000000000
Un00D= 0000001D58</td><td>JOG SVON</td><td>When the origin search is completed, press the JOG SVON Key.
The status display changes from "RUN" to "BB", and the servomotor turns OFF. The display "-Complete-" changes to "-Z-Search-."</td></tr>
<tr><td>6</td><td>BB –FUNCTION–
Fn002:JOG
Fn003:Z–Search
Fn004:Program JOG
Fn005:Prm Init</td><td>MODE/SET</td><td>Press the MODE/SET Key.
The display returns to the main menu of the utility function.</td></tr>
<tr><td>7</td><td colspan="3">To enable the change in the setting, restart the SERVOPACK.</td></tr>
</table>

2.5 Parameters (Pn□□□)

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

2.5.1 Parameter Classification

Parameters of the Σ-V Series SERVOPACK are classified into two types of parameters. One type of parameters is required for setting up the basic conditions for operation and the other type is required for tuning parameters that are required to adjust servomotor characteristics.

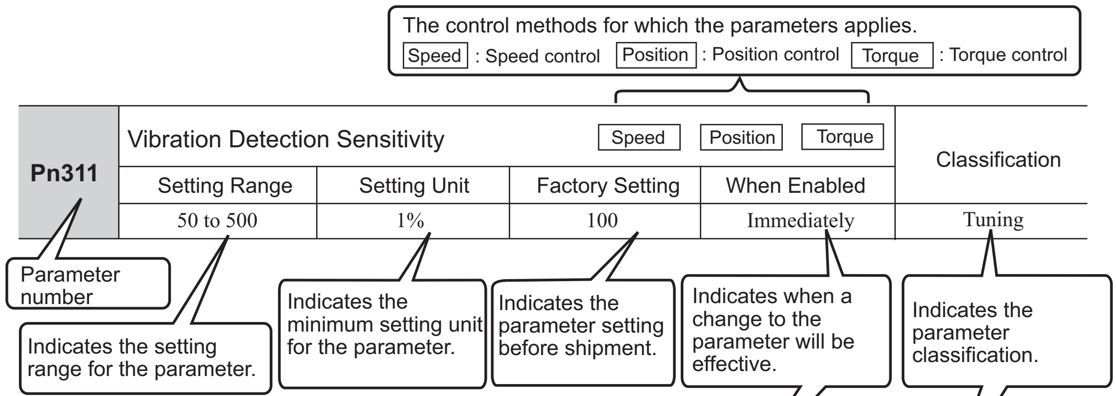
Classification	Meaning	Display Method	Setting Method
Setup Parameters	Parameters required for setup.	Always displayed (Factory setting: Pn00B.0 = 0)	Set each parameter individually.
Tuning Parameters	Parameters for tuning control gain and other parameters.	Set Pn00B.0 to 1.	There is no need to set each parameter individually.

There are two types of notation used for parameters, one for parameter that requires a value setting (parameter for numeric settings) and one for parameter that requires the selection of a function (parameter for selecting functions).

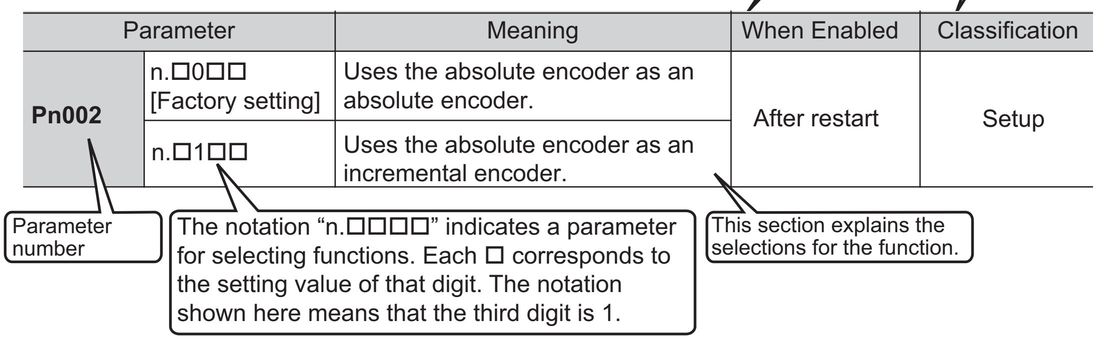
The notation and settings for both types of parameters are described next.

2.5.2 Notation for Parameters

(1) Parameters for Numeric Settings



(2) Parameters for Selecting Functions



Digital Operator Display (Display Example for Pn002)

n.0000

Digit	Digit Notation: Notation	Digit Notation: Meaning	Setting Notation: Notation	Setting Notation: Meaning
1st digit	Pn002.0	Indicates the value for the 1st digit of parameter Pn002.	Pn002.0 = x or n.□□□x	Indicates that the value for the 1st digit of parameter Pn002 is x.
2nd digit	Pn002.1	Indicates the value for the 2nd digit of parameter Pn002.	Pn002.1 = x or n.□□x□	Indicates that the value for the 2nd digit of parameter Pn002 is x.
3rd digit	Pn002.2	Indicates the value for the 3rd digit of parameter Pn002.	Pn002.2 = x or n.□x□□	Indicates that the value for the 3rd digit of parameter Pn002 is x.
4th digit	Pn002.3	Indicates the value for the 4th digit of parameter Pn002.	Pn002.3 = x or n.x□□□	Indicates that the value for the 4th digit of parameter Pn002 is x.

2.5.3 Setting Parameters

(1) How to Make Numeric Settings Using Parameters

The following example shows how to change the setting of parameter Pn304 (JOG speed) to 1000 min^{-1}.

Step	Display after Operation	Keys	Operation
1	BB −PRM/MON− Un000= 00000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	MODE/SET	Press the MODE/SET Key to select the main menu of parameters and monitor displays.
2	BB −PRM/MON− Un000= 00000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	< >	Press the < or > Key to move the cursor to "Un."
3	BB −PRM/MON− Pn000=n.0000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	∧ ∨	Press the ∧ or ∨ Key to change "Un" to "Pn."
4	BB −PRM/MON− Pn000=n.0000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	>	Press the > Key to move the cursor to the column on the right of "Pn."
5	BB −PRM/MON− Pn304=00500 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	< > ∧ ∨	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= 0000000000 Un00D= 0000000000	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= 0000000000 Un00D= 0000000000	<	Press the < Key twice to move the cursor to the hundred's place of Pn304.
8	BB −PRM/MON− Pn304=01000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	∧	Press the ∧ Key five times to change the setting to "1000."

(cont'd)

Step	Display after Operation	Keys	Operation
9	BB −PRM/MON− Pn304=01000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	DATA	Press the DATA Key to write the settings.

* If the DATA Key has not been pressed but the MODE/SET Key has been pressed to select another mode such as the utility function mode, any changes that have been made to the parameter will be saved in the SERVOPACK.

(2) How to Select Functions Using Parameters

The following example shows how to change the setting of the motor direction selection (Pn000.0) in the function selection basic switch 0 (Pn000) to 1 (reverse direction).

Step	Display after Operation	Keys	Operation
1	BB −PRM/MON− Un000= 00000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	MODE/SET	Press the MODE/SET Key to select the main menu of parameters and monitor displays.
2	BB −PRM/MON− Un000= 00000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	< >	Press the < or > Key to move the cursor to "Un."
3	BB −PRM/MON− Pn000=n.0000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	∧ ∨	Press the ∧ or ∨ Key to change "Un" to "Pn."
4	BB −PRM/MON− Pn000=n.0000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	DATA	Press the DATA Key to move the cursor to the setting side (to the position of the first digit of Pn000.0).
5	BB −PRM/MON− Pn000=n.0001 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	∧	Press the ∧ Key once to set "1" for the first digit of Pn.000.0.
6	A. 941 −PRM/MON− Pn000=n.0001 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	DATA	Press the DATA Key. The new setting of Pn000 is written to the SERVOPACK. The cursor moves to the parameter number side and the warning A.941 is displayed.
7	To enable the change in the setting, restart the SERVOPACK.*		

* When the setting is modified, the parameters whose modified setting is validated only after setting validation, the warning A.941 "Change of Parameters Requires the Setting Validation" is displayed. Restart the SERVOPACK to clear the warning and validate the new setting.

2.6 Monitor Displays (Un□□□)

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

For details, refer to *8.2 Viewing Monitor Displays*.

The digital operator shows numbers beginning with Un.

The following four settings are the factory settings.

```
BB          －PRM／MON－
Un000＝  00000
Un002＝  00000
Un008＝  00000
Un00D＝00000000
```

← Shows the setting of Un000 (motor rotating speed) as 0 min^{-1}.

3

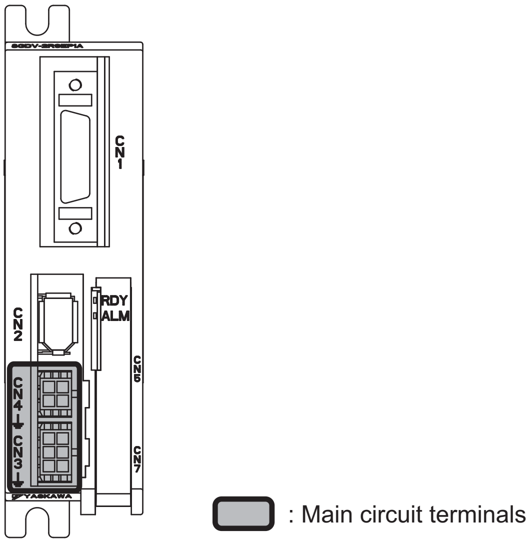
Wiring and Connection

3.1 Main Circuit Wiring

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

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

3.1.1 Main Circuit Terminals (CN3, CN4)



<table>
<tr><th>Connector Number</th><th>Terminal Symbol</th><th>Pin Number</th><th>Name</th><th>Specification</th></tr>
<tr><td rowspan="5">CN3</td><td>L1</td><td>6</td><td>Main circuit power input terminal (+)</td><td rowspan="2">24 VDC ±15% or 48 VDC ±15%</td></tr>
<tr><td>L2</td><td>3</td><td>Main circuit power input terminal (-)</td></tr>
<tr><td>C1</td><td>5</td><td>Control power input terminal (+)</td><td rowspan="2">24 VDC ±15%</td></tr>
<tr><td>C2</td><td>4</td><td>Control power input terminal (-)</td></tr>
<tr><td>⏚</td><td>1, 2</td><td>Ground terminals</td><td>Use for connecting the power supply ground terminal.</td></tr>
<tr><td rowspan="4">CN4</td><td>U</td><td>1</td><td>Servomotor connection terminal (phase U)</td><td rowspan="3">Use for connecting to the servomotor.</td></tr>
<tr><td>V</td><td>2</td><td>Servomotor connection terminal (phase V)</td></tr>
<tr><td>W</td><td>3</td><td>Servomotor connection terminal (phase W)</td></tr>
<tr><td>⏚</td><td>4</td><td>Ground terminals</td><td>Use for connecting the servomotor ground terminal.</td></tr>
</table>

3.1.2 Main Circuit Wires

Use the following cables for main circuit of the SERVOPACK. Contact your Yaskawa representative for details.

<table>
<tr><th rowspan="2">Cable</th><th rowspan="2">Terminal Symbols</th><th colspan="2">SERVOPACK Model: SGDV-</th></tr>
<tr><th>1R7E</th><th>2R9E</th></tr>
<tr><td>For power supply</td><td>L1, L2, C1, C2, ⏚</td><td colspan="2">JZSP-CF1G00-□□-E</td></tr>
<tr><td>For servomotor main circuit</td><td>U, V, W, ⏚</td><td colspan="2">JZSP-CF1M00-□□-E (For servomotors without brakes)
JZSP-CF1M10-□□-E (For servomotors with brakes)
JZSP-CF1M20-□□-E (For servomotors without brakes, flexible type)
JZSP-CF1M30-□□-E (For servomotors with brakes, flexible type)</td></tr>
</table>

If you make cables by yourself, read the following items.

IMPORTANT

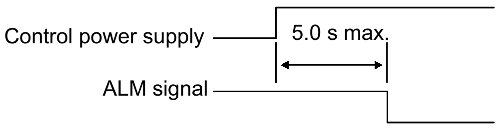
- Wire sizes are selected for three cables per bundle at 40°C surrounding air temperature with the rated current.
- Use the withstand voltage wires (for 100 V or more).
- Use the wires whose outside diameter of insulator is 1.85 mm or less.
- If cables are bundled in PVC or metal ducts, take into account the reduction of the allowable current.
- Use a heat-resistant wire under high surrounding air or panel temperatures.
- The length of cables for power supply is 10 m max., and the length of cables for servomotor main circuit is 50 m max.

<table>
<tr><th rowspan="2" colspan="3">Cable</th><th colspan="2">SERVOPACK Model: SGDV-</th><th rowspan="2">Remarks</th></tr>
<tr><th>1R7E</th><th>2R9E</th></tr>
<tr><td rowspan="4">CN3 for power supply</td><td colspan="2">Connector</td><td colspan="2">43025-0600 (Made by Molex Japan LLC)</td><td>6 poles</td></tr>
<tr><td colspan="2">Contact</td><td colspan="2">43030-0001 (Made by Molex Japan LLC)</td><td>–</td></tr>
<tr><td colspan="2">For main circuit power supply (L1, L2, ⏚)</td><td colspan="2">UL1007, AWG20</td><td>Rated voltage 300 V, Rated temperature 80°C</td></tr>
<tr><td colspan="2">For control circuit power supply (C1, C2, ⏚)</td><td colspan="2">UL1007, AWG20</td><td>Rated voltage 300 V, Rated temperature 80°C</td></tr>
<tr><td rowspan="6">CN4 for servomotor main circuit</td><td colspan="2">Connector (SERVOPACK side)</td><td colspan="2">43025-0400 (Made by Molex Japan LLC)</td><td>4 poles</td></tr>
<tr><td colspan="2">Contact (SERVOPACK side)</td><td colspan="2">43030-0001 (Made by Molex Japan LLC)</td><td>–</td></tr>
<tr><td rowspan="2">Connector (servomotor side)</td><td>without brake</td><td colspan="2">43020-0401 (Made by Molex Japan LLC)</td><td>4 poles</td></tr>
<tr><td>with brake</td><td colspan="2">43020-0601 (Made by Molex Japan LLC)</td><td>6 poles</td></tr>
<tr><td colspan="2">Contact (servomotor side)</td><td colspan="2">43031-0001 (Made by Molex Japan LLC)</td><td>–</td></tr>
<tr><td colspan="2">Power line for servomotor main circuit (U, V, W, brake power supply, ⏚)</td><td colspan="2">UL1007, AWG20</td><td>Rated voltage 300 V, Rated temperature 80°C</td></tr>
</table>

3.1.3 Typical Main Circuit Wiring Examples

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 (ALM) is output.
- The ALM signal is output for a maximum of five seconds when the control power is turned ON. Take this into consideration when designing the power ON sequence. Design the sequence so the ALM signal is activated and the alarm detection relay (1Ry) is turned OFF to stop the main circuit's power supply to the SERVOPACK.



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

IMPORTANT

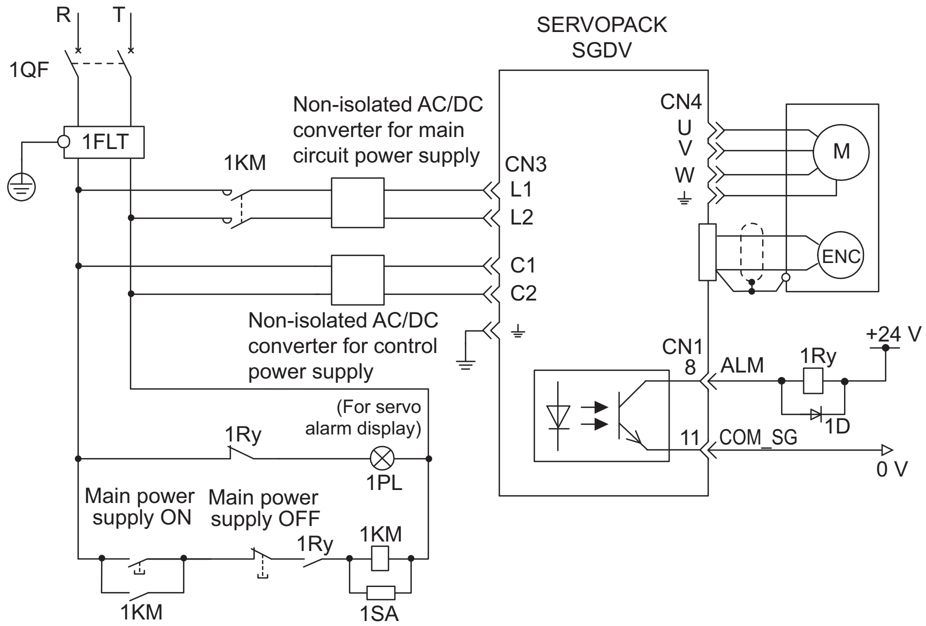
- When turning ON the control power supply and the main circuit power supply, turn them ON at the same time or turn the main circuit power supply after the control power supply. When turning OFF the power supplies, first turn the power for the main circuit OFF and then turn OFF the control power supply.
- Provide separate AC/DC power supplies for the main circuits and for controls.
- Power supplies must have double or reinforced insulation that conforms to safety standards.
- Do not connect devices (such as motors or solenoids) that greatly change the load or devices (such as electromagnetic switches) that generate surge voltages to the controller power line.

  Failure to observe this caution may result in deterioration of the internal elements or a blown fuse.

The typical main circuit wiring examples are shown below.

⚠ WARNING

- Voltage remains in the SERVOPACK even after the power supply is turned OFF. To prevent electric shock, do not touch the input terminals for the main circuit power supply or those for the control power supply. Before wiring or inspections, confirm that the SERVOPACK has completely discharged.



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

3.1.4 Power Supply Capacities and Power Losses

The following table shows the SERVOPACK's power supply capacities and power losses.

Main Circuit Power Supply	Maximum Applicable Servomotor Capacity [W]	SERVOPACK Model SGDV-	Power Supply Capacity per SERVOPACK [W]	Output Current [Arms]	Main Circuit Power Loss [W]	Control Circuit Power Loss [W]	Total Power Loss [W]
24 VDC	11	1R7E	108	1.7	3.4	7.2	10.6
	30	2R9E	165	2.9	6.9		14.1
48 VDC	11	1R7E	169	1.7	3.4		10.6
	30	2R9E	411	2.9	6.9		14.1

3.1.5 Input Power Supply, Molded-case Circuit Breaker, and Fuse

Use input power supplies that meet the following conditions.

- The main circuit power supply must be a 24-VDC or a 48-VDC power supply.
- The control circuit power supply must be a 24-VDC power supply.
- The main circuit power supply and the control power supply must be two separate input power supplies.
- Power supplies must have double or reinforced insulation that conforms to safety standards.

When choosing molded-case circuit breakers and fuses for input power supplies on the AC side, confirm the specifications of the input power supplies and refer to this table.
Also, choose molded-case circuit breakers and fuses that meet the following cutoff characteristics.

Cutoff characteristics (25°C): 300% of the rated load input current, five seconds min.
Does not cut off at the inrush current value of the power supply.

SERVOPACK Model SGDV-	Main Circuit Power Supply	Max. Applicable Servomotor Capacity [W]	Power Supply Capacity per SERVOPACK *1 [W]	Input Current Capacity			Rated Voltage			
				Main Circuit		Control Circuit *2 [A]	Fuse [V]		MCCB [V]	
				Continuous Rated [A]	Instantaneous Max. [A]		100 V 200 V	400 V	100 V 200 V	400 V
1R7E	24 VDC	11	108	2.0	5.5	0.3	250	600	240	480
	48 VDC		169	1.0	4.5					
2R9E	24 VDC	30	165	3.5	8.5					
	48 VDC		411	2.0	10.5					

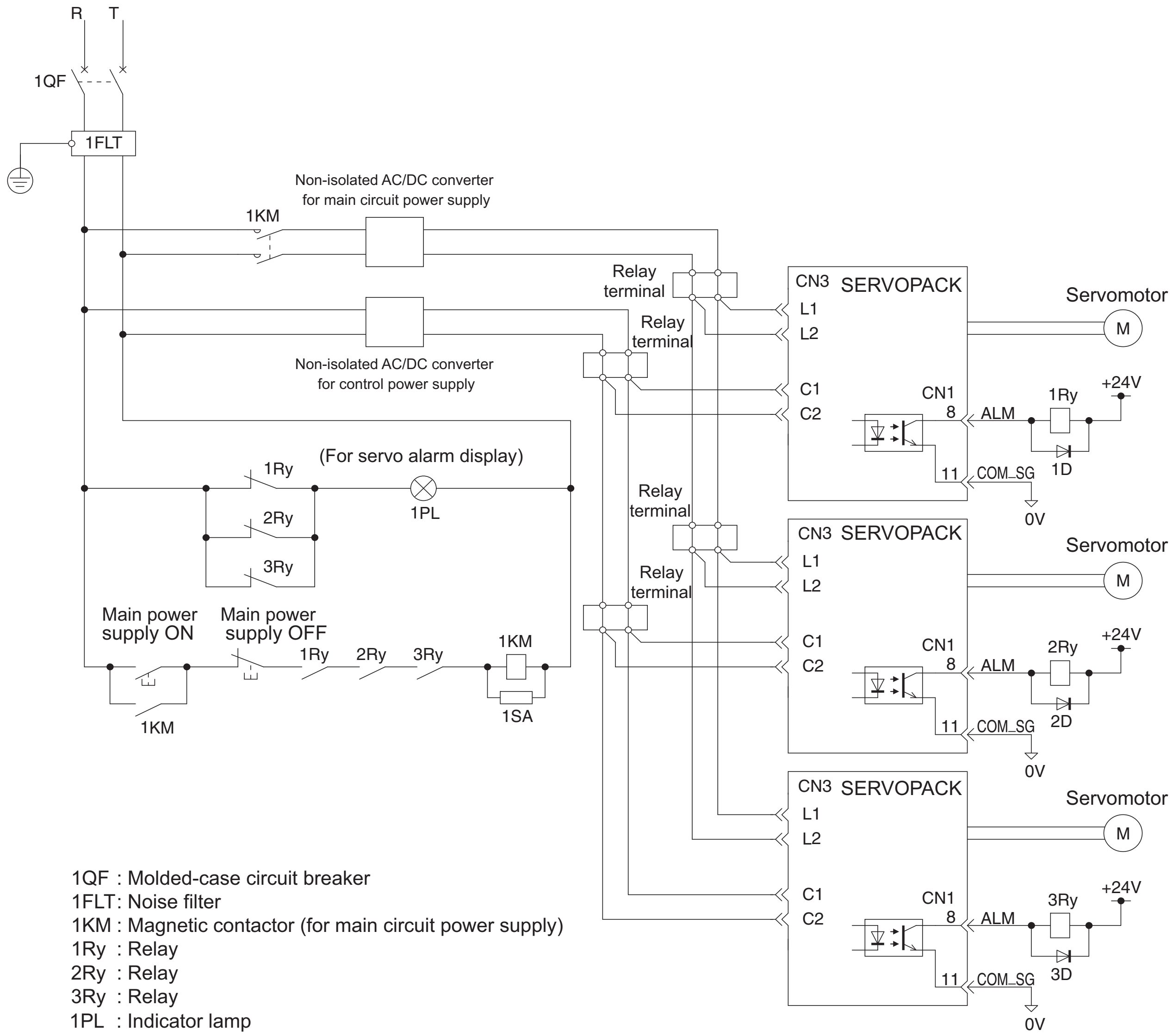
*1. Values with instantaneous maximum load.
*2. Values with rated load.

3.1.6 Using More Than One SERVOPACK

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

(1) Wiring Example

The alarm output (ALM) of each SERVOPACK operates a separate alarm detection relay (1Ry, 2Ry or 3Ry). When the alarm occurs, the ALM output signal transistor is turned OFF.



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

(2) Precautions

- Multiple SERVOPACKs can share a single molded-case circuit breaker (1QF) or noise filter. Always select a molded-case circuit breaker or noise filter that has enough capacity for the total power supply capacity (load conditions) of the SERVOPACKs.
- The same ground, COM_SG, is used for all four sequence output signals for a Σ-series SERVOPACK with a DC power input. If the alarm outputs from the SERVOPACKs are connected in series, it will not be possible to receive the output signals normally when an alarm occurs.

3.1.7 General Precautions for Wiring

IMPORTANT

- Always use a molded-case circuit breaker (1QF) or a fuse to protect the servo system from intersystem faults.
- Install a ground fault detector.
  The SERVOPACK does not have a built-in protective circuit for grounding.
  To configure a safer system, install a ground fault detector against overloads and short-circuiting, or install a ground fault detector combined with a molded-case circuit breaker.
- Do not turn the power ON and OFF more than necessary.
  - Do not use the SERVOPACK for applications that require the power to turn ON and OFF frequently. Such applications will cause elements in the SERVOPACK to deteriorate.
  - As a guideline, at least one hour should be allowed between the power being turned ON and OFF once actual operation has been started.

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

- Use the connection cables specified in *Σ-V Series Product Catalog* (Catalog No.: KAEP S800000 42). Design and arrange the system so that each cable will be as short as possible.
- Use shielded twisted-pair cables or screened unshielded twisted-pair cables for I/O signal cables and encoder cables.
- The maximum wiring length is 3 m for I/O signal cables, 50 m for servomotor main circuit cables and encoder cables, and 10 m for power supply cables.
- Observe the following precautions when wiring the ground.
  - Use a cable as thick as possible.
  - Ground to a ground resistance of 100 Ω or less.
  - 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^2 or 0.3 mm^2. Do not impose excessive bending force or tension.

■ Precaution When Wiring a Magnetic Contactor on the DC Side of the Main Circuit Power Supply

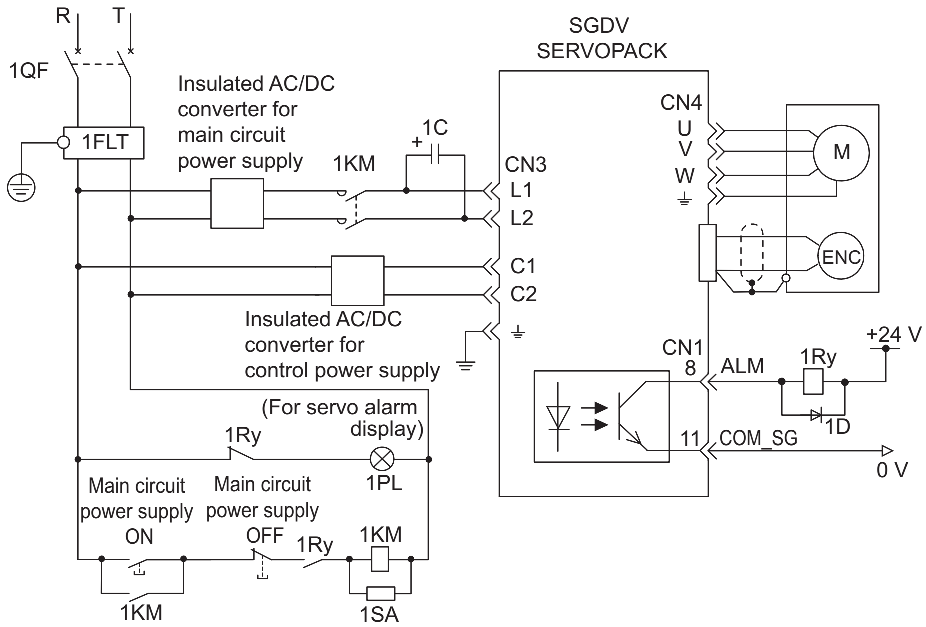
To shut OFF the main circuit power supply to the SERVOPACK, we recommend that you do so on the AC side of the AC/DC power supply. To shut OFF the power supply on the DC side, connect a capacitor (1C) with the following specifications after the magnetic contactor (1KM). Wire the capacitor (1C) as close to the SERVOPACK as possible.

<table>
<tr><th rowspan="3">Main Circuit Power Supply</th><th rowspan="3">SERVOPACK Model</th><th colspan="4">Recommended Capacitor Specifications per SERVOPACK</th></tr>
<tr><th rowspan="2">Rated Voltage</th><th rowspan="2">Rated Capacitance</th><th colspan="2">Recommended Capacitor</th></tr>
<tr><th>Model*</th><th>Manufacturer</th></tr>
<tr><td rowspan="2">24 VDC</td><td>SGDV-1R7E□1A</td><td rowspan="2">50 VDC min.</td><td>3,000 µF to 3,900 µF</td><td>UPJ1H152MHD × 2</td><td rowspan="4">Nichicon Corporation</td></tr>
<tr><td>SGDV-2R9E□1A</td><td>3,600 µF to 4,700 µF</td><td>UPJ1H182MHD × 2</td></tr>
<tr><td rowspan="2">48 VDC</td><td>SGDV-1R7E□1A</td><td rowspan="2">100 VDC min.</td><td>2,700 µF to 3,900 µF</td><td>LGU2A272MELB</td></tr>
<tr><td>SGDV-2R9E□1A</td><td>3,300 µF to 4,700 µF</td><td>LGU2A332MELB</td></tr>
</table>

* Use the capacitor given above or the equivalent.

IMPORTANT	• The larger the capacitance of the capacitor (1C), the more charging current will flow when the power supply is turned ON. Select an AC/DC power supply so that there will not be insufficient current. Consult the manufacturer of the power supply for the output current capacity of the power supply. • If you connect a capacitor (1C), more time may be required until the servo ready output signal (/S-RDY) turns ON. Consider this when you design the operation sequence. Also, more time will be required to discharge after the main circuit power supply is shut OFF. Be careful of electric shock. For the recommended AC/DC power supplies, refer to the *Σ-V Series Product Catalog* (Catalog No.: KAEP S800000 42).

A wiring example is provided below for connecting a magnetic contactor on the DC side of the main circuit power supply.



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

3.2 I/O Signal Connections

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

3.2.1 I/O Signal (CN1) Names and Functions

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

(1) Input Signals

Control Method	Signal Name	Pin No.	Function		Reference Section
Common	/S-ON	15	Servo ON/OFF: Turns ON/OFF the servomotor.		5.2.1
	/P-CON	16	Proportional control reference	Switches the speed control loop from PI (proportional/integral) to P (proportional) control when ON.	6.9.3
			Rotation Direction reference	With internal set speed control selected: Switches the servomotor rotation direction.	5.6.1
			Control switching	Switches control method between torque control and speed control.	5.7.2
			Zero-clamp reference	With speed control with zero-clamp function selected: Reference speed is zero when ON.	5.3.5
			Reference pulse block	With position control with reference pulse stop selected: Stops reference pulse input when ON.	5.4.8
	P-OT N-OT	17 18	Forward run prohibited, Reverse run prohibited	With overtravel prevention: Stops servomotor when movable part travels beyond the allowable range of motion.	5.2.3
	/P-CL	26	Forward external torque limit	Activates/deactivates external torque limit function.	5.8.2 5.8.4
	/N-CL	12	Reverse external torque limit		
			Internal set speed switching	With internal set speed control selected: Switches the internal set speed settings.	5.6.1
	/ALM-RST	25	Alarm reset: Releases the servo alarm state.		–
	+24VIN	14	Control power supply input for sequence signals Allowable voltage range: 11 to 25 V Note: The 24 VDC power supply is not included.		3.4.2
	/SEN /SPD-D /SPD-A /SPD-B /C-SEL /ZCLAMP /INHIBIT /G-SEL /PSEL	Can be allocated	The following input signals can be changed to allocate functions: /S-ON, /P-CON, P-OT, N-OT, /P-CL, /N-CL, and /ALM-RST.		3.3.1 5.3.5 5.4.3 5.4.8 5.6.1 5.7.1 6.8.1
Analog Voltage Reference	V-REF	1 (2)	Inputs speed reference. Input voltage range: ± 12 V max.		5.3.1 5.5.4
	T-REF	3 (4)	Inputs torque reference. Input voltage range: ± 12 V max.		5.5.1 5.8.3 5.8.5

(cont'd)

Control Method	Signal Name	Pin No.	Function	Reference Section
Pulse Train Reference	PULS /PULS SIGN /SIGN	1 2 3 4	Input pulse modes: Select one of them. • Sign + pulse train • CW + CCW pulse train • Two-phase pulse train with 90° phase differential	5.4.1
	CLR /CLR	5 6	Clears position error during position control.	5.4.2

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

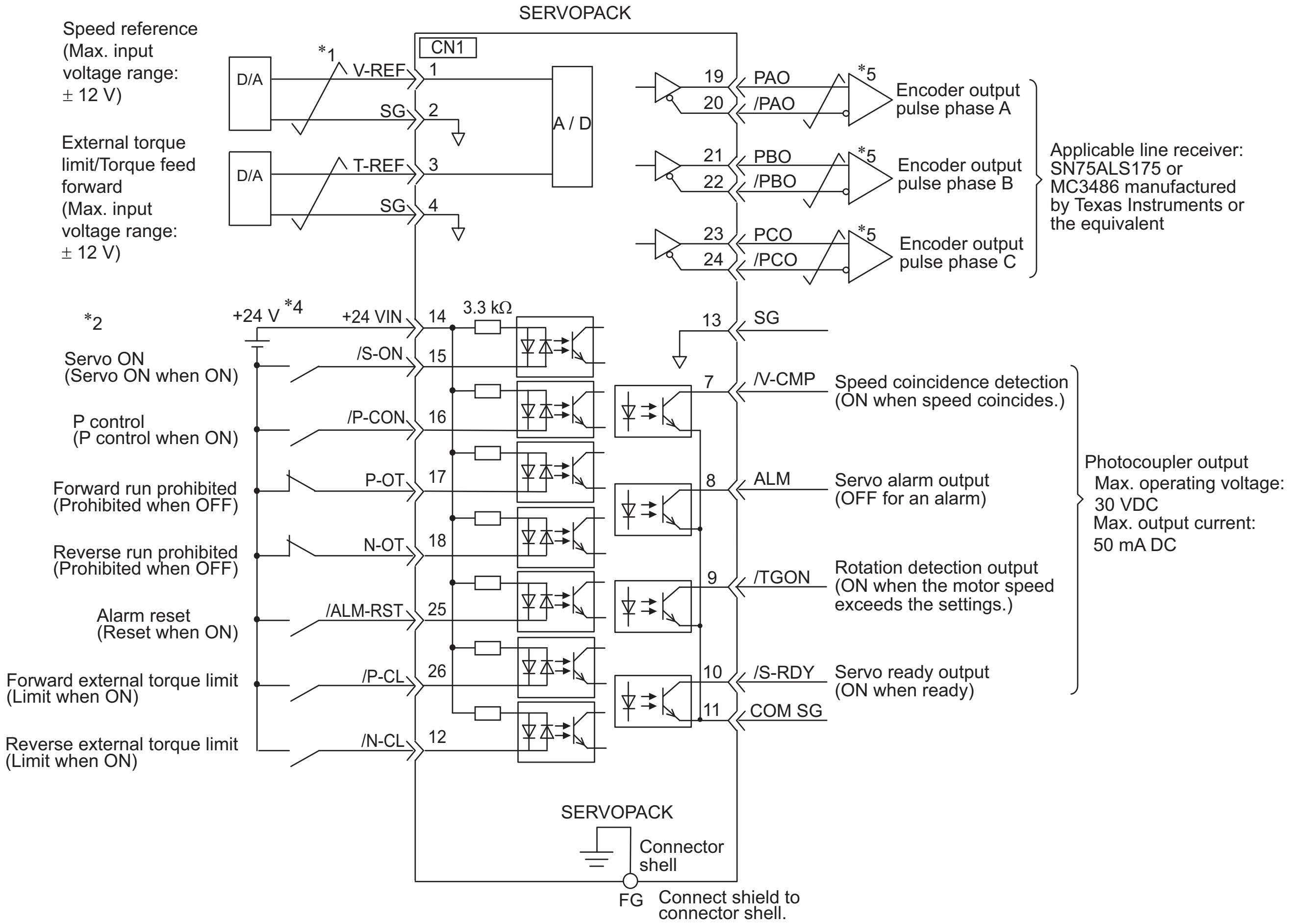
(2) Output Signals

Control Method	Signal Name	Pin No.	Function		Reference Section
Common	ALM	8 (11)	Turns OFF when an error is detected.		5.10.1
	/TGON	9 (11)	Turns ON when the servomotor is rotating at a speed higher than the motor speed setting.		5.10.3
	/S-RDY	10 (11)	Turns ON when the SERVOPACK is ready to accept the servo ON (/S-ON) signal.		5.10.4
	PAO /PAO	19 20	Phase-A signal	Encoder output pulse signals for two-phase pulse train with 90° phase differential	5.3.6 5.9.5
	PBO /PBO	21 22	Phase-B signal		
	PCO /PCO	23 24	Phase-C signal	Origin pulse output signal	
	SG	13	Signal ground		–
	FG	Shell	Connected to frame ground if the shielded wire of the I/O signal cable is connected to the connector shell.		–
	/CLT /VLT /BK /WARN /NEAR /PSELA	Can be allocated	The following output signals can be changed to allocate functions: /TGON, /S-RDY, and /V-CMP (/COIN).		5.2.4 5.4.3 5.4.7 5.5.4 5.8.5 5.10.2
Analog Voltage Reference	/V-CMP	7 (11)	If speed control is selected, the signal turns ON when the motor speed is within the setting range and it matches the reference speed value.		5.3.8
Pulse Train Reference	/COIN	7 (11)	If position control is selected, the signal turns ON when the number of position error reaches the value set.		5.4.6

Note 1. The pin number in parentheses is the common ground for output signals (COM_SG).
2. The functions allocated to /TGON, /S-RDY, and /V-CMP (/COIN) output signals can be changed by using the parameters. Refer to *3.3.2 Output Signal Allocations* for details.

3.2.2 Example of I/O Signal Connections in Speed Control (Analog Voltage Reference)

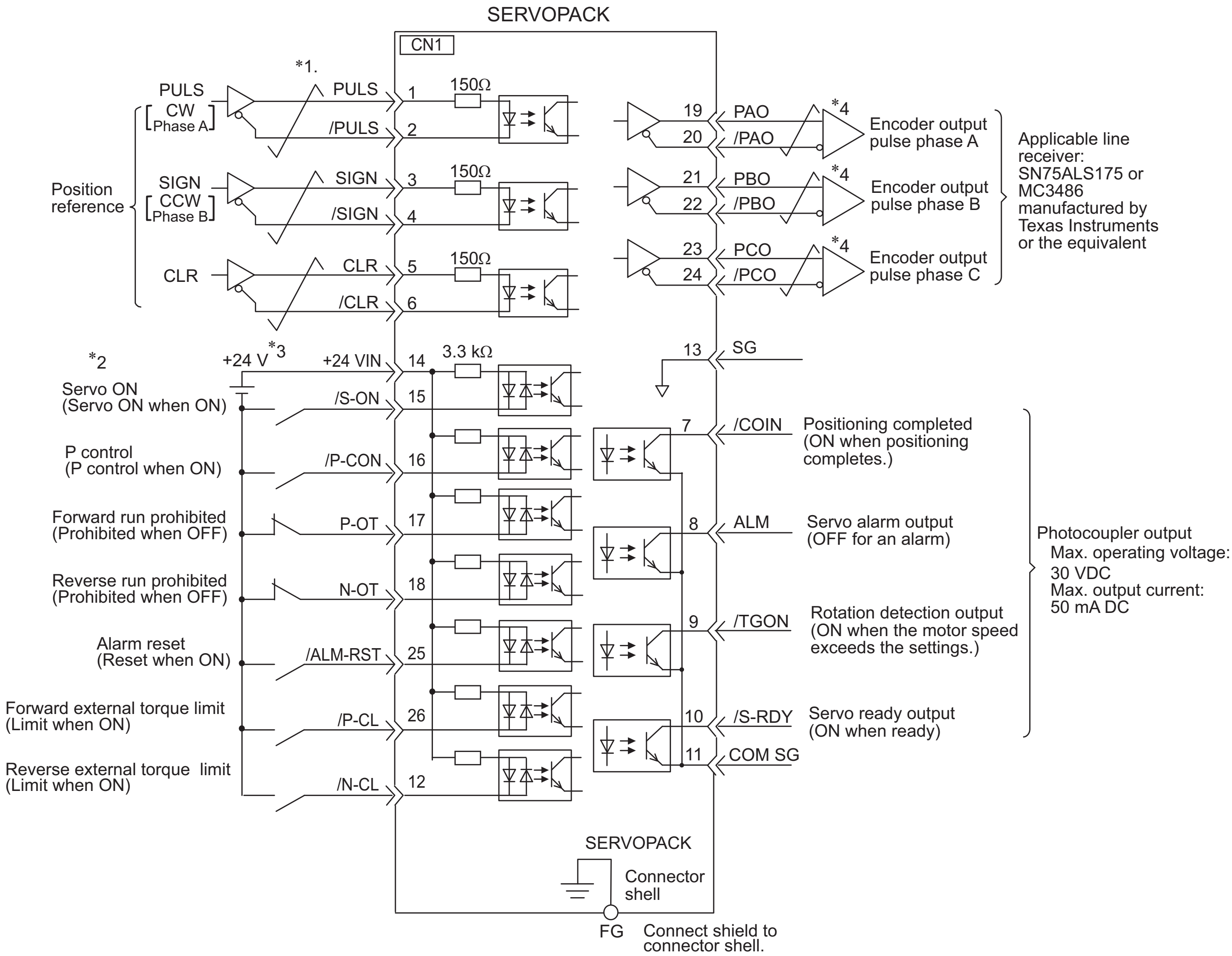
Connection example in speed control is as shown below.



∗1. [twisted-pair symbol] represents twisted-pair wires.
∗2. If using an absolute encoder, allocate the SEN signal to one of the seven input signals.
∗3. Enabled by the parameter setting.
∗4. The 24-VDC power supply is not included. Use a 24-VDC power supply with double insulation or reinforced insulation.
∗5. Always use line receivers to receive the output signals.

3.2.3 Example of I/O Signal Connections in Position Control (Pulse Train Reference)

Connection example in position control is as shown below.



∗1. represents twisted-pair wires.

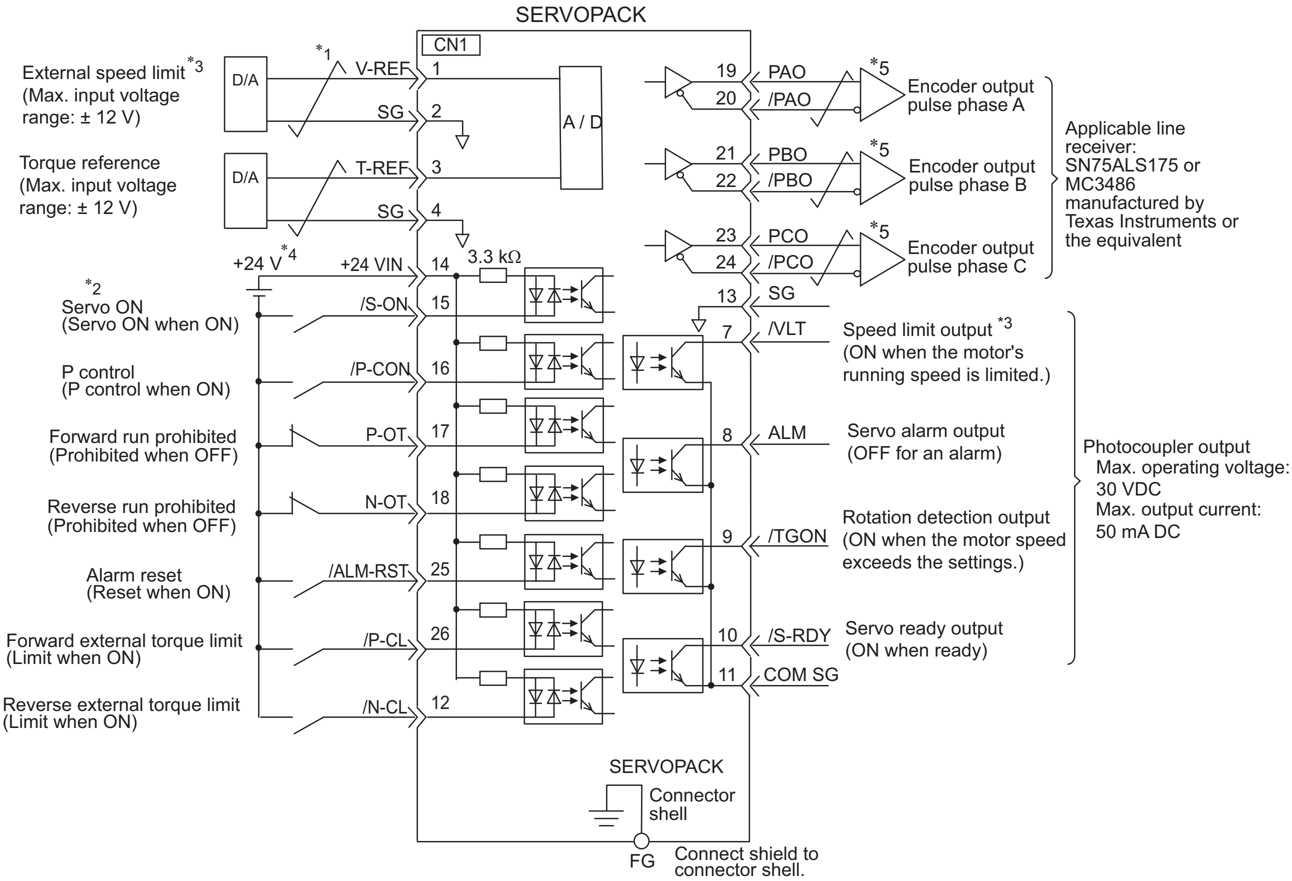
∗2. If using an absolute encoder, allocate the SEN signal to one of the seven input signals.

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

∗4. Always use line receivers to receive the output signals.

3.2.4 Example of I/O Signal Connections in Torque Control (Analog Voltage Reference)

Connection example in torque control is as shown below.



∗1. represents twisted-pair wires.
∗2. If using an absolute encoder, allocate the SEN signal to one of the seven input signals.
∗3. Enabled by the parameter setting.
∗4. The 24-VDC power supply is not included. Use a 24-VDC power supply with double insulation or reinforced insulation.
∗5. Always use line receivers to receive the output signals.

3.3 I/O Signal Allocations

This section describes the I/O signal allocations.

3.3.1 Input Signal Allocations

In most cases, input signals can be used at the factory settings. Input signals can also be allocated as required.

(1) Using Factory Settings

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

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

<Example>
When the control method is set to internal set speed control with a contact reference, i.e., when Pn000.1 is set to 3, signal /P-CON (CN1-16) will function as /SPD-D, signal /P-CL (CN1-26) as /SPD-A, and signal /N-CL (CN1-12) as /SPD-B.

■ Analog Voltage Reference (Model: SGDV-□□□ES1A)

<table>
<tr><th rowspan="2">Pn000.1 Setting</th><th rowspan="2">Control Method Selection</th><th colspan="7">CN1 Pin No.</th></tr>
<tr><th>15</th><th>16</th><th>17</th><th>18</th><th>25</th><th>26</th><th>12</th></tr>
<tr><td>0</td><td>Speed control</td><td rowspan="7">/S-ON</td><td rowspan="2">/P-CON</td><td rowspan="7">P-OT</td><td rowspan="7">N-OT</td><td rowspan="7">/ALM-RST</td><td rowspan="2">/P-CL</td><td rowspan="2">/N-CL</td></tr>
<tr><td>2</td><td>Torque control</td></tr>
<tr><td>3</td><td>Internal set speed control</td><td rowspan="3">Uses as /SPD-D</td><td rowspan="3">Uses as /SPD-A</td><td rowspan="3">Uses as /SPD-B</td></tr>
<tr><td>4</td><td>Internal set speed control ⇔ Speed control</td></tr>
<tr><td>6</td><td>Internal set speed control ⇔ Torque control</td></tr>
<tr><td>9</td><td>Torque control ⇔ Speed control</td><td>Uses as /C-SEL</td><td rowspan="2">Uses as /P-CL</td><td rowspan="2">Uses as /N-CL</td></tr>
<tr><td>A</td><td>Speed control ⇔ Speed control with zero clamp function</td><td>Uses as /ZCLAMP</td></tr>
</table>

■ Pulse Train Reference (Model: SGDV-□□□EP1A)

<table>
<tr><th rowspan="2">Pn000.1 Setting</th><th rowspan="2">Control Method Selection</th><th colspan="7">CN1 Pin No.</th></tr>
<tr><th>15</th><th>16</th><th>17</th><th>18</th><th>25</th><th>26</th><th>12</th></tr>
<tr><td>1</td><td>Position control</td><td rowspan="4">/S-ON</td><td>/P-CON</td><td rowspan="4">P-OT</td><td rowspan="4">N-OT</td><td rowspan="4">/ALM-RST</td><td>/P-CL</td><td>/N-CL</td></tr>
<tr><td>3</td><td>Internal set speed control</td><td rowspan="2">Uses as /SPD-D</td><td rowspan="2">Uses as /SPD-A</td><td rowspan="2">Uses as /SPD-B</td></tr>
<tr><td>5</td><td>Internal set speed control ⇔ Position control</td></tr>
<tr><td>B</td><td>Position control ⇔ Position control with reference pulse inhibit function</td><td>Uses as /INHIBIT</td><td>Uses as /P-CL</td><td>Uses as /N-CL</td></tr>
</table>

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

Pn50A = n.2100

- 0: Uses input terminal with factory setting.
- 0: Allocates /S-ON signal to CN1-15.
- 1: Allocates /P-CON signal to CN1-16.
- 2: Allocates /P-OT signal to CN1-17.

Pn50B = n.6543

- 3: Allocates N-OT signal to CN1-18.
- 4: Allocates /ALM-RST signal to CN1-25.
- 5: Allocates /P-CL signal to CN1-26.
- 6: Allocates /N-CL signal to CN1-12.

(2) Changing Input Signal Allocations

IMPORTANT

- Inverting the polarity of the Servo ON, forward run prohibited, and reverse run prohibited signals from the factory setting will prevent the main circuit's power supply from being turned OFF or the overtravel function from working in case of signal line disconnections or other failures.
  If this setting is absolutely necessary, check the operation and confirm that there are no safety problems.
- When two or more signals are allocated to the same input circuit, input signal level is valid for all allocated signals, resulting in an unexpected machine operation.

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

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

<Interpreting the Input Signal Allocation Tables>

Level at which input signal allocations are valid.

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

Input Signal Names and Parameters	Validity Level	Input Signal	CN1 Pin Numbers							Connection Not Required (SERVOPACK judges the connection)	
			15	16	17	18	25	26	12	Always ON	Always OFF
Servo ON **Pn50A.1**	L	/S-ON	**0**	1	2	3	4	5	6	7	8
	H	S-ON	9	A	B	C	D	E	F		

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

Input Signal Names and Parameters	Validity Level	Input Signal	CN1 Pin Numbers							Connection Not Required (SERVOPACK judges the connection)	
			15	16	17	18	25	26	12	Always ON	Always OFF
Servo ON **Pn50A.1**	L	/S-ON	0	1	2	3	4	5	6	7	8
	H	S-ON	9	A	B	C	D	E	F		
Proportional Operation Reference **Pn50A.2**	L	/P-CON	0	1	2	3	4	5	6	7	8
	H	P-CON	9	A	B	C	D	E	F		
Forward Run Prohibited **Pn50A.3**	H	P-OT	0	1	2	3	4	5	6	7	8
	L	/P-OT	9	A	B	C	D	E	F		
Reverse Run Prohibited **Pn50B.0**	H	N-OT	0	1	2	3	4	5	6	7	8
	L	/N-OT	9	A	B	C	D	E	F		
Alarm Reset **Pn50B.1**	L	/ARM-RST	0	1	2	3	4	5	6	–	8
	H	ARM-RST	9	A	B	C	D	E	F		
Forward External Torque Limit **Pn50B.2**	L	/P-CL	0	1	2	3	4	5	6	7	8
	H	P-CL	9	A	B	C	D	E	F		
Reverse External Torque Limit **Pn50B.3**	L	/N-CL	0	1	2	3	4	5	6	7	8
	H	N-CL	9	A	B	C	D	E	F		
Switching Servomotor Rotation Direction **Pn50C.0**	L	/SPD-D	0	1	2	3	4	5	6	7	8
	H	SPD-D	9	A	B	C	D	E	F		
Internal Set Speed Control **Pn50C.1**	L	/SPD-A	0	1	2	3	4	5	6	7	8
	H	SPD-A	9	A	B	C	D	E	F		
Internal Set Speed Control **Pn50C.2**	L	/SPD-B	0	1	2	3	4	5	6	7	8
	H	SPD-B	9	A	B	C	D	E	F		
Control Method Selection **Pn50C.3**	L	/C-SEL	0	1	2	3	4	5	6	7	8
	H	C-SEL	9	A	B	C	D	E	F		
Zero Clamp **Pn50D.0**	L	/ZCLAMP	0	1	2	3	4	5	6	7	8
	H	ZCLAMP	9	A	B	C	D	E	F		
Reference Pulse Inhibit **Pn50D.1**	L	/INHIBIT	0	1	2	3	4	5	6	7	8
	H	INHIBIT	9	A	B	C	D	E	F		
Gain Changeover **Pn50D.2**	L	/G-SEL	0	1	2	3	4	5	6	7	8
	H	G-SEL	9	A	B	C	D	E	F		
SEN Signal* **Pn515.0**	L	/SEN	0	1	2	3	4	5	6	7	8
	H	SEN	9	A	B	C	D	E	F		
Reference Pulse Input Multiplication Switching **Pn515.1**	L	/PSEL	0	1	2	3	4	5	6	7	8
	H	PSEL	9	A	B	C	D	E	F		

* If using an absolute encoder, allocate the SEN signal to one of the seven input signals.

(3) Example of Changing Input Signal Allocations

The procedure to replace Servo ON (/S-ON) signal allocated on CN1-15 and Forward External Torque Limit (/P-CL) allocated on CN1-26 is shown below.

`<Parameter Changes>`

- Pn50A is changed from n.2100 to n.2151.
- Pn50B is changed from n.6543 to n.6043.

Step	Display after Operation	Keys	Operation
1	BB –PRM/MON– Un000= 00000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	MODE/SET	Press the MODE/SET Key to select the parameter/ monitor mode.
2	BB –PRM/MON– Un000= 00000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	< >	Press the < or > Key to move the cursor to “Un.”
3	BB –PRM/MON– Pn000=n.0000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	∧ ∨	Press the ∧ or ∨ Key to switch “Un” to “Pn.”
4	BB –PRM/MON– Pn000=n.0000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	>	Press the > Key once to move the cursor to the right side of “Pn.”
5	BB –PRM/MON– Pn50A=n.2100 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	< > ∧ ∨	Press the arrow keys to display “Pn50A.” To move the cursor to different columns: <, > Key To change the settings: ∧ or ∨ Key
6	BB –PRM/MON– Pn50A=n.2100 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	DATA	Press the DATA Key. The cursor moves to the setting side to the position of the first digit of Pn50A. Note: The current allocation status is displayed for the set data. /S-ON is allocated to CN1-15 in the factory setting.
7	BB –PRM/MON– Pn50A=n.2101 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	∧	Press the ∧ Key once to change the set value of Pn50A.0 to 1. Note: If setting Pn50A.0 to 1, can be changed the input signal allocation.
8	BB –PRM/MON– Pn50A=n.2151 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	< > ∧ ∨	Press the ∧, ∨, <, and > Keys to change the set value of Pn50A from n.2101 to n.2151. Note: If setting Pn50A.1 to 5, the allocation for /S-ON can be changed from CN1-15 to CN1-16.
9	BB –PRM/MON– Pn50A=n.2151 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	DATA	Press the DATA Key to write the settings*. The cursor moves to the parameter number side.

Step	Display after Operation	Keys	Operation
10	Refer to steps 5 to 9 and change the set value of Pn50B from n.6543 to n.6043. Note: If setting Pn50B.2 to 0, the allocation for /P-CL can be changed from CN1-26 to CN1-15.		
11	To enable the change in the setting, restart the SERVOPACK.		

* If the DATA Key has not been pressed but the MODE/SET Key has been pressed to select another mode such as the utility function mode, any changes that have been made to the parameter will be saved in the SERVOPACK.

<Input signal polarities>

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

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

(4) Checking Input Signals

Input signal status can be checked using the input signal monitor (Un005). As for the input signal monitor (Un005), refer to *8.3 Monitoring Input Signals.*

3.3.2 Output Signal Allocations

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

(1) Checking Factory Settings

Factory settings can be checked using the following parameters.

Pn50E = n.3211

- Allocates /COIN signal to CN1-7.
- Allocates /V-CMP signal to CN1-7.
- Allocates /TGON signal to CN1-9.
- Allocates /S-RDY signal to CN1-10.

Pn50F = n.0000

- Not to use /CLT signal.
- Not to use /VLT signal.
- Not to use /BK signal.
- Not to use /WARN signal.

Pn510 = n.0000

- Not to use /NEAR signal.
- Reserved (Cannot be changed)
- Not to use /PSELA signal.
- Reserved (Cannot be changed)

Pn512 = n.0000

- Not to invert CN1-7 output signals.
- Not to invert CN1-9 output signals.
- Not to invert CN1-10 output signals.
- Reserved (Cannot be changed)

(2) Changing Output Signal Allocations

IMPORTANT

- The signals not detected are considered as "Invalid." For example, Positioning Completion (/COIN) signal in speed control is "Invalid."
- Inverting the polarity of the brake signal (/BK), i.e. positive logic, will prevent the holding brake from working in case of its signal line disconnection.
  If this setting is absolutely necessary, check the operation and confirm that there are no safety problems.
- When two or more signals are allocated to the same output circuit, a signal is output with OR logic circuit.

Output signals are allocated as shown in the following table.

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

<Interpreting the Output Signal Allocation Tables>

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

Output Signal Names and Parameters	Output Signal	CN1 Pin Numbers			Invalid (not use)
		7	9	10	
Positioning Completion **Pn50E.0**	/COIN	1	2	3	0

Output Signal Names and Parameters	Output Signal	CN1 Pin Numbers			Invalid (not use)
		7	9	10	
Positioning Completion **Pn50E.0**	/COIN	1	2	3	0
Speed Coincidence Detection **Pn50E.1**	/V-CMP	1	2	3	0
Rotation Detection **Pn50E.2**	/TGON	1	2	3	0
Servo Ready **Pn50E.3**	/S-RDY	1	2	3	0
Torque Limit Detection **Pn50F.0**	/CLT	1	2	3	0
Speed Limit Detection **Pn50F.1**	/VLT	1	2	3	0
Brake **Pn50F.2**	/BK	1	2	3	0
Warning **Pn50F.3**	/WARN	1	2	3	0
Near **Pn510.0**	/NEAR	1	2	3	0
Reference Pulse Input Multiplication Switching Output **Pn510.2**	/PSELA	1	2	3	0
Pn512.0=1	Polarity inversion of CN1-7				0 (Not invert at factory setting)
Pn512.1=1	Polarity inversion of CN1-9				
Pn512.2=1	Polarity inversion of CN1-10				

(3) Example of Changing Output Signal Allocations

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

<Parameter Changes>

- Pn50E is changed from n.3211 to n.3011.
- Pn50F is changed from n.0000 to n.0200.

Step	Display after Operation	Keys	Operation
1	BB -PRM/MON- Un000= 00000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	MODE/SET	Press the MODE/SET Key to select the parameter/ monitor mode.
2	BB -PRM/MON- Un000= 00000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	< >	Press the < or > Key to move the cursor to "Un."
3	BB –PRM/MON– Pn000=n.0000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	∧ ∨	Press the ∧ or ∨ Key to switch "Un" to "Pn."
4	BB –PRM/MON– Pn000=n.0000 Un002= 00000 Un008= 00000pulse Un00D= 0000000000	>	Press the > Key once to move the cursor to the right side of "Pn."
5	BB –PRM/MON– Pn50E=n.3211 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	< > ∧ ∨	Press the arrow keys to display "Pn50E." To move the cursor to different columns: <, > Key To change the settings: ∧ or ∨ Key
6	BB –PRM/MON– Pn50E=n.3211 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	DATA	Press the DATA Key. The cursor moves to the setting side to the position of the first digit of Pn50E. Note: The current allocation status is displayed for the set data. /TGON is allocated to CN1-9 in the factory setting.
7	BB –PRM/MON– Pn50E=n.3211 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	<	Press the < Key twice to move the cursor to Pn50E.2.
8	BB –PRM/MON– Pn50E=n.3011 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	∨	Press the ∨ Key twice to change the set value of Pn50E from n.3211 to n.3011. Note: If setting Pn50E.2 to 0, /TGON is disabled.

Wiring and Connection

3

(cont'd)

Step	Display after Operation	Keys	Operation
9	B B –PRM/MON– P n 5 0 E = n.3 0 1 1 U n 0 0 2 = 0 0 0 0 0 U n 0 0 8 = 0 0 0 0 0 0 0 0 0 0 U n 0 0 D = 0 0 0 0 0 0 0 0 0 0	DATA	Press the DATA Key to write the settings*. The cursor moves to the parameter number side.
10	Refer to steps 5 to 9 and change the set value of Pn50F from n.0000 to n.0200. Note: If setting Pn50F.2 to 2, /BK is allocated to CN1-9.		
11	To enable the change in the setting, restart the SERVOPACK.		

* If the DATA Key has not been pressed but the MODE/SET Key has been pressed to select another mode such as the utility function mode, any changes that have been made to the parameter will be saved in the SERVOPACK.

(4) Checking Output Signals

Output signal status can be checked using the output signal monitor (Un006). As for the output signal monitor (Un006), refer to *8.4 Monitoring Output Signals.*

3.4 Examples of Connection to Host Controller

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

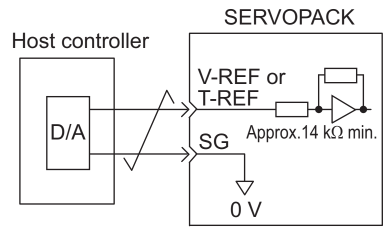
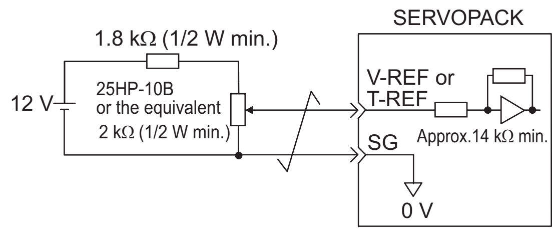
3.4.1 Reference Input Circuit

(1) Analog Input Circuit (Analog Voltage Reference)

CN1 connector terminals, 1-2 (speed reference input) and 3-4 (torque reference input) are explained below. Analog signals are either speed or torque reference signals at the impedance below.

- Reference speed input: Approx. 14 kΩ
- Reference torque input: Approx. 14 kΩ

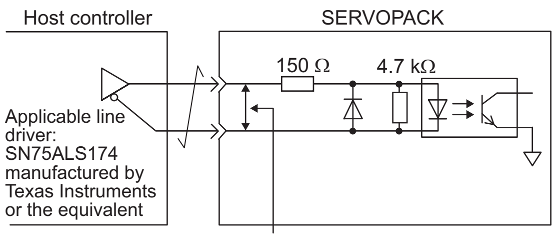
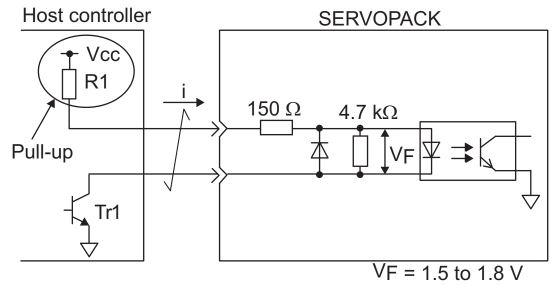
The maximum allowable voltages for input signals is ±12 V.

Analog Voltage Input Circuit (D/A)	Analog Voltage Input Circuit (Wiring Example)*
	

* This wiring example is for forward operation.

(2) Position Reference Input Circuit (Pulse Train Reference)

CN1 connector terminals, 1-2 (reference pulse input), 3-4 (reference sign input) and 5-6 (clear input) are explained below. The output circuits for the reference pulse and position error clear signal from the host controller can be either a line-driver output or open-collector output. The position reference input circuits are shown below by output type.

Line-driver Output Circuit	Open-collector Output Circuit (Power supply not included.)
	

2.8 V ≤ (H level) – (L level) ≤ 3.7 V

If the above formula is not satisfied, the inputs to the SERVOPACK will be unstable. Pulses may be missed from the reference pulse input, reference inversion may occur for the reference sign input, and the clear signal may be OFF for the clear input.

Before wiring, confirm that the specifications of the host controller satisfy the values shown in the following table.
If these conditions are not satisfied, the SERVOPACK may malfunction.

Pull-up voltage (Vcc)	Pull-up resistance (R1)
24 V	1.8 to 2.7 kΩ
12 V or less	820 Ω to 1.5 kΩ
5 V or less	180 to 470 Ω

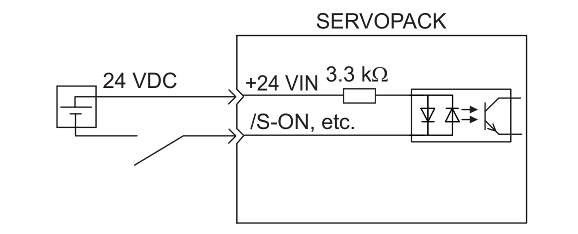
3.4.2 Sequence Input Circuit

(1) Photocoupler Input Circuit

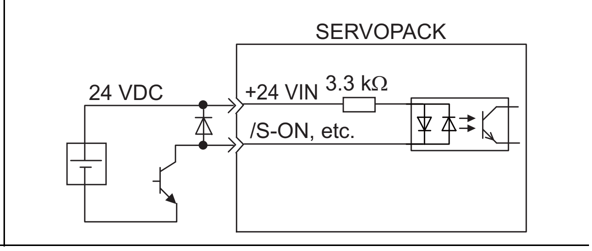
CN1 connector terminals 12, 14 to 18, 25, 26 are explained below.

The sequence input circuit interface is connected through a relay or open-collector transistor circuit. When connecting through a relay, use a low-current relay. If a low-current relay is not used, a faulty contact may result.

Relay Circuit Example



Open-collector Circuit Example

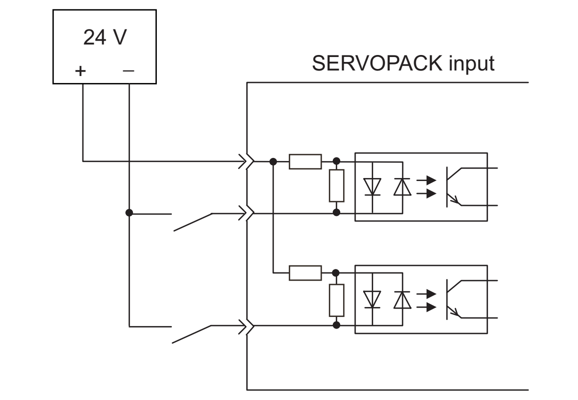


Note: The 24 VDC external power supply capacity must be 50 mA minimum.

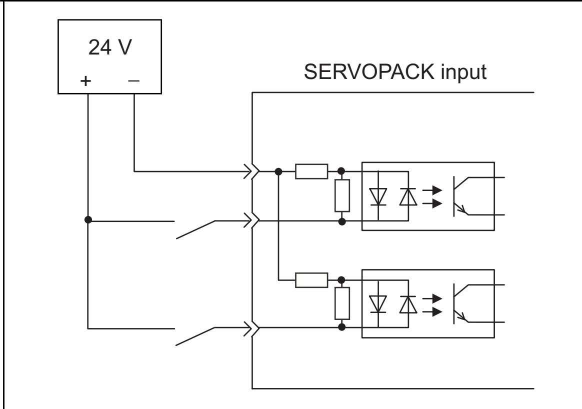
The SERVOPACK's input circuit uses bidirectional photocoupler. Select either the sink circuit or the source circuit according to the specifications required for each machine.

Note:
- The connection examples in *3.2.2* to *3.2.4* show sink circuits.
- The ON/OFF polarity differs between when a sink circuit is connected and when a source circuit is connected.

Sink Circuit



Source Circuit



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

3.4.3 Sequence Output Circuit

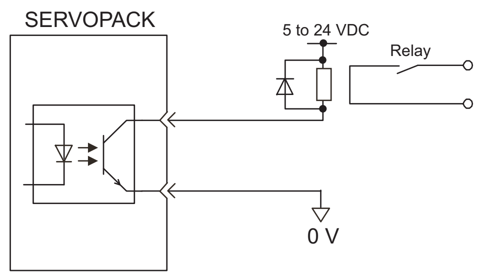
Two types of signal output circuits from the SERVOPACK are described below.

> **IMPORTANT**
> Incorrect wiring or incorrect voltage application to the output circuit may cause short-circuit.
> If a short-circuit occurs as a result of any of these causes, the holding brake will not work. This could damage the machine or cause an accident resulting in death or injury.

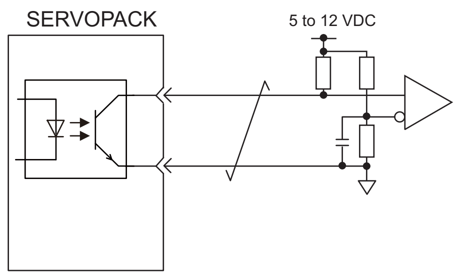
(1) Photocoupler Output Circuit

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 the allowable range of current capacity for photocoupler output circuits are as follows.
- Voltage: 30 VDC
- Current: 5 to 50 mA DC

(2) Line Driver Output Circuit

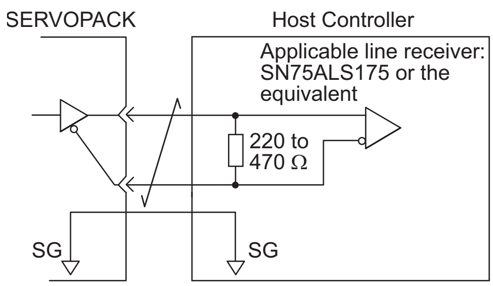
CN1 connector terminals, 19-20 (phase-A signal), 21-22 (phase-B signal), and 23-24 (phase-C signal) are explained below.

These terminals output the following signals via the line-driver output circuits.

- Output signals for which encoder serial data is converted as two phases pulses (PAO, /PAO, PBO, /PBO)
- Origin pulse signals (PCO, /PCO)

Connect the line-driver output circuit through a line receiver circuit at the host controller.

Line Receiver Circuit Example



3.5 Encoder Connection

This section describes the encoder signal (CN2) names, functions, and connection examples.

3.5.1 Encoder Signal (CN2) Names and Functions

The following table shows the names and functions of encoder signals (CN2).

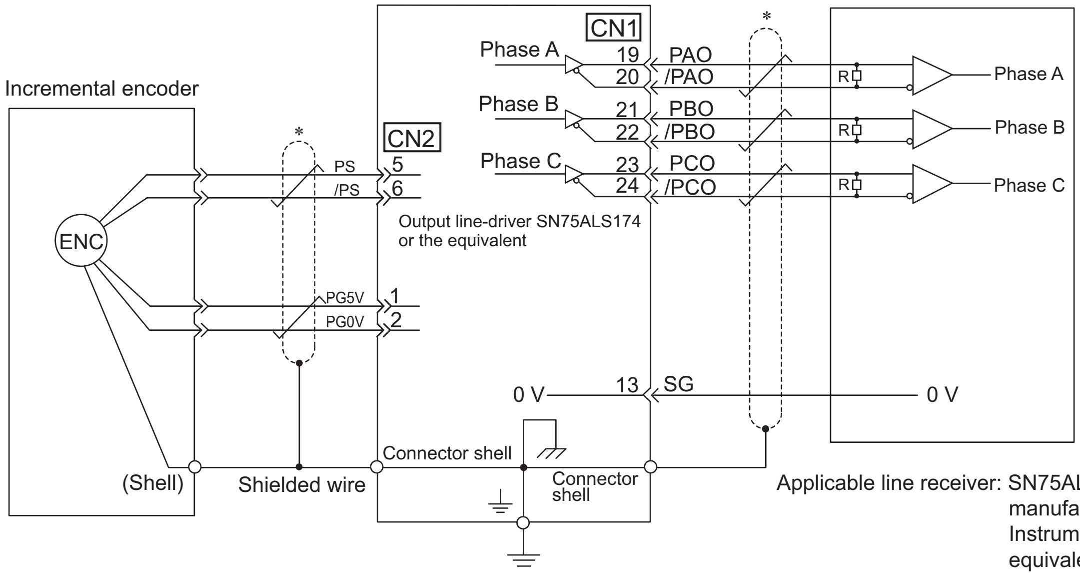
Signal Name	Pin No.	Function
PG 5 V	1	Encoder power supply +5 V
PG 0 V	2	Encoder power supply 0 V
(BAT (+))*	3	Battery (+)
(BAT (-))*	4	Battery (-)
PS	5	Serial data (+)
/PS	6	Serial data (-)
Shield	Shell	–

* It is not necessary to connect these pins to the SERVOPACK.

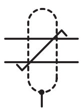
3.5.2 Encoder Connection Examples

The following diagrams show connection examples of the encoder, the SERVOPACK, and the host controller.

(1) Using as an Incremental Encoder

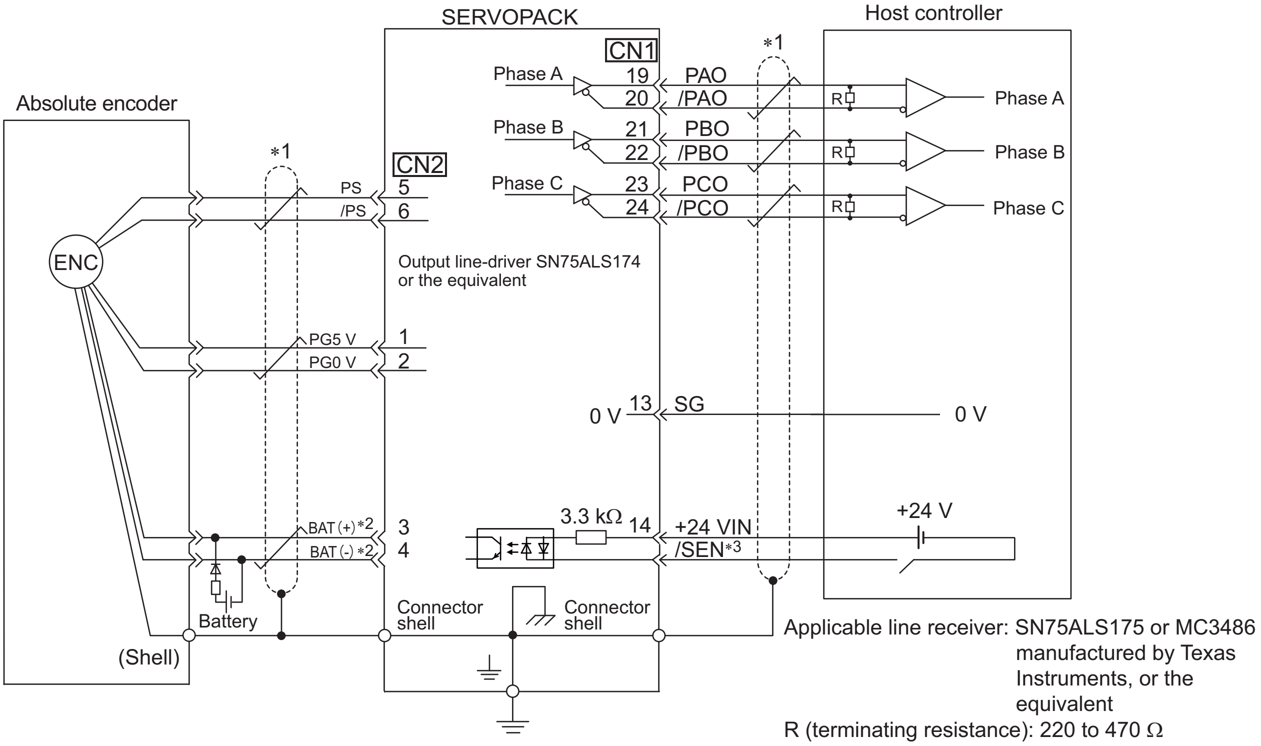


Applicable line receiver: SN75ALS175 or MC3486 manufactured by Texas Instruments, or the equivalent
R (terminating resistance): 220 to 470 Ω



* : represents shielded twisted-pair wires.

(2) Using as an Absolute Encoder



∗1. : represents shielded twisted-pair wires.

∗2. When using an absolute encoder, provide power by installing an encoder cable with a JUSP-BA01-E Battery Case.
∗3. If using an absolute encoder, allocate the SEN signal to one of the seven input signals.

IMPORTANT

When using an absolute encoder, use the encoder cable with a battery case that is specified by Yaskawa.
For details, refer to the *Σ-V Series Product Catalog* (Catalog No.: KAEP S800000 42).

3.6 Noise Control and Measures for Harmonic Suppression

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

3.6.1 Wiring for Noise Control

IMPORTANT

- Because the SERVOPACK is designed as an industrial device, it provides no mechanism to prevent noise interference.
- The SERVOPACK uses high-speed switching elements in the main circuit. Therefore peripheral devices may receive switching noise. If the equipment is to be used near private houses or if radio interference is a problem, take countermeasures against noise.
- If installation conditions by the EMC directive must be met, refer to *DC Power Input Σ-V Series User's Manual Setup Rotational Motor* (Manual No.: SIEP S800000 80).

The SERVOPACK uses microprocessors. Therefore it may receive switching noise from peripheral devices.

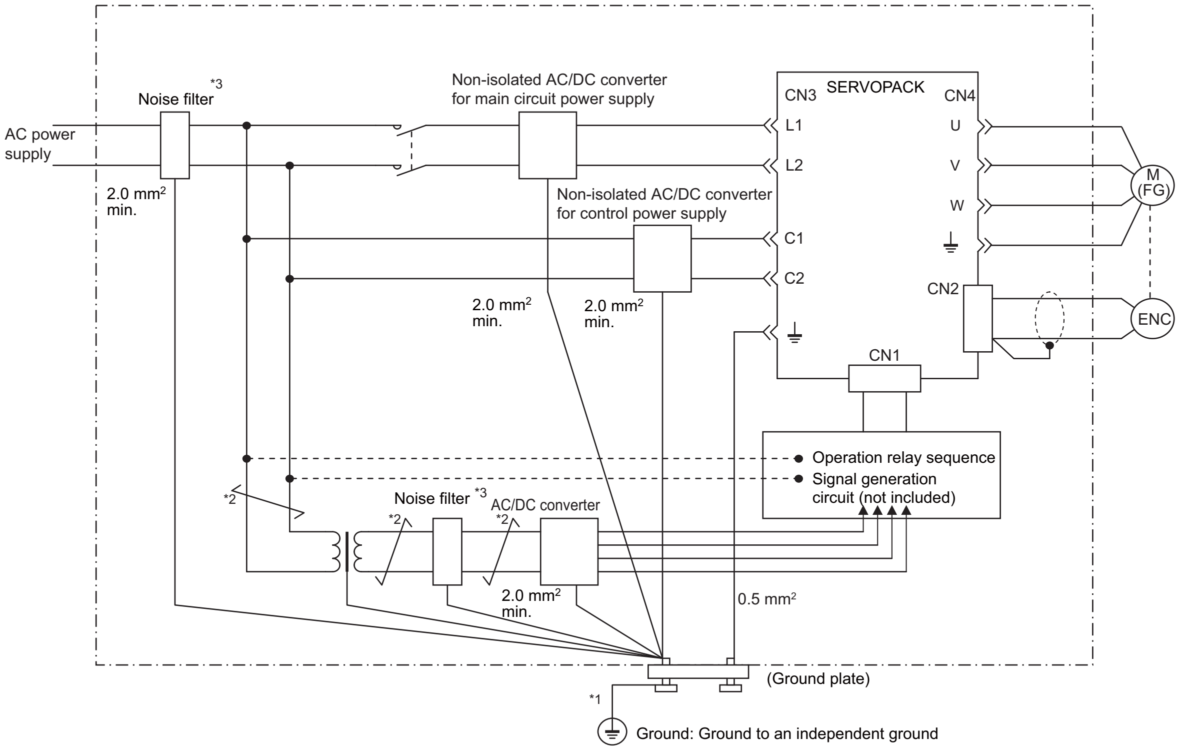
To prevent the noise from the SERVOPACK or the peripheral devices from causing a malfunction of any one of these devices, take the following precautions against noise as required.

- 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.
- Do not bundle or run the servomotor main circuit cables together with the I/O signal cables or the encoder cables in the same duct. Keep the servomotor main circuit cables separated from the I/O signal cables and encoder cables by at least 30 cm.
- 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 cables. 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 ground plate, use a thick wire (preferably, plain stitch cooper wire).

∗2. should be twisted-pair wires.

∗3. When using a noise filter, follow the precautions in *3.6.2 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 main circuit through servomotor stray capacitance. The above grounding is required to prevent the adverse effects of switching noise.

■ Noise on the I/O Signal Cable

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

3.6.2 Precautions on Connecting Noise Filter

This section describes the precautions on installing a noise filter.

(1) Noise Filter Brake Power Supply

If using a servomotor with a holding brake, use the following noise filter on the brake power supply input.

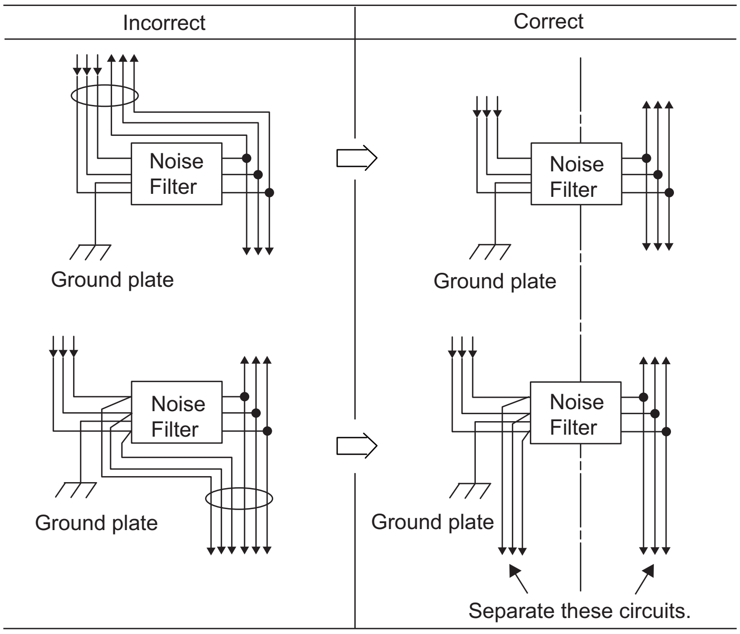
Model: FN2070-6-07 (Manufactured by SCHAFFNER Electronic.)

(2) Precautions on Using Noise Filters

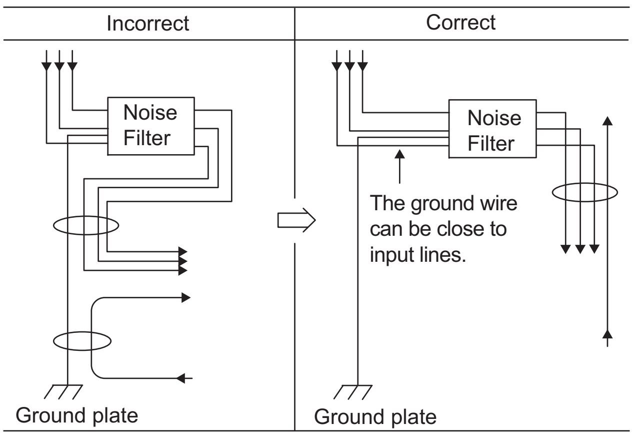
Always observe the following installation and wiring instructions.

IMPORTANT	Some noise filters have large leakage currents. The grounding measures taken also affects the extent of the leakage current. If necessary, select an appropriate leakage current detector or leakage current breaker taking into account the grounding measures that are used and leakage current from the noise filter. Contact the manufacturer of the noise filter for details.

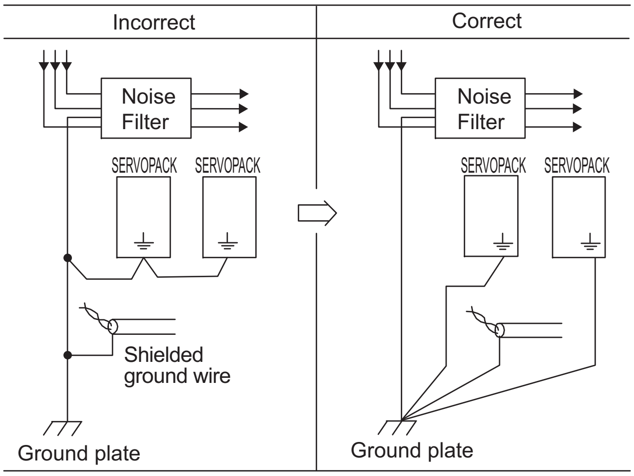
Do not put the input and output lines in the same duct or bundle them together.



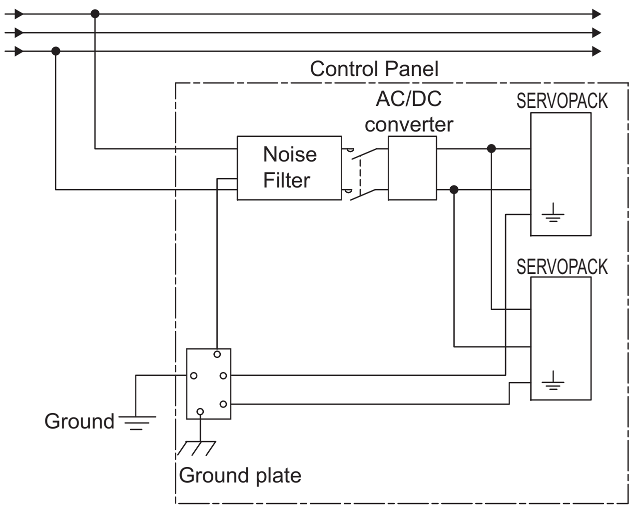
Separate the noise filter ground wire from the output lines.
Do not accommodate the noise filter ground wire, output lines and other signal lines in the same duct or bundle them together.



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, first 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, then ground the plates.



Wiring and Connection

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4

Trial Operation

4.1 Inspection and Checking before Trial Operation

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

(1) Servomotors

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

- Are all wiring and connections correct?
- Are all nuts and bolts securely tightened?

Note: When performing trial operation on a servomotor that has been stored for a long period of time, perform the inspection according to the procedures described in *AC Servomotor Safety Precautions* (Manual No.: TOBP C230200 00).

(2) SERVOPACKs

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

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

4.2 Trial Operation for Servomotor without Load

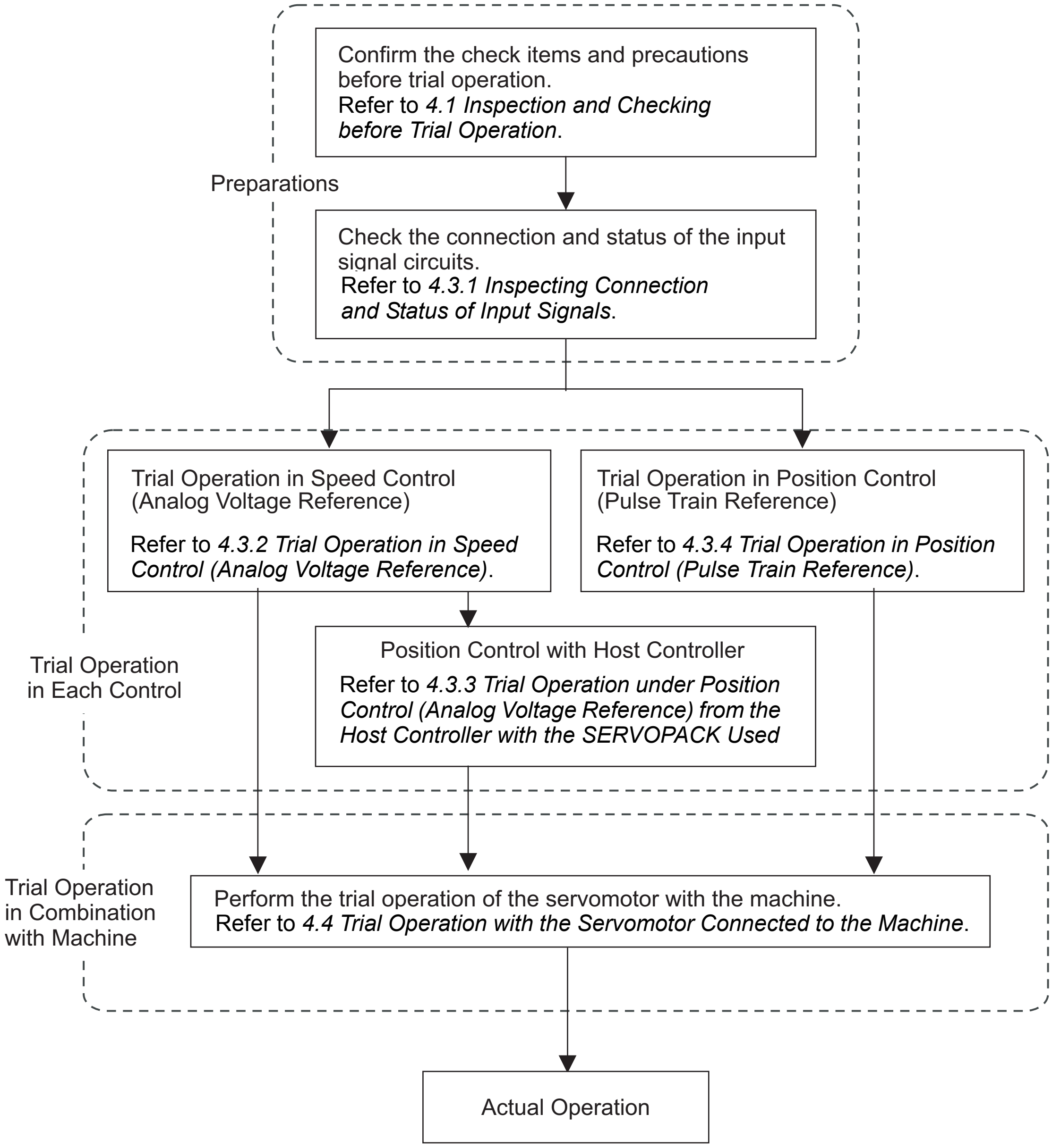
For the trial operation for servomotor without load, refer to *DC Power Input Σ-V Series User's Manual, Setup, Rotational Motor* (Manual No.: SIEP S800000 80).

4.3 Trial Operation for Servomotor without Load from Host Reference

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

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

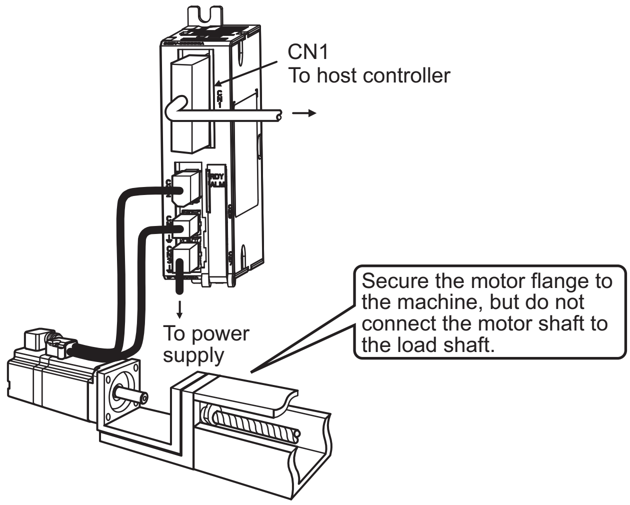
Perform the trial operation using the following procedure.



Note: To perform trial operation of a servomotor with a brake, refer to *4.5 Trial Operation of Servomotor with Brakes*.

⚠ CAUTION

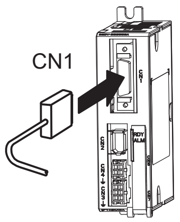
Before performing trial operation of the servomotor alone under references from the host controller, be sure that the servomotor has no load (i.e., the coupling and belt are removed from the servomotor) to prevent unexpected accidents.



4.3.1 Inspecting Connection and Status of Input Signals

Check the items in step 1 before trial operation of the servomotor under speed control (Analog voltage reference) and position control (Pulse train reference) from the host controller.

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

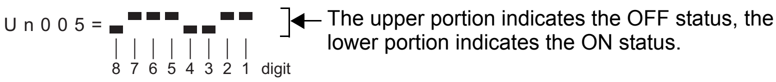
Step	Operation	Reference
1	Connect the necessary input signals to the I/O signal connector (CN1) under the following conditions. • It must be possible to input servo ON signal (/S-ON). • The forward run prohibited (P-OT) and reverse run prohibited (N-OT) input signals must be ON (L level) (i.e., the servomotor must be able to run in forward and reverse). Settings: CN1-17 and CN1-18 must be ON (low) or Pn50A.3 and Pn50B.0 must be set to 8 to disable the forward and reverse run prohibited function. Note: Return the settings to the previous ones after completing trial operation.  • Make sure that there is no reference input. Note: If Pn002.2 is set to 1, the absolute encoder can temporarily be used as an incremental encoder, which makes it possible to perform trial operation of the servomotor without Fn008 and SEN signal settings.	Refer to the following connection diagrams. *3.2.2 Example of I/O Signal Connections in Speed Control (Analog Voltage Reference)* *3.2.3 Example of I/O Signal Connections in Position Control (Pulse Train Reference)* *3.2.4 Example of I/O Signal Connections in Torque Control (Analog Voltage Reference)* *5.9 Absolute Encoders*
2	Connect the connector of the host controller to the I/O signal connector (CN1).	–

(cont'd)

<table>
<tr><th>Step</th><th>Operation</th><th>Reference</th></tr>
<tr><td>3</td><td>
Turn ON the SERVOPACK power and make sure that the digital operator display is as shown below.

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

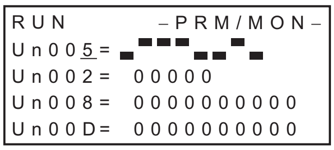
Check the input signal using the input signal monitor (Un005) from the digital operator. If the display is not the same as shown below, correct the input signal setting.



<table>
<tr><th>Display LED Number</th><th>Input Terminal Name</th><th>Signal Name (Factory Setting)</th></tr>
<tr><td>1</td><td>CN1-15 (can be allocated)</td><td>/S-ON (Servo ON) input</td></tr>
<tr><td>2</td><td>CN1-16 (can be allocated)</td><td>/P-CON (Proportional operation reference) input</td></tr>
<tr><td>3</td><td>CN1-17 (can be allocated)</td><td>P-OT (Forward run prohibited) input</td></tr>
<tr><td>4</td><td>CN1-18 (can be allocated)</td><td>N-OT (Reverse run prohibited) input</td></tr>
<tr><td>5</td><td>CN1-25 (can be allocated)</td><td>/ALM-RST (Alarm reset) input</td></tr>
<tr><td>6</td><td>CN1-26 (can be allocated)</td><td>/P-CL (Forward current limit ON) input</td></tr>
<tr><td>7</td><td>CN1-12 (can be allocated)</td><td>/N-CL (Reverse current limit ON) input</td></tr>
<tr><td>8</td><td>–</td><td>–</td></tr>
</table>

Note:
- If an absolute encoder is being used, turn ON the SEN signal. The servomotor will not turn ON when only the servo ON signal (/S-ON) is input.
- If using an absolute encoder, allocate the SEN signal to one of the seven input signals.
- Input signals can be also checked using wiring check function of SigmaWin+.
</td><td>

8.3 Monitoring Input Signals
3.3.1 Input Signal Allocations
</td></tr>
<tr><td>4</td><td>
Input the /S-ON signal, then make sure that "RUN" is displayed on upper left of the display on the digital operator.



If an alarm display appears, correct it according to *9.1 Alarm Displays*. If the cause of alarm is not corrected, the servo ON signal cannot be input and the servomotor cannot be turned ON.
</td><td>9.1 Alarm Displays</td></tr>
<tr><td>5</td><td>This completes all preparations for trial operation. Perform trial operation in each control method.</td><td>

4.3.2 Trial Operation in Speed Control (Analog Voltage Reference)
4.3.3 Trial Operation under Position Control (Analog Voltage Reference) from the Host Controller with the SERVOPACK Used for Speed Control
4.3.4 Trial Operation in Position Control (Pulse Train Reference)
</td></tr>
</table>

4.3.2 Trial Operation in Speed Control (Analog Voltage Reference)

Perform the following steps for trial operation in speed control (Analog voltage reference). The steps are specified on the condition that input signal wiring for the speed control has been completed according to *4.3.1 Inspecting Connection and Status of Input Signals*.

Step	Operation	Reference
1	Recheck the power supply and the input signal circuits, and turn ON the SERVOPACK control power supply.	*3.2.2 Example of I/O Signal Connections in Speed Control (Analog Voltage Reference)*
2	Adjust the speed reference input gain (Pn300).	*5.3.1 Basic Settings for Speed Control*
3	Turn ON the main circuit power supply of the SERVOPACK.	–
4	Check that speed reference input (the voltage between V-REF and SG) is 0 V, and turn ON the servo ON (/S-ON) input signal. Note: If the servomotor rotates at a very low speed with the speed reference input at 0 V, adjust the reference offset so that the servomotor will not rotate.	*5.3.2 Reference Offset Adjustment*
5	Gradually increase the voltage of the speed reference input (i.e., the voltage between V-REF and SG) from 0 V. Note: The factory setting is 6 V at the rated speed.	*5.3.1 Basic Settings for Speed Control*
6	Check the speed reference value using the monitor display (Un001).	*8.1 List of Monitor Displays*
7	Check the motor rotating speed using the monitor display (Un000).	*8.1 List of Monitor Displays*
8	Check that the values in step 6 and step 7 (Un001 and Un000) are equal to each other.	–
9	Check the motor rotation direction. Note: To switch the motor rotation direction without changing the polarity of the analog speed reference, refer to *5.2.2 Servomotor Rotation Direction*.	*5.2.2 Servomotor Rotation Direction*
10	Return the speed reference input to 0 V.	–
11	Turn OFF the servo ON signal (/S-ON).	–

4.3.3 Trial Operation under Position Control (Analog Voltage Reference) from the Host Controller with the SERVOPACK Used for Speed Control

To operate the SERVOPACK in speed control (analog voltage reference) under the position control from the host controller, check the operation of the servomotor after finishing the trial operation explained in *4.3.2 Trial Operation in Speed Control (Analog Voltage Reference).*

Step	Operation	Reference
1	Recheck the power supply and the input signal circuits, and turn ON the SERVOPACK control power supply.	*3.2.2 Example of I/O Signal Connections in Speed Control (Analog Voltage Reference)*
2	Adjust the speed reference input gain (Pn300).	*5.3.1 Basic Settings for Speed Control*
3	Set the encoder output pulses (Pn212).	*5.3.7 Setting Encoder Output Pulse*
4	Turn ON the main circuit power supply of the SERVOPACK.	–
5	Check that speed reference input (the voltage between V-REF and SG) is 0 V, and turn ON the servo ON (/S-ON) input signal. Note: If the servomotor rotates at a very low speed with the speed reference input at 0 V, adjust the reference offset so that the servomotor will not rotate.	*5.3.2 Reference Offset Adjustment*
6	To check the speed of the servomotor, execute a constant speed reference at a low speed through the host controller. Example: Visually check that the servomotor rotates once per second with a speed reference of 60 min^{-1}. Note: If the speed of the servomotor is not correct, check the reference sent by the host controller.	*8.1 List of Monitor Displays*
7	To check the rotation of the servomotor, execute a simple positioning reference through the host controller. Example: Input a reference that is equivalent to a single rotation of the servomotor. To confirm that the servomotor moved a single rotation, do a visual check or check the rotational angle 1 (Un003 [pulse]) Note: If the rotation of the servomotor is not correct, check the reference sent by the host controller.	*8.1 List of Monitor Displays*
8	Return the speed reference input to 0 V.	–
9	Turn OFF the servo ON signal (/S-ON).	–

4.3.4 Trial Operation in Position Control (Pulse Train Reference)

Perform the following steps for trial operation in position control (pulse train reference). The steps are specified on the condition that input signal wiring for the position control has been completed according to *4.3.1 Inspecting Connection and Status of Input Signals.*

Step	Operation	Reference
1	Recheck the power supply and the input signal circuits, and turn ON the SERVOPACK control power supply.	*3.2.3 Example of I/O Signal Connections in Position Control (Pulse Train Reference)*
2	Set the reference pulse form with Pn200.0 according to the output pulse form of the host pulse reference form.	*5.4.1 Basic Settings for Position Control*
3	Set the reference unit, and then set the electronic gear ratio according to the host controller. The electronic gear ratio is set in Pn20E and Pn210.	*5.4.4 Electronic Gear*
4	Turn ON the main circuit power supply of the SERVOPACK.	–
5	Turn ON the servo ON (/S-ON) input signal.	–
6	Output a low-speed pulse reference for an easy-to-check number of rotations (e.g., one rotation) from the host controller. Note: To ensure safety, set the reference pulse speed so that the motor speed will be around 100 min^{-1}.	–
7	Check the number of reference pulses input to the SERVOPACK from the changes in the input reference pulse monitor before and after the reference. The input reference pulse can be checked with Un00C.	–
8	Check the actual number of motor rotations from the changes in the feedback pulse monitor before and after the reference. The feedback pulse can be checked with Un00D.	–
9	Check that step 7 and step 8 satisfy the following formula. Un00D = Un00C × (Pn20E/Pn210)	–
10	Check that the servomotor is rotating in the direction specified by the reference. Note: To switch the motor rotation direction without changing the polarity of the input pulse, refer to *5.2.2 Servomotor Rotation Direction.*	*5.2.2 Servomotor Rotation Direction*
11	Input a pulse reference for a comparatively large number of motor rotations from the host controller so that the servomotor will rotate at a constant speed.	–
12	Check the reference pulse speed input to the SERVOPACK from the input reference pulse speed monitor (min^{-1}). The input reference pulse speed can be checked with Un007. Note: Obtain Un007 from the following formula (if the model uses a 17-bit encoder). $\text{Un007} = \underbrace{\text{input reference pulse speed [pulses/s]} \times 60}_{\text{Reference input pulse speed}} \times \underbrace{\frac{\text{Pn20E}}{\text{Pn210}}}_{\text{Electronic gear ratio}} \times \underbrace{\frac{1}{2^{17}(=131072)}}_{\text{Encoder pulse}}$	
13	Check the motor rotating speed (min^{-1}). The motor rotating speed can be checked with Un000.	–
14	Check that the values in step 12 and step 13 (Un007 and Un000) are equal to each other.	–
15	Stop the pulse reference and turn OFF the servo ON signal (/S-ON).	–

4.4 Trial Operation with the Servomotor Connected to the Machine

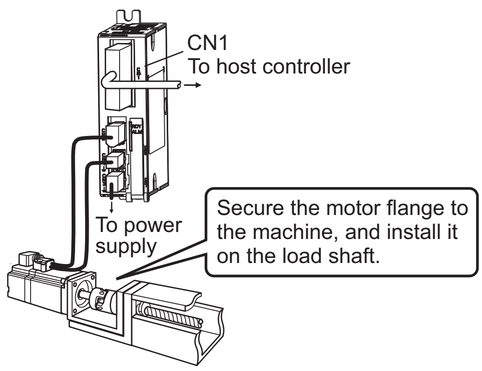
Perform the following steps for trial operation when the servomotor is connected to the machine.
The steps are specified on the condition that trial operation for servomotor without load has been completed in each control method.

⚠ WARNING

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

IMPORTANT

Enable the overtravel signals (P-OT and N-OT) during trial operation with the servomotor connected to the machine to provide a protective function.

Step	Operation	Reference
1	Turn ON the control power and main circuit power supplies and make the settings for mechanical configuration related to protective function such as overtravel and brake. Note: When a servomotor with brake is used, take advance measures to prevent vibration due to gravity acting on the machine or external forces before checking the brake operation. Check that both servomotor and brake operations are correct.	*5.2.3 Overtravel* *5.2.4 Holding Brakes*
2	Set the necessary parameters for control method used.	*5.3 Speed Control (Analog Voltage Reference)* *5.4 Position Control (Pulse Train Reference)* *5.5 Torque Control (Analog Voltage Reference)*
3	Connect the servomotor to the machine with coupling, etc., while the power is turned OFF.  	–
4	Turn ON the power to the machine (host controller) and then check that the SERVOPACK is servo OFF status. Check again that the protective function in step 1 operates normally. Note: For steps 4 to 8, take advance measures for emergency stop so that the servomotor can stop safely when an error occurs during operation.	*5.2.5 Stopping Servomotors after /S-ON Turned OFF or Alarm Occurrence*
5	Perform trial operation with the servomotor connected to the machine, following each section in *4.3 Trial Operation for Servomotor without Load from Host Reference*. Check that the trial operation is completed with as the trial operation for servomotor without load. Also check the settings for machine such as reference unit.	*4.3 Trial Operation for Servomotor without Load from Host Reference*
6	Check the settings of parameters for control method used set in step 2 again. Check that the servomotor rotates matching the machine operating specifications.	–

(cont'd)

Step	Operation	Reference
7	Adjust the servo gain and improve the servomotor response characteristics, if necessary. Note: The servomotor will not be broken in completely during the trial operation. Therefore, let the system run for a sufficient amount of additional time to ensure that it is properly broken in.	*6 Adjustments*
8	Write the parameters set for maintenance in *10.4 Parameter Recording Table*. Then the trial operation with the servomotor connected to the machine is completed. Note: If the digital operator is used, parameters can be saved. SigmaWin+, which is a tool for supporting the servo drive, can then manage the saved parameters in files.	*10.4 Parameter Recording Table*

4.5 Trial Operation of Servomotor with Brakes

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

- When checking the brake operation, take advance measures to prevent vibration due to gravity acting on the machine or external forces.
- Check the operation of the servomotor disconnected from the machine and then check the operation with a holding brake. If no problems occur, connect the servomotor to the machine and perform a trial operation.

Use the brake signal (/BK) from the SERVOPACK to control the brake.

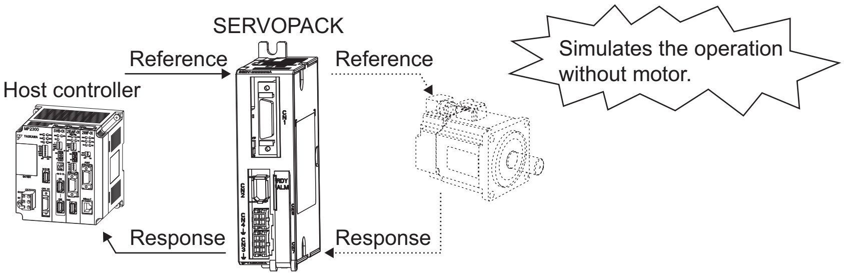
For wiring on a servomotor with brakes and setting parameters, refer to *5.2.4 Holding Brakes*.

IMPORTANT

Failures caused by incorrect wiring or wrong voltage application in the brake circuit may damage the equipment or cause an accident resulting in death or injury. Follow the procedures and instructions for wiring and trial operation precisely as described in this manual.

4.6 Test Without Motor Function

The test without a motor is used to check the operation of the host controller and peripheral devices by simulating the operation of the servomotor in the SERVOPACK, i.e., without actually operating a servomotor. This function enables you to check wiring, verify the system while debugging, and verify parameters, thus shortening the time required for setup work and preventing damage to the machine 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.



Use Pn00C.0 to enable or disable the test without a motor.

Parameter		Meaning	When Enabled	Classification
Pn00C	n.□□□0 [Factory setting]	Disables the test without a motor.	After restart	Setup
	n.□□□1	Enables the test without a motor.		

4.6.1 Motor Information

The motor information that is used for a test without a motor is given below.

(1) Motor Connected

If a motor is connected, the information from the connected motor is used for the motor and encoder information. The set values of Pn00C.1 and Pn00C.2 are not used.

(2) Motor Not Connected

The virtual motor information that is stored in the SERVOPACK is used. The set values of Pn00C.1 and Pn00C.2 are used for the encoder information.

■ Encoder Resolution

The encoder information for the motor is set in Pn00C.1.

Parameter		Meaning	When Enabled	Classification
Pn00C	n.□□0□ [Factory setting]	Sets 13 bits as encoder resolution for the test without a motor.	After restart	Setup
	n.□□1□	Sets 20 bits as encoder resolution for the test without a motor.		

■ Encoder Type

The encoder information for the motor is set in Pn00C.2.

Parameter		Meaning	When Enabled	Classification
Pn00C	n.□0□□ [Factory setting]	Sets an incremental encoder as encoder type for the test without a motor.	After restart	Setup
	n.□1□□	Sets an absolute encoder as encoder type for the test without a motor.		

■ Rated Motor Speed and Maximum Motor Speed

The values previously saved in the SERVOPACK will be used for the rated motor speed and maximum motor speed. Use the monitor displays (Un020: Motor rated speed and Un021: Motor maximum speed) to check the values.

4.6.2 Motor Position and Speed Responses

For the test without a motor, the following responses are simulated for references from the host controller according to the gain settings for position or speed control.

• Servomotor position
• Servomotor speed

However, the load model will be a rigid system with the moment of inertia ratio that is set in Pn103.

4.6.3 Limitations

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

- Brake output signal (The brake output signal can be checked with the I/O signal monitor function of the SigmaWin+.)
- Items marked with "×" in the following utility function table.

Fn No.	Contents	Can be used or not	
		Motor not connected	Motor connected
Fn000	Alarm history display	○	○
Fn002	JOG operation	○	○
Fn003	Origin search	○	○
Fn004	Program JOG operation	○	○
Fn005	Initializing parameter settings	○	○
Fn006	Clearing alarm history	○	○
Fn008	Absolute encoder multiturn reset and encoder alarm reset	×	○
Fn009*1	Automatic tuning of analog (speed, torque) reference offset	○	○
Fn00A*1	Manual servo tuning of speed reference offset	○	○
Fn00B*1	Manual servo tuning of torque reference offset	○	○
Fn00C	Offset adjustment of analog monitor output	○	○
Fn00D	Gain adjustment of analog monitor output	○	○
Fn00E	Automatic offset-signal adjustment of the motor current detection signal	×	○
Fn00F	Manual offset-signal adjustment of the motor current detection signal	×	○
Fn010	Write prohibited setting	○	○
Fn011	Servomotor model display	○	○
Fn012	Software version display	○	○
Fn013	Multiturn limit value setting change when a multiturn limit disagreement alarm occurs	×	○
Fn01B	Vibration detection level initialization	×	×
Fn01E	Display of SERVOPACK and servomotor ID	○	○
Fn030	Software reset	○	○
Fn200	Tuning-less levels setting	×	×
Fn201	Advanced autotuning	×	×
Fn202*2	Advanced autotuning by reference	×	×
Fn203	One-parameter tuning	×	×
Fn204	Anti-resonance control adjustment function	×	×
Fn205*2	Vibration suppression function	×	×
Fn206	EasyFFT	×	×
Fn207	Online vibration monitor	×	×

Note: ○: Can be used
×: Cannot be used
*1. This function can be used only with a SERVOPACK for analog voltage references.
*2. This function can be used only with a SERVOPACK for pulse train references.

4.6.4 Digital Operator Displays during Testing without Motor

An asterisk (*) is displayed during execution of the test without a motor.

Example: Status of power to the servomotor is OFF

```
＊BB          －PRM/MON－
Un000=  00000
Un002=  00000
Un008=  0000000000
Un00D=  0000000000
```

Display	Status
*RUN	Power is supplied to the servomotor.
*BB	Power to the servomotor is OFF.
*PT NT	Forward or reverse run is prohibited.
*P-OT	Forward run is prohibited.
*N-OT	Reverse run is prohibited.

Note: The test without a motor status is not displayed during alarm occurs (A.☐☐☐).

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Operation

5.1 Control Method Selection

The control method supported by the SGDV SERVOPACK are described below.

The control method can be selected with parameter Pn000.

■ Analog Voltage Reference (Model: SGDV-☐☐☐ES1A)

Control Method Selection			
Pn.000.1	Control	Description	Reference Section
n.☐☐0☐ [Factory setting]	Speed Control	Controls servomotor speed by means of an analog voltage speed reference. Use in the following instances. • To control speed • For position control using the encoder pulse output from the SERVOPACK to form a position loop in the host controller.	*5.3 Speed Control (Analog Voltage Reference)*
n.☐☐2☐	Torque Control	Controls the servomotor's output torque by means of an analog voltage torque reference. Use to output the required amount of torque for operations such as stopping on contact.	*5.5 Torque Control (Analog Voltage Reference)*
n.☐☐3☐	Internal Set Speed Control	Uses the three input signals /P-CON (/SPD-D), /P-CL (/SPD-A), and /N-CL (/SPD-B) to control the speed as set in advance in the SERVOPACK. Three operating speeds can be set in the SERVOPACK. When selecting this control, an analog reference is not necessary.	*5.6 Internal Set Speed Control*
n.☐☐4☐	Internal Set Speed Control ↔ Speed Control	These are switching modes for using the three control methods given above in combination. Select the control switching method that best suits the application.	*5.7 Combination of Control Methods*
n.☐☐6☐	Internal Set Speed Control ↔ Torque Control		
n.☐☐9☐	Torque Control ↔ Speed Control		
n.☐☐A☐	Speed Control ↔ Speed Control with Zero Clamp Function	The zero clamp function can be used in speed control.	*5.3.5 Zero Clamp Function*

■ Pulse Train Reference (Model: SGDV-☐☐☐EP1A)

Control Method Selection			
Pn.000.1	Control	Description	Reference Section
n.☐☐1☐ [Factory setting]	Position Control	Controls the position of the machine by means of a pulse train position reference. Controls the position with the number of input pulses, and controls the speed with the input pulse frequency. Use when positioning is required.	*5.4 Position Control (Pulse Train Reference)*
n.☐☐3☐	Internal Set Speed Control	Uses the three input signals /P-CON (/SPD-D), /P-CL (/SPD-A), and /N-CL (/SPD-B) to control the speed as set in advance in the SERVOPACK. Three operating speeds can be set in the SERVOPACK. When selecting this control, an analog reference is not necessary.	*5.6 Internal Set Speed Control*
n.☐☐5☐	Internal Set Speed Control ↔ Position Control	These are switching modes for using the two control methods given above in combination.	*5.7 Combination of Control Methods*
n.☐☐B☐	Position Control ↔ Position Control with Reference Pulse Inhibit Function	The reference pulse inhibit function can be used in position control.	*5.4.8 Reference Pulse Inhibit Function*

5.2 Basic Functions Settings

This section describes how to set the basic functions for operation.

5.2.1 Servo ON Signal

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

(1) Signal Setting

Type	Name	Connector Pin Number	Setting	Meaning
Input	/S-ON	CN1-15 [Factory setting]	ON	Servomotor power is ON. Servomotor can be operated.
			OFF	Servomotor power is OFF. Servomotor cannot be operated.

Note: Use parameter Pn50A.1 to allocate the /S-ON signal to another terminal. For details, refer to *3.3.1 Input Signal Allocations* for details.

IMPORTANT

Always input the servo ON signal before inputting the speed/position/torque reference to start or stop the servomotor. Do not input the references first and then use the servo ON signal or turn ON/OFF the power supply to start or stop. Doing so will degrade internal elements and lead to accident. Input the servo ON signal while the servomotor stops. While the servomotor is rotating, the servo ON signal cannot be input.

(2) Settings for Continuous Servo ON Signal

Parameter Pn50A.1 can be used to enable the Servo ON condition constantly.

Parameter		Meaning	When Enabled	Classification
Pn50A	n.□□0□ [Factory setting]	Inputs the servo ON signal from the input terminal CN1-15.	After restart	Setup
	n.□□7□	Constantly enables the servo ON signal.		

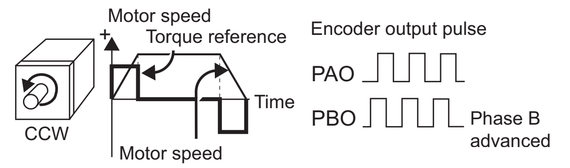
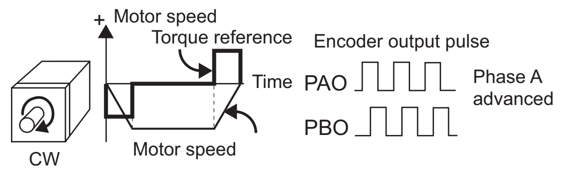
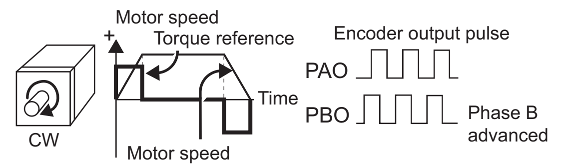
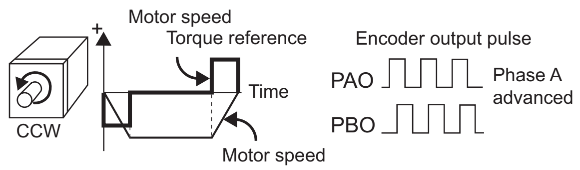
IMPORTANT

SERVOPACK operation will be possible (i.e., power will be supplied) when the main circuit power supply is turned ON if the servo ON signal is set to be always enabled. When inputting speed/position/torque reference, be sure to implement safety measures for unexpected operation of the servomotor and machine.
SERVOPACK operation will be possible (i.e., power will be supplied) when an alarm is reset after an alarm occurs. The servomotor or machine may operate unexpectedly if an alarm is reset while a reference is being input.

5.2.2 Servomotor Rotation Direction

The servomotor rotation direction can be reversed with parameter Pn000.0 without changing the polarity of the speed/position reference. This causes the rotation direction of the servomotor to change, but the polarity of the signal, such as encoder output pulses, output from the SERVOPACK does not change. (refer to *5.3.6 Encoder Output Pulses.*)

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

Parameter		Forward/ Reverse Reference	Direction of Motor Rotation and Encoder Output Pulse	Applicable Overtravel (OT)
Pn000	n.□□□0 Sets CCW as forward direction. [Factory setting]	Forward Reference		P-OT
		Reverse Reference		N-OT
	n.□□□1 Sets CW as forward direction. (Reverse Rotation Mode)	Forward Reference		P-OT
		Reverse Reference		N-OT

Note: SigmaWin+ trace waveforms are shown in the above table.

Operation

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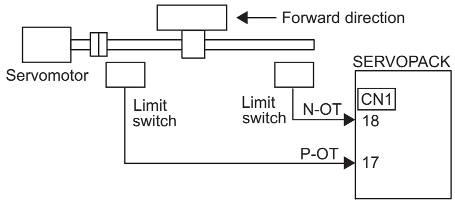
5.2.3 Overtravel

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

For rotating application such as disc table and conveyor, overtravel function is not necessary. In such a case, no wiring for overtravel input signals is required.

⚠ CAUTION

- Installing limit switches
  For machines that move using linear motion, connect limit switches to P-OT and N-OT of CN1 as shown below to prevent machine damage. To prevent a contact fault or disconnection from causing accidents, make sure that the limit switches are normally closed.



- Axes to which external force is applied in overtravel
  Vertical axes:
  Occurrence of overtravel may cause a workpiece to fall, because the /BK signal is on, that is when the brake is released. Set the parameter (Pn001 = n.□□1□) to bring the servomotor to zero clamp state after stopping to prevent a workpiece from falling.
  Other axes to which external force is applied:
  Overtravel will bring about a baseblock state after the servomotor stops, which may cause the servomotor to be pushed back by the load's external force. To prevent this, set the parameter (Pn001 = n.□□1□) to bring the servomotor to zero clamp state after stopping.
  For details on how to set the parameter, refer to *(3) Servomotor Stopping Method When Overtravel is Used*.

(1) Signal Setting

Type	Name	Connector Pin Number	Setting	Meaning
Input	P-OT	CN1-17	ON	Forward run allowed. Normal operation status.
			OFF	Forward run prohibited. Forward overtravel.
	N-OT	CN1-18	ON	Reverse run allowed. Normal operation status.
			OFF	Reverse run prohibited. Reverse overtravel.

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

IMPORTANT

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

(2) Overtravel Function Setting

Parameters Pn50A and Pn50B can be set to enable or disable the overtravel function.

If the overtravel function is not used, no wiring for overtravel input signals will be required.

Parameter		Meaning	When Enabled	Classification
Pn50A	n.2□□□ [Factory setting]	Inputs the Forward Run Prohibited (P-OT) signal from CN1-17.	After restart	Setup
	n.8□□□	Disables the Forward Run Prohibited (P-OT) signal. Allows constant forward rotation.		
Pn50B	n.□□□3 [Factory setting]	Inputs the Reverse Run Prohibited (N-OT) signal from CN1-18.		
	n.□□□8	Disables the Reverse Run Prohibited (N-OT) signal. Allows constant reverse rotation.		

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

(3) Servomotor Stopping Method When Overtravel is Used

There are two servomotor stopping methods when an overtravel is used.

- Decelerate to a stop
  Stops by using emergency stop torque.
- Coast to a stop
  Stops naturally, with no control, by using the friction resistance of the servomotor in operation.

After servomotor stopping, there are two modes.

- Coast mode
  Stopped naturally, with no control, by using the friction resistance of the servomotor in operation.
- Zero clamp mode
  A mode forms a position loop by using the position reference zero.

The servomotor 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 Method	Mode After Stopping	When Enabled	Classification
Pn001	n.□□02 [Factory setting]	Coast	Coast	After restart	Setup
	n.□□1□	Deceleration to a stop	Zero clamp		
	n.□□2□		Coast		

- A servomotor under torque control cannot be decelerated to a stop. Coast status is maintained after the servomotor coasts to a stop.
- For details on servomotor stopping methods after the /S-ON (Servo ON) signal turns OFF or an alarm occurs, refer to *5.2.5 Stopping Servomotors after /S-ON Turned OFF or Alarm Occurrence*.

■ When Servomotor Stopping Method is Set to Decelerate to Stop

Emergency stop torque can be set with Pn406.

Pn406	Emergency Stop Torque [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 torque.
- The factory setting is 800% so that the setting is large enough a value to operate the servomotor at maximum torque. The maximum value of emergency stop torque that is actually available, however, is limited to the maximum torque of the servomotor.

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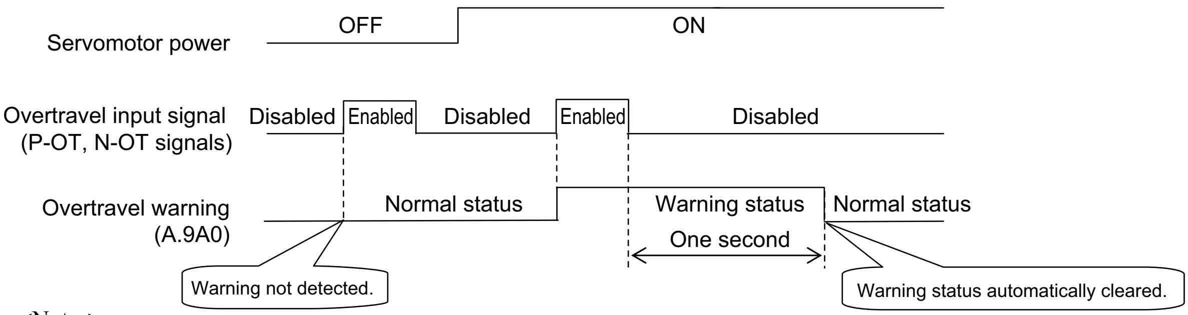
(4) Overtravel Warning Function

This function detects an overtravel warning (A.9A0) if overtravel occurs while the servomotor power is ON. Using this function enables notifying the host controller when the SERVOPACK detects overtravel even if the overtravel signal is ON only momentarily.

To use this function, perform the following settings.
- Set Pn00D = n.1□□□ (overtravel warning function).
- Allocate one of the output signals to the warning signal.

■ Warning Output Timing



<Notes>
- Warnings are detected for overtravel in the same direction as the reference.
- Warnings are not detected for overtravel in the reverse direction from the reference.
  Example: A warning will not be output for a forward reference even if the N-OT signal (reverse run prohibited) turns ON.
- A warning can be detected in either the forward or reverse direction, when there is no reference.
- A warning will not be detected when the servomotor power is OFF even if overtravel occurs.
- A warning will not be detected when the servomotor power changes from OFF to ON even if overtravel status exists.
- The warning output will be held for one second after the overtravel status no longer exists and it will then be cleared automatically.

⚠ CAUTION

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

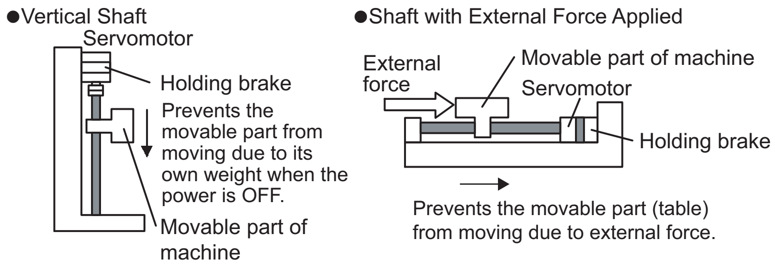
■ Related Parameter

Parameter		Meaning	When Enabled	Classification
Pn00D	n.0□□□ [Factory setting]	Does not detect overtravel warning.	Immediately	Setup
	n.1□□□	Detects overtravel warning.		

5.2.4 Holding Brakes

A holding brake is a brake used to hold the position of the movable part of the machine when the SERVOPACK is turned OFF so that movable part does not move due to gravity or external forces. Holding brakes are built into servomotors with brakes.

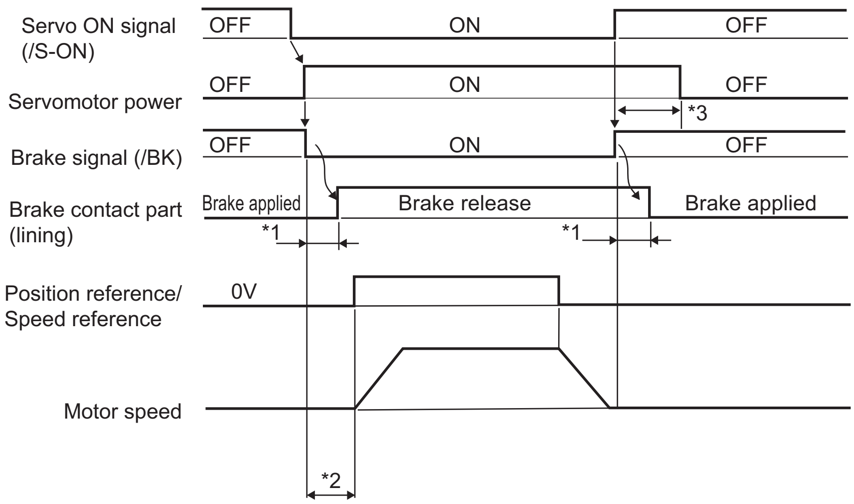
The holding brake is used in the following cases.



IMPORTANT

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

There is a delay in the braking operation. Set the following ON/OFF timing.



*1. The delay time in brake operation is given in the following table. This is just example of the operation delay time for switching with a direct current. Always evaluate performance on the actual equipment before actual operation.

Model	Voltage	Brake Release Time (ms)	Brake Applied Time (ms)
SGM7M SGMMV	24 VDC	40	100

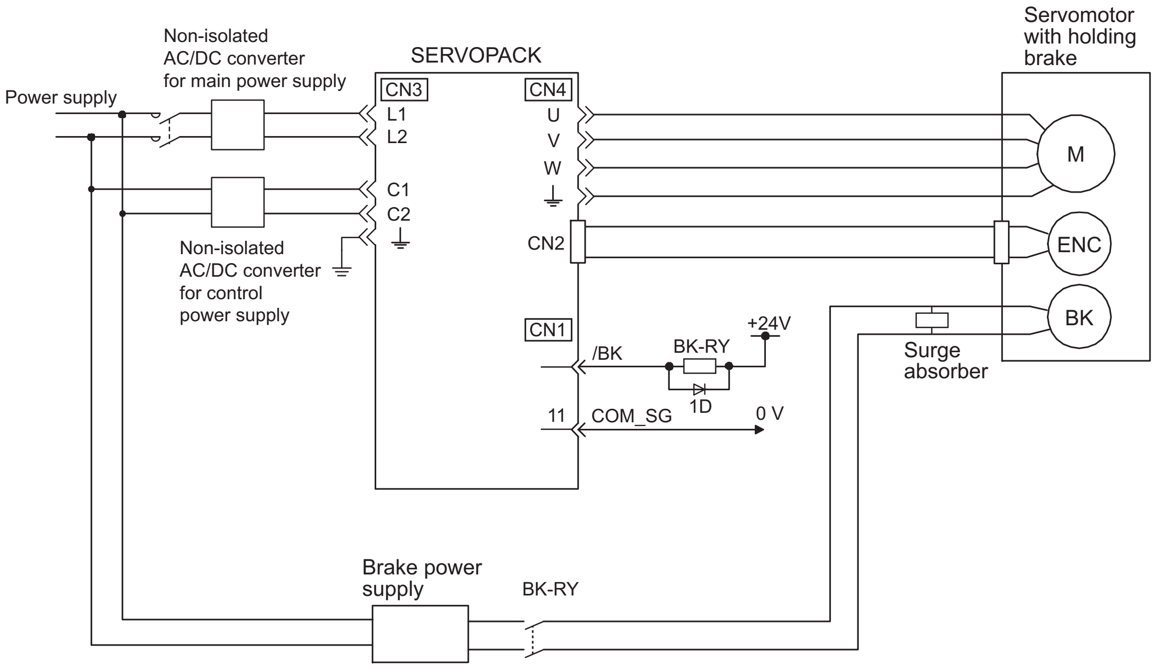
*2. After the/S-ON signal has turned ON and 50 ms has passed since the brake was released, output the reference from the host controller to the SERVOPACK.

*3. Use Pn506, Pn507, and Pn508 to set the timing of when the brake will be activated and when the servomotor power will be turned OFF.

(1) Wiring Example

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

The timing can be easily set using the brake signal (/BK).

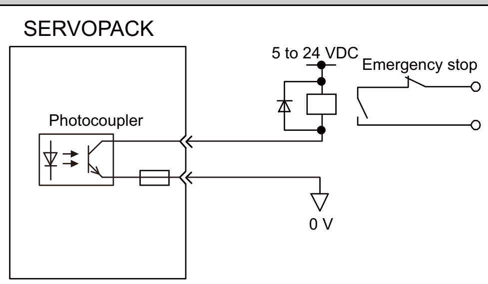


BK-RY: Brake control relay
Brake power supply for 24 VDC is not included.

IMPORTANT

- Always connect a surge absorber.
  Recommended surge absorber: Z15D151 (manufactured by SEMITEC Corporation)
- After the surge absorber is connected, check the total time the brake is applied for the system. Depending on the surge absorber, the total time the brake is applied can be changed.
- Configure the relay circuit to apply the holding brake by the emergency stop.

Relay Circuit Example



- The brake signal (/BK) cannot be used with factory settings. The output signal must be allocated. Refer to *(3) Brake Signal (/BK) Allocation* to set the parameter Pn50F.
- Always separate the 24-VDC power supply for the 24-V brake from other power supplies, such as the control or I/O signal (CN1) power supplies. If the power supply is shared, the I/O signals might malfunction.

(2) Brake Signal (/BK) Setting

This output signal controls the brake. The output signal must be allocated with Pn50F. Refer to *(3) Brake Signal (/BK) Allocation* for allocation.

The /BK signal turns OFF (applies the brake) when an alarm is detected or the /S-ON signal is turned OFF. The brake OFF timing can be adjusted with Pn506.

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

IMPORTANT

The /BK signal is still ON during overtravel and the brake is still released.

(3) Brake Signal (/BK) Allocation

The brake signal (/BK) is not allocated at shipment. Use parameter Pn50F.2 to allocate the /BK signal.

Parameter		Connector Pin Number	Meaning	When Enabled	Classification
Pn50F	n.□0□□ [Factory setting]	–	The /BK signal is not used.	After restart	Setup
	n.□1□□	CN1-7	The /BK signal is output from output terminal CN1-7.		
	n.□2□□	CN1-9	The /BK signal is output from output terminal CN1-9.		
	n.□3□□	CN1-10	The /BK signal is output from output terminal CN1-10.		

IMPORTANT

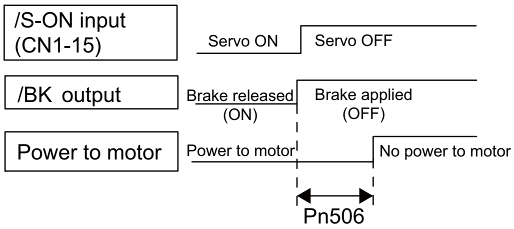
When multiple signals are allocated to the same output terminal, the signals are output with OR logic. For the /BK signal, do not use the output terminal that is already being used for another signal.

(4) Brake ON Timing after the Servomotor Stops

When the servomotor stops, the /BK signal turns OFF at the same time as the /S-ON signal is turned OFF. Use parameter Pn506 to change the timing to turn OFF the servomotor power after the /S-ON signal has turned OFF.

Pn506	Brake Reference-Servo OFF Delay Time (Speed, Position, Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 50	10 ms	0	Immediately	Setup

- When using the servomotor to control a vertical axis, the machine movable part may shift slightly depending on the brake ON timing due to gravity or an external force. To eliminate this slight shift, set parameter so that the power to the servomotor turns OFF after the brake is applied.
- This parameter changes the brake ON timing while the servomotor is stopped.



IMPORTANT

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

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

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

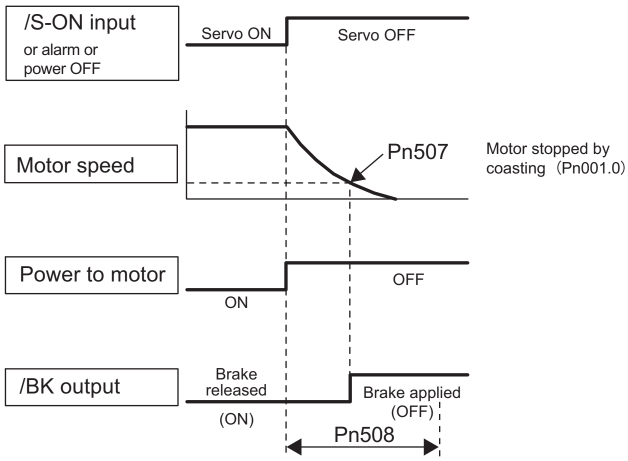
Note: If the servomotor is set so that it comes to a zero-speed stop for an alarm, follow the information in *(4) Brake ON Timing after the Servomotor Stops* after the servomotor comes to a stop for a zero position reference.

Pn507	Brake Reference Output Speed Level		Speed / Position / Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	100	Immediately	Setup
Pn508	Waiting Time for Brake Signal When Motor Running		Speed / Position / Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	10 ms	50	Immediately	Setup

/BK Signal Output Conditions When Servomotor Rotating

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

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



IMPORTANT

- The servomotor will be limited to its maximum speed even if the value set in Pn507 is higher than the maximum speed.
- Do not allocate the rotation detection signal (/TGON) and the brake signal (/BK) to the same terminal. The /TGON signal will otherwise be turned ON by the falling speed on a vertical axis, and the brake may not operate.
  For the /BK signal, do not use the terminal that is already being used for another signal.

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5.2.5 Stopping Servomotors after /S-ON Turned OFF or Alarm Occurrence

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

IMPORTANT

- The elements in the SERVOPACK will deteriorate if turning the power supply ON and OFF or starting and stopping the servomotor during the servo ON status while there is a reference input. Use a speed reference or position reference to start and stop the servomotor.
- If turning OFF the main circuit power supply or the control power supply during operation without turning OFF the servo, the servomotor will coast to a stop. In this case, the stop method cannot be set in a parameter.
- To minimize the coasting distance of the servomotor to come to a stop when an alarm occurs, the zero-speed stopping method is factory-set for alarms to which the zero-speed stopping method is applicable. However, in some applications, coasting to a stop may be more suitable than the zero-speed stopping method.

  For example, for multiple shafts in coupled operation (e.g., a twin-drive operation), machinery may damage due to differences in the stopping operation if a zero-speed stop alarm occurs for one of the coupled shafts and the other coupled shaft coasts to a stop. In such cases, change the stopping method so that the servomotor coasts to a stop.

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

The servomotor coasts to a stop when the servo is turned OFF.

(2) Stopping Method for Servomotor When an Alarm Occurs

There are two types of alarms, Gr.1 and Gr.2, that vary in the stopping method when the alarm occurs.

When a Gr.1 alarm occurs, the servomotor coasts to a stop.

When a Gr.2 alarm occurs, the stopping method that is set in Pn00B.1 is used.

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

■ Stopping Method for Servomotor for Gr.2 Alarms

Parameter		Stop Mode	Mode After Stopping	When Enabled	Classification
Pn00B	n.□□0□ [Factory setting]	Zero-speed stopping*	Coast	After restart	Setup
	n.□□1□	Coast			

* Zero-speed stopping: The speed reference is set to 0 to stop quickly.

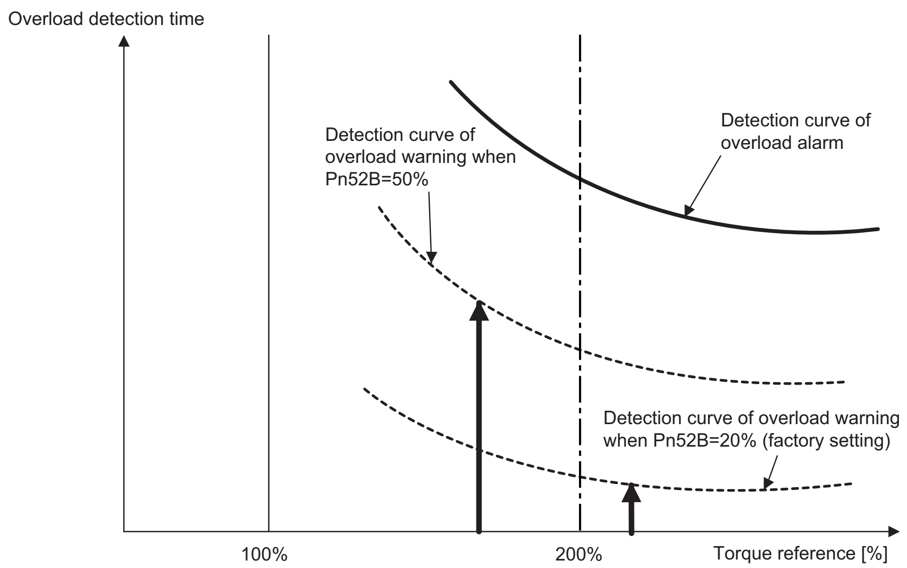
Note: The setting of Pn00B.1 is effective for position control and speed control. The setting of Pn00B.1 is ignored for torque control and the servomotor coasts to a stop.

5.2.6 Setting Motor Overload Detection Level

In this SERVOPACK, the detection timing of the warnings and alarms can be changed by changing how to detect an overload warning (A.910) and overload (low load) alarm (A.720).
The overload characteristics and the detection level of the overload (high load) 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 (Pn52B). This protective function enables the warning output signal (/WARN) to 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.



Note: For details, refer to *Overload Characteristics* listed in the section for the relevant servomotor in the *Σ-V Series Product Catalog* (Catalog No.: KAEP S800000 42).

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

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

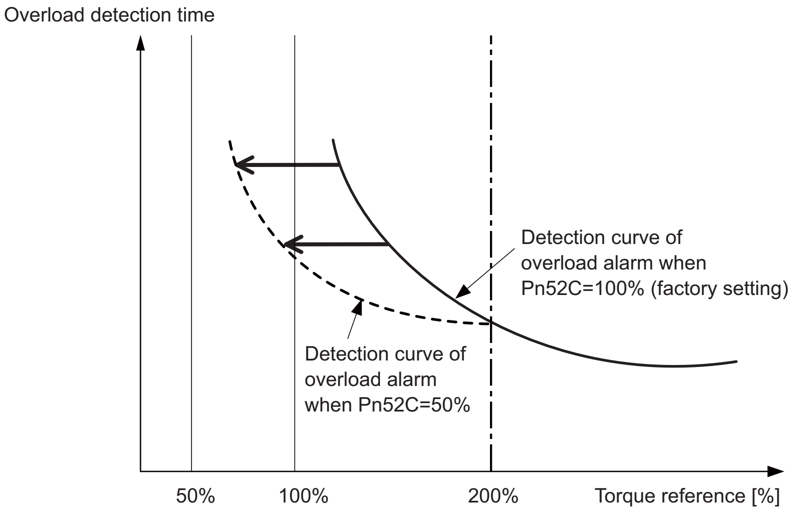
An overload (low load) alarm (A.720) can be detected earlier to protect the servomotor from overloading. The time required to detect an overload alarm can be shortened by using the derated motor base current obtained with the following equation.

Note: The detection level of the overload (high load) alarm (A.710) cannot be changed.

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

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



As a guideline of motor heating conditions, the relationship between the heat sink sizes and deratings of base current is shown in a graph in:
Servomotor Heating Conditions in *Rotary Servomotors General Instruction* in *Σ-V Series Product Catalog* (Catalog No.: KAEP S800000 42).
Set Pn52C to a value in accordance with the heat sink size and derating shown in the graph, so that an overload alarm can be detected at the best timing to protect the servomotor from overloading.

Note: For details, refer to *Overload Characteristics* listed in the section for the relevant servomotor in the *Σ-V Series Product Catalog* (Catalog No.: KAEP S800000 42).

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

5.3 Speed Control (Analog Voltage Reference)

This section describes operation with speed control.

Select the speed control with parameter Pn000.1.

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

5.3.1 Basic Settings for Speed Control

This section describes the basic settings for speed control.

(1) Signal Setting

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

Type	Signal Name	Connector Pin Number	Name
Input	V-REF	CN1-1	Speed reference input
	SG	CN1-2	Signal ground for speed reference input

Maximum input voltage: ±12 VDC

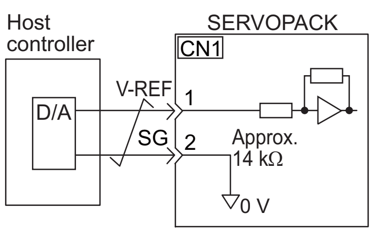
■ Input Circuit Example

Example:
Motor rated speed with Pn300 = 006.00: 6.00 V [Factory setting]

Note: The setting value is 600, but it will be displayed on the operator as 006.00.

Speed Reference Input	Rotation Direction	Motor Speed	SGM7M, SGMMV Servomotor
+6 V	Forward	Rated motor speed	3000 min^{-1}
–3 V	Reverse	1/2 rated motor speed	–1500 min^{-1}
+1 V	Forward	1/6 rated motor speed	500 min^{-1}

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



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

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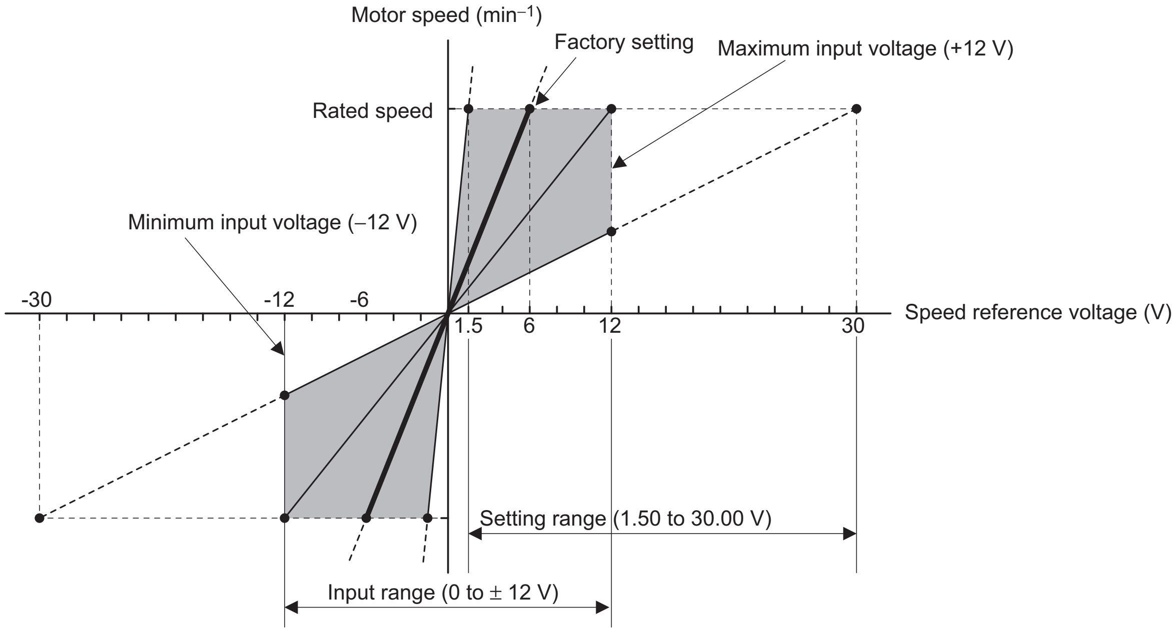
(2) Parameter Setting

Using Pn300, set the analog voltage level for the speed reference (V-REF) necessary to operate the servomotor at the rated speed.

Pn300	Speed Reference Input Gain Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	150 to 3000	0.01 V	600 (rated speed at 6.00 V)	Immediately	Setup

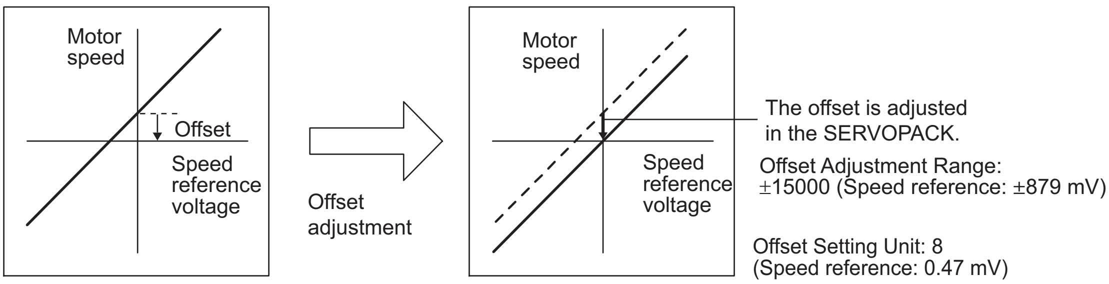


5.3.2 Reference Offset Adjustment

In speed control, the servomotor may rotate at a very low speed with a voltage reference of 0 V. This occurs because the internal reference voltage of the SERVOPACK has a slight offset of a few millivolts. It is called "offset".

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

Use either automatic adjustment or manual adjustment. Automatic adjustment uses the automatic adjustment parameter for reference offset (Fn009). Manual adjustment uses the manual adjustment parameter for reference offset (Fn00A).



(1) Automatic Adjustment of Reference Offset (Fn009)

The automatic adjustment of reference offset measures the amount of offset and adjusts the reference voltage automatically. After completion of the automatic adjustment, the amount of offset measured is saved in the SERVOPACK.

IMPORTANT	The servomotor power must be OFF when automatically adjusting the reference offset.

Note: The adjusted value is not initialized by executing the Fn005 function (Initializing Parameter Settings).

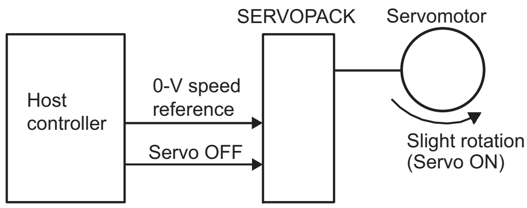
■ Preparation

The following conditions must be met to adjust the offsets of speed or torque analog reference automatically.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The servomotor power must be OFF.

■ Operating Procedure

Adjust the reference offset automatically with the digital operator using the following steps.

Step	Display after Operation	Keys	Operation
1	BB −PRM/MON− Un000= 00000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	–	Turn OFF the servo ON signal (/S-ON), and input the 0-V reference voltage from the host controller or external circuit. 
2	BB −FUNCTION− Fn008:Mturn Clr Fn009:Ref Adj Fn00A:Vel Adj Fn00B:Trq Adj	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu of the utility function mode. Use the ∧ or ∨ Key to move through the list and select Fn009.
3	BB Ref Adjust Start : [DATA] Return: [SET]	DATA	Press the DATA Key. The display changes to the Fn009 execution display.
4	BB Ref Adjust Start : [DATA] Return: [SET]	DATA or MODE/SET	Press the DATA Key to execute the automatic adjustment of analog voltage reference (speed or torque) offset. "DONE" is displayed during the processing, and "BB" is displayed at the completion. Press the MODE/SET Key not to execute the automatic adjustment. The display returns to the main menu of the utility function mode.

Note: The automatic adjustment of reference offset (Fn009) cannot be used when a position loop has been formed with a host controller. Use the manual adjustment of reference offset described in *(2) Manual Adjustment of Reference Offset (Fn00A)*.

(2) Manual Adjustment of Reference Offset (Fn00A)

This method adjusts the offset inputting the amount of reference offset directly.

Use the manual adjustment of the reference offset (Fn00A) in the following cases:

- To adjust the position error to zero when a position loop is formed with the host controller and the servomotor is stopped by servolock.
- To deliberately set the offset amount to some value.
- To check the offset amount set in the automatic adjustment mode of reference offset.

Note: The adjusted value is not initialized by executing the Fn005 function (Initializing Parameter Settings).

■ Preparation

The following conditions must be met to adjust the offsets of speed reference manually.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

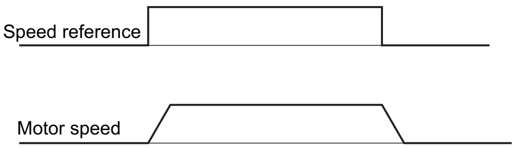
■ Operating Procedure

Adjust the reference offset manually with the digital operator using the following steps.

Step	Display after Operation	Keys	Operation
1			Set the analog voltage input to 0 V.
2	BB –FUNCTION– Fn009:Ref Adj Fn00A:Vel Adj Fn00B:Trq Adj Fn00C:MonZero Adj	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu of the utility function mode. Use the ∧ or ∨ Key to move through the list and select Fn00A.
3	BB Velocity Adjust ZADJV= 00000 Vref = 00000	DATA	Press the DATA Key. The display changes to the Fn00A execution display.
4	RUN Velocity Adjust ZADJV= 00000 Vref = 00000	–	Turn ON the servo ON (/S-ON) signal.
5	RUN Velocity Adjust ZADJV=+00012 Vref = 00000	∧ or ∨	Press the ∧ or ∨ Key to adjust the reference speed offset value.
6	RUN Velocity Adjust ZADJV=+00015 Vref = 00000	DATA	Press the DATA Key to write the speed reference offset value into the SERVOPACK. When the writing is completed, the status display shows "DONE" for one second.
7	RUN –FUNCTION– Fn009:Ref Adj Fn00A:Vel Adj Fn00B:Trq Adj Fn00C:MonZero Adj	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function mode.

5.3.3 Soft Start

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



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

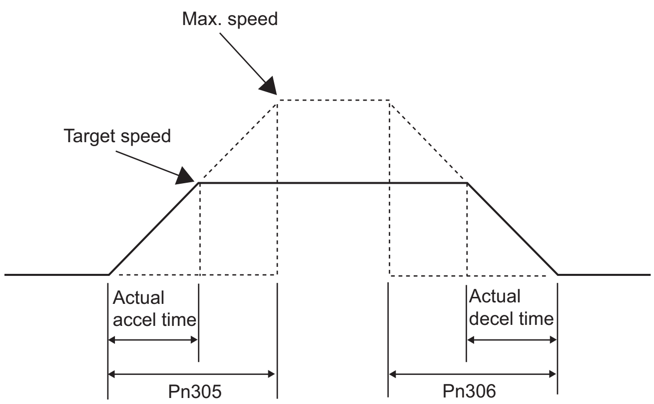
Note: Set both parameters Pn305 and Pn306 to "0" (factory setting) for normal speed control.

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

Pn305: The time interval from the time the servomotor starts until the motor maximum speed is reached.
Pn306: The time interval from the time the servomotor is operating at the motor maximum speed until it stops.

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

- Actual accel time = $\dfrac{\text{Target speed}}{\text{Max. speed}} \times$ Soft start time (accel time Pn305)
- Actual decel time = $\dfrac{\text{Target speed}}{\text{Max. speed}} \times$ Soft start time (decel time Pn306)



5.3.4 Speed Reference Filter

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

Note: The user need not usually change the setting. A setting value that is too large, however, will slow down response. Check the response characteristics when setting this parameter.

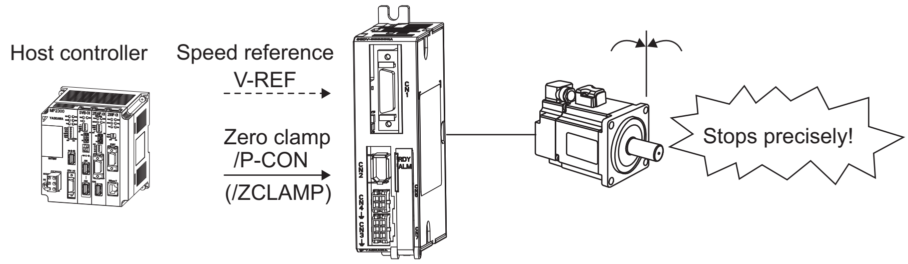
Pn307	Speed Reference Filter Time Constant		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	40	Immediately	Setup

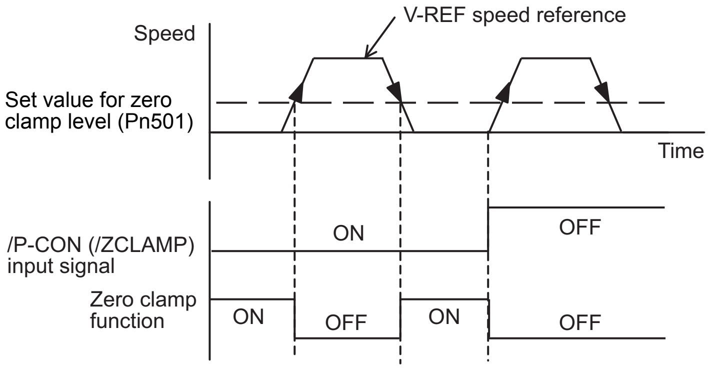
5.3.5 Zero Clamp Function

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

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

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





Adjust the position loop gain (Pn102) if the servomotor oscillates in the zero clamp state. If the gain switching function is used, adjusting the 2nd position loop gain (Pn106) is required as well. For details, refer to *6.8.1 Switching Gain Settings*.

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

When Pn000.1 is set to A, the control method becomes "speed control <=> speed control with zero clamp function" and the /P-CON signal is used as a zero clamp signal.

Type		Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-16 [Factory setting]	ON (closed)	The zero clamp function will be turned ON if the input voltage of the speed reference (V-REF) drops below the set speed in the zero clamp level (Pn501).
			OFF (open)	Turns OFF the zero clamp function.

Parameter		Control Method	When Enabled	Classification
Pn000	n.□□A□	Speed control <=> speed control with zero clamp function	After restart	Setup

(2) Changing Input Signal Allocations (Pn50A.0 = 1)

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

Type		Connector Pin Number	Setting	Meaning
Input	/ZCLAMP	Must be allocated	ON (closed)	The zero clamp function will be turned ON if the input voltage of the speed reference (V-REF) drops below the set speed in the zero clamp level (Pn501).
			OFF (open)	Turns OFF the zero clamp function.

Note: Use parameter Pn50D.0 to allocate the /ZCLAMP signal for use. For details, refer to *3.3.1 Input Signal Allocations*.

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

Parameter		Control Method	Input Signal Used	When Enabled	Classification
Pn000	n.□□0□	Speed control	/ZCLAMP	After restart	Setup
	n.□□3□	Internal set speed control	/ZCLAMP, SPD-A, SPD-B, SPD-D, C-SEL		
	n.□□4□	Internal set speed control <=> Speed control	/ZCLAMP, SPD-A, SPD-B, SPD-D, C-SEL		
	n.□□6□	Internal set speed control <=> Torque control	/ZCLAMP, SPD-A, SPD-B, SPD-D, C-SEL		
	n.□□9□	Torque control <=> Speed control	/ZCLAMP, C-SEL		
	n.□□A□	Speed control <=> Speed control with zero clamp function	/ZCLAMP, C-SEL		

Note: If Pn000.1 is set to 6 or 9, the zero clamp function will become invalid when the control is changed to any methods other than speed control and internal set speed control.

For speed control, the zero clamp function locks the servomotor when the speed reference drops below the set speed in the zero clamp level by setting Pn50D.0 to 7 (zero clamp function is always valid). The input signals (/ZCLAMP, /P-CON) are not necessary.

(3) Related Parameter

Set the motor speed at which to enter zero clamp operation.

Pn501	Zero Clamp Level		Speed		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	10	Immediately	Setup

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

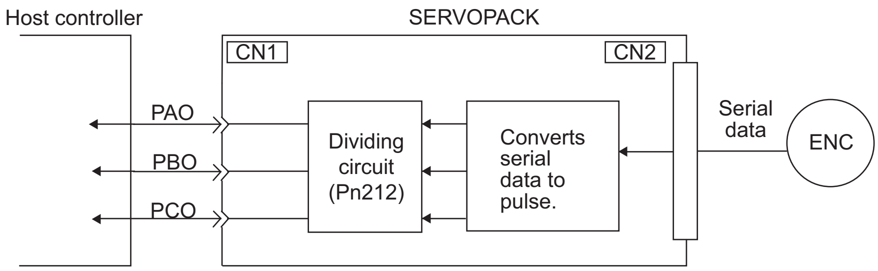
5.3.6 Encoder Output Pulses

The encoder pulse output is a signal that is output from the encoder and processed inside the SERVOPACK. It is then output externally in the form of two phase pulse signal (phases A and B) with a 90° phase differential. It is used as the position feedback to the host controller.

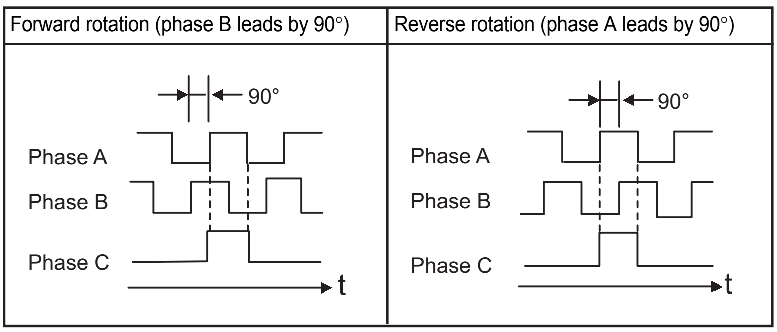
Signals and output phase form are as shown below.

(1) Signals

Type	Signal Name	Connector Pin Number	Name	Remarks
Output	PAO	CN1-19	Encoder output pulse: phase A	These encoder pulse output pins output the number of pulses per motor revolution that is set in Pn212. Phase A and phase B are different from each other in phase by an electric angle of 90°.
	/PAO	CN1-20		
	PBO	CN1-21	Encoder output pulse: phase B	
	/PBO	CN1-22		
	PCO	CN1-23	Encoder output pulse: phase C	One pulse is output per motor rotation.
	/PCO	CN1-24		



(2) Output Phase Form



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

IMPORTANT

If using the SERVOPACK's phase-C pulse output for a zero point return, rotate the servomotor two or more times before starting a zero point return. If the servomotor cannot be rotated two or more times, perform a zero point return at a motor speed of 600 min^{-1} or below. If the motor speed is faster than 600 min^{-1}, the phase-C pulse may not be output correctly.

5.3.7 Setting Encoder Output Pulse

Set the encoder output pulse using the following parameter.

Pn212	Encoder Output Pulses — Speed, Position, Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	16 to 1073741824	1 P/rev	2048	After restart	Setup

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

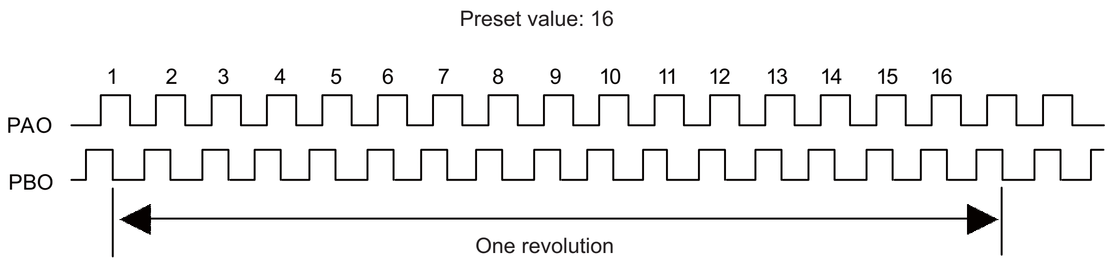
According to the encoder resolution, the number of encoder output pulses are limited.

Setting Range of Encoder Output Pulses (P/Rev)	Setting Unit	Encoder Resolution: 17 bits (131,072 pulses)	Upper Limit of Servomotor Speed for Set Encoder Output Pulses (min^{-1})
16 to 16384	1	✓	6000
16386 to 32768	2	✓	3000

Note 1. An encoder output pulse setting error (A.041) will occur if the setting is outside the allowable range or does not satisfy the setting conditions.
Pn212 = 25000 (P/Rev) is accepted, but
Pn212 = 25001 (P/Rev) is not accepted. The alarm A.041 is output because the setting unit differs from that in the above table.

2. The upper limit of the pulse frequency is approx. 1.6 Mpps.
The servomotor speed is limited if the setting value of the encoder output pulses (Pn212) is large.
An overspeed of encoder output pulse rate alarm (A.511) will occur if the motor speed exceeds the upper limit specified in the above table.

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



Operation

5

5.3.8 Setting Speed Coincidence Signal

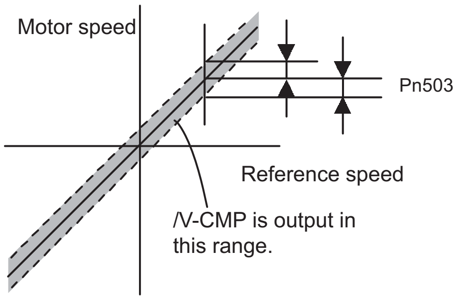
The speed coincidence output signal (/V-CMP) is output when the actual servomotor speed is the same as the reference speed. The host controller uses the signal as an interlock. This signal is the output signal during speed control.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/V-CMP	CN1-7 [Factory Setting]	ON (closed)	Speed coincides.
			OFF (open)	Speed does not coincide.

Note: Use parameter Pn50E.1 to allocate the /V-CMP signal to another terminal. Refer to *3.3.2 Output Signal Allocations* for details.

Pn503	Speed Coincidence Signal Output Width (Speed)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1 min^{-1}	10	Immediately	Setup

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



<Example>

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

5.4 Position Control (Pulse Train Reference)

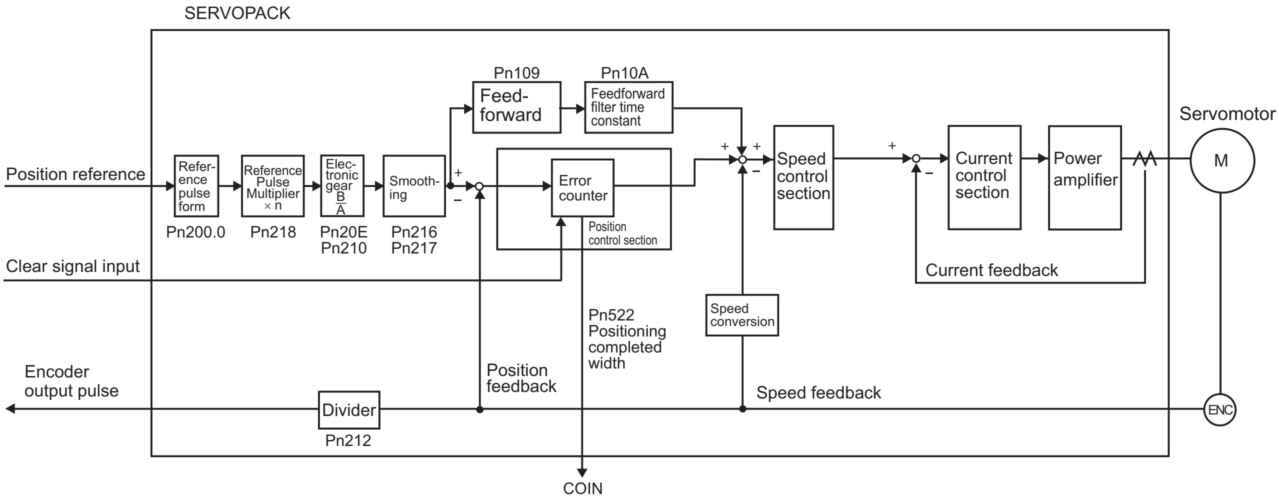
This section describes operation with position control.

Select position control with Pn000.1.

Parameter		Meaning	When Enabled	Classification
Pn000	n.□□1□ [Factory setting]	Position Control (pulse train reference)	After restart	Setup

■ Block Diagram for Position Control

A block diagram for position control is shown below.

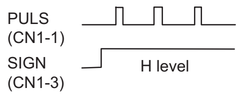
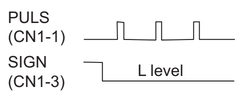
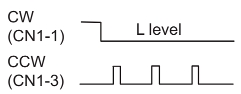
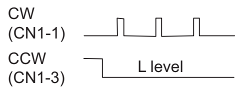
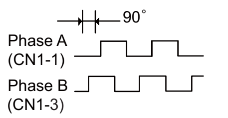
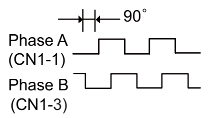
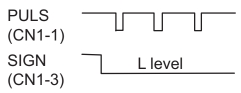
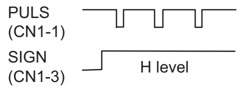
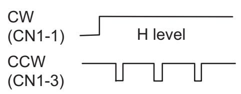
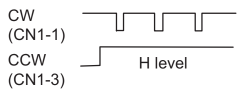


5.4.1 Basic Settings for Position Control

This section describes the basic settings for position control.

(1) Reference Pulse Form

Set the reference pulse form using Pn200.0.

Parameter		Reference Pulse Form	Input Pulse Multiplier	Forward Run Reference	Reverse Run Reference
Pn200	n.□□□0 [Factory setting]	Sign + pulse train (Positive logic)	–		
	n.□□□1	CW + CCW pulse train (Positive logic)	–		
	n.□□□2	Two-phase pulse train with 90° phase differential	×1		
	n.□□□3		×2		
	n.□□□4		×4		
	n.□□□5	Sign + pulse train (Negative logic)	–		
	n.□□□6	CW + CCW pulse train (Negative logic)	–		

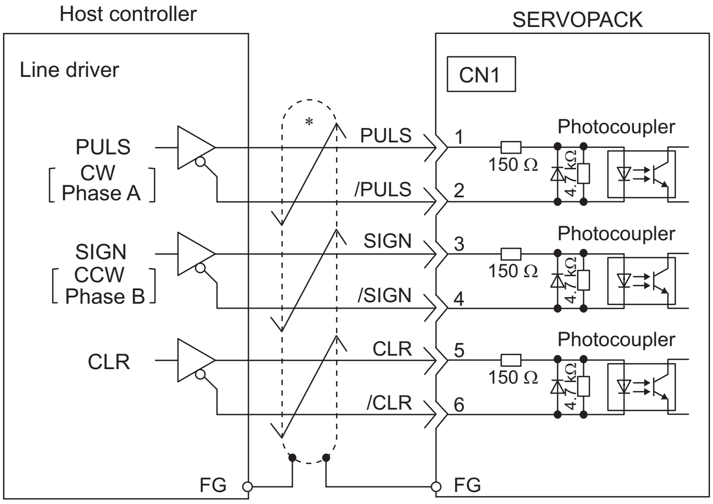
(2) Input Filter Selection

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

(3) Connection Example

The following diagram shows a connection example. Use an SN75ALS174 or MC3487 manufactured by Texas Instruments Inc., or equivalent for the line driver.

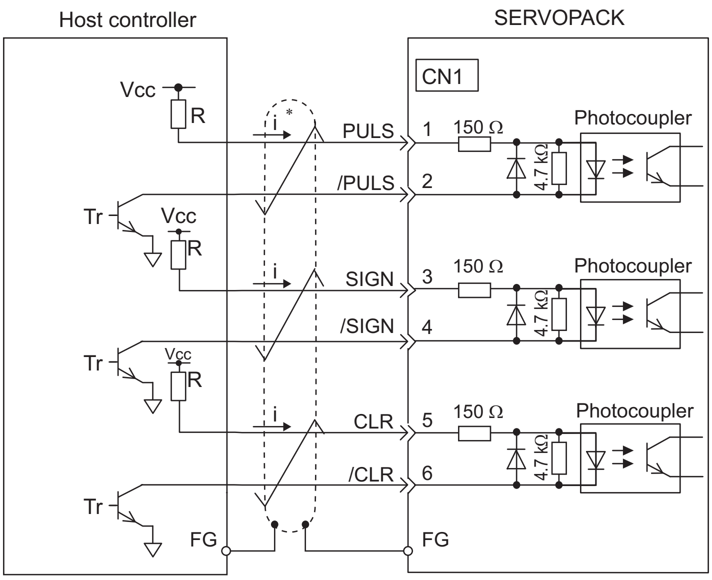
■ Line Driver Output



* represents twisted-pair wires.

■ Open-collector Output

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



■ Example

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

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

When Tr is ON	High level input or equivalent
When Tr is OFF	Low level input or equivalent

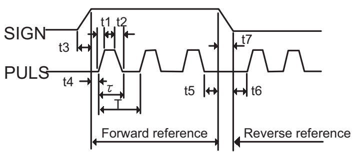
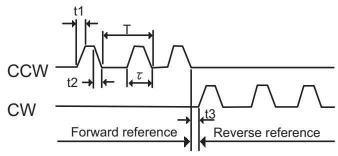
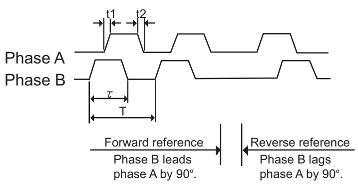
* represents twisted-pair wires.

IMPORTANT

- Use a shielded cable for I/O signals and ground both ends of the shield.
- Connect the shield of the cable on the SERVOPACK side to the connector shell so that the shield will be connected to the frame ground (FG) through the connector.

(4) Electrical Specifications for Pulse Train Reference

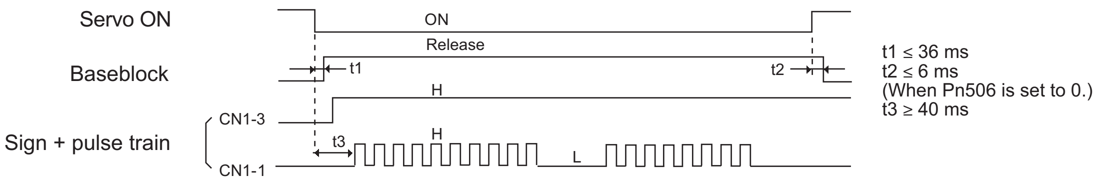
Forms of pulse train references are as shown below.

Pulse Train Reference Form	Electrical Specifications		Remarks
Sign + pulse train input (SIGN + PULS signal) Maximum reference frequency: 4 Mpps (Maximum reference frequency in case of open-collector output: 200 kpps)		t1, t2, t3, t7 ≤ 0.025 µs t4, t5, t6 ≥ 0.5 µs τ ≥ 0.125 µs T-τ ≥ 0.125 µs	Sign (SIGN) H = Forward reference L = Reverse reference
CW + CCW pulse train Maximum reference frequency: 4 Mpps (Maximum reference frequency in case of open-collector output: 200 kpps)		t1, t2 ≤ 0.025 µs t3 ≥ 0.5 µs τ ≥ 0.125 µs T-τ ≥ 0.125 µs	
Two-phase pulse train with 90° phase differential (phase A + phase B) Maximum reference frequency: 1 Mpps* (Maximum reference frequency in case of open-collector output: 200 kpps)		t1 ≤ 0.1 µs t2 ≤ 0.1 µs τ ≥ 0.5 µs T-τ ≥ 0.5 µs	Reference pulse form is set with Pn200.0.

* Each multiplier's maximum reference frequency before multiplication is 1 Mpps.
×1 input pulse multiplier: 1 Mpps
×2 input pulse multiplier: 1 Mpps
×4 input pulse multiplier: 1 Mpps

(5) I/O Signal Timing Example

I/O signal timing example is as shown below.



Note: The interval from the time the servo ON signal is turned ON until a reference pulse is input must be at least 40 ms. Otherwise the reference pulse may not be received by the SERVOPACK (t3).

5.4.2 Clear Signal Setting

Clear input signal sets SERVOPACK error counter to zero.

(1) Connecting the Clear Signal

Type	Signal Name	Connector Pin Number	Name
Input	CLR	CN1-5	Clear input
	/CLR	CN1-6	

(2) Clear Input Signal Form

Set the clear input signal form using Pn200.1.

Parameter		Description	Clear Timing	When Enabled	Classification
Pn200	n.□□0□ [Factory setting]	Clears at ON. Position errors do not accumulate while the signal is ON.	CLR (CN1-5) Clears at ON.	After restart	Setup
	n.□□1□	Clears at the rising edge.	CLR (CN1-5) ON Clears here just once.		
	n.□□2□	Clears at OFF. Position errors do not accumulate while the signal is OFF.	CLR (CN1-5) Clears at OFF.		
	n.□□3□	Clears at the falling edge.	CLR (CN1-5) OFF Clears here just once.		

The following items will be changed in the SERVOPACK after the error counter has been reset to zero.

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

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

■ Pulse Width of Clear Signal

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

(3) Clear Operation

This parameter determines when the position error should be set to zero according to the condition of the SERVOPACK. Any of three clearing modes can be selected with Pn200.2.

Parameter		Description	When Enabled	Classification
Pn200	n.□0□□ [Factory setting]	Sets the position error to zero during a baseblock when an alarm occurs or when the servo ON signal (/S-ON) turns OFF.	After restart	Setup
	n.□1□□	Does not set the error counter to zero. Clears the position error only with the CLR signal.		
	n.□2□□	Sets the position error to zero when an alarm occurs.		

5.4.3 Reference Pulse Input Multiplication Switching Function

The input multiplier for the position reference pulses can be switched between 1 and n (n = 1 to 100) by turning the Reference Pulse Input Multiplication Switching Input signal (/PSEL) ON and OFF. The Reference Pulse Input Multiplication Switching Output signal (/PSELA) can be used to confirm that the multiplier has been switched.

To use this function, set the multiplier in Pn218.

Switch the multiplier of the reference pulse only when the position reference pulse is 0. If the position reference pulse is not 0 when the multiplier is switched, the servomotor position may shift.

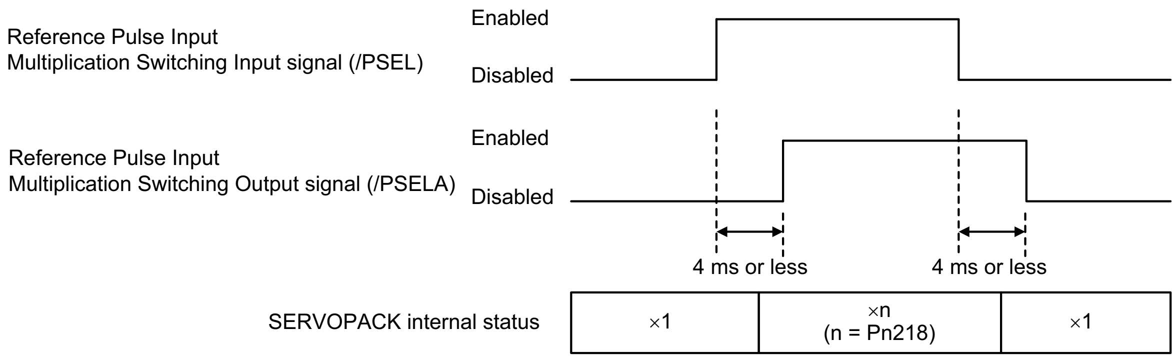
⚠ CAUTION

- Unexpected operation may occur if a position reference pulse is input before the multiplier changes. Always use the /PSELA signal to confirm that the multiplier has been switched before inputting a position reference pulse.
- If changing the setting of Pn218, disconnect the servomotor shaft from the machine and perform trial operation. Be sure that no problems will occur before connecting the shaft to the machine again.

(1) Related Parameter

Pn218	Reference Pulse Input Multiplication			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 100	1 time	1	Immediately	Setup

(2) Timing Chart for Reference Pulse Input Multiplication Switching



(3) Input Signal Setting

Use the /PSEL signal when switching to the multiplier of the input reference pulse that is set in Pn218.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/PSEL	Must be allocated	ON (closed)	Enables the multiplier of the input reference pulse.
			OFF (open)	Disables the multiplier of the input reference pulse.

Note: Use parameter Pn515.1 to allocate the /PSEL signal for use. For details, refer to *3.3.1 Input Signal Allocations*.

(4) Output Signal Setting

This output signal indicates when the multiplier of the input reference pulse has been switched for the Reference Pulse Input Multiplication Switching Input signal (/PSEL).

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/PSELA	Must be allocated	ON (closed)	The multiplier of the input reference pulse is enabled.
			OFF (open)	The multiplier of the input reference pulse is disabled.

Note: Use parameter Pn510.2 to allocate the /PSELA signal for use. For details, refer to *3.3.2 Output Signal Allocations*.

(5) Restriction

When using the following utility functions, the reference pulse input multiplication switching function is disabled.

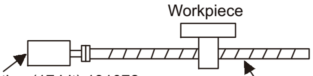
Parameter No.	Function
Fn004	Program JOG operation
Fn201	Advanced autotuning

5.4.4 Electronic Gear

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

Note: If the multiplier of the input reference pulse is switched, the input reference pulse from the host controller will be multiplied by n and defined as the reference unit of the position data. ("n" is the multiplier of the reference pulse.)

The section indicates the difference between using and not using an electronic gear when a workpiece is moved 10 mm in the following configuration.



When the Electronic Gear is Not Used:

1. Calculate the revolutions.
   1 revolution is 6 mm. Therefore, 10/6 revolutions.
2. Calculate the required reference pulses.
   131072 pulses is 1 revolution. Therefore, 10/6 × 131072 = 218453.33··· pulses.
3. Input 218453 pulses as reference pulses.

Reference pulses must be calculated per reference. → complicated

When the Electronic Gear is Used:

The reference unit is 1 µm. Therefore, to move the workpiece 10 mm (10000 µm),
1 pulse = 1 µm, so 10000 ÷ 1 = 10000 pulses.
Input 10000 pulses as reference pulses.

Calculation of reference pulses per reference is not required. → simplified

(1) Electronic Gear Ratio

Set the electronic gear ratio using Pn20E and Pn210.

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

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

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

■ Encoder Resolution

Encoder resolution can be checked with servomotor model designation.

SGM7M −□□□□□□□

Symbol	Specification	Encoder Resolutions
3	20-bit absolute	1048576

SGMMV −□□□□□□□

Symbol	Specification	Encoder Resolutions
2	17-bit absolute	131072

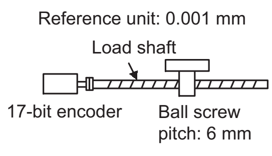
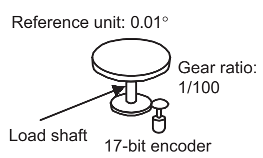
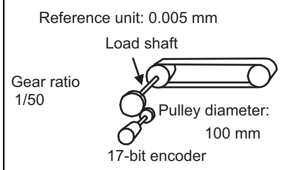
IMPORTANT

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 1 (A.040) will be output.

(2) Electronic Gear Ratio Setting Examples

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

Step	Operation	Load Configuration		
		Ball Screw	Disc Table	Belt and Pulley
				
1	Check machine specifications.	• Ball screw pitch: 6 mm • Gear ratio: 1/1	Rotation angle per revolution: 360° Gear ratio: 1/100	Pulley diameter: 100 mm (pulley circumference: 314 mm) • Gear ratio: 1/50
2	Check the encoder resolution.	131072 (17-bit)	131072 (17-bit)	131072 (17-bit)
3	Determine the reference unit used.	Reference unit: 0.001 mm (1 μm)	Reference unit: 0.01°	Reference unit: 0.005 mm (5 μm)
4	Calculate the travel distance per load shaft revolution. (Reference unit)	6 mm/0.001 mm = 6000	360°/0.01° = 36000	314 mm/0.005 mm = 62800
5	Calculate the electronic gear ratio.	$\frac{B}{A} = \frac{131072}{6000} \times \frac{1}{1}$	$\frac{B}{A} = \frac{131072}{36000} \times \frac{100}{1}$	$\frac{B}{A} = \frac{131072}{62800} \times \frac{50}{1}$
6	Set parameters.	Pn20E: 131072 Pn210: 6000	Pn20E: 13107200 Pn210: 36000	Pn20E: 6553600 Pn210: 62800

5.4.5 Smoothing

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

- When the host controller that outputs a reference cannot perform acceleration/deceleration processing.
- When the reference pulse frequency is too low.

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

■ Related Parameters

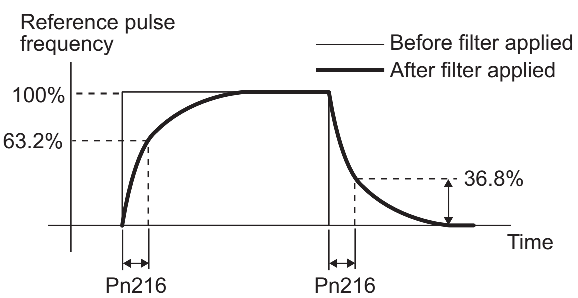
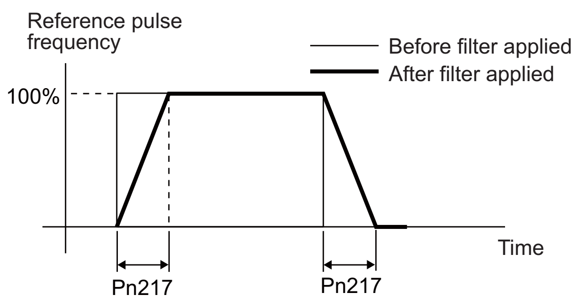
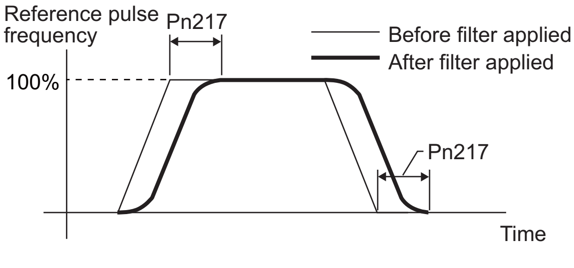
Set the following filter-related parameters.
Change the setting while there is no reference pulse input and the servomotor stops.

Pn216	Position Reference Acceleration/Deceleration Time Constant			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.1 ms	0*	Immediately after the servomotor stops	Setup
Pn217	Average Movement Time of Position Reference			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	0.1 ms	0*	Immediately after the servomotor stops	Setup

* When set to 0, a filter becomes ineffective.

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

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

Acceleration/Deceleration Filter (Pn216)	Average Movement Time Filter (Pn217)
	
	

5.4.6 Positioning Completed Signal

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

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

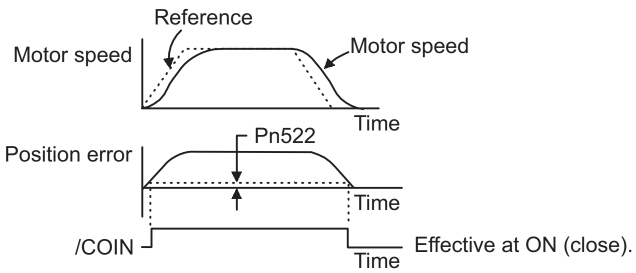
Use this signal to check the completion of positioning from the host controller.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/COIN	CN1-7 [Factory setting]	ON (closed)	Positioning has been completed.
			OFF (open)	Positioning is not completed.

Note: Use parameter Pn50E.0 to allocate the /COIN signal to another terminal. Refer to *3.3.2 Output Signal Allocations* for details.

Pn522	Positioning Completed Width			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1073741824	1 reference unit	7	Immediately	Setup

The positioning completed width setting has no effect on final positioning accuracy.



Note: If the parameter is set to a value that is too large, a positioning completed signal might be output if the position error is low during a low speed operation. This will cause the positioning completed signal to be output continuously. If this signal is output unexpectedly, reduce the set value until it is no longer output.

If the position error is kept to a minimum when the positioning completed width is small, use Pn207.3 to change output timing for the /COIN signal.

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

5.4.7 Positioning Near Signal

Before confirming that the positioning completed signal has been received, the host controller first receives a positioning near signal and can prepare the operating sequence after positioning has been completed. The time required for this sequence after positioning can be shortened.

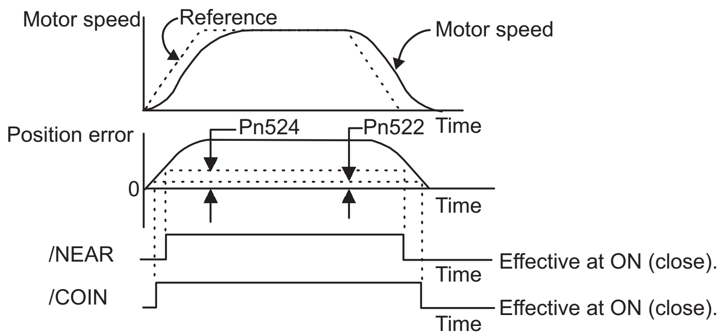
This signal is generally used in combination with the positioning completed output signal.

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

Note: Use parameter Pn510.0 to allocate the /NEAR signal for use. Refer to *3.3.2 Output Signal Allocations* for details.

Pn524	NEAR Signal Width			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824	1 reference unit	1073741824	Immediately	Setup

The positioning near signal (/NEAR) is output when the difference between the number of reference pulses output by the host controller and the travel distance of the servomotor (position error) is less than the set value.



Note: Normally, the value of Pn524 should be larger than that for the positioning completed width (Pn522).

5.4.8 Reference Pulse Inhibit Function

This function inhibits the SERVOPACK from counting input pulses during position control. When this function is enabled, the SERVOPACK does not accept the reference pulse input.

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

Use Pn000.1=B and the /P-CON signal to use the reference pulse inhibit function while the input signal allocations are still in the factory settings.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-16 [Factory setting]	ON (closed)	Stops counting the reference pulses.
			OFF (open)	Counts the reference pulses.

Parameter		Control Method	Input Signal Used	When Enabled	Classification
Pn000	n.□□B□	Position Control ↔ Position Control with Reference Pulse Inhibit Function	/P-CON	After restart	Setup

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

(2) Changing Input Signal Allocations (Pn50A.0 = 1)

Allocate the /INHIBIT signal as the reference pulse inhibit signal to use the reference pulse inhibit function while the Pn000.1 (control method) is set to 1 or 5.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/INHIBIT	Must be allocated.	ON (closed)	Stops counting the reference pulses.
			OFF (open)	Counts the reference pulses.

Note: Use parameter Pn50D.1 to allocate the /INHIBIT signal for use. For details, refer to *3.3.1 Input Signal Allocations to Input Terminals*.

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

Parameter		Control Method	Input Signal Used	When Enabled	Classification
Pn000	n.□□1□	Position Control	/INHIBIT	After restart	Setup
	n.□□5□	Internal Set Speed Control ⇔Position Control	/INHIBIT /SPD-A /SPD-B /SPD-D /C-SEL		

Note: Reference pulse inhibit function is effective only with position control.

Operation

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5.5 Torque Control (Analog Voltage Reference)

This section describes operation with torque control.

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

Select the torque control with parameter Pn000.1.

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

5.5.1 Basic Settings for Torque Control

This section describes the basic settings for torque control.

(1) Signal Setting

Set the following input signals.

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-3	Torque reference input
	SG	CN1-4	Signal ground for torque reference input

Maximum input voltage: ±12 VDC

■ Input Circuit Example

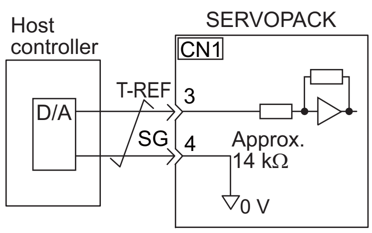
Example
Pn400 = 0003.0: Motor rated torque at 3.0 V [Factory setting]

Note: The value is 30, but it will be displayed on the operator as 0003.0.

Torque Reference Input	Rotation Direction	Torque
+3 V	Forward	Rated torque
+1 V	Forward	1/3 rated torque
–1.5 V	Reverse	1/2 rated torque

Connect the pins for the T-REF signal and SG to the analog reference output terminal on the host controller when using a host controller, such as a programmable controller, for torque control.

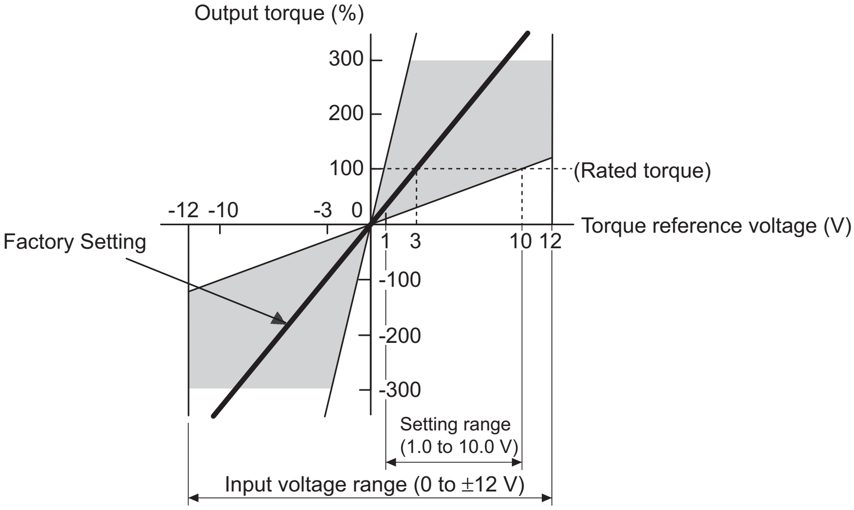
Note: Always use twisted-pair cables to control noise.



(2) Parameter Setting

Using Pn400, set the analog voltage level for the torque reference (T-REF) that is necessary to operate the servomotor at the rated torque.

Pn400	Torque Reference Input Gain Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	0.1 V	30 (Rated torque at 3.0 V)	Immediately	Setup



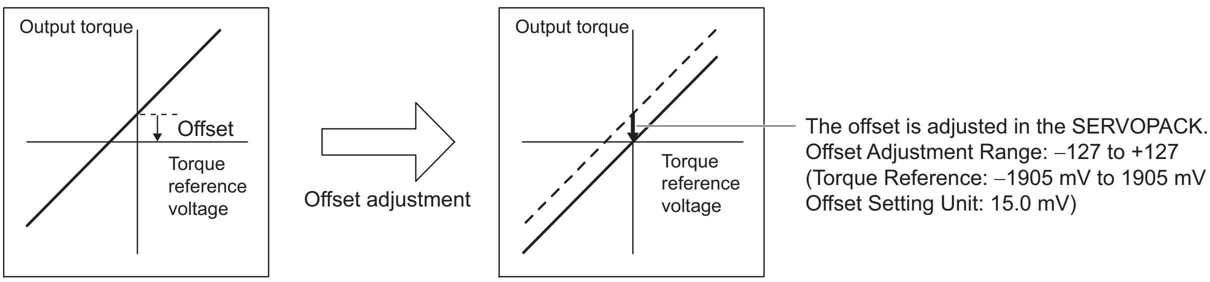
Note: A torque reference above the rated torque can be applied but it may cause an overload (high load) alarm (A.710) or overload (low load) alarm (A.720) if excessive torque is output for a long time. Refer to *9.1.2 Troubleshooting of Alarms*.

5.5.2 Reference Offset Adjustment

In torque control, the servomotor may rotate at a very low speed with a voltage reference of 0 V. This occurs because the internal reference voltage of the SERVOPACK has a slight offset of a few millivolts. It is called "offset."

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

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



Operation

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(1) Automatic Adjustment of Reference Offset (Fn009)

The automatic adjustment of reference offset measures the amount of offset and adjusts the reference voltage automatically.
After completion of the automatic adjustment, the amount of offset measured is saved in the SERVOPACK.

> **IMPORTANT**
> The servomotor power must be OFF when automatically adjusting the reference offset.

Note: The adjusted value is not initialized by executing the Fn005 function (Initializing Parameter Settings).

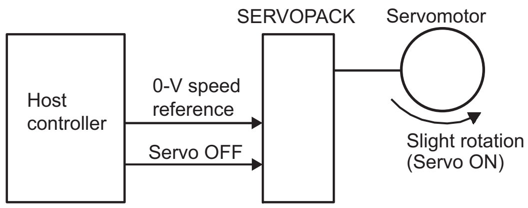
■ Preparation

The following conditions must be met to adjust the offsets of torque analog reference automatically.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The servomotor power must be OFF.

■ Operating Procedure.

Adjust the reference offset automatically with the digital operator using the following steps.

Step	Display after Operation	Keys	Operation
1	BB –PRM/MON– Un000= 00000 Un002= 00000 Un008= 0000000000 Un00D= 0000000000	–	Turn OFF the servo ON signal (/S-ON), and input the 0-V reference voltage from the host controller or external circuit. 
2	BB –FUNCTION– Fn008:Mturn Clr Fn009:Ref Adj Fn00A:Vel Adj Fn00B:Trq Adj	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu of the utility function mode. Use the ∧ or ∨ Key to move through the list and select Fn009.
3	BB Ref Adjust Start : [DATA] Return: [SET]	DATA	Press the DATA Key. The display changes to the Fn009 execution display.
4	BB Ref Adjust Start : [DATA] Return: [SET]	DATA or MODE/SET	Press the DATA Key to execute the automatic adjustment of analog voltage reference (speed or torque) offset. "DONE" is displayed during the processing, and "BB" is displayed at the completion. Press the MODE/SET Key not to execute the automatic adjustment. The display returns to the main menu of the utility function mode.

Note: The automatic adjustment of reference offset (Fn009) cannot be used when a position loop has been formed with the host controller. Use the manual adjustment of reference offset described in *(2) Manual Adjustment of Reference Offset (Fn00B)*.

(2) Manual Adjustment of Reference Offset (Fn00B)

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

Use the manual adjustment of the torque reference offset (Fn00B) in the following cases:

- To deliberately set the offset amount to some value.
- To check the offset amount set in the automatic adjustment mode of reference offset.

Note: The adjusted value is not initialized by executing the Fn005 function (Initializing Parameter Settings).

■ Preparation

The following conditions must be met to adjust the offsets of torque reference manually.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

■ Operating Procedure

Adjust the reference offset manually with the digital operator using the following steps.

Step	Display after Operation	Keys	Operation
1			Set the analog voltage input to 0 V.
2	BB −FUNCTION− Fn00A:Vel Adj Fn00B:Trq Adj Fn00C:MonZero Adj Fn00D:MonGain Adj	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu of the utility function mode. Use the ∧ or ∨ Key to move through the list and select Fn00B.
3	BB Torque Adjust ZADJT=-00004 Tref = 00000	DATA	Press the DATA Key. The display changes to the Fn00B execution display.
4	RUN Torque Adjust ZADJT=-00004 Tref = 00000	–	Turn ON the servo ON (/S-ON) signal.
5	RUN Torque Adjust ZADJT=-00007 Tref = 00000	∧ or ∨	Press the ∧ or ∨ Key to adjust the reference torque offset value.
6	RUN Torque Adjust ZADJT=-00007 Tref = 00000	DATA	Press the DATA Key to write the torque reference offset value into the SERVOPACK. When the writing is completed, the status display shows “DONE” for one second.
7	RUN −FUNCTION− Fn00A:Vel Adj Fn00B:Trq Adj Fn00C:MonZero Adj Fn00D:MonGain Adj	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function mode.

5.5.3 Torque Reference Filter

This smooths the torque reference by applying a first order lag filter to the torque reference (T-REF) input.

Note: A setting value that is too large, however, will slow down response.
Check the response characteristics when setting this parameter.

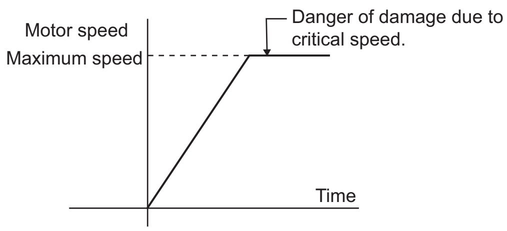
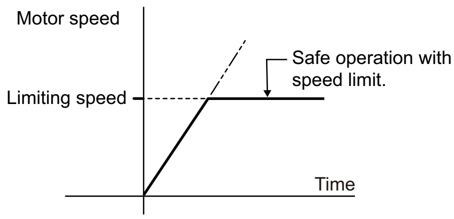
Pn415	T-REF Filter Time Constant Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	0	Immediately	Setup

5.5.4 Speed Limit in Torque Control

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

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

Note: The actual limit value of motor speed depends on the load conditions of the servomotor.

With No Speed Limit	With Speed Limit
	

Refer to the following parameters for speed limit.

(1) Signals Output during Servomotor Speed Limit

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

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

Note: Use parameter Pn50F.1 to allocate the /VLT signal for use. For details, refer to *3.3.2 Output Signal Allocations*.

(2) Speed Limit Setting

Select the speed limit mode with Pn002.1.

Parameter		Meaning	When Enabled	Classification
Pn002	n.□□0□ [Factory setting]	Uses the value set in Pn407 as the speed limit (internal speed limit function).	After restart	Setup
	n.□□1□	Uses V-REF (CN1-1, 2) as an external speed limit input. Applies a speed limit using the input voltage of V-REF and the setting in Pn300 (external speed limit function).		

■ Internal Speed Limit Function

If the internal speed limit function is selected in Pn002.1, set the limit of the maximum speed of the servomotor in Pn407. The limit of the speed in Pn408.1 can be either the maximum speed of the servomotor or the overspeed alarm detection speed. Select the overspeed alarm detection speed to limit the speed to the maximum speed of the servomotor or the equivalent.

Pn407	Speed Limit During Torque Control (Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	10000	Immediately	Setup

Note: The servomotor's maximum speed or the overspeed alarm detection speed will be used when the setting in this parameter exceeds the maximum speed of the servomotor used.

Parameter		Meaning	When Enabled	Classification
Pn408	n.□□0□ [Factory setting]	Uses the smaller value of the maximum motor speed and the value of Pn407 as the speed limit value.	After restart	Setup
	n.□□1□	Uses the smaller value of the overspeed alarm detection speed and the value of Pn407 as speed limit value.		

■ External Speed Limit Function

If the external speed limit function is selected in Pn002.1, set the V-REF input signal and Pn300.

Type	Signal Name	Connector Pin Number	Name
Input	V-REF	CN1-1	External speed limit input
	SG	CN1-2	Signal ground for external speed limit input

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

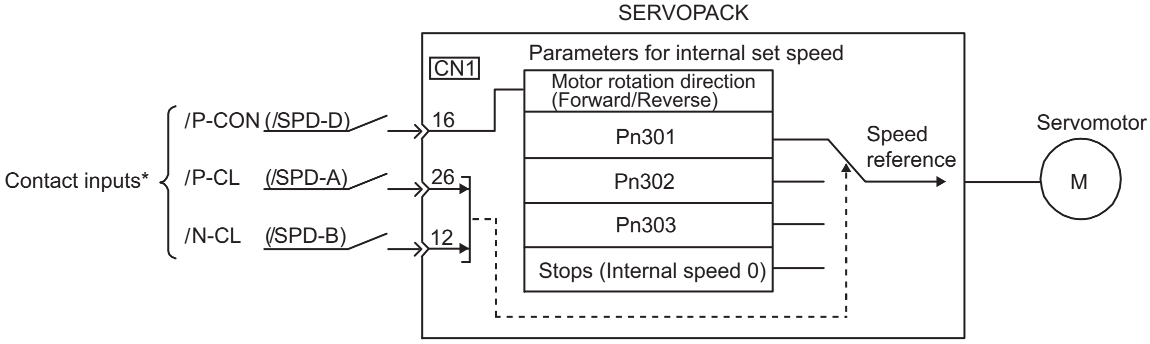
Notes:
- The smaller value of the speed limit input from the V-REF and the value of Pn407 is enabled when Pn002.1 is set to 1.
- The setting in Pn300 determines the voltage level to be input as the limit value. Polarity has no effect.
- When Pn300 is set to 6.00 (factory setting) and 6 V is input to V-REF (CN1-1, 2), the speed is limited to the rated speed of the servomotor used.

Pn300	Speed Reference Input Gain (Speed) (Position) (Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	150 to 3000	0.01 V	600	Immediately	Setup

5.6 Internal Set Speed Control

This section describes operation using speed control with the internal set speeds.

This function enables an operation to be executed at a controlled speed. The speed, direction, or both are selected in accordance with a combination of input signals from an external source. Servomotor speed settings are made beforehand using the parameters in the SERVOPACK. Because the speed is controlled with a parameter in the SERVOPACK, an external pulse generator or a reference generator that controls speed is not needed.



* When using the external input signal pins as factory settings, the functions of /P-CON, /P-CL, and /N-CL change to the functions of /SPD-D, /SPD-A, and /SPD-B, respectively.

5.6.1 Basic Settings for Speed Control with an Internal Set Speed

This section describes the basic settings for the internal set speeds.

(1) Signal Setting

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

■ Factory-set Input Signal Allocations: /P-CON, /P-CL, and /N-CL

Type	Signal Name	Connector Pin Number	Meaning
Input	/P-CON	CN1-16	Switches the servomotor rotation direction.
	/P-CL	CN1-26	Selects the internal set speed.
	/N-CL	CN1-12	Selects the internal set speed.

■ Changing Input Signal Allocations: /SPD-D, /SPD-A, and /SPD-B

Type	Signal Name	Connector Pin Number	Meaning
Input	/SPD-D	Must be allocated	Switches the servomotor rotation direction.
	/SPD-A		Selects the internal set speed.
	/SPD-B		Selects the internal set speed.

(2) Parameter Setting

Select the speed control with an internal set speed with Pn000.1.

Parameter		Meaning	When Enabled	Classification
Pn000	n.□□3□	Internal set speed control	After restart	Setup

(3) Related Parameters

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

Pn301	Internal Set Speed 1		Speed		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	100	Immediately	Setup
Pn302	Internal Set Speed 2		Speed		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	200	Immediately	Setup
Pn303	Internal Set Speed 3		Speed		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	300	Immediately	Setup

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

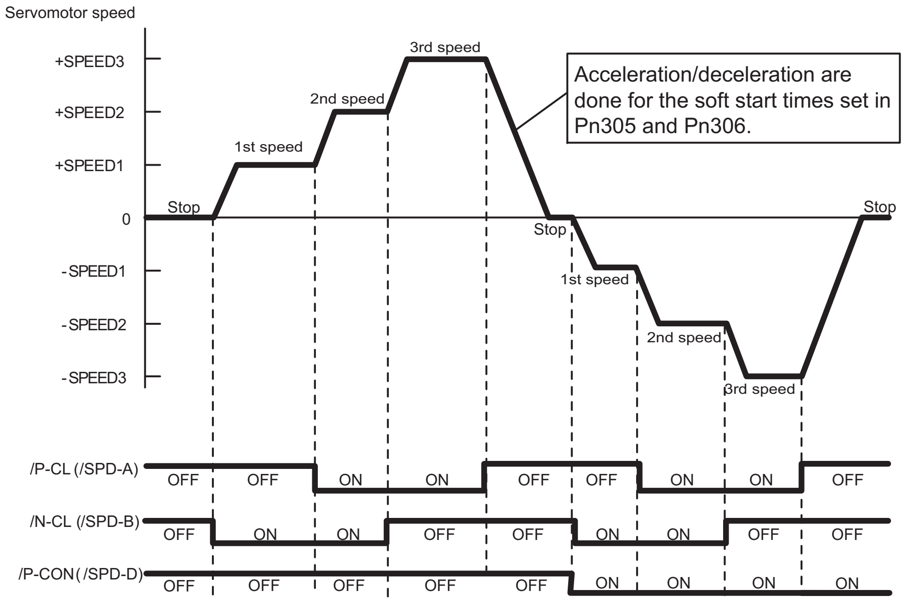
(4) Operating Using an Internal Set Speed

Use ON/OFF combinations of the following input signals to operate with the internal set speeds.

Input Signal			Motor Rotation Direction	Speed
/P-CON /SPD-D	/P-CL /SPD-A	/N-CL /SPD-B		
OFF	OFF	OFF	Forward	Stops at 0 of the internal set speed.
	OFF	ON		Pn301: Internal Set Speed 1
	ON	ON		Pn302: Internal Set Speed 2
	ON	OFF		Pn303: Internal Set Speed 3
ON	OFF	OFF	Reverse	Stops at 0 of the internal set speed.
	OFF	ON		Pn301: Internal Set Speed 1
	ON	ON		Pn302: Internal Set Speed 2
	ON	OFF		Pn303: Internal Set Speed 3

5.6.2 Example of Operating with Internal Set Speeds

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



5.7 Combination of Control Methods

SERVOPACK can switch the combination of control methods. Select the control method with Pn000.1.

■ Analog Voltage Reference (Model: SGDV-□□□ES1A)

Parameter		Combination of Control Methods	When Enabled	Classification
Pn000	n.□□4□	Internal Set Speed Control ⇔ Speed Control	After restart	Setup
	n.□□6□	Internal Set Speed Control ⇔ Torque Control		
	n.□□9□	Torque Control ⇔ Speed Control		
	n.□□A□	Speed Control ⇔ Speed Control with Zero Clamp Function		

■ Pulse Train Reference (Model: SGDV-□□□EP1A)

Parameter		Combination of Control Methods	When Enabled	Classification
Pn000	n.□□5□	Internal Set Speed Control ⇔ Position Control	After restart	Setup
	n.□□B□	Position Control ⇔ Position Control with Reference Pulse Inhibit Function		

5.7.1 Switching Internal Set Speed Control (Pn000.1 = 4, 5, or 6)

Conditions for switching internal set speed control are as shown below.

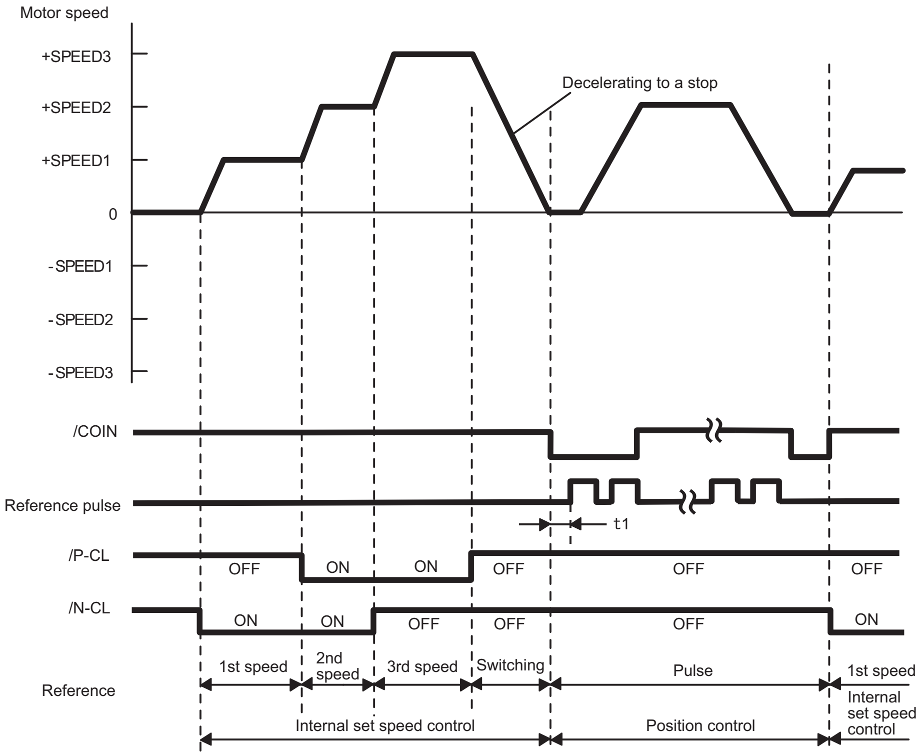
(1) Factory-set Input Signal Allocations (Pn50A.0 = 0)

The control method and internal set speed can be switched using /P-CL and /N-CL signals.

Input Signal			Pn000.1 Settings and Operations		
/P-CON (CN1-16)	/P-CL (CN1-26)	/N-CL (CN1-12)	n.□□4□	n.□□5□	n.□□6□
OFF	OFF	OFF	Speed control	Position control	Torque control
	OFF	ON	Forward rotation at internal set speed 1 set in Pn301.		
	ON	ON	Forward rotation at internal set speed 2 set in Pn302.		
	ON	OFF	Forward rotation at internal set speed 3 set in Pn303.		
ON	OFF	OFF	Speed control	Position control	Torque control
	OFF	ON	Reverse rotation at internal set speed 1 set in Pn301.		
	ON	ON	Reverse rotation at internal set speed 2 set in Pn302.		
	ON	OFF	Reverse rotation at internal set speed 3 set in Pn303.		

It is possible to switch from speed control, position control, or torque control to the internal set speed control even while the servomotor is rotating.

The following diagram describes an operation example for internal set speed control + soft start <=> position control.



Note 1. The t1 value is not affected by whether the soft start function is used.
A maximum delay of 2 ms occurs in loading /P-CL and /N-CL.
2. The speed is decelerated for the time set in Pn306, and the internal set speed control will be changed to the position control after the servomotor comes to a stop.

(2) Changing Input Signal Allocations (Pn50A.0 = 1)

The control method can be switched by turning the /C-SEL signal ON/OFF.

Type	Signal Name	Connector Pin Number	Setting	Pn000 Setting and Control Method		
				n.□□4□	n.□□5□	n.□□6□
Input	/C-SEL	Must be allocated	ON (closed)	Speed	Position	Torque
			OFF (open)	Internal set speed	Internal set speed	Internal set speed

Note: Use parameter Pn50C.3 to allocate the /C-SEL signal for use. For details, refer to *3.3.1 Input Signal Allocations*.

The following table shows the speed and direction in accordance with settings for the input signals for the setting for internal set speed control when the /C-SEL signal is OFF.

Input Signal			Speed and Direction
/SPD-D	/SPD-A	/SPD-B	
OFF	OFF	OFF	Stops at internal set speed 0.
	OFF	ON	Forward rotation at internal set speed 1 set in Pn301.
	ON	ON	Forward rotation at internal set speed 2 set in Pn302.
	ON	OFF	Forward rotation at internal set speed 3 set in Pn303.
ON	OFF	OFF	Stops at internal set speed 0.
	OFF	ON	Reverse rotation at internal set speed 1 set in Pn301.
	ON	ON	Reverse rotation at internal set speed 2 set in Pn302.
	ON	OFF	Reverse rotation at internal set speed 3 set in Pn303.

Note: Use parameter Pn50C.0 to 2 to allocate the /SPD-D, /SPD-A, and /SPD-B signals for use. For details, refer to *3.3.1 Input Signal Allocations*.

5.7.2 Switching Other Than Internal Set Speed Control (Pn000.1 = 9)

Use the following signals to switch control methods when Pn000.1 is set to 9. The control methods switch depending on the signal status as shown below.

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

Type	Signal Name	Connector Pin Number	Setting	Control Method
Input	/P-CON	CN1-16	ON (closed)	Speed
			OFF (open)	Torque

(2) Changing Input Signal Allocations (Pn50A.0 = 1)

Type	Signal Name	Connector Pin Number	Setting	Control Method
Input	/C-SEL	Must be allocated	ON (closed)	Speed
			OFF (open)	Torque

5.7.3 Switching Other Than Internal Set Speed Control (Pn000.1 = A or B)

Use the following signals to switch control methods when Pn000.1 is set to A or B. The control methods switch depending on the signal status as shown below.

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

Type	Signal Name	Connector Pin Number	Setting	Pn000.1 Setting and Control Method	
				n.□□A□	n.□□B□
Input	/P-CON	CN1-16	ON (closed)	Speed control with zero clamp function	Position control with reference pulse inhibit function
			OFF (open)	Speed	Position

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

Type	Signal Name	Connector Pin Number	Setting	Pn000.1 Setting and Control Method	
				n.□□A□	n.□□B□
Input	/ZCLAMP	Must be allocated	ON (closed)	Speed control with zero clamp function	–
			OFF (open)	Speed	–
	/INHIBIT		ON (closed)	–	Position control with reference pulse inhibit function
			OFF (open)	–	Position

5.8 Limiting Torque

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

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

Note: The maximum torque of the servomotor is used when the set value exceeds the maximum torque.

5.8.1 Internal Torque Limit

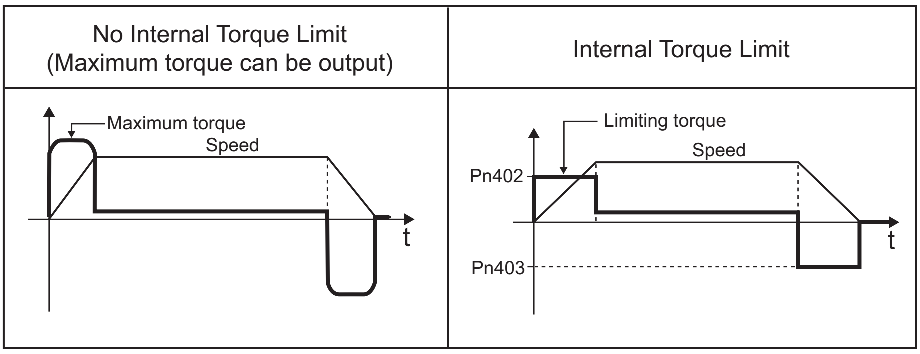
This function always limits maximum output torque by setting values of following parameters.

Pn402	Forward Torque Limit			Speed Position Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup
Pn403	Reverse Torque Limit			Speed Position Torque	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 torque.

Note: If the settings of Pn402 and Pn403 are too low, the torque may be insufficient for acceleration or deceleration of the servomotor.

Torque waveform



5.8.2 External Torque Limit

Use this function to limit torque by inputting a signal from the host controller at specific times during machine operation. For example, some pressure must continually be applied (but not enough to damage the workpiece) when the robot is holding a workpiece or when a device is stopping on contact.

(1) Input Signals

Use the following input signals to limit a torque by external torque limit.

Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit value
Input	/P-CL	CN1-26 [Factory setting]	ON (closed)	Forward external torque limit ON	The smaller value of these settings: Pn402 or Pn404
			OFF (open)	Forward external torque limit OFF	Pn402
Input	/N-CL	CN1-12 [Factory setting]	ON (closed)	Reverse external torque limit ON	The smaller value of these settings: Pn403 or Pn405
			OFF (open)	Reverse external torque limit OFF	Pn403

Note: Use parameter Pn50B.2 and Pn50B.3 to allocate the /P-CL signal and the /N-CL signal to another terminal. For details, refer to *3.3.1 Input Signal Allocations*.

(2) Related Parameters

Set the following parameters for external torque limit.

Pn402	Forward Torque Limit			Speed Position Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup
Pn403	Reverse Torque Limit			Speed Position Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup
Pn404	Forward External Torque Limit			Speed Position Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	100	Immediately	Setup
Pn405	Reverse External Torque Limit			Speed Position Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	100	Immediately	Setup

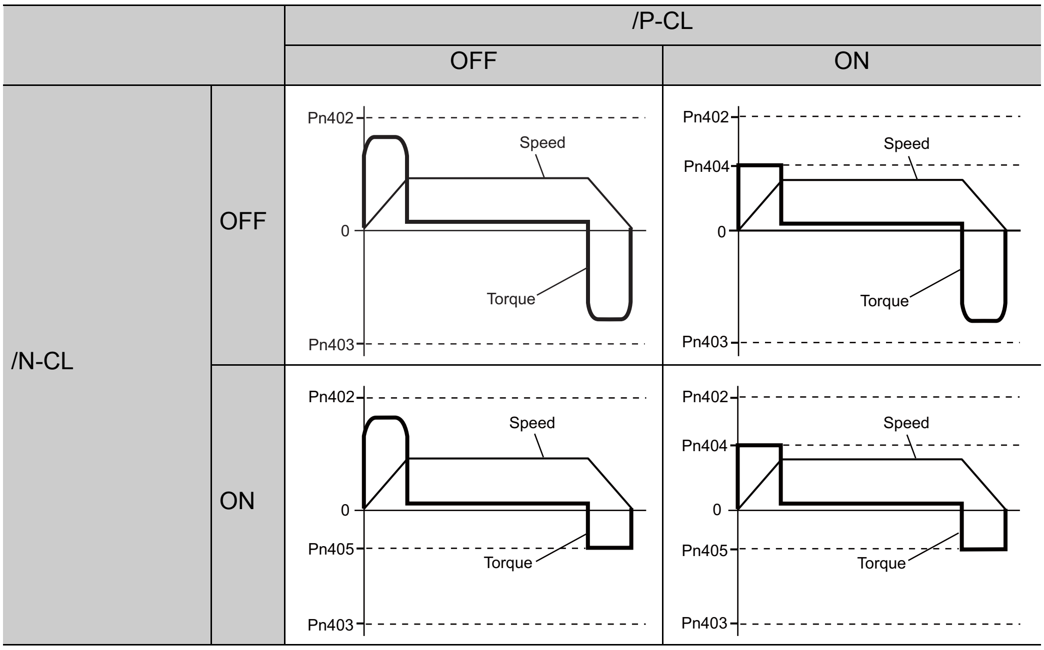
The setting unit is a percentage of the rated torque.

Note: If the settings of Pn402, Pn403, Pn404, and Pn405 are too low, the torque may be insufficient for acceleration or deceleration of the servomotor.

(3) Changes in Output Torque during External Torque Limiting

The following diagrams show the change in output torque when the internal torque limit is set to 800%.

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



5.8.3 Torque Limiting Using an Analog Voltage Reference

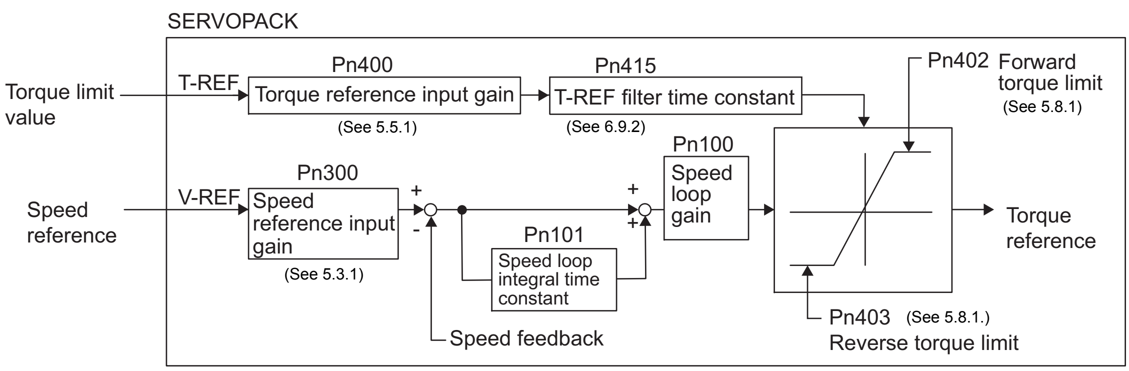
For torque limiting by analog voltage reference, the torque is limited by using the analog voltage at the T-REF terminals for CN1-3 and CN1-4.

From the torque limit value by analog reference and torque limit value by Pn402 and Pn403, whichever is smaller will be applied.

Parameter		Meaning	When Enabled	Classification
Pn002	n.□□□1	Uses the T-REF terminal as an external torque limit input.	After restart	Setup

This function can be used only during speed control, not during torque control.

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



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

Operation

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(1) Input Signals

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

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-3	Torque reference input
	SG	CN1-4	Signal ground for torque reference input

Refer to *5.5.1 Basic Settings for Torque Control*.

(2) Related Parameters

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

Pn400	Torque Reference Input Gain		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	0.1 V	30 (Rated torque at 3.0 V)	Immediately	Setup
Pn402	Forward Torque Limit		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup
Pn403	Reverse Torque Limit		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	800	Immediately	Setup
Pn415	T-REF Filter Time Constant		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	0	Immediately	Setup

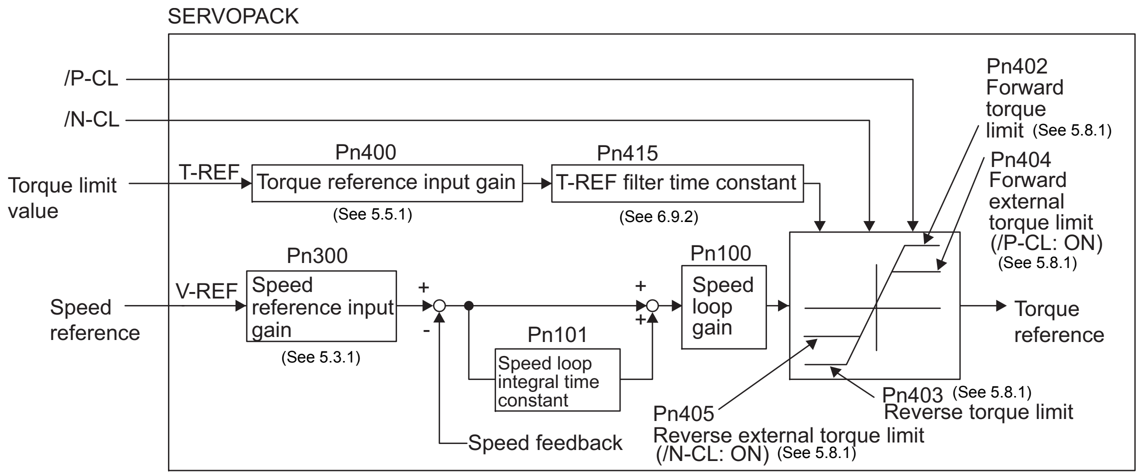
5.8.4 Torque Limiting Using an External Torque Limit and Analog Voltage Reference

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

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

Parameter		Meaning	When Enabled	Classification
Pn002	n.□□□3	When /P-CL or /N-CL is enabled, the T-REF terminal is used as the external torque limit input.	After restart	Setup

The following chart shows the external torque limiting using an analog voltage reference.



Note: This function cannot be used during torque control since the torque limit by analog voltage reference is input from T-REF (CN1-3, 4).

(1) Input Signals

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

Type	Signal Name	Connector Pin Number	Name
Input	T-REF	CN1-3	Torque reference input
	SG	CN1-4	Signal ground for torque reference input

Refer to *5.5.1 Basic Settings for Torque Control*.

Type	Signal Name	Connector Pin Number	Setting	Meaning	Limit Value
Input	/P-CL	CN1-26 [Factory setting]	ON	Forward external torque limit ON	The smallest value of these settings: the analog voltage reference limit, Pn402, or Pn404
			OFF	Forward external torque limit OFF	Pn402
Input	/N-CL	CN1-12 [Factory setting]	ON	Reverse external torque limit ON	The smallest value of these settings: the analog voltage reference limit, Pn403, or Pn405
			OFF	Reverse external torque limit OFF	Pn403

Operation

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(2) Related Parameters

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

Pn400	Torque Reference Input Gain		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	10 to 100	0.1 V	30 (Rated torque at 3.0 V)	Immediately	
Pn402	Forward Torque Limit		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	0 to 800	1%	800	Immediately	
Pn403	Reverse Torque Limit		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	0 to 800	1%	800	Immediately	
Pn404	Forward External Torque Limit		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	0 to 800	1%	100	Immediately	
Pn405	Reverse External Torque Limit		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	Setup
	0 to 800	1%	100	Immediately	

The setting unit is a percentage of the rated torque.

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

5.8.5 Checking Output Torque Limiting during Operation

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

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

Note: Use parameter Pn50F.0 to allocate the /CLT signal for use. For details, refer to *3.3.2 Output Signal Allocations*.

5.9 Absolute Encoders

If using an absolute encoder, a system to detect the absolute position can be designed for use with the host controller. As a result, an operation can be performed without a zero point return operation immediately after the power is turned ON.

A battery case is required to save position data in the absolute encoder.
The battery is attached to the battery case of the encoder cable.

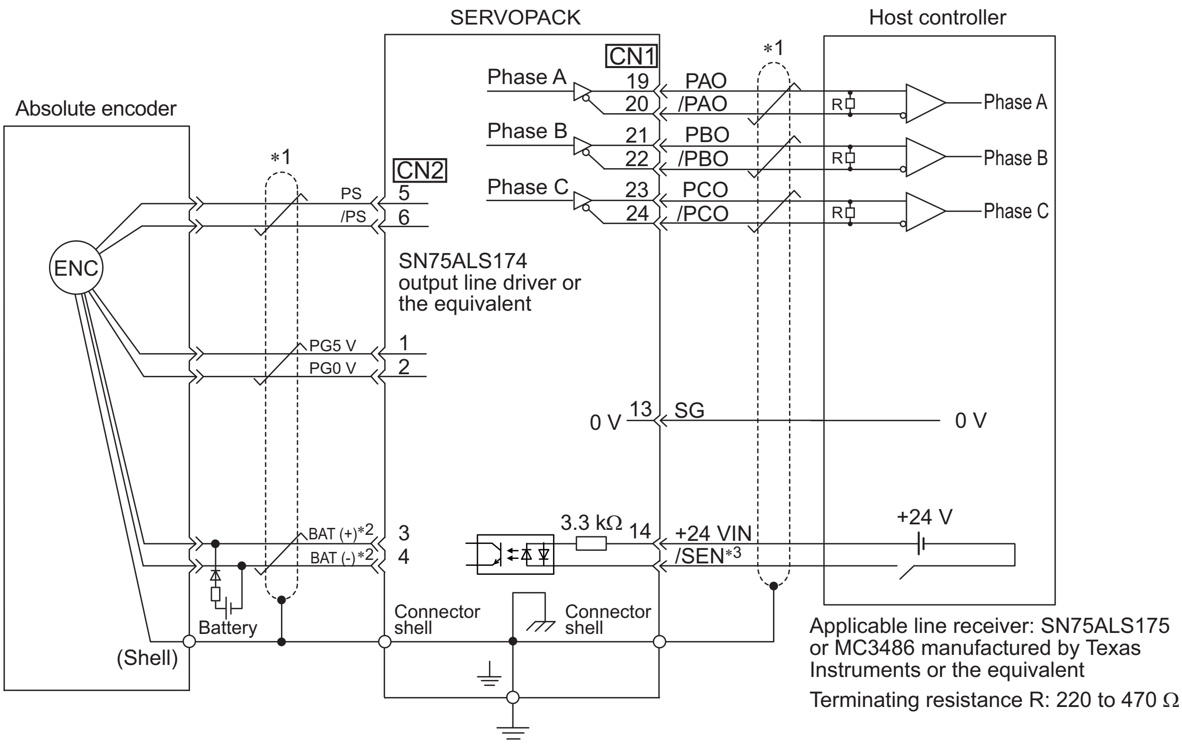
Set Pn002.2 to 0 (factory setting) to use the absolute encoder.

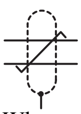
Parameter		Meaning	When Enabled	Classification
Pn002	n.□0□□ [Factory setting]	Uses the absolute encoder as an absolute encoder.	After restart	Setup
	n.□1□□	Uses the absolute encoder as an incremental encoder.		

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

5.9.1 Connecting the Absolute Encoder

The following diagram shows the connection between a servomotor with an absolute encoder, the SERVOPACK, and the host controller.



∗1.  : represents shielded twisted-pair wires.

∗2. When using an absolute encoder, provide power by installing an encoder cable with a JUSP-BA01-E Battery Case or install a battery on the host controller.
∗3. If using an absolute encoder, allocate the SEN signal to one of the seven input signals.

IMPORTANT

When using an absolute encoder, use the encoder cable with a battery case that is specified by Yaskawa.
For details, refer to the *Σ-V Series Product Catalog* (Catalog No.: KAEP S800000 42).

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5.9.2 Absolute Data Request Signal (/SEN)

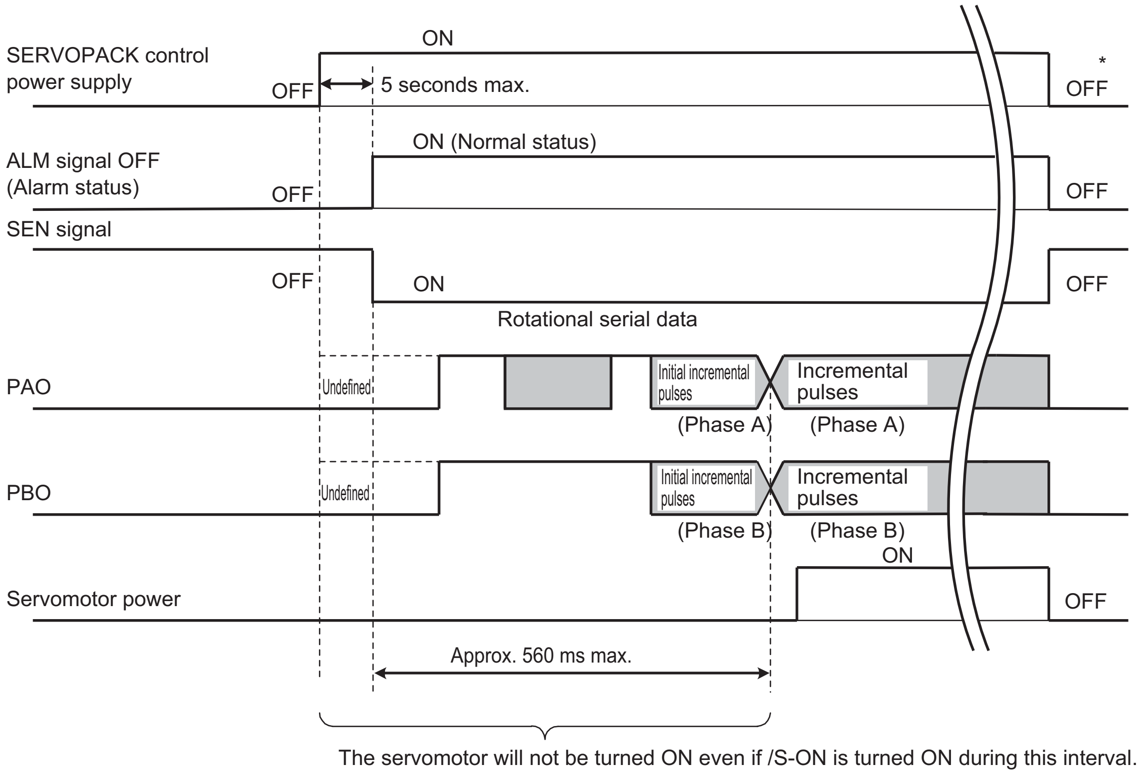
The absolute data request signal (/SEN) must be input to obtain absolute data as an output from the SERVOPACK.

The following table describes the SEN signal.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/SEN	Must be allocated	ON (closed)	The host controller sends a request to the SERVOPACK for the absolute data.
			OFF (open)	Disabled

Note: The SEN signal must be allocated. It can be allocated to a terminal with Pn515.0. For details, refer to *3.3.1 Input Signal Allocations*

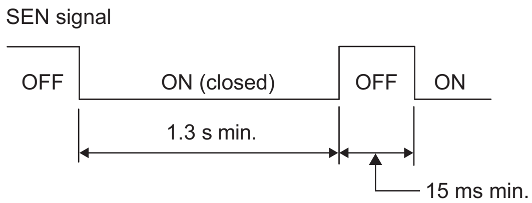
The SEN signal is input at the following timing.



* Turn OFF the SEN signal to turn OFF the control power supply.

IMPORTANT

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



- SEN Signal cannot be OFF while the servomotor power is ON.

For the details of the absolute data reception sequence, refer to *5.9.5 Absolute Data Reception Sequence*.

5.9.3 Battery Replacement

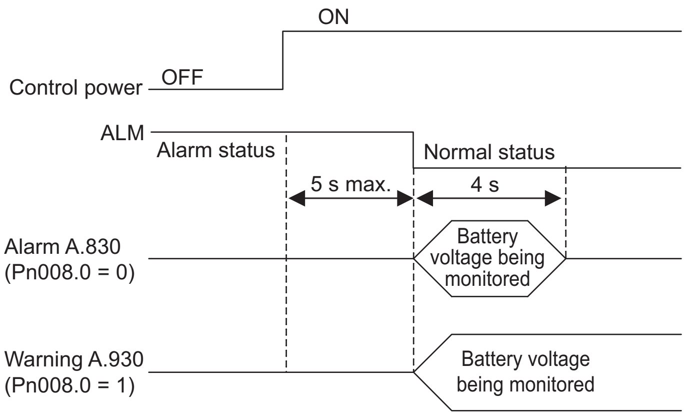
If the battery voltage drops to approximately 2.7 V or less, an absolute encoder battery error alarm (A.830) or an absolute encoder battery error warning (A.930) will be displayed.

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

Use Pn008.0 to set either an alarm (A.830) or a warning (A.930).

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

- If Pn008.0 is set to 0, alarm detection will be enabled for 4 seconds after the ALM signal outputs max. 5 seconds when the control power is turned ON.
  No battery-related alarm will be displayed even if the battery voltage drops below the specified value after these 4 seconds.
- If Pn008.0 is set to 1, alarm detection will be always enabled after the ALM signal outputs max. 5 seconds when the control power supply is turned ON.



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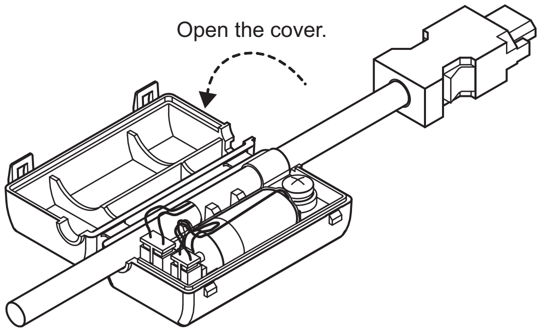
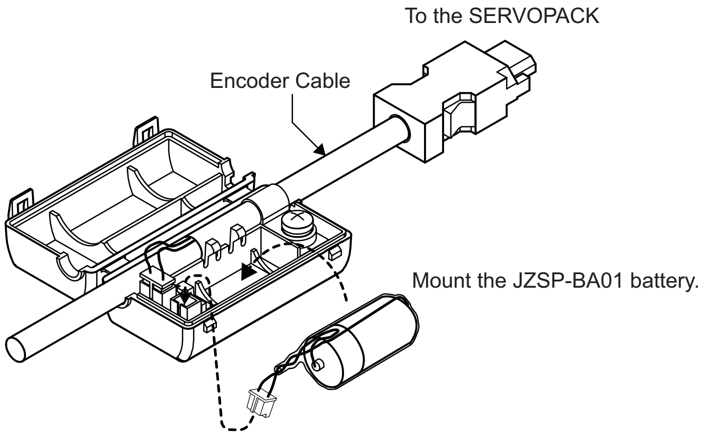
(1) Battery Replacement Procedure

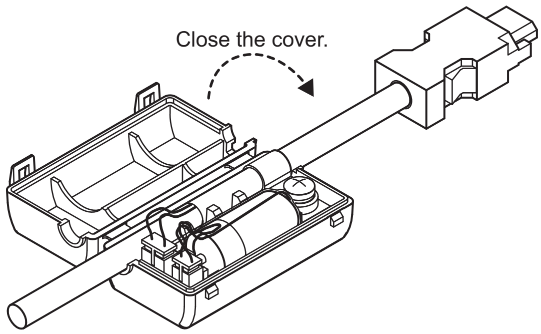
1. Turn ON the control power supply of the SERVOPACK only.
2. Open the battery case cover.



3. Remove the old battery and mount the new JZSP-BA01 battery as shown below.



4. Close the battery case cover.



5. After replacing the battery, turn OFF the control power supply to clear the absolute encoder battery error alarm (A.830).
6. Turn ON the control power supply again.
7. Check that the alarm display has been cleared and that the SERVOPACK operates normally.

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

5.9.4 Absolute Encoder Setup

⚠ CAUTION
• The rotational data will be a value between -2 and +2 rotations when the absolute encoder setup is executed. The reference position of the machine system will change. Set the reference position of the host controller to the position after setup. If the machine is started without adjusting the position of the host controller, unexpected operation may cause injury or damage to the machine. Take sufficient care when operating the machine.

Setting up the absolute encoder is necessary in the following cases.
- When starting the machine for the first time
- When an encoder backup error alarm (A.810) is generated
- When an encoder checksum error alarm (A.820) is generated
- When initializing the rotational serial data of the absolute encoder

Set up the absolute encoder with Fn008.

(1) Precautions on Setup

- If the following absolute encoder alarms are displayed, cancel the alarm by using the same method as the absolute encoder setup. They cannot be canceled with the SERVOPACK alarm reset input signal (/ALM-RST).
  - Encoder backup error alarm (A.810)
  - Encoder checksum error alarm (A.820)
- Any other alarms (A.8□□) that monitor the inside of the encoder should be canceled by turning OFF the power.

(2) Preparation

The following conditions must be met to setup the absolute encoder.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The servomotor power must be OFF.

(3) Operating Procedure

Use the following procedure.

Step	Panel Display	Keys	Description
1	BB -FUNCTION- Fn006:AlmHist Clr Fn008:Mturn Clr Fn009:Ref Adj Fn00A:Vel Adj	MODE/SET ∧ ∨	Press the MODE/SET Key to select the utility function mode (Fn□□□). And press the ∧ or ∨ Key to select the Fn008.
2	BB Multiturn Clear PGCL1	DATA	Press the DATA Key to view the execution display of Fn008.
3	BB Multiturn Clear PGCL5	∧	Keep pressing the ∧ Key until "PGCL1" is changed to "PGCL5."
4	BB Multiturn Clear PGCL5	DATA	Press the DATA Key to setup the absolute encoder. After completing the setup, "DONE" is flashed for approximately one second and "BB" is displayed.
5	BB -FUNCTION- Fn006:AlmHist Clr Fn008:Mturn Clr Fn009:Ref Adj Fn00A:Vel Adj	MODE/SET	Press the MODE/SET Key to return to the display of the procedure 1.
6	To enable the change in the setting, restart the SERVOPACK.		

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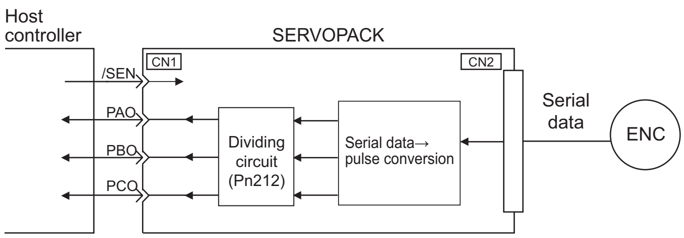
5.9.5 Absolute Data Reception Sequence

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

(1) Outline of Absolute Data

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



Signal Name	Status	Contents
PAO	At initialization	Rotational serial data Initial incremental pulses
	Normal Operations	Incremental pulses
PBO	At initialization	Initial incremental pulses
	Normal Operations	Incremental pulses
PCO	Always	Origin pulses

■ Phase-C Output Specifications

The pulse width of phase C (origin pulse) changes depending on the encoder output pulse (Pn212), becoming the same width as phase A.

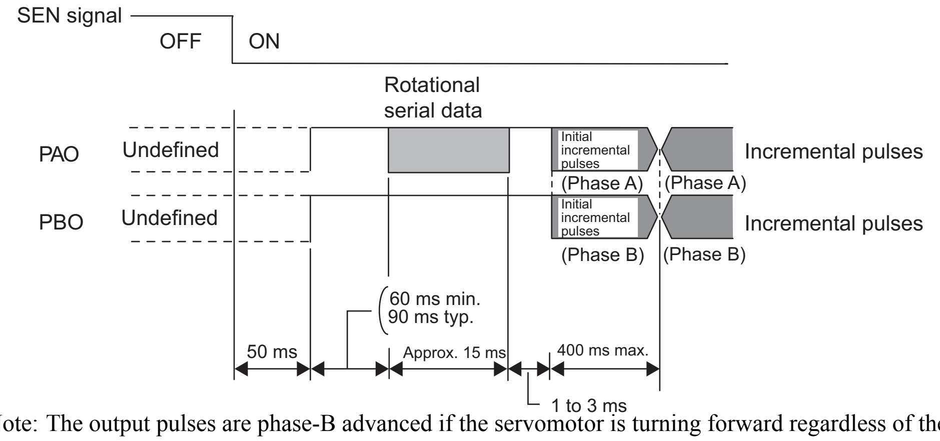
The output timing is one of the following.

- Synchronized with the rising edge of phase A
- Synchronized with the falling edge of phase A
- Synchronized with the rising edge of phase B
- Synchronized with the falling edge of phase B

Note: When host controller receives the data of absolute encoder, do not perform counter reset using the output of PCO signal.

(2) Absolute Data Reception Sequence

1. Set the SEN signal at ON (closed).
2. After 100 ms, the system is set to rotational serial data reception standby and the incremental pulse up/down counter is cleared to zero.
3. Eight characters of rotational serial data is received.
4. The system enters a normal incremental operation state about 400 ms after the last rotational serial data is received.



Note: The output pulses are phase-B advanced if the servomotor is turning forward regardless of the setting in Pn000.0.

Rotational serial data:
Indicates how many turns the motor shaft has made from the reference position, which was the position at setup.

Initial incremental pulses:
Initial incremental pulses which provide absolute data are the number of pulses required to rotate the motor shaft from the servomotor origin to the present position.
Just as with normal incremental pulses, these pulses are divided by the dividing circuit inside the SERVOPACK and then output.

The initial incremental pulse speed depends on the setting of the encoder output pulses (Pn212). Use the following formula to obtain the initial incremental pulse speed.

Setting of the Encoder Output Pulses (Pn212)	Formula of the Initial Incremental Pulse Speed
16 to 16384	$\frac{680 \times Pn212}{16384}$ [kpps]
16386 to 32768	$\frac{680 \times Pn212}{32768}$ [kpps]

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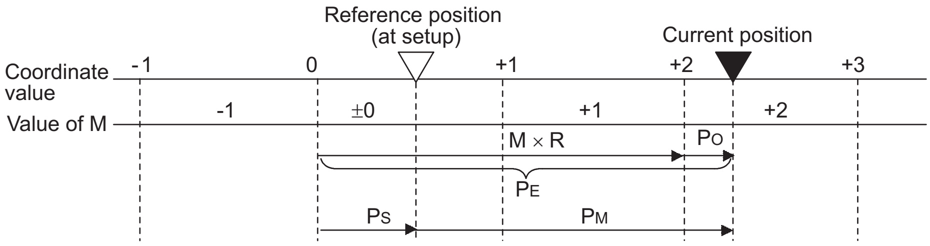


Final absolute data P_M is calculated by following formula.

P_E=M× R+P_O

P_S=M_S× R+P_S'

P_M=P_E-P_S

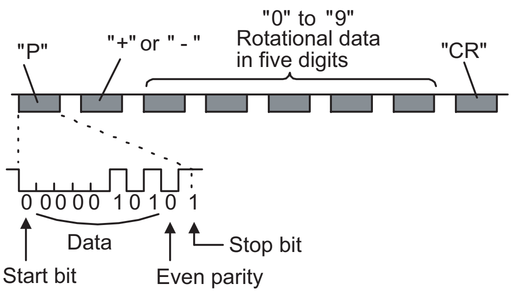
Signal	Meaning
P_E	Current value read by encoder
M	Rotational serial data
P_O	Number of initial incremental pulses
P_S	Absolute data read at setup (This is saved and controlled by the host controller.)
M_S	Rotational data read at setup
P_S'	Number of initial incremental pulses read at setup
P_M	Current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

Note: The following formula applies in reverse mode. (Pn000.0 = 1)
$P_E = -M \times R + P_O$
$P_S = M_S \times R + P_S'$
$P_M = P_E - P_S$

(3) Rotational Serial Data Specifications and Initial Incremental Pulses

■ Rotational Serial Data Specifications

The rotational serial data is output from PAO signal.

Data Transfer Method	Start-stop Synchronization (ASYNC)
Baud rate	9600 bps
Start bits	1 bit
Stop bits	1 bit
Parity	Even
Character code	ASCII 7-bit code
Data format	8 characters, as shown below.  Note 1. Data is "P+00000" (CR) or "P-00000" (CR) when the number of revolutions is zero. 2. The revolution range is "-32768" to "+32767". When this range is exceeded, the data changes from "+32767" to "-32678" or from "-32678" to "+32767". When changing multiturn limit, the range changes. For details, refer to *5.9.6 Multiturn Limit Setting*.

■ Initial Incremental Pulses

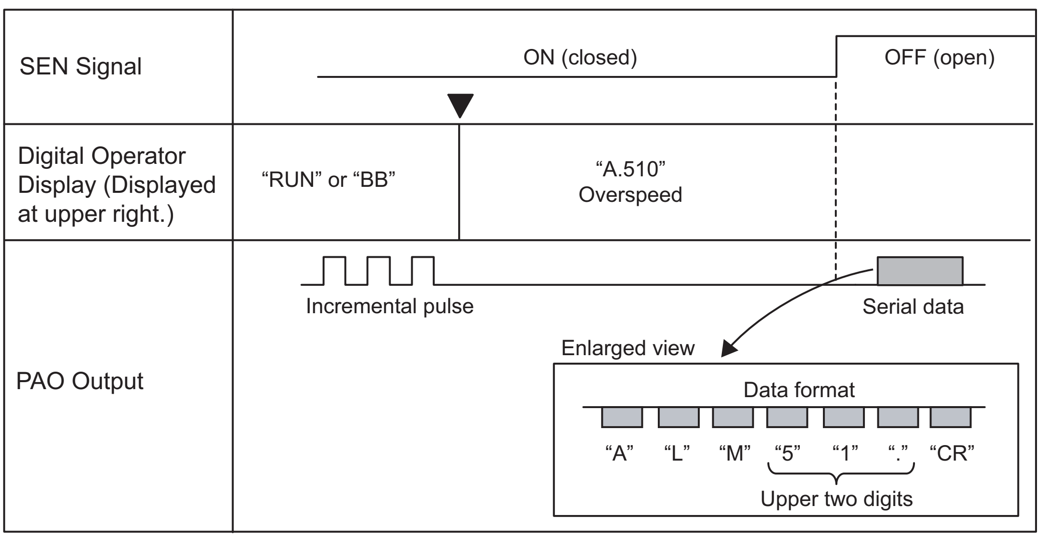
The initial incremental pulses are output after division inside the SERVOPACK in the same way as for normal incremental pulses. Refer to *5.3.6 Encoder Output Pulses* for details.

(4) Transferring Alarm Contents

If an absolute encoder is used, the contents of alarms detected by the SERVOPACK are transmitted in serial data to the host controller from the PAO output when the SEN signal changes from ON (closed) to OFF (open).

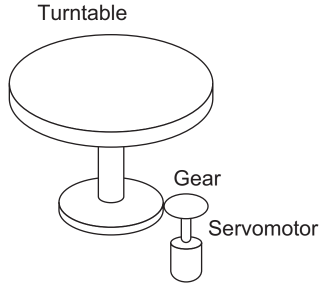
Note: The SEN signal cannot be OFF while the servomotor power is ON.

Output example of alarm contents are as shown below.



5.9.6 Multiturn Limit Setting

The multiturn limit setting is used in position control applications for a turntable or other rotating device. For example, consider a machine that moves the turntable in the following diagram in only one direction.



Because the turntable moves in only one direction, the upper limit for revolutions that can be counted by an absolute encoder will eventually be exceeded. The multiturn limit setting is used in cases like this to prevent fractions from being produced by the integral ratio of the motor revolutions and turntable revolutions.

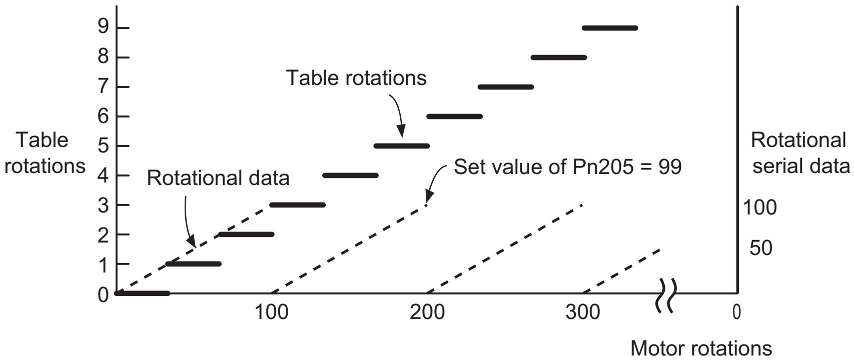
For a machine with a gear ratio of n:m, as shown above, the value of m minus 1 will be the setting for the multiturn limit setting (Pn205).

Multiturn limit setting (Pn205) = m-1

The case in which the relationship between the turntable revolutions and motor revolutions is m = 100 and n = 3 is shown in the following graph.

Pn205 is set to 99.

Pn205 = 100 – 1 = 99



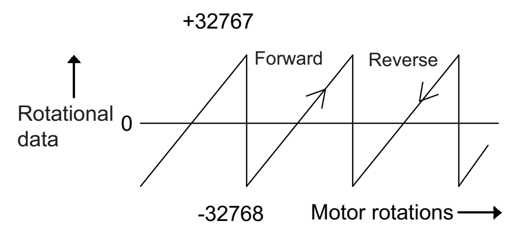
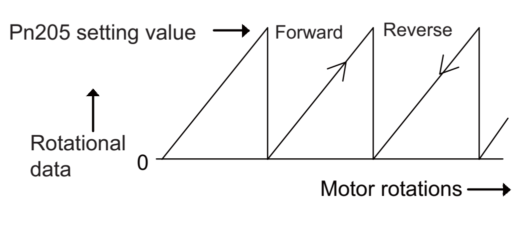
Pn205	Multiturn Limit Setting Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 Rev	65535	After restart	Setup

Note: This parameter is valid when the absolute encoder is used.

The range of the data will vary when this parameter is set to anything other than the factory setting.

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

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

Factory Setting (= 65535)	Other Setting (≠65535)
	

5.9.7 Multiturn Limit Disagreement Alarm (A.CC0)

When the multiturn limit set value is changed with parameter Pn205, a multiturn limit disagreement alarm (A.CC0) will be displayed because the value differs from that of the encoder.

Alarm Display	Alarm Name	Meaning
A.CC0	Multiturn Limit Disagreement	Different multiturn limits have been set in the encoder and SERVOPACK.

If this alarm is displayed, perform the procedure given in *(2) Operating Procedure* to change the multiturn limit value in the encoder to the value set in Pn205.

(1) Preparation

The following condition must be met to clear the alarm and change the multiturn limit value.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	A.CC0 -FUNCTION- Fn012:Soft Ver Fn013:MturnLmSet Fn01B:Viblvl Init Fn01E:SvMotOp ID	MODE/SET ∧ ∨	Press the MODE/SET Key to select the utility function mode. And press the ∧ or ∨ Key to select the Fn013.
2	A.CC0 Multiturn Limit Set Start :[DATA] Return:[SET]	DATA	Press the DATA Key to view the execution display of Fn013. 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	A.CC0 Multiturn Limit Set Start :[DATA] Return:[SET]	DATA MODE/SET	Press the DATA Key to set the multiturn limit value. When the setting is completed, the status display shows "DONE" for one second. The status display then returns to show "A.CC0" again. Note: If the MODE/SET Key is pressed instead of the DATA Key, the multiturn limit value will not be reset.
4	A.CC0 -FUNCTION- Fn012:Soft Ver Fn013:MturnLmSet Fn01B:Viblvl Init Fn01E:SvMotOp ID	MODE/SET	Press the MODE/SET Key to return to the display the procedure 1.
5	To enable the change in the setting, restart the SERVOPACK.		

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5.10 Other Output Signals

This section explains other output signals.

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

5.10.1 Servo Alarm Output Signal (ALM)

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

(1) Servo Alarm Output Signal (ALM)

This signal is output when the SERVOPACK detects an error.

IMPORTANT

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

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	ALM	CN1-8	ON (closed)	Normal SERVOPACK status
			OFF (open)	SERVOPACK alarm status

(2) Alarm Reset Method

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

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

IMPORTANT

Be sure to eliminate the cause of the alarm before resetting it.

If the alarm is reset and operation continued without eliminating the cause of the alarm, it may result in damage to the equipment or fire.

■ Resetting Alarms by Turning ON the /ALM-RST Signal

Type	Signal Name	Connector Pin Number	Meaning
Input	/ALM-RST	CN1-25	Alarm reset

■ Resetting Alarms Using the Digital Operator

Press the ALARM RESET Key on the digital operator. For details, refer to *Σ-V Series User's Manual, Operation of Digital Operator* (Manual No.: SIEP S800000 55).

5.10.2 Warning Output Signal (/WARN)

This signal is for a warning issued before the occurrence of an alarm.
Refer to *9.2.1 List of Warnings*.

■ Signal Specifications

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

Note: Use parameter Pn50F.3 to allocate the /WARN signal for use. For details, refer to *3.3.2 Output Signal Allocations*.

5.10.3 Rotation Detection Output Signal (/TGON)

This output signal indicates that the servomotor is rotating at the speed set for Pn502 or a higher speed.

(1) Signal Specifications

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/TGON	CN1-9 [Factory setting]	ON (closed)	Servomotor is rotating with the motor speed above the setting in Pn502.
			OFF (open)	Servomotor is rotating with the motor speed below the setting in Pn502.

Note: Use parameter Pn50E.2 to allocate the /TGON signal to another terminal. For details, refer to *3.3.2 Output Signal Allocations*.

(2) Related Parameter

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

Pn502	Rotation Detection Level (Speed, Position, Torque)				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 10000	1 min^{-1}	20	Immediately	Setup

5.10.4 Servo Ready Output Signal (/S-RDY)

This signal is turned ON when the SERVOPACK is ready to accept the servo ON signal (/S-ON).

The /S-RDY signal is turned ON under the following conditions.

- The main circuit power supply is ON.
- No servo alarms
- The SEN signal is ON (closed). (When an absolute encoder is used.)
- If an absolute encoder is used, the output of absolute data to the host controller must have been completed when the SEN signal is ON (closed) before /S-RDY is output.

(1) Signal Specifications

Type	Signal Name	Connector Pin Number	Setting	Meaning
Output	/S-RDY	CN1-10 [Factory setting]	ON (closed)	The SERVOPACK is ready to accept the servo ON signal.
			OFF (open)	The SERVOPACK is not ready to accept the servo ON signal.

Note: Use parameter Pn50E.3 to allocate the /S-RDY signal to another terminal. For details, refer to *3.3.2 Output Signal Allocations*.

6

Adjustments

6.1 Type of Adjustments and Basic Adjustment Procedure

This section describes type of adjustments and the basic adjustment procedure.

6.1.1 Adjustments

Adjustments (tuning) are 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, such as speed loop gain, position loop gain, filters, friction compensation, and moment of inertia ratio. 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. In such case, it is possible to suppress the vibration with a variety of vibration suppression functions in the SERVOPACK.

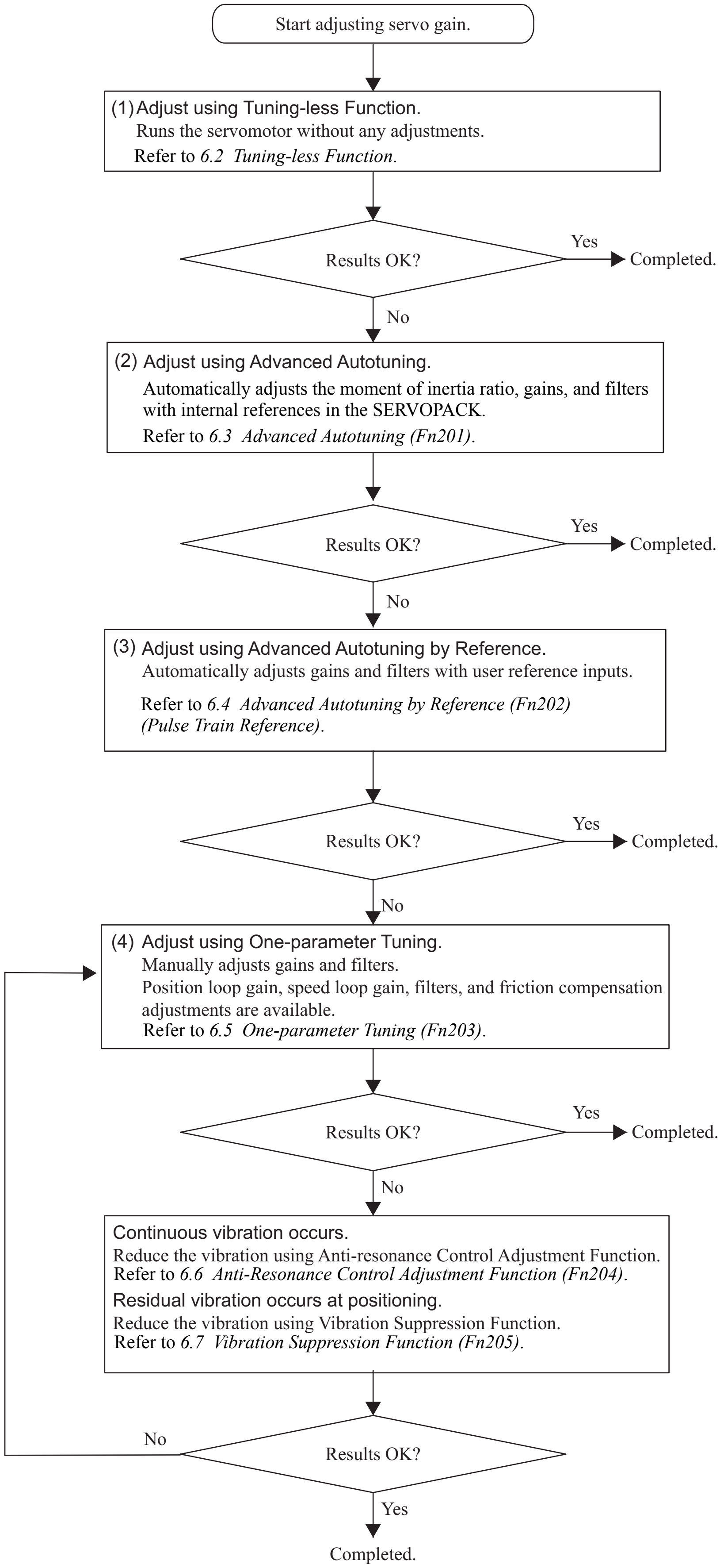
The servo gains are factory-set to appropriate values for stable operation. The following utility function can be used to adjust the servo gain to increase the responsiveness of the machine in accordance with the actual conditions. With this function, parameters related to adjustment above will be adjusted automatically and the need to adjust them individually will be eliminated.

This section describes the following utility adjustment functions. The digital operator or SigmaWin+ is required to make adjustments.

Utility Function for Adjustment	Outline	Applicable Control Method
Tuning-less Levels Setting (Fn200)	This function is enabled when the factory settings are used. This function can be used to obtain a stable response regardless of the type of machine or changes in the load.	Speed and Position
Advanced Autotuning (Fn201)	The following parameters are automatically adjusted using internal references in the SERVOPACK during automatic operation. • Moment of inertia ratio • Gains (position loop gain, speed loop gain, etc.) • Filters (torque reference filter, notch filter) • Friction compensation • Anti-resonance control adjustment function • Vibration suppression function	Speed and Position
Advanced Autotuning by Reference (Fn202)	The following parameters are automatically adjusted with the position reference input from the host controller while the machine is in operation. • Gains (position loop gain, speed loop gain, etc.) • Filters (torque reference filter, notch filter) • Friction compensation • Anti-resonance control adjustment function • Vibration suppression function	Position
One-parameter Tuning (Fn203)	The following parameters are manually adjusted with the position or speed reference input from the host controller while the machine is in operation. • Gains (position loop gain, speed loop gain, etc.) • Filters (torque reference filter, notch filter) • Friction compensation • Anti-resonance control adjustment function	Speed and Position
Anti-Resonance Control Adjustment Function (Fn204)	This function effectively suppresses continuous vibration.	Speed and Position
Vibration Suppression Function (Fn205)	This function effectively suppresses residual vibration if it occurs when positioning.	Position

6.1.2 Basic Adjustment Procedure

The basic adjustment procedure is shown in the following flowchart. Make suitable adjustments considering the conditions and operating requirements of the machine.



6.1.3 Monitoring Operation during Adjustment

While adjusting the servo gain, always monitor the operating status of the machine and the signal waveform. Connect a measurement instrument, such as a memory recorder, to the SERVOPACK to monitor the signal waveform.

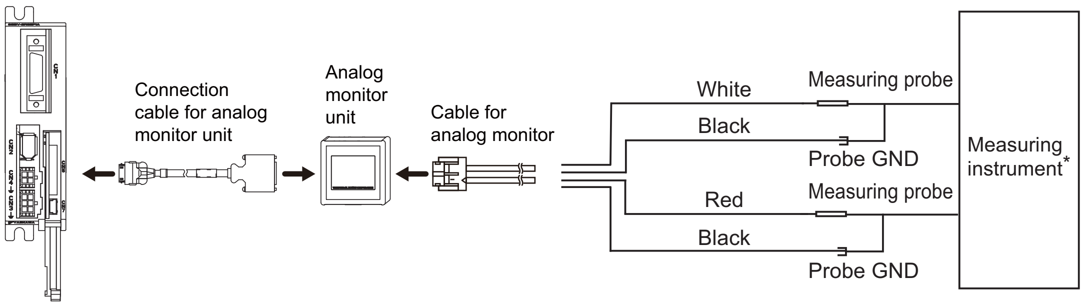
The settings and parameters that are related to monitoring the analog signal are described in the following sections.

(1) Connecting the Measurement Instrument

Use the external monitor connector (CN5) on the SERVOPACK to connect the measurement instrument. The devices and cables that are required for connection are listed below.

- Analog monitor unit (model: JUSP-PC001-E)
- Analog monitor unit connection cable (model: JZSP-CF1S05-A3-E)
- Analog monitor cable (model: JZSP-CA01-E)

Connection examples are shown below.



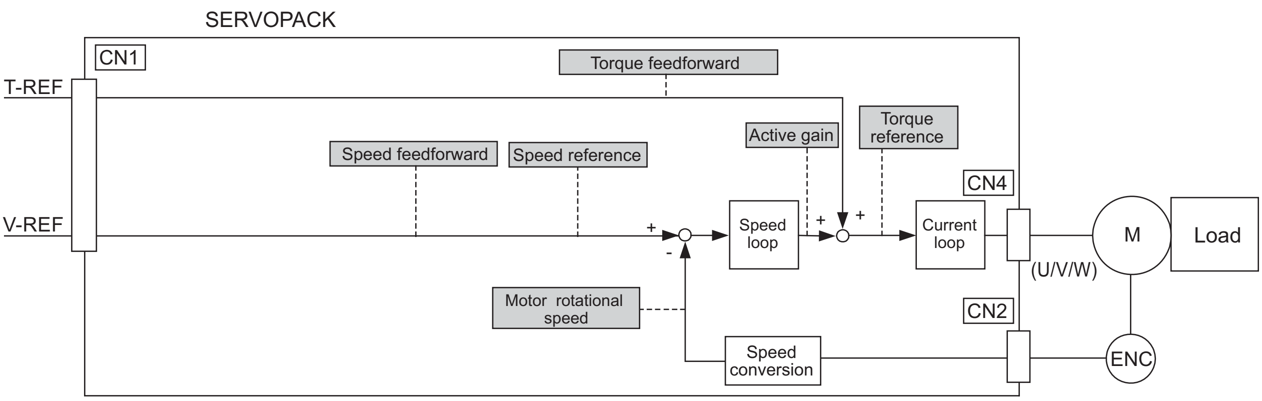
* Measuring instrument is not included.

Line Color	Signal Name	Factory Setting
White	Analog monitor 1	Torque reference: 1 V/100% rated torque
Red	Analog monitor 2	Motor speed: 1 V/1000 min^{-1}
Black (2 lines)	GND	Analog monitor GND: 0 V

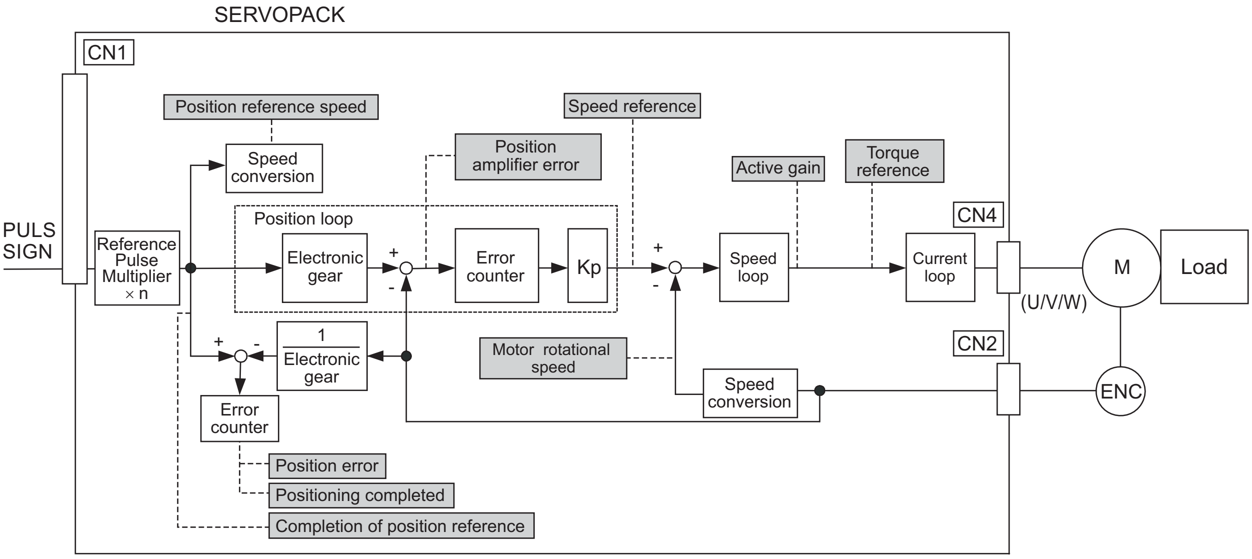
(2) Monitor Signal

The shaded parts in the following diagram indicate analog output signals that can be monitored.

■ Analog Voltage Reference



■ Pulse Train Reference



The following signals can be monitored by selecting functions with parameters Pn006 and Pn007. Pn006 is used for analog monitor 1 and Pn007 is used for analog monitor 2.

Parameter		Description: Monitor Signal	Unit	Remarks
Pn006 Pn007	n.□□00 [Pn007 Factory Setting]	Motor rotating speed	1 V/1000 min^{-1}	–
	n.□□01	Speed reference	1 V/1000 min^{-1}	–
	n.□□02 [Pn006 Factory Setting]	Torque reference	1 V/100% rated torque	–
	n.□□03	Position error	0.05 V/1 reference unit	0 V at speed/torque control
	n.□□04	Position amplifier error	0.05 V/1 encoder pulse unit	Position error after electronic gear conversion
	n.□□05	Position reference speed	1 V/1000 min^{-1}	The input reference pulses will be multiplied by n to output the position reference speed.
	n.□□06 n.□□07	Reserved (Do not change.)	–	–
	n.□□08	Positioning completed	Positioning completed: 5 V Positioning not completed: 0 V	Completion indicated by output voltage.
	n.□□09	Speed feedforward	1 V/1000 min^{-1}	–
	n.□□0A	Torque feedforward	1 V/100% rated torque	–
	n.□□0B	Active gain *	1st gain: 1 V 2nd gain: 2 V	Gain type indicated by output voltage.
	n.□□0C	Completion of position reference	Completed: 5 V Not completed: 0 V	Completion indicated by output voltage.
	n.□□0D	Reserved (Do not change.)	–	–

* Refer to *6.8.1 Switching Gain Settings* for details.

(3) Setting Monitor Factor

The output voltages on analog monitors 1 and 2 are calculated by the following equations.

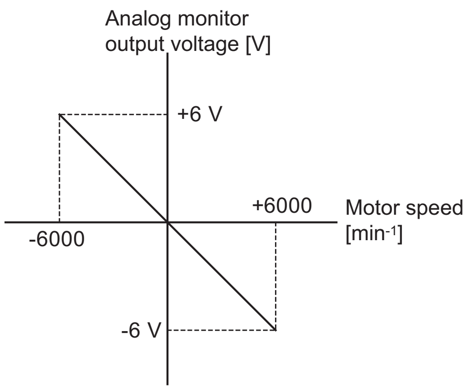
Analog monitor 1 output voltage = (-1) × (Signal selection (Pn006=n.00□□) × Multiplier (Pn552) + Offset voltage [V] (Pn550))

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

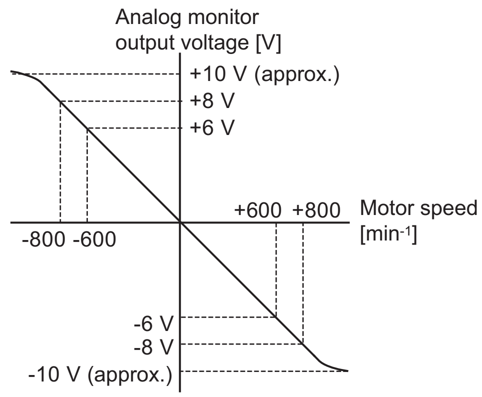
<Example>

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

When multiplier is set to × 1:



When multiplier is set to × 10:



Note: Linear effective range: within ± 8 V
Output resolution: 16-bit

(4) Related Parameters

Use the following parameters to change the monitor factor and the offset.

Parameter	Name / Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
Pn550	Analog Monitor 1 Offset Voltage (Speed, Position, Torque)				
	Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
	-10000 to 10000	0.1 V	0	Immediately	Setup
Pn551	Analog Monitor 2 Offset Voltage (Speed, Position, Torque)				
	Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
	-10000 to 10000	0.1 V	0	Immediately	Setup
Pn552	Analog Monitor Magnification (× 1) (Speed, Position, Torque)				
	Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
	-10000 to 10000	× 0.01	100	Immediately	Setup
Pn553	Analog Monitor Magnification (× 2) (Speed, Position, Torque)				
	Setting Range	Setting Unit	Factory Setting	When Enabled	Classification
	-10000 to 10000	× 0.01	100	Immediately	Setup

6.1.4 Safety Precautions on Adjustment of Servo Gains

⚠ CAUTION

- If adjusting the servo gains, observe the following precautions.
  - Do not touch the rotating section of the servomotor while power is being supplied to the motor.
  - Before starting the servomotor, make sure that the SERVOPACK can come to an emergency stop at any time.
  - Make sure that a trial operation has been performed without any trouble.
  - Install a safety brake on the machine.

Set the following protective functions of the SERVOPACK to the correct settings before starting to adjust the servo gains.

(1) Overtravel Function

Set the overtravel function. For details on how to set the overtravel function, refer to *5.2.3 Overtravel*.

(2) Torque Limit

The torque limit calculates the torque required to operate the machine and sets the torque limits so that the output torque will not be greater than required. Setting torque limits can reduce the amount of shock applied to the machine when troubles occur, such as collisions or interference. If a torque limit is set lower than the value that is needed for operation, overshooting or vibration can be occurred.
For details, refer to *5.8 Limiting Torque*.

(3) Excessive Position Error Alarm Level (Pulse Train Reference)

The excessive position error alarm is a protective function that will be enabled when the SERVOPACK is used in position control.

If this alarm level is set to a suitable value, the SERVOPACK will detect an excessive position error and will stop the servomotor if the servomotor does not operate according to the reference. The position error indicates the difference between the position reference value and the actual motor position.
The position error can be calculated from the position loop gain (Pn102) and the motor speed with the following equation.

$$\text{Position Error [reference unit]} = \frac{\text{Motor Speed [min}^{-1}]}{60} \times \frac{\text{Encoder Resolution}^{*1}}{\text{Pn102 [0.1/s]}/10^{*2}} \times \frac{\text{Pn210}}{\text{Pn20E}}$$

- Excessive Position Error Alarm Level (Pn520 [1 reference unit])

$$\text{Pn520} > \frac{\text{Max. Motor Speed [min}^{-1}]}{60} \times \frac{\text{Encoder Resolution}^{*1}}{\text{Pn102 [0.1/s]}/10^{*2}} \times \frac{\text{Pn210}}{\text{Pn20E}} \times \underline{\underline{(1.2 \text{ to } 2)}}$$

∗1. Refer to *5.4.4 Electronic Gear*.
∗2. To check the Pn102 setting, change the parameter display setting to display all parameters (Pn00B.0 = 1).

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 position error overflow alarm (A.d00) from occurring in actual operation of the servomotor.

Set the level to a value that satisfies these equations, and no position error overflow alarm (A.d00) will be generated during normal operation. The servomotor will be stopped, however, if it does not operate according to the reference and the SERVOPACK detects an excessive position error.

The following example outlines how the maximum limit for position deviation is calculated. These conditions apply.

- Maximum speed = 6000
- Encoder resolution = 131072 (17 bits)
- Pn102 = 400
- $\frac{\text{Pn210}}{\text{Pn20E}} = \frac{1}{1}$

Under these conditions, the following equation is used to calculate the maximum limit (Pn520).

$$\begin{aligned} Pn520 &= \frac{6000}{60} \times \frac{131072}{400/10} \times \frac{1}{1} \times 2 \\ &= 327680 \times 2 \\ &= 655360 \end{aligned}$$

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 increase the excessive position error alarm level (Pn520).

■ Related Parameter

Pn520	Excessive Position Error Alarm Level		Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741823	1 reference unit	5242880	Immediately	Setup

■ Related Alarm

Alarm Display	Alarm Name	Meaning
A.d00	Position Error Overflow	Position errors exceeded parameter Pn520.

(4) Vibration Detection Function

Set the vibration detection function to an appropriate value with the vibration detection level initialization (Fn01B). For details on how to set the vibration detection function, refer to *7.15 Vibration Detection Level Initialization (Fn01B)*.

(5) Excessive Position Error Alarm Level at Servo ON (Pulse Train Reference)

If position errors remain in the error counter when turning ON the servomotor power, the servomotor will move and this movement will clear the counter of all position errors. Because the servomotor will move suddenly and unexpectedly, safety precautions are required. To prevent the servomotor from moving suddenly, select the appropriate level for the excessive position error alarm level at servo ON (Pn526) to restrict operation of the servomotor.

■ Related Parameters

Pn526	Excessive Position Error Alarm Level at Servo ON		Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741823	1 reference unit	5242880	Immediately	Setup

Pn528	Excessive Position Error Warning Level at Servo ON		Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	1%	100	Immediately	Setup

Pn529	Speed Limit Level at Servo ON		Position		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	10000	Immediately	Setup

■ Related Alarms

Alarm Display	Alarm Name	Meaning
A.d01	Position Error Overflow Alarm at Servo ON	This alarm occurs if the servomotor power is turned ON when the position error is greater than the set value of Pn526 while the servomotor power is OFF.
A.d02	Position Error Overflow Alarm by Speed Limit at Servo ON	When the position errors remain in the error counter, Pn529 limits the speed if the servomotor power is turned ON. If Pn529 limits the speed in such a state, this alarm occurs when reference pulses are input and the number of position errors exceeds the value set for the excessive position error alarm level (Pn520).

When an alarm occurs, refer to *9 Troubleshooting* and take the corrective actions.

6.2 Tuning-less Function

The tuning-less function is enabled in the factory settings. If resonance is generated or excessive vibration occurs, refer to *6.2.2 Tuning-less Levels Setting (Fn200) Procedure* and change the set value of Pn170.2 for the rigidity level and the set value in Pn170.3 for the load level.

> ⚠ **CAUTION**
>
> - The tuning-less function is enabled in the factory settings. A sound may be heard for a moment when the /S_ON signal is turned ON for the first time after the servo drive 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 /S_ON signal 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 load moment of inertia exceeds the allowable load value.
>   If vibration occurs, set the load level to mode 2 in Turning-less Levels Setting (Fn200) or lower the rigidity level.

6.2.1 Tuning-less Function

The tuning-less function obtains a stable response without manual 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	Setup
	n.□□□1 [Factory setting]	Enables tuning-less function.		
	n.□□0□ [Factory setting]	Used as speed control.		
	n.□□1□	Used as speed control and host controller used as position control.		

(2) Application Restrictions

The tuning-less function can be used in position control or speed control. This function is not available in torque control. The following application restrictions apply to the tuning-less function.

Function	Availability	Remarks
Vibration detection level initialization (Fn01B)	Available	–
Advanced autotuning (Fn201)	Available (Some conditions apply)	• This function can be used when the moment of inertia is calculated. • While this function is being used, the tuning-less function cannot be used. After completion of the autotuning, it can be used again.
Advanced autotuning by reference (Fn202)	Not available	–
One-parameter tuning (Fn203)	Not available	–
Anti-resonance control adjustment function (Fn204)	Not available	–
Vibration suppression function (Fn205)	Not available	–
EasyFFT (Fn206)	Available	While this function is being used, the tuning-less function cannot be used. After completion of the EasyFFT, it can be used again.
Friction compensation	Not available	–
Gain switching	Not available	–

(cont'd)

Function	Availability	Remarks
Offline moment of inertia calculation *	Not available	Disable the tuning-less function by setting Pn170.0 to 0 before executing this function.
Mechanical analysis*	Available	While this function is being used, the tuning-less function cannot be used. After completion of the analysis, it can be used again.

* 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 when the tuning-less function is enabled.

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 with utility function.	Immediately	Tuning
	n.□1□□ [Factory setting]	Set the 2nd notch filter automatically with utility function.		

(4) Tuning-less Level Settings

Two tuning-less levels are available: the rigidity level and load level. Both levels can be set in the Fn200 utility function or in the Pn170 parameter.

■ Rigidity Level

a) Using the utility function
To change the setting, refer to *6.2.2 Tuning-less Levels Setting (Fn200) Procedure*.

Rigidity Level	Meaning
Level 0	Rigidity level 0
Level 1	Rigidity level 1
Level 2	Rigidity level 2
Level 3	Rigidity level 3
Level 4 [Factory setting]	Rigidity level 4

b) Using the parameter

Parameter		Meaning	When Enabled	Classification
Pn170	n.□0□□	Rigidity level 0 (Level 0)	Immediately	Setup
	n.□1□□	Rigidity level 1 (Level 1)		
	n.□2□□	Rigidity level 2 (Level 2)		
	n.□3□□	Rigidity level 3 (Level 3)		
	n.□4□□ [Factory setting]	Rigidity level 4 (Level 4)		

■ Load Level

a) Using the utility function

To change the setting, refer to *6.2.2 Tuning-less Levels Setting (Fn200) Procedure*.

Load Level	Meaning
Mode 0	Load level : Low
Mode 1 [Factory setting]	Load level : Medium
Mode 2	Load level : High

b) Using the parameter

Parameter		Meaning	When Enabled	Classification
Pn170	n.0□□□	Load level : Low (Mode 0)	Immediately	Setup
	n.1□□□ [Factory setting]	Load level : Medium (Mode 1)		
	n.2□□□	Load level : High (Mode 2)		

6.2.2 Tuning-less Levels Setting (Fn200) Procedure

⚠ CAUTION

- To ensure safety, perform the tuning-less function in a state where the SERVOPACK can come to an emergency stop at any time.

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

The digital operator or SigmaWin+ is required to execute this function.

For the basic operation of the digital operator, refer to *Σ-V Series User's Manual, Operation of Digital Operator* (Manual No.: SIEP S800000 55).

(1) Preparation

The following conditions must be met to perform the tuning-less function. The message “NO-OP” indicating that the settings are not appropriate will be displayed, if all of the following conditions are not met.

- The tuning-less function must be enabled (Pn170.0 = 1).
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The test without a motor function must be disabled. (Pn00C.0 = 0).

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	RUN —FUNCTION— Fn080:Pole Detect Fn200:TuneLvl Set Fn201:AAT Fn202:Ref−AAT	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list, select Fn200.
2	RUN —TuneLvlSet— Mode=1	DATA	Press the DATA Key to display the load level of the tuning-less mode setting screen. Notes: • If the response waveform causes overshooting or if the load moment of inertia exceeds the allowable level (i.e., outside the scope of product guarantee), press the ∧ Key and change the mode setting to 2. • If a high-frequency noise is heard, press the ∨ Key and change the mode setting to 0.

(cont'd)

Step	Display after Operation	Keys	Operation
3	RUN —TuneLvlSet— Level=4	DATA	Press the DATA Key to display the rigidity level of the tuning-less mode setting screen.
4	RUN —TuneLvlSet— Level=4 NF2 2nd notch filter	∧ ∨ JOG SVON	Press the ∧ Key or the ∨ Key to select the rigidity level. Select the rigidity 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.) Notes: • Vibration may occur if the rigidity level is too high. Lower the rigidity level if vibration occurs. • If a high-frequency noise is heard, press the JOG SVON Key to automatically set a notch filter to the vibration frequency.
5	RUN —TuneLvlSet— Level=4	DATA	Press the DATA Key. "DONE" will flash for approximately two seconds and then "RUN" will be displayed. The settings are saved in the SERVOPACK.
6	RUN —FUNCTION— Fn030 Fn200 Fn201 Fn202	MODE/SET	Press the MODE/SET Key to complete the tuning-less function. The screen in step 1 will appear again.

Note: If the rigidity level is changed, the automatically set notch filter will be canceled. If vibration occurs, however, the notch filter will be set again automatically.

(3) Alarm and Corrective Actions

The autotuning alarm (A.521) will occur if resonance sound is generated or excessive vibration occurs during position control. In such case, take one of the following actions.

- Increase the setting of the rigidity level or reduce the load level in the Fn200 utility function.
- Increase the setting of Pn170.3 or reduce the setting of Pn170.2.

(4) Parameters Disabled by Tuning-less Function

When the tuning-less function is enabled in the factory settings, the settings of these parameters are not available: Pn100, Pn101, Pn102, Pn103, Pn104, Pn105, Pn106, Pn160, Pn139, and Pn408. These gain-related parameters, however, may become effective depending on the executing conditions of the functions specified in the following table. For example, if EasyFFT is executed when the tuning-less function is enabled, the settings in Pn100, Pn104, Pn101, Pn105, Pn102, Pn106, and Pn103, as well as the manual gain switch setting, will be enabled, but the settings in Pn408.3, Pn160.0, and Pn139.0 will be not enabled**.**

Parameters Disabled by Tuning-less Function			Related Functions and Parameters*		
Item	Name	Pn Number	Torque Control	Easy FFT	Mechanical Analysis (Vertical Axis Mode)
Gain	Speed Loop Gain 2nd Speed Loop Gain	Pn100 Pn104	○	○	○
	Speed Loop Integral Time Constant 2nd Speed Loop Integral Time Constant	Pn101 Pn105	×	○	○
	Position Loop Gain 2nd Position Loop Gain	Pn102 Pn106	×	○	○
	Moment of Inertia Ratio	Pn103	○	○	○

(cont'd)

Parameters Disabled by Tuning-less Function			Related Functions and Parameters*		
Item	Name	Pn Number	Torque Control	Easy FFT	Mechanical Analysis (Vertical Axis Mode)
Advanced Control	Friction Compensation Function Selection	Pn408.3	×	×	×
	Anti-resonance Control Adjustment Selection	Pn160.0	×	×	×
Gain Switching	Gain Switching Selection Switch	Pn139.0	×	×	×

* ○: Parameter enabled
×: Parameter disabled

(5) Tuning-less Function Type

The following table shows the types of tuning-less functions.

Parameter		Meaning	When Enabled	Classification
Pn14F	n.□□0□	Tuning-less type 1	After restart	Tuning
	n.□□1□ [Factory setting]	Tuning-less type 2 (The level of noise produced is lower than that of Type 1.)		

6.2.3 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.
- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
  No : Parameters cannot be changed using SigmaWin+ while this function is being executed.
- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn170	Tuning-less Function Related Switch	No	Yes
Pn401	Torque Reference Filter Time Constant	No	Yes
Pn40C	2nd Notch Filter Frequency	No	Yes
Pn40D	2nd Notch Filter Q Value	No	Yes

6.3 Advanced Autotuning (Fn201)

This section describes the adjustment using advanced autotuning.

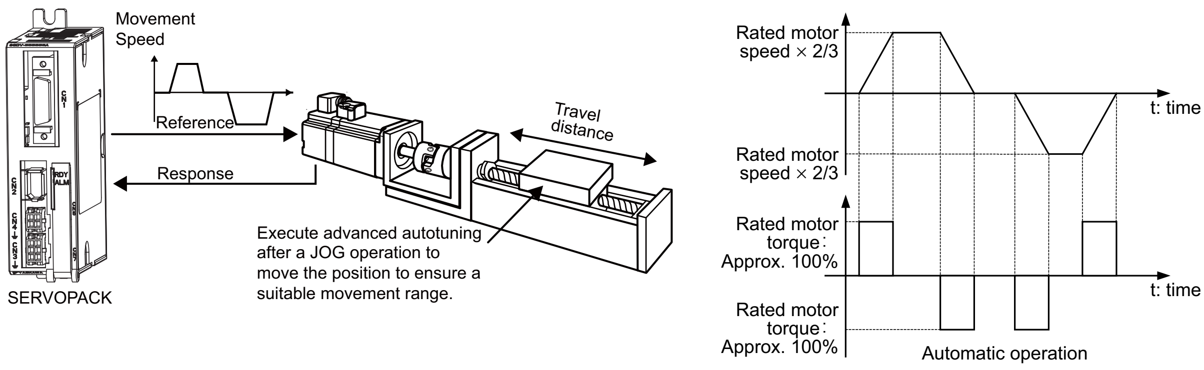
IMPORTANT	• Advanced autotuning starts adjustments based on the set speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when starting adjustments. In this case, make adjustments after lowering the speed loop gain (Pn100) until vibration is eliminated. • Before performing advanced autotuning with the tuning-less function enabled (Pn170.0 = 1: Factory setting), always set Jcalc to ON to calculate the load moment of inertia. The tuning-less function will automatically be disabled, and the gain will be set by advanced autotuning. With Jcalc set to OFF so the load moment of inertia is not calculated, "Error" will be displayed on the panel operator, and advanced autotuning will not be performed. • If the operating conditions, such as the machine-load or drive system, are changed after advanced autotuning, then change the following related parameters to disable any values that were adjusted before performing advanced autotuning once again with the setting to calculate the moment of inertia (Jcalc = ON). 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.)

6.3.1 Advanced Autotuning

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

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

- Maximum speed: Rated motor speed × 2/3
- Acceleration torque: Approximately 100% of rated motor torque
  The acceleration torque varies with the influence of the moment of inertia ratio (Pn103), machine friction, and external disturbance.
- Travel distance: The travel distance can be set freely. The distance is factory-set to a value equivalent to 3 motor rotations.



Advanced autotuning performs the following adjustments.

- Moment of inertia ratio
- Gains (e.g., position loop gain and speed loop gain)
- Filters (torque reference filter and notch filter)
- Friction compensation
- Anti-resonance control
- Vibration suppression (Mode = 2 or 3)

Refer to *6.3.3 Related Parameters* for parameters used for adjustments.

⚠ CAUTION
• Because advanced autotuning adjusts the SERVOPACK during automatic operation, vibration or over-shooting may occur. To ensure safety, perform advanced autotuning in a state where the SERVOPACK can come to an emergency stop at any time.

(1) Preparation

The following conditions must be met to perform advanced autotuning.
The message "NO-OP" indicating that the settings are not appropriate will be displayed, if all of the following conditions are not met.

- The main circuit power supply must be ON.
- There must be no overtravel.
- The servo ON signal (/S-ON) must be OFF.
- The control method must not be set to torque control.
- The gain selection switch must be in manual switching mode (Pn139.0 = 0).
- Gain setting 1 must be selected.
- The test without a motor function must be disabled (Pn00C.0 = 0).
- All alarms and warning must be cleared.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- Jcalc must be set to ON to calculate the load moment of inertia when the tuning-less function is enabled (Pn170.0 = 1: factory setting) or the tuning-less function must be disabled (Pn170.0 = 0).

Notes:

- 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. To perform advanced autotuning in speed control, set the mode to 1 (Mode = 1).
- The reference pulse input multiplication switching function is disabled while performing advanced autotuning.

(2) When Advanced Autotuning Cannot Be Performed

Advanced autotuning cannot be performed normally under the following conditions. Refer to *6.4 Advanced Autotuning by Reference (Fn202) (Pulse Train Reference)* and *6.5 One-parameter Tuning (Fn203)* for details.

- The machine system can work only in a single direction.
- The operating range is within 0.5 rotation.

(3) When Advanced Autotuning Cannot Be Performed Successfully

Advanced autotuning cannot be performed successfully under the following conditions. Refer to *6.4 Advanced Autotuning by Reference (Fn202) (Pulse Train Reference)* and *6.5 One-parameter Tuning (Fn203)* for details.

- The operating range is not applicable.
- The moment of inertia changes within the set operating range.
- The machine has high friction.
- The rigidity of the machine is low and vibration occurs when positioning is performed.
- The position integration function is used.
- P control operation (proportional control) is used.

  Note: If a setting is made for calculating the moment of inertia, an error will result when P control operation is selected using /P-CON signal while the moment of inertia is being calculated.
- The mode switch is used.

  Note: If a setting is made for calculating the moment of inertia, the mode switch function will be disabled while the moment of inertia is being calculated. At that time, PI control will be used. The mode switch function will be enabled after calculating the moment of inertia.
- Speed feedforward or torque feedforward is input.
- The positioning completed width (Pn522) is too small.

IMPORTANT

- Advanced autotuning makes adjustments by referring to the positioning completed width (Pn522). If the SERVOPACK is operated in position control (Pn000.1=1), set the electronic gear ratio (Pn20E/Pn210) and positioning completed width (Pn522) to the actual value during operation. If the SERVOPACK is operated in speed control (Pn000.1=0), set Mode to 1 to perform advanced autotuning.
- Unless the positioning completed signal (/COIN) is turned ON within approximately 3 seconds after positioning has been completed, "WAITING" will flash. Furthermore, unless the positioning completed signal (/COIN) is turned ON within approximately 10 seconds, "Error" will flash for 2 seconds and tuning will be aborted.

Change only the overshoot detection level (Pn561) to finely adjust the amount of overshooting 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 overshooting the positioning completed width. If the setting of Pn561 is changed, however, the positioning time may be extended.

<table>
<tr><td rowspan="3">Pn561</td><td colspan="4">Overshoot Detection Level   Speed   Position   Torque</td><td rowspan="2">Classification</td></tr>
<tr><td>Setting Range</td><td>Setting Unit</td><td>Factory Setting</td><td>When Enabled</td></tr>
<tr><td>0 to 100</td><td>1%</td><td>100</td><td>Immediately</td><td>Setup</td></tr>
</table>

6.3.2 Advanced Autotuning Procedure

The following procedure is used for advanced autotuning.

The digital operator or SigmaWin+ is required to execute this function.

Refer to the *Σ-V Series User's Manual, Operation of Digital Operator* (Manual No.: SIEP S800000 55) for basic key operations of the digital operator.

⚠ CAUTION
• When using the SERVOPACK with Jcalc = OFF (load moment of inertia is not calculated), be sure to set a suitable value for the moment of inertia ratio (Pn103). If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.

(1) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	BB —FUNCTION— Fn200:TuneLvl Set Fn201:AAT Fn202:Ref-AAT Fn203:OnePrmTun	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list, select Fn201.
2	Status Display BB Advanced AT Jcalc=ON Mode=2 Type=2 Stroke=+00800000 (0003.0)rev	DATA	Press the DATA Key to display the initial setting screen for advanced autotuning.
3	BB Advanced AT Jcalc=ON Mode=2 Type=2 Stroke=+00800000 (0003.0)rev	∧ ∨ SCROLL	Press the ∧, ∨, or SCROLL Key and set the items in steps 3-1 to 3-4.
3-1	■Calculating Moment of Inertia Select the mode to be used. Usually, set Jcalc to ON. Jcalc = ON: Moment of inertia calculated [Factory setting] Jcalc = OFF: Moment of inertia not calculated Note: If the moment of inertia ratio is already known from the machine specifications, set the value in Pn103 and set Jcalc to OFF.		
3-2	■Mode Selection Select the mode. Mode = 1: Makes adjustments considering response characteristics and stability (Standard level). Mode = 2: Makes adjustments for positioning [Factory setting]. Mode = 3: Makes adjustments for positioning, giving priority to overshooting suppression.		
3-3	■Type Selection Select the type according to the machine element to be driven. If there is noise or the gain does not increase, better results may be obtained by changing the rigidity type. Type = 1: For belt drive mechanisms Type = 2: For ball screw drive mechanisms [Factory setting] Type = 3: For rigid systems in which the servomotor is directly coupled to the machine (without gear or other transmissions)		

(cont'd)

<table>
<tr><th>Step</th><th>Display after Operation</th><th>Keys</th><th>Operation</th></tr>
<tr><td>3-4</td><td colspan="3">■STROKE (Travel Distance) Setting
Travel distance setting range:
The travel distance setting range is from -99990000 to +99990000 [reference unit]. Specify the STROKE (travel distance) in increments of 1000 reference units. The negative (-) direction is for reverse rotation, and the positive (+) direction is for forward rotation.
Initial value:
About 3 rotations
Notes:
• Set the number of motor rotations to at least 0.5; otherwise, "Error" will be displayed and the travel distance cannot be set.
• To calculate the moment of inertia and ensure precise tuning, it is recommended to set the number of motor rotations to around 3.</td></tr>
<tr><td>4</td><td>BB Advanced AT
Pn103=00100
Pn100=0040.0
Pn101=0020.00
Pn102=0040.0</td><td>DATA</td><td>Press the DATA Key. The advanced autotuning execution screen will be displayed.</td></tr>
<tr><td>5</td><td>RUN Advanced AT
Pn103=00100
Pn100=0040.0
Pn101=0020.00
Pn141=0050.0</td><td>JOG SVON</td><td>Press the JOG SVON Key. The servomotor power will be ON and the display will change from "BB" to "RUN."
Note: If the mode is set to 1, Pn102 is displayed. If the mode is set to 2 or 3, the Pn102 display will change to the Pn141.</td></tr>
<tr><td>6</td><td>ADJ Advanced AT
Pn103=00300
Pn100=0040.0
Pn101=0020.0
Pn141=0050.0
Display example:
After the moment of inertia is calculated.</td><td>∧ ∨</td><td>Calculates the moment of inertia.
Press the ∧ Key if a positive (+) value is set in STROKE (travel distance), or press the ∨ Key if a negative (-) value is set. Calculation of the moment of inertia will start. While the moment of inertia is being calculated, the set value for Pn103 will flash and “ADJ” will flash instead of “RUN.” When calculating the moment of inertia is completed, the display will stop flashing and the moment of inertia is displayed. The servomotor will remain ON, but the auto run operation will be stopped temporarily.
Notes:
• The wrong key for the set travel direction is pressed, the calculation will not start.
• If the moment of inertia is not calculated (Jcalc = OFF), the set value for Pn103 will be displayed.
• If "NO-OP" or "Error" is displayed during operation, press the MODE/SET Key to cancel the function. Refer to (2) Failure in Operation and take a corrective action to enable operation.</td></tr>
<tr><td>7</td><td></td><td>DATA MODE/SET</td><td>After the servomotor is temporarily stopped, press the DATA Key to save the calculated moment of inertia ratio in the SERVOPACK. “DONE” will flash for one second, and “ADJ” will be displayed again.
Notes:
To end operation by calculating only the moment of inertia ratio and without adjusting the gain, press the MODE/SET Key to end operation.</td></tr>
</table>

(cont'd)

Step	Display after Operation	Keys	Operation
8	ADJ Advanced AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0	∧ ∨	■Gain Adjustment When the ∧ or ∨ Key is pressed according to the sign (+ or -) of the value set for stroke (travel distance), the calculated value of the moment of inertia ratio will be saved in the SERVOPACK and the auto run operation will restart. While the servomotor is running, the filters, and gains will be automatically set. "ADJ" will flash during the auto setting operation. Note: Precise adjustments cannot be made and "Error" will be displayed as the status if there is machine resonance when starting adjustments. If that occurs, make adjustments using one-parameter tuning (Fn203).
9	ADJ Advanced AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0	–	When the adjustment has been completed normally, the servomotor power will turn OFF, and "END" will flash for approximately two seconds and then "ADJ" will be displayed on the status display.
10	A.941 Advanced AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0	DATA	Press the DATA Key. The adjusted values will be saved in the SERVOPACK. • If Pn170.0 = 1 (factory setting), "DONE" will flash for approximately two seconds, and "A.941" will be displayed. • If Pn170.0 = 0, "DONE" will flash for approximately two seconds, and "BB" will be displayed. Note: Press the MODE/SET Key to not save the values. The display will return to that shown in step 1.
11	After executing advanced autotuning, restart the SERVOPACK.		

Adjustments

6

(2) Failure in Operation

■ When "NO-OP" Flashes on the Display

Probable Cause	Corrective Actions
The main circuit power supply was OFF.	Turn ON the main circuit power supply.
An alarm or warning occurred.	Remove the cause of the alarm or the warning.
Overtraveling occurred.	Remove the cause of the overtravel.
Gain setting 2 was selected by gain switching.	Disable the automatic gain switching.

■ When "Error" Flashes on the Display

Error	Probable Cause	Corrective Actions
The gain adjustment was not successfully completed.	Machine vibration is occurring or the positioning completed signal (/COIN) is turning ON and OFF when the servomotor is stopped.	• Increase the set value for Pn522. • Change the mode from 2 to 3. • If machine vibration occurs, suppress the vibration with the anti-resonance control adjustment function and the vibration suppression function.
An error occurred during the calculation of the moment of inertia.	Refer to the following table ■ *When an Error Occurs during Calculation of Moment of Inertia*.	
Travel distance setting error	The travel distance is set to approximately 0.5 rotation or less, which is less than the minimum adjustable travel distance.	Increase the travel distance. It is recommended to set the number of motor rotations to around 3.
The positioning completed signal (/COIN) did not turn ON within approximately 10 seconds after positioning adjustment was completed.	The positioning completed width is too narrow or proportional control (P control) is being used.	• Increase the set value for Pn522. • If P control is used, turn OFF the /P-CON signal.
The moment of inertia cannot be calculated when the tuning-less function was activated.	When the tuning-less function was activated, Jcalc was set to OFF so the moment of inertia was not calculated.	• Turn OFF the tuning-less function. • Set Jcalc to ON, so the moment of inertia will be calculated.

■ When an Error Occurs during Calculation of Moment of Inertia

The following table shows the probable causes of errors that may occur during the calculation of the moment of inertia with the Jcalc set to ON, along with corrective actions for the errors.

Error Display	Probable Cause	Corrective Actions
Err1	The SERVOPACK started calculating the moment of inertia, but the calculation was not completed.	• Increase the speed loop gain (Pn100). • Increase the STROKE (travel distance).
Err2	The moment of inertia 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 was detected.	Double the set value of the moment of inertia calculating start level (Pn324).
Err4	The torque limit was reached.	• When using the torque limit, increase the torque limit. • Double the set value of the moment of inertia calculating start level (Pn324).
Err5	While calculating the moment of inertia, the speed control was set to proportional control with the /P-CON input.	Operate the SERVOPACK with PI control while calculating the moment of inertia.

(3) Related Functions on Advanced Autotuning

This section describes functions related to advanced tuning.

■ 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 during advanced autotuning 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 with the utility function.	Immediately	Tuning
	n.□□□1 [Factory setting]	Sets the 1st notch filter automatically with the utility function.		
	n.□0□□	Does not set the 2nd notch filter automatically with the utility function.		
	n.□1□□ [Factory setting]	Sets the 2nd notch filter automatically with the utility function.		

■ Anti-Resonance Control Adjustment

This function reduces low vibration frequency, which the notch filter does not detect.

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.

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

■ 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 vibration suppression will be automatically adjusted and set.
Set this function to Not Auto Setting only if you do not change the setting for vibration suppression before executing advanced autotuning.

Note: This function uses model following control. Therefore, the function can be executed only if the mode is set to 2 or 3.

• Related Parameter

Parameter		Function	When Enabled	Classification
Pn140	n.□0□□	Does not use the vibration suppression function automatically with the utility function.	Immediately	Tuning
	n.□1□□ [Factory setting]	Uses the vibration suppression function automatically with the utility function.		

■ 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 friction resistance resulting from variations in the machine assembly
- Changes in the friction resistance due to aging

The conditions for applying friction compensation depend on the mode. The friction compensation setting in Pn408.3 applies when the Mode is 1. The friction compensation function is always enabled regardless of the friction compensation setting in Pn408.3 when the Mode is 2 or 3.

Friction Compensation Selecting \ Mode		Mode = 1	Mode = 2	Mode = 3
Pn408	n.0□□□ [Factory setting]	Adjusted without the friction compensation function	Adjusted with the friction compensation function	Adjusted with the friction compensation function
	n.1□□□	Adjusted with the friction compensation function		

■ Feedforward

If Pn140 is set to the factory setting and the mode setting is changed to 2 or 3, the feedforward gain (Pn109), speed feedforward (V-REF) input, and torque feedforward (T-REF) input will be disabled.

Set Pn140.3 to 1 if model following control is used together with the speed feedforward (V-REF) input and torque feedforward (T-REF) input from the host controller.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□ [Factory setting]	Model following control is not used together with the speed/torque feedforward input.	Immediately	Tuning
	n.1□□□	Model following control is used together with the speed/torque feedforward input.		

IMPORTANT

- Model following control is used to make optimum feedforward settings in the SERVOPACK when model following control is used with the feedforward function. Therefore, model following control is not normally used together with either the speed feedforward (V-REF) input or torque feedforward (T-REF) input from the host controller. However, model following control can be used with the speed feedforward (V-REF) input or torque feedforward (T-REF) input if required. An improper feedforward input may result in overshooting.

6.3.3 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.

- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
  No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn100	Speed Loop Gain	No	Yes
Pn101	Speed Loop Integral Time Constant	No	Yes
Pn102	Position Loop Gain	No	Yes
Pn103	Moment of Inertia Ratio	No	No
Pn121	Friction Compensation Gain	No	Yes
Pn123	Friction Compensation Coefficient	No	Yes
Pn124	Friction Compensation Frequency Correction	No	No
Pn125	Friction Compensation Gain Correction	No	Yes
Pn401	Torque Reference Filter Time Constant	No	Yes
Pn408	Torque Related Function Switch	Yes	Yes
Pn409	1st Notch Filter Frequency	No	Yes
Pn40A	1st Notch Filter Q Value	No	Yes
Pn40C	2nd Notch Filter Frequency	No	Yes
Pn40D	2nd Notch Filter Q Value	No	Yes
Pn140	Model Following Control Related Switch	Yes	Yes
Pn141	Model Following Control Gain	No	Yes
Pn142	Model Following Control Gain Compensation	No	Yes
Pn143	Model Following Control Bias (Forward Direction)	No	Yes
Pn144	Model Following Control Bias (Reverse Direction)	No	Yes
Pn145	Vibration Suppression 1 Frequency A	No	Yes
Pn146	Vibration Suppression 1 Frequency B	No	Yes
Pn147	Model Following Control Speed Feedforward Compensation	No	Yes
Pn160	Anti-Resonance Control Related Switch	Yes	Yes
Pn161	Anti-Resonance Frequency	No	Yes
Pn163	Anti-Resonance Damping Gain	No	Yes
Pn531	Program JOG Movement Distance	No	No
Pn533	Program JOG Movement Speed	No	No
Pn534	Program JOG Acceleration/Deceleration Time	No	No
Pn535	Program JOG Waiting Time	No	No
Pn536	Number of Times of Program JOG Movement	No	No

6.4 Advanced Autotuning by Reference (Fn202) (Pulse Train Reference)

Adjustments with advanced autotuning by reference are described below.

This function can be used only with a SERVOPACK for pulse train reference.

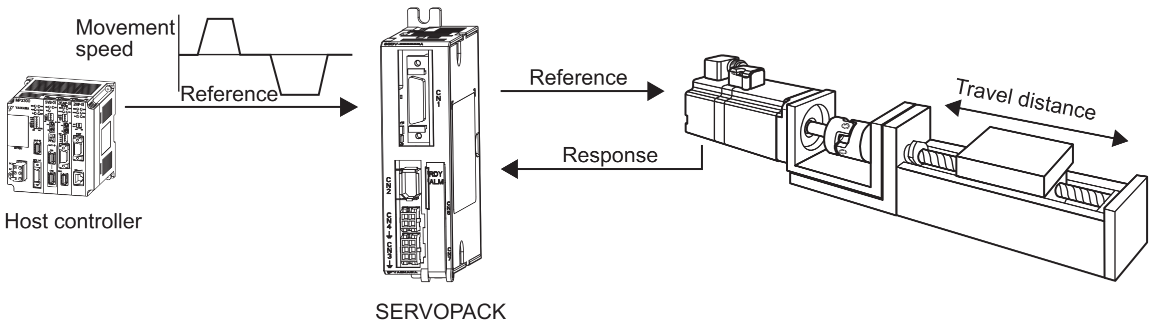
> **IMPORTANT**
>
> • Advanced autotuning by reference starts adjustments based on the set speed loop gain (Pn100). Therefore, precise adjustments cannot be made if there is vibration when starting adjustments. In this case, make adjustments after lowering the speed loop gain (Pn100) until vibration is eliminated.

6.4.1 Advanced Autotuning by Reference

Advanced autotuning by reference is used to automatically achieve optimum tuning of the SERVOPACK in response to the user reference inputs (pulse train reference) from the host controller.

Advanced autotuning by reference is performed generally to fine-tune the SERVOPACK after advanced autotuning of the SERVOPACK has been performed.

If the moment of inertia ratio is correctly set to Pn103, advanced autotuning by reference can be performed without performing advanced autotuning.



Advanced autotuning by reference performs the following adjustments.

- Gains (e.g., position loop gain and speed loop gain)
- Filters (torque reference filter and notch filter)
- Friction compensation
- Anti-resonance control
- Vibration suppression

Refer to *6.4.3 Related Parameters* for parameters used for adjustments.

> ⚠ **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.

(1) Preparation

The following conditions must be met to perform advanced autotuning by reference. The message “NO-OP” indicating that the settings are not appropriate will be displayed, if all of the following conditions are not met.

- The SERVOPACK must be in Servo Ready status (Refer to *5.10.4*).
- There must be no overtravel.
- The servo ON signal (/S-ON) must be OFF.
- The position control must be selected when the servomotor power is ON.
- The gain selection switch must be in manual switching mode (Pn139.0 = 0).
- Gain setting 1 must be selected.
- The test without a motor function must be disabled. (Pn00C.0 = 0).
- All alarms and warnings must be cleared.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The tuning-less function must be disabled (Pn170.0 = 0).

(2) When Advanced Autotuning by Reference Cannot Be Performed Successfully

Advanced autotuning by reference cannot be performed successfully under the following conditions. If the result of autotuning is not satisfactory, perform one-parameter tuning (Fn203). Refer to *6.5 One-parameter Tuning (Fn203)* for details.

- The travel distance in response to references from the host controller is smaller than the set positioning completed width (Pn522).
- The motor speed in response to references from the host controller is smaller than the set rotation detection level (Pn502).
- The stopping time, i.e., the period while the positioning completed /COIN signal is OFF, is 10 ms or less.
- The rigidity of the machine 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.
- The positioning completed width (Pn522) is too small.

IMPORTANT

- Advanced autotuning by reference starts adjustments based on the positioning completed width (Pn522). Set the electronic gear ratio (Pn20E/Pn210) and positioning completed width (Pn522) to the actual value during operation.
- Unless the positioning completed signal (/COIN) is turned ON within approximately 3 seconds after positioning has been completed, "WAITING" will flash. Furthermore, unless the positioning completed signal (/COIN) is turned ON within approximately 10 seconds, "Error" will flash for 2 seconds and tuning will be aborted.

Change only the overshoot detection level (Pn561) to finely adjust the amount of overshooting 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 without 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 Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1%	100	Immediately	Setup

6.4.2 Advanced Autotuning by Reference Procedure

The following procedure is used for advanced autotuning by reference.

The digital operator or SigmaWin+ is required to execute this function.

Refer to the *Σ-V Series User's Manual, Operation of Digital Operator* (Manual No.: SIEP S800000 55) for basic key operations of the digital operator.

(1) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	Confirm that the correct moment of inertia ratio in Pn103 is set by using the advanced autotuning.		
2	BB —FUNCTION— Fn201:AAT Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn202.
3	Status Display BB Advanced AT Mode=3 Type=2	DATA	Press the DATA Key to display the initial setting screen for advanced autotuning by reference.
4	BB Advanced AT Mode=3 Type=2	∧ ∨ SCROLL	Press the ∧, ∨, or SCROLL Key and set the items in steps 4-1 and 4-2.
4-1	■Mode Selection Select the mode. Mode = 1: Makes adjustments considering response characteristics and stability (Standard level). Mode = 2: Makes adjustments for positioning [Factory setting]. Mode = 3: Makes adjustments for positioning, giving priority to overshooting suppression.		
4-2	■Type Selection Select the type according to the machine element to be driven. If there is noise or the gain does not increase, better results may be obtained by changing the rigidity type. Type = 1: For belt drive mechanisms Type = 2: For ball screw drive mechanisms [Factory setting] Type = 3: For rigid systems in which the servomotor is directly coupled to the machine (without gear or other transmissions)		
5	BB Advanced AT Pn103=00300 Pn100=0040.0 Pn101=0020.00 Pn141=0050.0	DATA	Press the DATA Key. The advanced autotuning by reference execution screen will be displayed. Note: If the mode is set to 1, Pn102 is displayed. If the mode 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	–	Input servo ON signal (/S-ON) from an external device.
7	Confirm safety around moving parts.		
8	ADJ Advanced AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0	∧ ∨	Input a reference from the host controller and then press the ∧ or ∨ Key to start the adjustment. "ADJ" will flash during adjustment on the status display. Note: Adjustment cannot be performed during "BB" is shown on the status display.

(cont'd)

Step	Display after Operation	Keys	Operation
9	ADJ Advanced AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0	–	When the adjustment has been completed normally, "END" will flash for approximately two seconds and "ADJ" will be displayed.
10	RUN Advanced AT Pn103=00300 Pn100=0100.0 Pn101=0006.36 Pn141=0150.0	DATA	Press the DATA Key to save the settings. "DONE" will flash for approximately two seconds and "RUN" will be displayed. Note: Not to save the values set in step 6, press the MODE/SET Key. The display will return to that shown in step 2.
11	After executing advanced autotuning by reference, restart the SERVOPACK.		

(2) Failure in Operation

■ When "NO-OP" Flashes on the Display

Probable Cause	Corrective Actions
The main circuit power supply was OFF.	Turn ON the main circuit power supply.
An alarm or warning occurred.	Remove the cause of the alarm or the warning.
Overtraveling occurred.	Remove the cause of the overtravel.
Gain setting 2 was selected by gain switching.	Disable the automatic gain switching.

■ When "Error" Flashes on the Display

Error	Probable Cause	Corrective Actions
The gain adjustment was not successfully completed.	Machine vibration is occurring or the positioning completed signal (/COIN) is turning ON and OFF when the servomotor is stopped.	• Increase the set value for Pn522. • Change the mode from 2 to 3. • If machine vibration occurs, suppress the vibration with the anti-resonance control adjustment function and the vibration suppression function.
The positioning completed signal (/COIN) did not turn ON within approximately 10 seconds after positioning adjustment was completed.	The positioning completed width is too narrow or proportional control (P control) is being used.	• Increase the set value for Pn522. • If P control is used, turn OFF the /P-CON signal.

(3) Related Functions on Advanced Autotuning by Reference

This section describes functions related to advanced autotuning by reference.

■ 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 during advanced autotuning by reference, 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 by reference.

Parameter		Function	When Enabled	Classification
Pn460	n.□□□0	Does not set the 1st notch filter automatically with the utility function.	Immediately	Tuning
	n.□□□1 [Factory setting]	Sets the 1st notch filter automatically with the utility function.		
	n.□0□□	Does not set the 2nd notch filter automatically with the utility function.		
	n.□1□□ [Factory setting]	Sets the 2nd notch filter automatically with the utility function.		

■ Anti-Resonance Control Adjustment

This function reduces low vibration frequency, which the notch filter does not detect.

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.

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

■ 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 vibration suppression will be automatically adjusted and set.
Set this function to Not Auto Setting only if you do not change the setting for vibration suppression before executing advanced autotuning by reference.

Note: This function uses model following control. Therefore, the function can be executed only if the mode is set to 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□□ [Factory setting]	Uses the vibration suppression function automatically.		

■ 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 friction resistance resulting from variations in the machine assembly
- Changes in the friction resistance due to aging

Conditions to which friction compensation is applicable depend on the mode. The friction compensation setting in Pn408.3 applies when the mode is 1. Mode = 2 and Mode = 3 are adjusted with the friction compensation function regardless of the friction compensation setting in P408.3.

Friction Compensation Selecting \ Mode		Mode = 1	Mode = 2	Mode = 3
Pn408	n.0□□□ [Factory setting]	Adjusted without the friction compensation function	Adjusted with the friction compensation function	Adjusted with the friction compensation function
	n.1□□□	Adjusted with the friction compensation function		

■ Feedforward

If Pn140 is set to the factory setting and the mode setting is changed to 2 or 3, the feedforward gain (Pn109), speed feedforward (V-REF) input, and torque feedforward (T-REF) input will be disabled.

Set Pn140.3 to 1 if model following control is used together with the speed feedforward (V-REF) input and torque feedforward (T-REF) input from the host controller.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□ [Factory setting]	Model following control is not used together with the speed/torque feedforward input.	Immediately	Tuning
	n.1□□□	Model following control is used together with the speed/torque feedforward input.		

IMPORTANT

- Model following control is used to make optimum feedforward settings in the SERVOPACK when model following control is used with the feedforward function. Therefore, model following control is not normally used together with either the speed feedforward (V-REF) input or torque feedforward (T-REF) input from the host controller. However, model following control can be used with the speed feedforward (V-REF) input or torque feedforward (T-REF) input if required. An improper feedforward input may result in overshooting.

6.4.3 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.

- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
  No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn100	Speed Loop Gain	No	Yes
Pn101	Speed Loop Integral Time Constant	No	Yes
Pn102	Position Loop Gain	No	Yes
Pn103	Moment of Inertia Ratio	No	No
Pn121	Friction Compensation Gain	No	Yes
Pn123	Friction Compensation Coefficient	No	Yes
Pn124	Friction Compensation Frequency Correction	No	No
Pn125	Friction Compensation Gain Correction	No	Yes
Pn401	Torque Reference Filter Time Constant	No	Yes
Pn408	Torque Related Function Switch	Yes	Yes
Pn409	1st Notch Filter Frequency	No	Yes
Pn40A	1st Notch Filter Q Value	No	Yes
Pn40C	2nd Notch Filter Frequency	No	Yes
Pn40D	2nd Notch Filter Q Value	No	Yes
Pn140	Model Following Control Related Switch	Yes	Yes
Pn141	Model Following Control Gain	No	Yes
Pn142	Model Following Control Gain Compensation	No	Yes
Pn143	Model Following Control Bias (Forward Direction)	No	Yes
Pn144	Model Following Control Bias (Reverse Direction)	No	Yes
Pn145	Vibration Suppression 1 Frequency A	No	Yes
Pn146	Vibration Suppression 1 Frequency B	No	Yes
Pn147	Model Following Control Speed Feedforward Compensation	No	Yes
Pn160	Anti-Resonance Control Related Switch	Yes	Yes
Pn161	Anti-Resonance Frequency	No	Yes
Pn163	Anti-Resonance Damping Gain	No	Yes

6.5 One-parameter Tuning (Fn203)

Adjustments with one-parameter tuning are described below.

6.5.1 One-parameter Tuning

One-parameter tuning is used to manually make tuning level adjustments during operation with a position reference or speed reference input from the host controller.

One-parameter tuning enables automatically setting related servo gain settings to balanced conditions by adjusting one or two tuning levels.

One-parameter tuning performs the following adjustments.

- Gains (e.g., position loop gain and speed loop gain)
- Filters (torque reference filter and notch filter)
- Friction compensation
- Anti-resonance control

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

Perform one-parameter tuning if satisfactory response characteristics is not obtained with advanced autotuning or advanced autotuning by reference.

To fine-tune each servo gain after one-parameter tuning, refer to *6.8 Additional Adjustment 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.

■ Preparation

The following conditions must be met to perform one-parameter tuning.
The message “NO-OP” indicating that the settings are not appropriate will be displayed, if all of the following conditions are not met.

- The test without a motor function must be disabled (Pn00C.0 = 0).
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The tuning-less function must be disabled (Pn170.0 = 0).
- The tuning mode must be set to 0 or 1 when performing speed control.

6.5.2 One-parameter Tuning Procedure

The following procedure is used for one-parameter tuning.

There are the following two operation procedures depending on the tuning mode being used.

- When the tuning mode is set to 0 or 1, the model following control will be disabled and one-parameter tuning will be used as the tuning method for applications other than positioning.
- When the tuning mode is set to 2 or 3, the model following control will be enabled and it can be used for tuning for positioning.

The digital operator or SigmaWin+ is required to execute this function.

Refer to the *Σ-V Series User's Manual, Operation of Digital Operator* (Manual No.: SIEP S800000 55) for basic key operations of the digital operator.

(1) Operating Procedure

■ Setting the Tuning Mode 0 or 1

Step	Display after Operation	Keys	Operation
1	Confirm that the correct moment of inertia ratio in Pn103 is set by using the advanced autotuning.		
2	BB —FUNCTION— Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Press the ∧ or ∨ Key to move through the list and select Fn203.
3	Status Display BB —OnePrmTun— Pn103=00300	DATA	Press the DATA Key to display the moment of inertia ratio set in Pn103 at present. Move the digit with the < or > Key and change the value with the ∧ or ∨ Key.
4	BB —OnePrmTun— Setting Tuning Mode = 0 Type = 2	DATA	Press the DATA Key to display the initial setting screen for one-parameter tuning.
5	BB —OnePrmTun— Setting Tuning Mode = 0 Type = 2	∧ ∨ SCROLL	Press the ∧, ∨, or SCROLL Key and set the items in steps 5-1 and 5-2.
5-1	■Tuning Mode Select the tuning mode. Select the tuning mode 0 or 1. Tuning Mode = 0: Makes adjustments giving priority to stability. Tuning Mode = 1: Makes adjustments giving priority to responsiveness.		
5-2	■Type Selection Select the type according to the machine element to be driven. If there is noise or the gain does not increase, better results may be obtained by changing the rigidity type. Type = 1: For belt drive mechanisms Type = 2: For ball screw drive mechanisms [Factory setting] Type = 3: For rigid systems in which the servomotor is directly coupled to the machine (without gear or other transmissions).		
6	RUN —OnePrmTun— Setting Tuning Mode = 0 Type = 2	–	If the servomotor power is OFF, input a servo ON signal (/S-ON) from the host controller. The display will change from "BB" to "RUN." If the servomotor power is ON, go to step 7.
7	RUN —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn102=0040.0	DATA	Press the DATA Key to display the set value.
8	RUN —OnePrmTun— LEVEL = 0050 NF1 NF2 ARES	DATA	Press the DATA Key again to display the LEVEL setting screen.

(cont'd)

Step	Display after Operation	Keys	Operation
9	RUN —OnePrmTun— LEVEL = 0050 NF1 NF2 ARES	< > ∧ ∨	If readjustment is required, select the digit with the < or > Key or change the LEVEL with the ∧ or ∨ Key. Check the response. If readjustment is not required, go to step 10. Note: The higher the level, the greater the responsiveness will be. If the value is too large, however, vibration will occur. • If vibration occurs, press the JOG SVON Key. The SERVOPACK will automatically detect the vibration frequencies and make notch filter or an anti-resonance control settings. When the notch filter is set, "NF1" or "NF2" will be displayed on the bottom row. When the anti-resonance control is set, "ARES" will be displayed in the lower right corner. RUN —OnePrmTun— LEVEL=0070 NF1 NF2 ARES • If the vibration is great, the vibration frequency will be detected automatically even if the JOG SVON Key is not pressed and a notch filter or an anti-resonance control will be set.
10	RUN —OnePrmTun— Pn100=0050.0 Pn101=0016.0 Pn102=0050.0	DATA	Press the DATA Key. A confirmation screen will be displayed after LEVEL adjustment.
11	RUN —OnePrmTun— Pn100=0050.0 Pn101=0016.0 Pn102=0050.0	DATA	• Press the DATA Key to save the adjusted values. After the data is saved, "DONE" will flash for approximately two seconds and then "RUN" will be displayed. • To return to the previous value, press the MODE/SET Key. • Press the < Key to readjust the level without saving the values.
12	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 2 will appear again.

Note: The status display will always be RUN when the servomotor power is ON.

Adjustments

6

■ Setting the Tuning Mode 2 or 3

Step	Display after Operation	Keys	Operation
1	Confirm that the correct moment of inertia ratio in Pn103 is set by using the advanced autotuning.		
2	BB —FUNCTION— Fn202:Ref-AAT Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Press the ∧ or ∨ Key to move through the list and select Fn203.
3	Status Display BB —OnePrmTun— Pn103=00300	DATA	Press the DATA Key to display the moment of inertia ratio set in Pn103 at present. Move the digit with the < or > Key and change the value with the ∧ or ∨ Key.
4	BB —OnePrmTun— Setting Tuning Mode = 2 Type = 2	DATA	Press the DATA Key to display the initial setting screen for one-parameter tuning.
5	BB —OnePrmTun— Setting Tuning Mode = 2 Type = 2	∧ ∨ SCROLL	Press the ∧, ∨, or SCROLL Key and set the items in steps 5-1 and 5-2.
5-1	■Tuning Mode Select the tuning mode. Select the tuning mode 2 or 3. Tuning Mode = 2: Enables model following control and makes adjustments for positioning. Tuning Mode = 3: Enables model following control, makes adjustments for positioning, and suppresses overshooting.		
5-2	■Type Selection Select the type according to the machine element to be driven. If there is noise or the gain does not increase, better results may be obtained by changing the rigidity type. Type = 1: For belt drive mechanisms Type = 2: For ball screw drive mechanisms [Factory setting] Type = 3: For rigid systems in which the servomotor is directly coupled to the machine (without gear or other transmissions).		
6	RUN —OnePrmTun— Setting Tuning Mode=2 Type=2	–	If the servomotor power is OFF, input a servo ON signal (/S-ON) from the host controller. The display will change from "BB" to "RUN." If the servomotor power is ON, go to step 7.
7	RUN —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn141=0050.0	DATA	Press the DATA Key to display the set value.
8	RUN —OnePrmTun— FF LEVEL=0050. 0 FB LEVEL=0040. 0	DATA	Press the DATA Key again to display FF LEVEL and FB LEVEL setting screens.

(cont'd)

Step	Display after Operation	Keys	Operation
9	RUN —OnePrmTun— FF LEVEL=0050. 0 FB LEVEL=0040. 0	[<] [>] [∧] [∨]	If readjustment is required, select the digit with the [<] or [>] Key or change the FF LEVEL and FB LEVEL with the [∧] or [∨] Key. Check the response. If readjustment is not required, go to step 10. Note: The higher the FF LEVEL, the positioning time will be shorter and the response will be better. If the level is too high, however, overshooting or vibration may occur. Overshooting will be reduced if the FB LEVEL is increased. ■ If Vibration Occurs • If vibration occurs, press the [JOG SVON] Key. The SERVOPACK will automatically detect the vibration frequencies and make notch filter or an anti-resonance control settings. When the notch filter is set, "NF1" and "NF2" are displayed on the bottom row. When the anti-resonance control is set, "ARES" will be displayed on the bottom low. RUN —OnePrmTun— FF LEVEL=0050. 0 FB LEVEL=0040. 0 NF1 NF2 ARES ■ If Vibration Is Large • Even if the [JOG SVON] Key is not pressed, the SERVOPACK will automatically detect the vibration frequencies and make notch filter or anti-resonance control settings. Notes: • If the FF LEVEL is changed when the servomotor is in operation, it will not be reflected immediately. The changes will be effective after the servomotor comes to a stop with no reference input and then the servomotor starts operation If the FF LEVEL is changed too much during operation, vibration may occur because the responsiveness is changed rapidly when the settings become effective. • The message "FF LEVEL" flashes until the machine reaches the effective FF LEVEL. If the servomotor does not stop within approximately 10 seconds after changing the setting, a timeout will occur. The setting will be returned to the previous value.
10	RUN —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn141=0050.0 NF1	DATA	Press the [DATA] Key to display the confirmation screen after level adjustment.
11	RUN —OnePrmTun— Pn100=0040.0 Pn101=0020.00 Pn141=0050.0 NF1	DATA	• Press the [DATA] Key to save the adjusted values. After the data is saved, "DONE" will flash for approximately two seconds and then "RUN" will be displayed. • To return to the previous value, press the [MODE/SET] Key. • Press the [<] Key to readjust the level without saving the values.
12	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 2 will appear again.

Note: The status display will always be RUN when the servomotor power is ON.

(2) Related Functions on One-parameter Tuning

This section describes functions related to one-parameter tuning.

■ 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 during one-parameter tuning 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 with the utility function.	Immediately	Tuning
	n.□□□1 [Factory setting]	Sets the 1st notch filter automatically with the utility function.		
	n.□0□□	Does not set the 2nd notch filter automatically with the utility function.		
	n.□1□□ [Factory setting]	Sets the 2nd notch filter automatically with the utility function.		

■ Anti-Resonance Control Adjustment

This function reduces low vibration frequency, which the notch filter does not detect.

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.

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

"ARES" will flash on the digital operator when anti-resonance control adjustment function is set.

```
RUN      —OnePrmTun—
FF  LEVEL  =  0050
FB  LEVEL  =  0040

 NF1  NF2    ARES
```

■ 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 friction resistance resulting from variations in the machine assembly
- Changes in the friction resistance due to aging

Conditions to which friction compensation is applicable depend on the tuning mode. The friction compensation setting in F408.3 applies when the mode is 0 or 1. Tuning Mode = 2 and Tuning Mode = 3 are adjusted with the friction compensation function regardless of the friction compensation setting in P408.3.

Friction Compensation Selecting \ Mode		Tuning Mode = 0	Tuning Mode = 1	Tuning Mode = 2	Tuning Mode = 3
Pn408	n.0□□□ [Factory setting]	Adjusted without the friction compensation function	Adjusted without the friction compensation function	Adjusted with the friction compensation function	Adjusted with the friction compensation function
	n.1□□□	Adjusted with the friction compensation function	Adjusted with the friction compensation function		

■ Feedforward

If Pn140 is set to the factory setting and the tuning mode setting is changed to 2 or 3, the feedforward gain (Pn109), speed feedforward (V-REF) input, and torque feedforward (T-REF) input will be disabled.

Set Pn140.3 to 1 if model following control is used together with the speed feedforward (V-REF) input and torque feedforward (T-REF) input from the host controller.

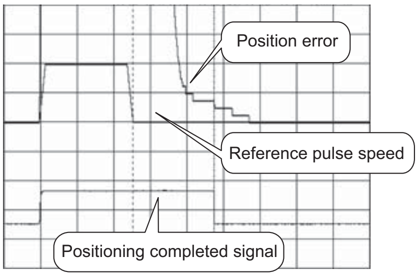
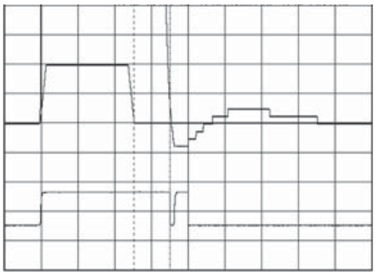
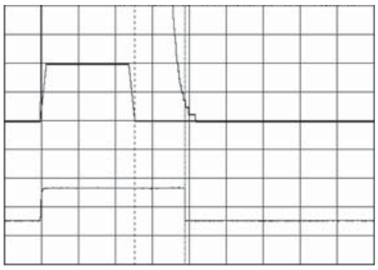
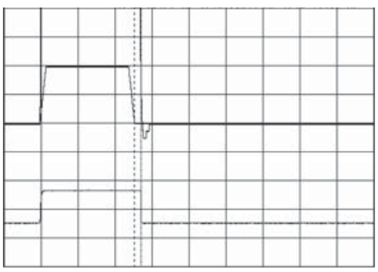
Parameter		Function	When Enabled	Classification
Pn140	n.0□□□ [Factory setting]	Model following control is not used together with the speed/torque feedforward input.	Immediately	Tuning
	n.1□□□	Model following control is used together with the speed/torque feedforward input.		

IMPORTANT

- Model following control is used to make optimum feedforward settings in the SERVOPACK when model following control is used with the feedforward function. Therefore, model following control is not normally used together with either the speed feedforward (V-REF) input or torque feedforward (T-REF) input from the host controller. However, model following control can be used with the speed feedforward (V-REF) input or torque feedforward (T-REF) input if required. An improper feedforward input may result in overshooting.

6.5.3 One-parameter Tuning Example

The following procedure is used for one-parameter tuning on the condition that the tuning mode is set to 2 or 3. This mode is used to reduce positioning time.

Step	Measuring Instrument Display Example	Operation
1		Measure the positioning time after setting the moment of inertia ratio (Pn103) correctly. Tuning will be completed if the specifications are met here. The tuning results will be saved in the SERVOPACK.
2		The positioning time will become shorter if the FF level is increased. The tuning will be completed if the specifications are met. The tuning results will be saved in the SERVOPACK. If overshooting occurs before the specifications are met, go to step 3.
3		Overshooting will be reduced if the FB level is increased. If the overshooting is eliminated, go to step 4.
4		The graph shows overshooting generated with the FF level increased after step 3. In this state, the overshooting occurs, but the positioning settling time is shorter. 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 and anti-resonance control. Note: The vibration frequencies may not be detected if the vibration is too small. If that occurs, press the JOG SVON Key to forcibly detect the vibration frequencies.
5	–	The adjustment results are saved in the SERVOPACK.

6.5.4 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.

- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
  No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn100	Speed Loop Gain	No	Yes
Pn101	Speed Loop Integral Time Constant	No	Yes
Pn102	Position Loop Gain	No	Yes
Pn103	Moment of Inertia Ratio	No	No
Pn121	Friction Compensation Gain	No	Yes
Pn123	Friction Compensation Coefficient	No	Yes
Pn124	Friction Compensation Frequency Correction	No	No
Pn125	Friction Compensation Gain Correction	No	Yes
Pn401	Torque Reference Filter Time Constant	No	Yes
Pn408	Torque Related Function Switch	Yes	Yes
Pn409	1st Notch Filter Frequency	No	Yes
Pn40A	1st Notch Filter Q Value	No	Yes
Pn40C	2nd Notch Filter Frequency	No	Yes
Pn40D	2nd Notch Filter Q Value	No	Yes
Pn140	Model Following Control Related Switch	Yes	Yes
Pn141	Model Following Control Gain	No	Yes
Pn142	Model Following Control Gain Compensation	No	Yes
Pn143	Model Following Control Bias (Forward Direction)	No	Yes
Pn144	Model Following Control Bias (Reverse Direction)	No	Yes
Pn145	Vibration Suppression 1 Frequency A	No	No
Pn146	Vibration Suppression 1 Frequency B	No	No
Pn147	Model Following Control Speed Feedforward Compensation	No	Yes
Pn160	Anti-Resonance Control Related Switch	Yes	Yes
Pn161	Anti-Resonance Frequency	No	Yes
Pn163	Anti-Resonance Damping Gain	No	Yes

6.6 Anti-Resonance Control Adjustment Function (Fn204)

This section describes the anti-resonance control adjustment function.

6.6.1 Anti-Resonance Control Adjustment Function

The anti-resonance control adjustment function increases the effectiveness of the vibration suppression after one-parameter tuning. This function is effective in supporting anti-resonance control adjustment if the vibration frequencies are from 100 to 1000 Hz.

This function rarely needs to be used because it is automatically set by the advanced autotuning or advanced autotuning by reference input. Use this function only if fine-tuning is required, or vibration detection is failed and readjustment is required.

Perform one-parameter tuning (Fn203) or use another method to improve the response characteristics after performing this function. If the anti-resonance gain is increased with one-parameter tuning performed, vibration may result again. If that occurs, perform this function again to fine-tune the settings.

⚠ CAUTION

- If this function is executed, related parameters will be set automatically. Therefore, there will be a large response change after this function is executed. Enable the function in a state where the machine can come to an emergency stop at any time to ensure the safety operation of the machine.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before executing the anti-resonance control adjustment function. If the setting greatly differs from the actual moment of inertia ratio, normal control of the machine may not be possible, and vibration may result.

IMPORTANT

- This function detects vibration between 100 and 1000 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 anti-resonance damping gain (Pn163). The amplitude of vibration may become larger if the damping gain is excessively high. Increase the damping 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.

■ Before Performing Anti-Resonance Control Adjustment Function

The following conditions must be met to perform anti-resonance control adjustment function.
The message “NO-OP” indicating that the settings are not appropriate will be displayed, if all of the following conditions are not met.

- The tuning-less function must be disabled (Pn170.0 = 0).
- The test without a motor function must be disabled (Pn00C.0 = 0).
- The control must not be set to torque control.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

6.6.2 Anti-Resonance Control Adjustment Function Operating Procedure

With this function, an operation reference is sent, and the function is executed while vibration is occurring.

The digital operator or SigmaWin+ is required to execute this function.
The following methods can be used for the anti-resonance control adjustment function.

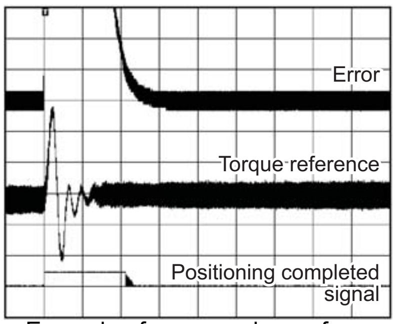
- Using anti-resonance control for the first time
  - With undetermined vibration frequency
  - With determined vibration frequency
- For fine-tuning after adjusting the anti-resonance control

The following describes the operating procedures.

Refer to the *Σ-V Series User's Manual, Operation of Digital Operator* (Manual No.: SIEP S800000 55) for basic key operations of the digital operator.

(1) Using Anti-Resonance Control for the First Time

■ With Undetermined Vibration Frequency

Step	Display after Operation	Keys	Operation
1	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list, select Fn204.
2	Status Display RUN — Vib Sup— Tuning Mode = 0	DATA	Press the DATA Key to display the initial setting screen for tuning mode.
3	RUN — Vib Sup— Tuning Mode = 0	∧ ∨	Press the ∧ or ∨ Key and set the tuning mode "0."
4	RUN — Vib Sup— freq = ---- Hz damp = 0000	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 flash. Return to step 3 if vibration is not detected. Note: If vibration is not detected even when vibration is occurring, 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 = 0000	–	The vibration frequency will be displayed in "freq" if vibration is detected.  Example of measured waveform

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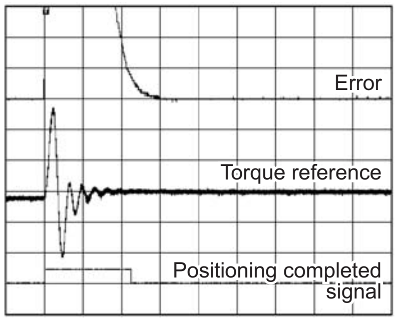
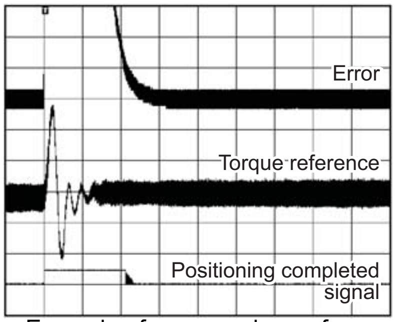
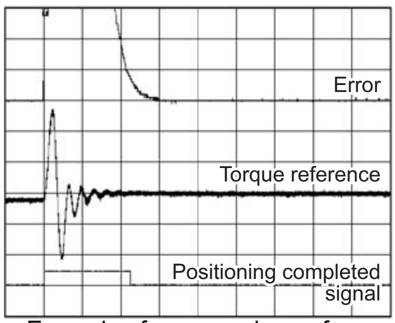
(cont'd)

Step	Display after Operation	Keys	Operation
6	RUN —Vib Sup— freq = 0400 Hz damp = 0000	DATA	Press the DATA Key. The cursor will move to "damp," and the flashing of "freq" will stop.
7	RUN —Vib Sup— freq = 0400 Hz damp = 0120	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to set the damping gain.  Example of measured waveform 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 = 0120	SCROLL	If fine tuning of the frequency is necessary, press the SCROLL Key. The cursor will move from "damp" to "freq." If fine-tuning is not necessary, skip step 9 and go to step 10.
9	RUN —Vib Sup— freq = 0420 Hz damp = 0120	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to fine-tune the frequency.
10	RUN —Vib Sup— freq = 0420 Hz damp = 0120	DATA	Press the DATA Key to save the settings. "DONE" will flash for approximately two seconds and "RUN" will be displayed.
11	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.

■ With Determined Vibration Frequency

Step	Display after Operation	Keys	Operation
1	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list, 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	∧ ∨	Press the ∧ or ∨ Key and set the tuning mode "1."
4	RUN — Vib Sup— freq = 0100 Hz damp = 0000	DATA	Press the DATA Key while "Tuning Mode = 1" is displayed. The screen shown on the left will appear and "freq" will flash.  Example of measured waveform
5	RUN — Vib Sup— freq = 0100 Hz damp = 0000	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to adjust the frequency.
6	RUN — Vib Sup— freq = 0400 Hz damp = 0000	SCROLL	Press the SCROLL Key. The cursor will move to "damp."
7	RUN — Vib Sup— freq = 0400 Hz damp = 0020	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to adjust the damping gain.  Example of measured waveform 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.

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(cont'd)

Step	Display after Operation	Keys	Operation
8	RUN —Vib Sup— freq = 0400 Hz damp = 0120	SCROLL	If fine tuning of the frequency is necessary, press the SCROLL Key. The cursor will move from "damp" to "freq." If fine-tuning is not necessary, skip step 9 and go to step 10.
9	RUN —Vib Sup— freq = 0400 Hz damp = 0120	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to fine-tune the frequency.
10	RUN —Vib Sup— freq = 0400 Hz damp = 0120	DATA	Press the DATA Key to save the settings. "DONE" will flash for approximately two seconds and "RUN" will be displayed.
11	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) For Fine-tuning After Adjusting the Anti-Resonance Control

Step	Display after Operation	Keys	Operation
1	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list, select Fn204.
2	RUN —FUNCTION— Tuning Mode = 1	DATA	Press the DATA Key to display the "Tuning Mode = 1" as shown on the left.
3	RUN —Vib Sup— freq = 0400 Hz damp = 0120	DATA	Press the DATA Key while "Tuning Mode = 1" is displayed. The screen shown on the left will appear and "damp" will flash.
4	RUN —Vib Sup— freq = 0400 Hz damp = 0150	< > ∧ ∨	Select the digit with the < or > Key, and press the ∧ or ∨ Key to set 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	If fine tuning of the frequency is necessary, press the SCROLL Key. The cursor will move from "damp" to "freq." If fine-tuning is not necessary, skip step 6 and go to step 7.
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.
7	RUN —Vib Sup— freq = 0420 Hz damp = 0150	DATA	Press the DATA Key to save the settings. "DONE" will flash for approximately two seconds and "RUN" will be displayed.

(cont'd)

Step	Display after Operation	Keys	Operation
8	RUN —FUNCTION— Fn203:OnePrmTun Fn204:A-Vib Sup Fn205:Vib Sup Fn206:Easy FFT	MODE/SET	Press the MODE/SET Key to complete the anti-resonance control adjustment function. The screen in step 1 will appear again.

6.6.3 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.

- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
  No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn160	Anti-Resonance Control Related Switch	Yes	Yes
Pn161	Anti-Resonance Frequency	No	Yes
Pn162	Anti-Resonance Gain Compensation	Yes	No
Pn163	Anti-Resonance Damping Gain	No	Yes
Pn164	Anti-Resonance Filter Time Constant 1 Compensation	Yes	No
Pn165	Anti-Resonance Filter Time Constant 2 Compensation	Yes	No

6.7 Vibration Suppression Function (Fn205)

The vibration suppression function is described in this section.

This function can be used only with a SERVOPACK for pulse train references.

6.7.1 Vibration Suppression Function

The vibration suppression function suppresses transitional vibration at frequency as low as 1 to 100 Hz that is generated mainly when positioning if the machine stand vibrates. This function is effective for vibration frequencies for which notch filter and anti-resonance control adjustment functions are not applicable.

This function is set automatically when advanced autotuning or advanced autotuning by reference is executed. In most cases, this function is not necessary. Use this function only if fine-tuning is required or readjustment is required as a result of a failure to detect vibration. Before executing this function, input an operation reference to create vibration.

Perform one-parameter tuning (Fn203) if required to improve the response characteristics after performing this function.

⚠ 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.
- If the parameter settings are changed while the motor is moving, the new settings will become valid after the /COIN signal is output.
- Be sure to set a suitable value for the moment of inertia ratio (Pn103) using advanced autotuning before executing the vibration suppression function. If the setting greatly differs from the actual moment of inertia ratio, normal control of the SERVOPACK may not be possible, and vibration may result.

IMPORTANT

- This function detects vibration frequency between 1 to 100 Hz. Vibration will not be detected for frequencies outside of this range, and instead, "F-----" will be displayed.
- Frequency detection will not be performed if no vibration results from position error or the vibration frequencies are outside the range of detectable frequencies. If so, use a device, such as a displacement sensor or vibration sensor, to measure the vibration frequency.
- If vibration frequencies automatically detected are not suppressed, the actual frequency and the detected frequency may differ. Fine-tune the detected frequency if necessary.

(1) Preparation

The following conditions must be met to perform the vibration suppression function.
The message “NO-OP” indicating that the settings are not appropriate will be displayed, if all of the following conditions are not met.

- The control must be set to position control.
- The tuning-less function must be disabled (Pn170.0 = 0).
- The test without a motor function must be disabled (Pn00C.0 = 0).
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

(2) Items Influencing Performance

If continuous vibration occurs when the servomotor is not rotating, the vibration suppression function cannot be used to suppress the vibration effectively. If the result is not satisfactory, perform anti-resonance control adjustment function (Fn204) or one-parameter tuning (Fn203).

(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) which is set as a percentage of the positioning completed width (Pn522). Perform the detection of vibration frequencies again after adjusting the remained vibration detection width (Pn560).

Pn560	Remained Vibration Detection Width Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 3000	0.1%	400	Immediately	Setup

Note: As a guideline, change the setting 10% at a time. 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.

The vibration frequencies that are automatically detected may vary somewhat with each positioning operation. Perform positioning several times and make adjustments while checking the effect of vibration suppression.

6.7.2 Vibration Suppression Function Operating Procedure

The following procedure is used for vibration suppression function.

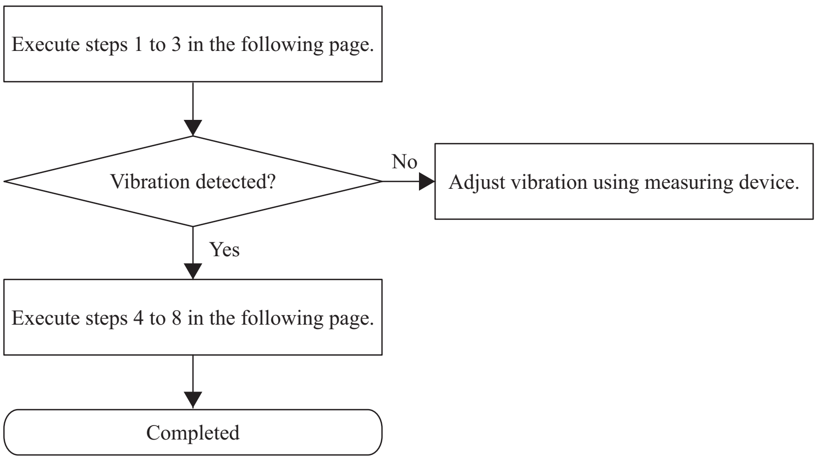
The digital operator or SigmaWin+ is required to execute this function.

Refer to the *Σ-V Series User's Manual, Operation of Digital Operator* (Manual No.: SIEP S800000 55) for basic key operations of the digital operator.

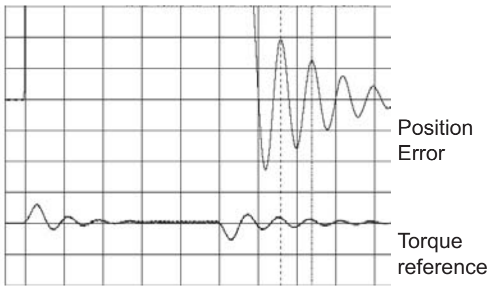
Note: If this function is aborted by pressing the MODE/SET Key, the SERVOPACK will continue operating until the servomotor comes to a stop. After the servomotor stops, the set value will return to the previous value.

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

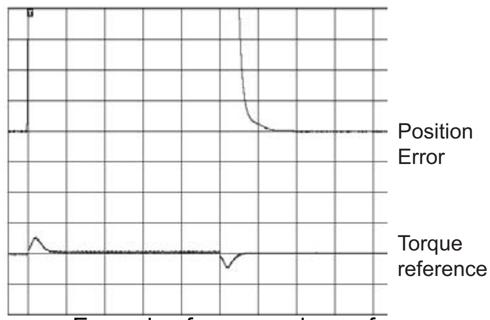
(1) Operating Flow



(2) Operating Procedure

Step	Display after Operation	Keys	Operation
1	Input a operation 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 ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list, select Fn205.
3	RUN —Vib Sup— Measure f=010.4Hz Setting f=050.4Hz	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] If the setting frequency and actual operating frequency are different, "Setting" will flash. Note: 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 to “Setting f.” 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.  Example of measured waveform
5	RUN —Vib Sup— Measure f=010.4Hz Setting f=012.4Hz	< > ∧ ∨	If the vibration is not completely suppressed, select the digit with the < or > Key, and press the ∧ or ∨ Key to fine-tune the frequency “setting f.” 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 flash.

(cont'd)

Step	Display after Operation	Keys	Operation
6	RUN　　　—Vib Sup— Measure　f=010. 4Hz Setting　f=012. 4Hz	DATA	Press the DATA Key. The "Setting f" will change to usual display and the frequency currently displayed will be set for the vibration suppression function.  Example of measured waveform
7	RUN　　　—Vib Sup— Measuref　=-----Hz Settingf　=012. 4Hz	DATA	Press the DATA Key to save the setting. "DONE" will flash for approximately two seconds and "RUN" will be displayed again.
8	RUN　　—FUNCTION— Fn204 Fn205 Fn206 Fn207	MODE/SET	Press the MODE/SET Key to complete the vibration suppression function. The screen in step 2 will appear again.

IMPORTANT

No settings related to the vibration suppression function will be changed during operation.

If the servomotor does not stop approximately 10 seconds after the setting changes, a timeout error will result and the previous setting will be automatically enabled again.

The vibration suppression function will be enabled in step 6. The motor response, however, will change when the servomotor comes to a stop with no reference input.

(3) Related Function on Vibration Suppression Function

This section describes functions related to vibration suppression function.

■ Feedforward

The feedforward gain (Pn109), speed feedforward (V-REF) input, and torque feedforward (T-REF) input will be disabled in the factory setting.

Set Pn140.3 to 1 if model following control is used together with the speed feedforward (V-REF) input and torque feedforward (T-REF) input from the host controller.

Parameter		Function	When Enabled	Classification
Pn140	n.0□□□ [Factory setting]	Model following control is not used together with the speed/torque feedforward input.	Immediately	Tuning
	n.1□□□	Model following control is used together with the speed/torque feedforward input.		

IMPORTANT

- Model following control is used to make optimum feedforward settings in the SERVOPACK when model following control is used with the feedforward function. Therefore, model following control is not normally used together with either the speed feedforward (V-REF) input or torque feedforward (T-REF) input from the host controller. However, model following control can be used with the speed feedforward (V-REF) input or torque feedforward (T-REF) input if required. An improper feedforward input may result in overshooting.

6.7.3 Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.

- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
  No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn140	Model Following Control Related Switch	Yes	Yes
Pn141	Model Following Control Gain	No	Yes
Pn142	Model Following Control Gain Compensation	No	No
Pn143	Model Following Control Bias (Forward Direction)	No	No
Pn144	Model Following Control Bias (Reverse Direction)	No	No
Pn145	Vibration Suppression 1 Frequency A	No	Yes
Pn146	Vibration Suppression 1 Frequency B	No	Yes
Pn147	Model Following Control Speed Feedforward Compensation	No	No
Pn14A	Vibration Suppression 2 Frequency	No	No
Pn14B	Vibration Suppression 2 Compensation	No	No

6.8 Additional Adjustment Function

This section describes the functions that can be used for additional fine tuning after making adjustments with advanced autotuning, advanced autotuning by reference, or one-parameter tuning.

- Switching gain settings
- Friction compensation
- Current control mode selection
- Current gain level setting
- Speed detection method selection

6.8.1 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.

By using the gain switching function, the positioning time can be shortened by increasing the gain during positioning and vibration can be suppressed by decreasing the gain while it is stopped.

Parameter		Function	When Enabled	Classification
Pn139	n.□□□0 [Factory setting]	Manual gain switching	Immediately	Tuning
	n.□□□2	Automatic gain switching		

Note: n.□□□1 is reserved. Do not use.

For the gain combinations for switching, refer to *(1) Gain Combinations for Switching*.

For the manual gain switching, refer to *(2) Manual Gain Switching*.

For the automatic gain switching, refer to *(3) Automatic Gain Switching*.

(1) Gain Combinations for Switching

Setting	Speed Loop Gain	Speed Loop Integral Time Constant	Position Loop Gain	Torque Reference Filter	Model Following Control Gain	Model Following Control Gain Compensation	Friction Compensation Gain
Gain Setting 1	Pn100 Speed Loop Gain	Pn101 Speed Loop Integral Time Constant	Pn102 Position Loop Gain	Pn401 Torque Reference Filter Time Constant	Pn141* Model Following Control Gain	Pn142* Model Following Control Gain Compensation	Pn121 Friction Compensation Gain
Gain Setting 2	Pn104 2nd Speed Loop Gain	Pn105 2nd Speed Loop Integral Time Constant	Pn106 2nd Position Loop Gain	Pn412 1st Step 2nd Torque Reference Filter Time Constant	Pn148* 2nd Model Following Control Gain	Pn149* 2nd Model Following Control Gain Compensation	Pn122 2nd Gain for Friction Compensation

* 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 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-SEL) to switch between gain setting 1 and gain setting 2.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/G-SEL	Must be allocated	OFF	Switches to gain setting 1.
			ON	Switches to gain setting 2.

(3) Automatic Gain Switching

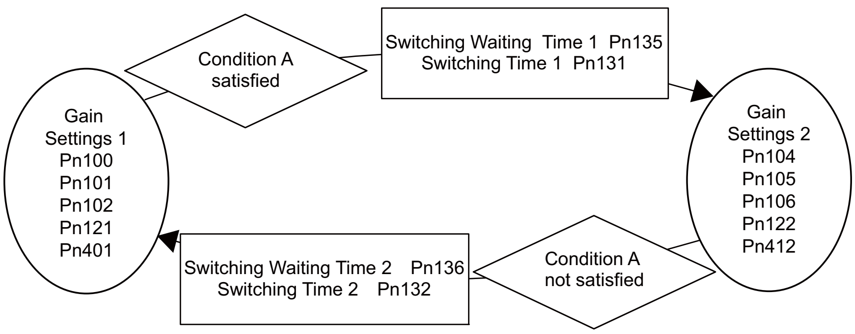
Automatic gain switching is enabled only in position control. The switching conditions are specified using the following settings.

Parameter Setting		Switching Condition	Setting	Switching Wait Time	Switching Time
Pn139	n.□□□2	Condition A satisfied.	Gain setting 1 to gain setting 2	Pn135 Gain Switching Waiting Time 1	Pn131 Gain Switching Time 1
		Condition A not satisfied.	Gain setting 2 to gain setting 1	Pn136 Gain Switching Waiting Time 2	Pn132 Gain Switching Time 2

Select one of the following settings for switching condition A.

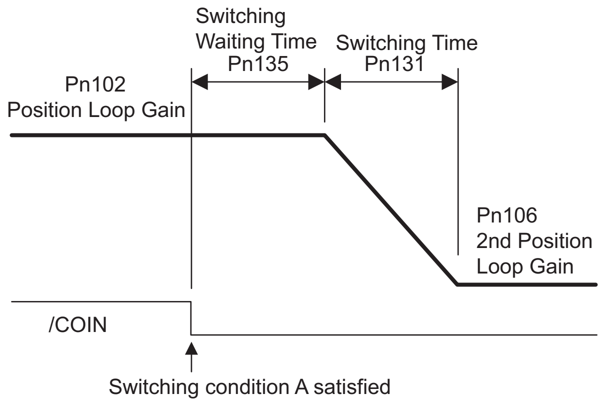
Parameter		Switching Condition A for Position Control	For Other than Position Control (No Switching)	When Enabled	Classification
Pn139	n.□□0□ [Factory setting]	Positioning completed signal (/COIN) ON	Fixed in gain setting 1	Immediately	Tuning
	n.□□1□	Positioning completed signal (/COIN) OFF	Fixed in gain setting 2		
	n.□□2□	Positioning near signal (/NEAR) ON	Fixed in gain setting 1		
	n.□□3□	Positioning near signal (/NEAR) OFF	Fixed in gain setting 2		
	n.□□4□	No output for position reference filter and reference pulse input OFF	Fixed in gain setting 1		
	n.□□5□	Position reference pulse input ON	Fixed in gain setting 2		

Automatic switching pattern 1 (Pn139.0 = 2)



■ Relationship between the Waiting and Switching Times for Gain Switching

In this example, the "positioning completed signal (/COIN) ON" condition is set as condition A for automatic gain switching. 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 within the switching time set in Pn131.



Note: Automatic gain switching is available in the PI and I-P controls (Pn10B).

(4) Related Parameters

Pn100	Speed Loop Gain			Speed Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1 Hz	400	Immediately	Tuning

Pn101	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

Pn102	Position Loop Gain			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1/s	400	Immediately	Tuning

Pn401	Torque Reference Filter Time Constant		Speed Position	Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning

Pn141	Model Following Control Gain			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 20000	0.1/s	500	Immediately	Tuning

Pn142	Model Following Control Gain Compensation			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	500 to 2000	0.1%	1000	Immediately	Tuning

Pn121	Friction Compensation Gain			Speed Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 1000	1%	100	Immediately	Tuning

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

Adjustments

6

(cont'd)

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
Pn412	1st Step 2nd Torque Reference Filter Time Constant Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning
Pn148	2nd Model Following Control Gain 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 Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	500 to 2000	0.1%	1000	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 Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning
Pn132	Gain Switching Time 2 Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning
Pn135	Gain Switching Waiting Time 1 Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning
Pn136	Gain Switching Waiting Time 2 Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	1 ms	0	Immediately	Tuning

(6) Related Monitor

Monitor No. (Un)	Name	Value	Remarks
Un014	Effective gain monitor	1	For gain setting 1
		2	For gain setting 2

Note: When using the tuning-less function, gain setting 1 is enabled.

Parameter No.	Analog Monitor	Name	Output Value	Remarks
Pn006 Pn007	n.□□0B	Effective gain monitor	1 V	Gain setting 1 is enabled.
			2 V	Gain setting 2 is enabled.

6.8.2 Manual Adjustment of Friction Compensation

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

The friction compensation function can be automatically adjusted with advanced autotuning (Fn201), advanced autotuning by reference input (Fn202), or one-parameter tuning (Fn203). This section describes the steps to follow if manual adjustment is required.

(1) Required Parameter Settings

The following parameter settings are required to use friction compensation.

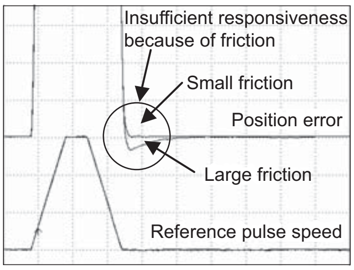
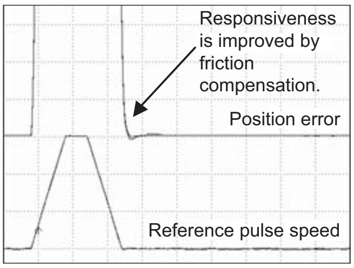
Parameter		Function	When Enabled	Classification
Pn408	n.0□□□ [Factory setting]	Does not use friction compensation.	Immediately	Setup
	n.1□□□	Uses friction compensation.		

Pn121	Friction Compensation Gain Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 1000	1%	100	Immediately	Tuning
Pn123	Friction Compensation Coefficient Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1%	0	Immediately	Tuning
Pn124	Friction Compensation Frequency Correction Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	-10000 to 10000	0.1 Hz	0	Immediately	Tuning
Pn125	Friction Compensation Gain Correction Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1000	1%	100	Immediately	Tuning

(2) Operating Procedure for Friction Compensation

The following procedure is used for friction compensation.

⚠ CAUTION
• Before using friction compensation, set the moment of inertia ratio (Pn103) as accurately as possible. If the wrong moment of inertia 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, gradually increase the friction compensation coefficient (Pn123). Note: Usually, set the friction compensation coefficient value to 95% or less. If the effect is insufficient, increase the friction compensation gain (Pn121) by 10% increments until it stops vibrating. Effect of Parameters for Adjustment 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 excessively high. 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.
3	Effect of Adjustment The following graph shows the responsiveness with and without proper adjustment.  Without friction compensation  With friction compensation

6.8.3 Current Control Mode Selection Function

This function reduces high-frequency noises while the servomotor is being stopped. This function is enabled by default and set to be effective under different application conditions. Set Pn009.1 = 1 to use this function.

Parameter		Meaning	When Enabled	Classification
Pn009	n. □□0□	Selects the current control mode 1.	After restart	Tuning
	n. □□1□ [Factory setting]	Selects the current control mode 2 (low noise).		

IMPORTANT

- If current control mode 2 is selected, the load ratio may increase while the servomotor is being stopped.

6.8.4 Current Gain Level Setting

This function reduces noises by adjusting the parameter value for current control inside the SERVOPACK according to the speed loop gain (Pn100). The noise level can be reduced by reducing the current gain level (Pn13D) from its factory setting of 2000% (disabled). If the set value of Pn13D is decreased, the level of noise will be lowered, but the response characteristics of the SERVOPACK will also be degraded. Adjust the current gain level within the allowable range at which SERVOPACK response characteristics can be secured. This function is always disabled in torque control (Pn000.1 = 2).

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

IMPORTANT

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

6.8.5 Speed Detection Method Selection

This function can ensure smooth movement of the servomotor while the servomotor is running. Set the value of Pn009.2 to 1 and select speed detection 2 to smooth the movement of the servomotor while the servomotor is running.

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

IMPORTANT

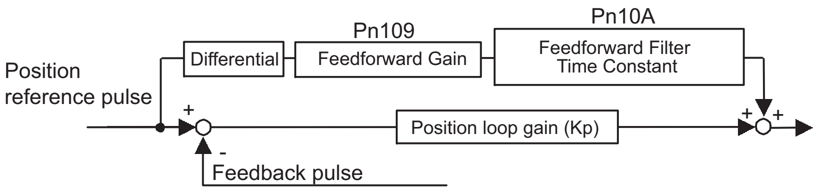
- If the speed detection method is changed, the response characteristics of the speed loop will change and the SERVOPACK must be readjusted again.

6.9 Compatible Adjustment Function

The DC Power Input Σ-V series SERVOPACKs have adjustment functions as explained in sections *6.1* to *6.8* to make machine adjustments.
This section explains compatible functions provided by earlier models, such as the Σ-III Series SERVOPACK.

6.9.1 Feedforward Reference (Pulse Train Reference)

This function applies feedforward compensation to position control and shortens positioning time. This function can be used only with a SERVOPACK for pulse train references.



Pn109	Feedforward Gain			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 100	1%	0	Immediately	Tuning
Pn10A	Feedforward Filter Time Constant			Position	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 6400	0.01 ms	0	Immediately	Tuning

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

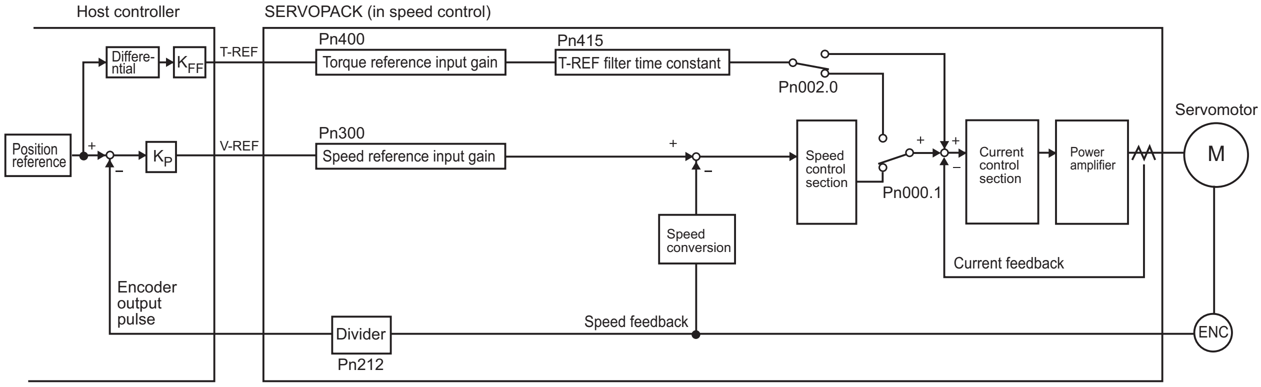
6.9.2 Torque Feedforward (Analog Voltage Reference)

The torque feedforward function shortens positioning time. This function can be used only with a SERVOPACK for analog voltages.

The host controller finds the difference from the position reference to generate a torque feedforward reference, and inputs the torque feedforward reference together with the speed reference to the SERVOPACK.

(1) Example of Connection with Host Controller

Connect a speed reference to V-REF (CN1-1 and -2) and a torque feedforward reference to T-REF (CN1-3 and -4) from the host controller.



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

(2) Related Parameters

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

The factory setting is Pn400 = 3.0 V/rated torque.
For example, the torque feedforward value is ±3 V, then, the torque is limited to ±100% of the rated torque.

Parameter		Meaning	When Enabled	Classification
Pn002	n.□□□0 [Factory setting]	Disabled	After restart	Setup
	n.□□□2	Uses T-REF terminal for torque feedforward input.		

Pn400	Torque Reference Input Gain Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	10 to 100	0.1 V	30	Immediately	Setup

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

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

6.9.3 Proportional Control

The /P-CON signal can be sent from the host control to select proportional control.

The speed control section uses a PI control if the reference stays zero in the speed control. This integral effect may cause the servomotor to move. Switch the PI control to a proportional control to prevent this from occurring.

If the speed control is set with a zero clamp function, however, a position loop will be formed so there is no need to use this function. The speed control is set to proportional control if the /P-CON signal is ON.

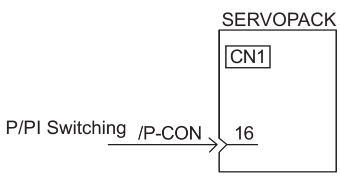
Proportional control operation is set using parameter Pn000.1 and input signal /P-CON.

(1) /P-CON Input Signal

Input signal /P-CON is used to switch between PI control and P control.

Type	Signal Name	Connector Pin Number	Setting	Meaning
Input	/P-CON	CN1-16 [Factory setting]	OFF (High level)	Switches to PI control (proportional-integral control).
			ON (Low level)	Switches to P control (proportional control).

Example: Factory-set Input Signal Allocations



Note: This is an example when the input signal allocations are at the default factory settings.

(2) Control Method and Proportional Control Input Signal

Proportional control operation is enabled when the control method is set to speed or position control.

Parameter		Contents	Switching to the Proportional Control
Pn000	n.□□0□ [Factory setting]	Speed control	Can be switched with the factory setting (CN1-16=/P-CON). /P-CON signal can be allocated to other terminals as required.
	n.□□1□	Position control	
	n.□□2□	Torque control	Cannot switch to proportional control.
	n.□□3□	Internal set speed control	Allocation of /P-CON to one of terminals CN1-12, 15 to 18, 25, or 26 are needed.
	n.□□4□	Internal set speed control ⇔ Speed control	
	n.□□5□	Internal set speed control ⇔ Position control	
	n.□□6□	Internal set speed control ⇔ Torque control	
	n.□□9□	Torque control ⇔ Speed control	
	n.□□A□	Speed control ⇔ Speed control with zero clamp function	
	n.□□B□	Position control ⇔ Position control with reference pulse inhibit function	

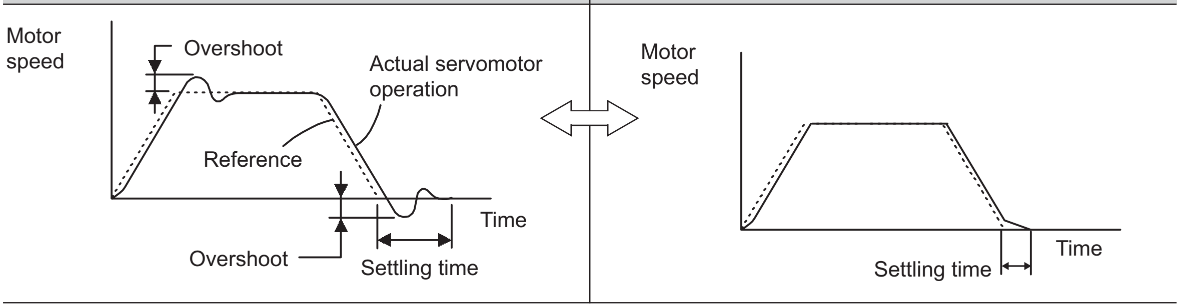
Note: Refer to *5.7 Combination of Control Methods* for how to switch control methods.

6.9.4 Mode Switch (P/PI Switching)

The mode switch automatically switches between proportional and PI control. Set the switching condition with Pn10B.0 and set the level of detection points with Pn10C, Pn10D, Pn10E, and Pn10F.

Overshooting caused by acceleration and deceleration can be suppressed and the settling time can be reduced by setting the switching condition and detection points.

Without Mode Switch	With Mode Switch



(1) Related Parameters

Select the switching condition of the mode switch with Pn10B.0.

Parameter		Mode Switch Selection	Parameter Containing Detection Point Setting	When Enabled	Classification
Pn10B	n.□□□0 [Factory setting]	Uses an internal torque reference level for the switching conditions.	Pn10C	Immediately	Setup
	n.□□□1	Uses a speed reference level for the switching conditions.	Pn10D		
	n.□□□2	Uses an acceleration level for the switching conditions.	Pn10E		
	n.□□□3	Uses a position error level for the switching conditions.	Pn10F		
	n.□□□4	Does not use mode switch function.	–		

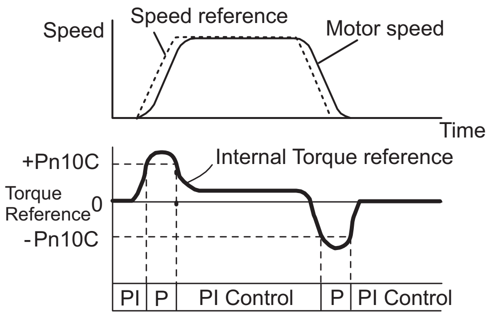
■ Parameters to Set the Level of Detection Points

Pn10C	Mode Switch (Torque Reference) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 800	1%	200	Immediately	Tuning
Pn10D	Mode Switch (Speed Reference) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	0	Immediately	Tuning
Pn10E	Mode Switch (Acceleration) Speed Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 30000	1 min^{-1}/s	0	Immediately	Tuning
Pn10F	Mode Switch (Position Error) Position				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 reference unit	0	Immediately	Tuning

(2) Operating Examples for Different Switching Conditions

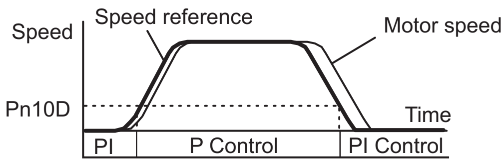
■ Using the Internal Torque Reference [Factory Setting]

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



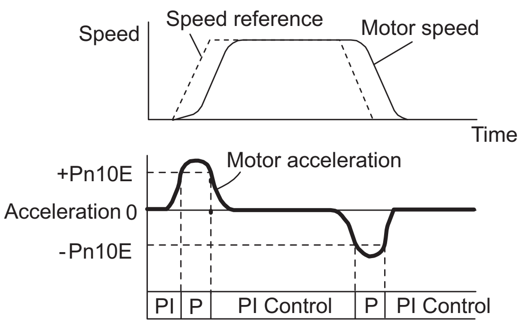
■ Using the Speed Reference

With this setting, the speed loop is switched to P control when the value of speed reference input exceeds the speed set in Pn10D.



■ Using Acceleration

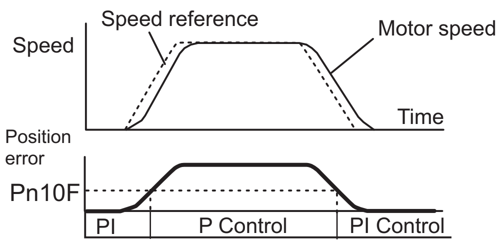
With this setting, the speed loop is switched to P control when the speed reference exceeds the acceleration set in Pn10E.



■ Using the Position Error

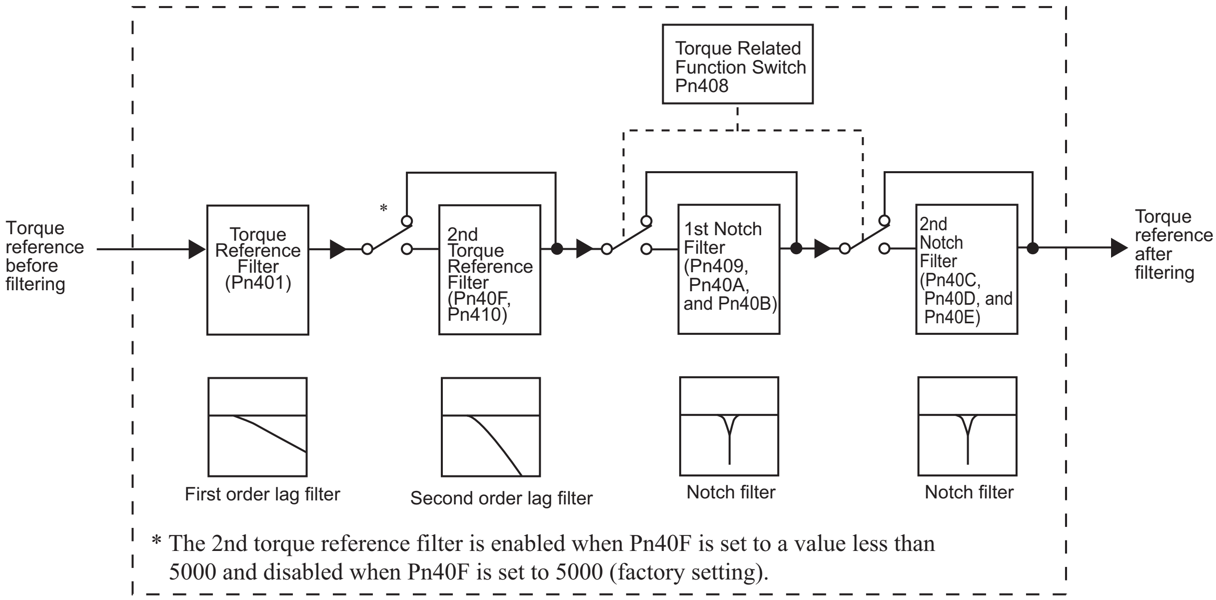
With this setting, the speed loop is switched to P control when the position error exceeds the value set in Pn10F.

This setting is effective with position control only.



6.9.5 Torque Reference Filter

As shown in the following diagram, the torque reference filter contains first order lag filter and notch filters arrayed in series, and each filter operates independently. The notch filters can be enabled and disabled with the Pn408.



(1) Torque Reference Filter

If you suspect that machine vibration is being caused by the servo drive, try adjusting the filter time constants with Pn401. This may stop the vibration. The lower the value, the better the response will be, but there may be a limit that depends on the machine conditions.

Pn401	Torque Reference Filter Time Constant [Speed] [Position] [Torque]				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 65535	0.01 ms	100	Immediately	Tuning

■ Torque Reference Filter Setting Guide

Use the speed loop gain (Pn100 [Hz]) and the torque filter time constant (Pn401 [ms]) to set the torque reference filter.

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)

Pn40F	2nd Step 2nd Torque Reference Filter Frequency [Speed] [Position] [Torque]				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	100 to 5000	1 Hz	5000*	Immediately	Tuning
Pn410	2nd Step 2nd Torque Reference Filter Q Value [Speed] [Position] [Torque]				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 100	0.01	50	Immediately	Tuning

* The filter is disabled if 5000 is set.

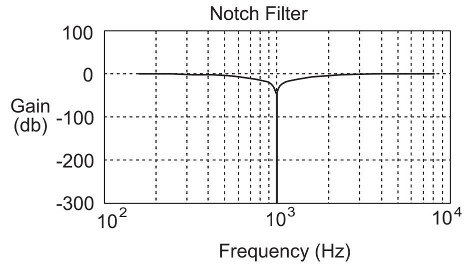
Adjustments

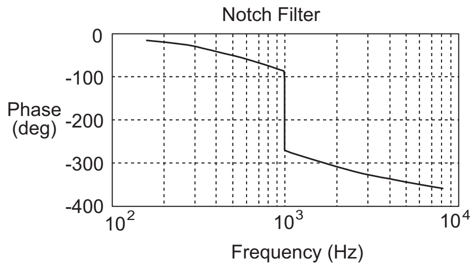
6

(2) Notch Filter

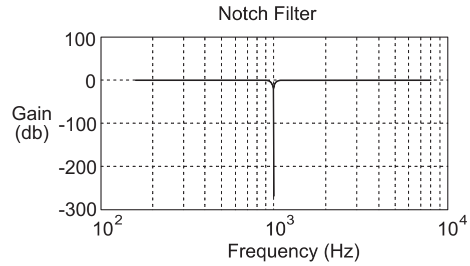
The notch filter can eliminate specific frequency elements generated by the vibration of sources such as resonance of the shaft of a ball screw. The notch filter puts a notch in the gain curve at the specific vibration frequency. The frequency characteristics near the notch can be reduced or removed with this filter. A higher Q value produces a sharper notch and phase delay.

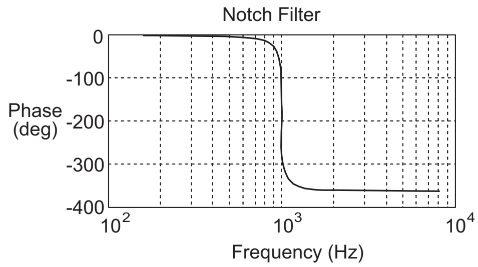
Q value = 0.7





Q value = 1.0





The notch filter can be enabled or disabled with Pn408.

Parameter		Meaning	When Enabled	Classification
Pn408	n.□□□0 [Factory setting]	Disables 1st notch filter.	Immediately	Setup
	n.□□□1	Enables 1st notch filter.		
	n.□0□□ [Factory setting]	Disables 2nd notch filter.		
	n.□1□□	Enables 2nd notch filter.		

Set the machine's vibration frequency as a parameter of the notch filter.

Pn409	1st Notch Filter Frequency		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 5000	1 Hz	5000	Immediately	Tuning

Pn40A	1st Notch Filter Q Value		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning

Pn40B	1st Notch Filter Depth		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning

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

Pn40D	2nd Notch Filter Q Value		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 1000	0.01	70	Immediately	Tuning

(cont'd)

Pn40E	2nd Notch Filter Depth Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	0.001	0	Immediately	Tuning

IMPORTANT

- Sufficient precautions must be taken when setting the notch filter frequencies. Do not set the notch filter 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 filter frequency too close to the response frequency may cause vibration and damage the machine.
- Change the notch filter frequencies (Pn409 or Pn40C) only when the servomotor is stopped. Vibration may occur if the notch filter frequency is changed when the servomotor is rotating.

6.9.6 Position Integral

The position integral is the integral function of the position loop. It is used for the electronic cams and electronic shafts when using the SERVOPACK with YASKAWA MP900/2000 Machine Controllers.

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

7

Utility Functions (Fn□□□)

7.1 List of Utility Functions

Utility functions are used to execute the functions related to servomotor operation and adjustment.
Each utility function has a number starting with Fn.

The following table lists the utility functions and reference section.

Function No.	Function	Reference Section	Comment: SigmaWin+ function names
Fn000	Alarm history display	7.2	Alarm Display
Fn002	JOG operation	7.3	JOG Operation
Fn003	Origin search	7.4	Origin Search
Fn004	Program JOG operation	7.5	Program JOG Operation
Fn005	Initializing parameter settings	7.6	Editing Parameters
Fn006	Clearing alarm history	7.7	Alarm Display
Fn008	Absolute encoder multiturn reset and encoder alarm reset	5.9.4	Setting the Absolute Encoder
Fn009*1	Automatic tuning of analog (speed, torque) reference offset	5.3.2 5.5.2	–
Fn00A*1	Manual servo tuning of speed reference offset	5.3.2	–
Fn00B*1	Manual servo tuning of torque reference offset	5.5.2	–
Fn00C	Offset adjustment of analog monitor output	7.8	Adjusting Analog Monitor Output
Fn00D	Gain adjustment of analog monitor output	7.9	Adjusting Analog Monitor Output
Fn00E	Automatic offset-signal adjustment of the motor current detection signal	7.10	Adjusting Motor Current Detection Offset
Fn00F	Manual offset-signal adjustment of the motor current detection signal	7.11	Adjusting Motor Current Detection Offset
Fn010	Write prohibited setting	7.12	Write Prohibited Setting
Fn011	Servomotor model display	7.13	Product Information
Fn012	Software version display	7.14	Product Information
Fn013	Multiturn limit value setting change when a multiturn limit disagreement alarm occurs	5.9.7	Setting the Multi-Turn Limit
Fn01B	Vibration detection level initialization	7.15	Initializing Vibration Detection Level
Fn01E	Display of SERVOPACK and servomotor ID	7.16	Product Information
Fn030	Software reset	7.17	Resetting the SERVOPACK by Software or MECHATROLINK Communication Reset
Fn200	Tuning-less levels setting	6.2.2	Editing Parameters
Fn201	Advanced autotuning	6.3.2	Tuning
Fn202*2	Advanced autotuning by reference	6.4.2	Tuning
Fn203	One-parameter tuning	6.5.2	Tuning
Fn204	Anti-resonance control adjustment function	6.6.2	Tuning
Fn205*2	Vibration suppression function	6.7.2	Tuning
Fn206	EasyFFT	7.18	EasyFFT
Fn207	Online vibration monitor	7.19	Online Vibration Monitor

Note: Execute the utility function with either a digital operator or SigmaWin+. If they are used together, "no_oP" or "NO-OP" will be displayed when the utility function is executed.

∗1. This function can be used only with a SERVOPACK for analog voltage references.

∗2. This function can be used only with a SERVOPACK for pulse train references.

7.2 Alarm History Display (Fn000)

This function displays the last ten alarms that have occurred in the SERVOPACK.
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 total 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 hour.

(1) Preparation

There are no tasks that must be performed before displaying the alarm history.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	BB −FUNCTION− Fn207:V−Monitor Fn000:Alm History Fn002:JOG Fn003:Z−Search	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn000.
2	A.D00 −ALARM− 0:D00 0000120 7196 1:720 0000003 2651 2:511 0000000 9043 3:−−−	DATA	Press the DATA Key. The display changes to the Fn000 execution display.
3	A.D00 −ALARM− 1:720 0000003 2651 2:511 0000000 9043 3:−−− 4:−−− Time stamp Alarm no. Alarm history no. 0: Latest 9: Oldest	∧ ∨	Press the ∧ or ∨ Key to scroll through the alarm history. The alarm history can be viewed.
4	BB −FUNCTION− Fn207:V−Monitor Fn000:Alm History Fn002:JOG Fn003:Z−Search	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function.

Note:

- If the same alarm occurs after more than one hour, the alarm will be saved. If it occurs in less than one hour, it will not be saved.
- The display "□.---" means no alarm occurs.
- Delete the alarm history using the parameter Fn006. The alarm history is not cleared on alarm reset or when the SERVOPACK main circuit power is turned OFF.

7.3 JOG Operation (Fn002)

JOG operation is used to check the operation of the servomotor under speed control without connecting the SERVOPACK to the host controller.

⚠ 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) Preparation

The following conditions must be met to perform a jog operation.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The main circuit power supply must be ON.
- All alarms must be cleared.
- The servo ON signal (/S-ON) must be OFF.
- The JOG speed must be set considering the operating range of the machine.
  Set the jog speed in Pn304.

Pn304	Jog Speed		Speed Position Torque		Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 10000	1 min^{-1}	500	Immediately	Setup

(2) Operating Procedure

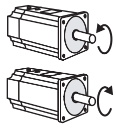
Use the following procedure. The following example is given when the rotating direction of servomotor is set as Pn000.0=0 (Forward rotation by forward reference).

IMPORTANT

The tuning-less function is by default set enabled. When the tuningless function is enabled, the gain may be so increased to cause vibration during no-load operation. If vibration occurs, disable the tuningless function by setting the parameter Pn170.0 to 0.

Step	Display after Operation	Keys	Operation
1	BB −FUNCTION− Fn000:Alm History Fn002:JOG Fn003:Z−Search Fn004:Program JOG	MODE/SET, ∧, ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn002.
2	BB −JOG− Pn304=00500 Un000= 00000 Un002= 00000 Un00D= 0000000000	DATA	Press the DATA Key. The display changes to the Fn002 execution display.
3	BB −JOG− Pn304=00500 Un000= 00000 Un002= 00000 Un00D= 0000000000	DATA	Press the DATA Key. The cursor moves to the setting side (the right side) of Pn304 (JOG speed).
4	BB −JOG− Pn304=01000 Un000= 00000 Un002= 00000 Un00D= 0000000000	<, >, ∧, ∨	Press the < or > Key and the ∧ or ∨ Key to set the JOG speed (Pn304) to 1000 min^{-1}.
5	BB −JOG− Pn304=01000 Un000= 00000 Un002= 00000 Un00D= 0000000000	DATA	Press the DATA Key. The setting value is entered, and the cursor moves to the parameter number side (the left side).

(cont'd)

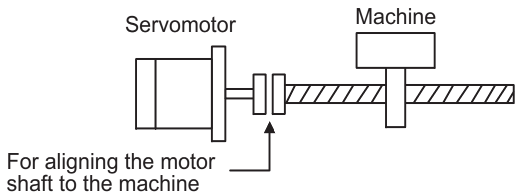
Step	Display after Operation	Keys	Operation
6	R U N – J O G – P n 3 0 4 = 0 1 0 0 0 U n 0 0 0 = 0 0 0 0 0 U n 0 0 2 = 0 0 0 0 0 U n 0 0 D = 0 0 0 0 0 0 0 0 0 0	JOG SVON	Press the JOG SVON Key. The status display changes from "BB" to "RUN", and the servomotor power turns ON.
7	R U N – J O G – P n 3 0 4 = 0 1 0 0 0 U n 0 0 0 = 0 0 0 0 0 U n 0 0 2 = 0 0 0 0 0 U n 0 0 D = 0 0 0 0 0 0 0 0 0 0	∧ ∨	The servomotor will rotate at the present speed set in Pn304 while the ∧ Key (for forward rotation) or ∨ Key (for reverse rotation) is pressed. 
8	B B – J O G – P n 3 0 4 = 0 1 0 0 0 U n 0 0 0 = 0 0 0 0 0 U n 0 0 2 = 0 0 0 0 0 U n 0 0 D = 0 0 0 0 0 0 0 0 0 0	JOG SVON	After having confirmed the correct motion of servomotor, press the JOG SVON Key. The status display changes from "RUN" to "BB", and the servomotor power turns OFF.
9	B B – F U N C T I O N – F n 0 0 0 : A l m H i s t o r y F n 0 0 2 : J O G F n 0 0 3 : Z – S e a r c h F n 0 0 4 : P r o g r a m J O G	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function.
10	To enable the change in the setting, restart the SERVOPACK.		

7.4 Origin Search (Fn003)

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

> **⚠ CAUTION**
>
> • Perform origin searches without connecting the coupling.
> The forward run prohibited (P-OT) and reverse run prohibited (N-OT) signals are not effective in origin search mode.

This function is used when the motor shaft needs to be aligned to the machine.
Motor speed at the time of execution: 60 min^{-1}



(1) Preparation

The following conditions must be met to perform the origin search.

• The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
• The main circuit power supply must be ON.
• All alarms must be cleared.
• The servo ON signal (/S-ON) must be OFF.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	BB −FUNCTION− Fn002:JOG Fn003:Z−Search Fn004:Program JOG Fn005:Prm Init	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn003.
2	BB −Z−Search− Un000= 00000 Un002= 00000 Un003= 0000000774 Un00D= 0000000000	DATA	Press the DATA Key. The display changes to the Fn003 execution display.
3	RUN −Z−Search− Un000= 00000 Un002= 00000 Un003= 0000000774 Un00D= 0000000000	JOG SVON	Press the JOG SVON Key. The status display changes from "BB" to "RUN", and the servomotor power turns ON. Note: If the servomotor is already at the zero position, "-Complete-" is displayed.

(cont'd)

<table>
<tr><th>Step</th><th>Display after Operation</th><th>Keys</th><th>Operation</th></tr>
<tr><td>4</td><td>RUN –Complete–
Un000= 00000
Un002= 00000
Un003= 0000000000
Un00D= 0000001D58</td><td>∧ ∨</td><td>Pressing the ∧ Key will rotate the servomotor in the forward direction. Pressing the ∨ Key will rotate the servomotor in the reverse direction. The rotation direction of the servomotor changes according to the setting of Pn000.0 as shown in the following table.
<table>
<tr><th colspan="2">Parameter</th><th>∧ key</th><th>∨ key</th></tr>
<tr><td rowspan="2">Pn000</td><td>n.□□□0</td><td>CCW</td><td>CW</td></tr>
<tr><td>n.□□□1</td><td>CW</td><td>CCW</td></tr>
</table>
Note: Direction when viewed from the load of the servomotor.
Press the ∧ or ∨ Key until the servomotor stops. If the origin search completed normally, "-Complete-" is displayed on the right top on the screen.</td></tr>
<tr><td>5</td><td>BB –Z–Search–
Un000= 00000
Un002= 00000
Un003= 0000000000
Un00D= 0000001D58</td><td>JOG SVON</td><td>When the origin search is completed, press the JOG SVON Key.
The status display changes from "RUN" to "BB", and the servomotor turns OFF. The display "-Complete-" changes to "-Z-Search-."</td></tr>
<tr><td>6</td><td>BB –FUNCTION–
Fn002:JOG
Fn003:Z–Search
Fn004:Program JOG
Fn005:Prm Init</td><td>MODE/SET</td><td>Press the MODE/SET Key.
The display returns to the main menu of the utility function.</td></tr>
<tr><td>7</td><td colspan="3">To enable the change in the setting, restart the SERVOPACK.</td></tr>
</table>

7.5 Program JOG Operation (Fn004)

The program JOG operation is a utility function, that allows continuous operation determined by the preset operation pattern, movement distance, movement speed, acceleration/deceleration time, waiting time, and number of times of movement.
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) Preparation

The following conditions must be met to perform the program JOG operation.

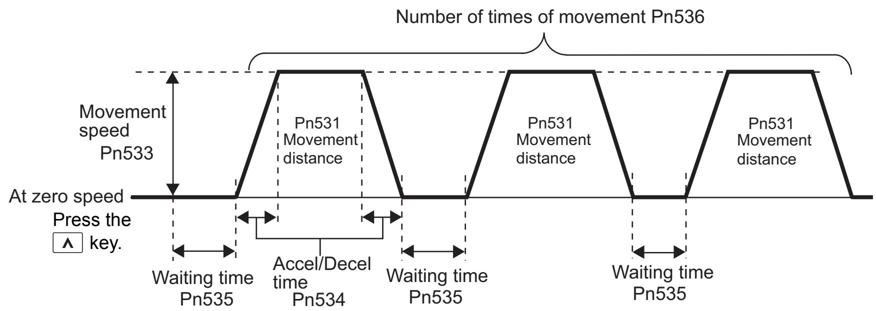
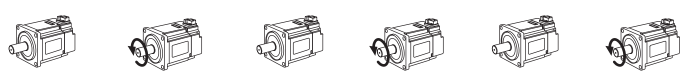
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The main circuit power supply must be ON.
- All alarms must be cleared.
- The servo ON signal (/S-ON) must be OFF.
- The travel distance and speed must be set correctly considering the machine operation range and safe operation speed.
- There must be no overtravel.

(2) Additional Information

- The program JOG operation is carried out in position control. However, the pulse reference input to the SERVOPACK cannot be used.
- The functions that are applicable for position control can be used.
- The overtravel function is enabled in this function.
- When using an absolute encoder, the SEN signal needs not be input since it is always enabled.
- The reference pulse input multiplication switching function is disabled.

(3) Program JOG Operation Patterns

The following describes an example of program JOG operation pattern. The following example is given when the rotating direction of the servomotor is set as Pn000.0 = 0 (Forward rotation by forward reference).

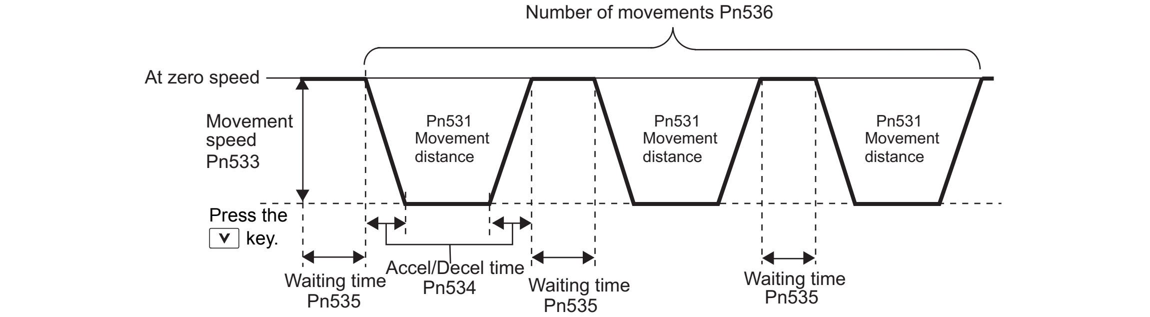
<table>
<tr><th colspan="2">Pn530.0 = 0</th></tr>
<tr><th colspan="2">(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536</th></tr>
<tr><td>Speed Diagram</td><td>
</td></tr>
<tr><td>Servomotor Run Status</td><td>
(Stop) (Forward) (Stop) (Forward) (Stop) (Forward)</td></tr>
</table>

Note: When Pn536 (number of times of program JOG movement) is set to 0, infinite time operation is enabled. To stop infinite time operation, press the JOG/SVON Key of digital operator to turn OFF the servomotor power.

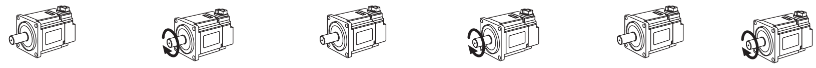
Pn530.0 = 1

(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536

Speed Diagram



Servomotor Run Status



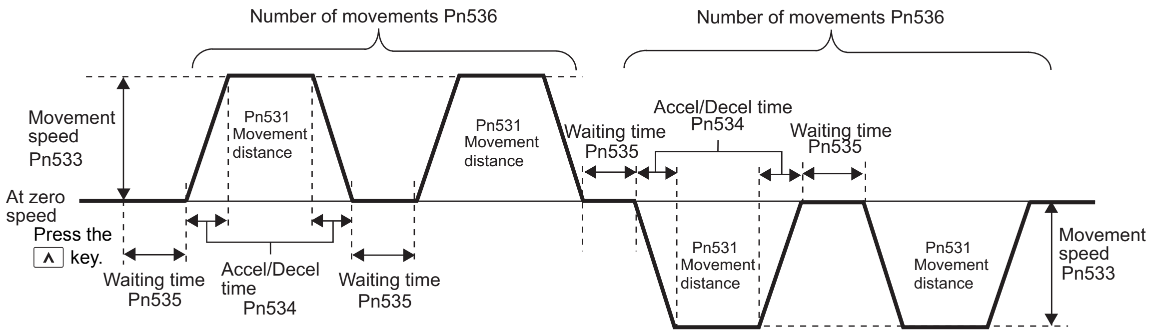
(Stop) (Reverse) (Stop) (Reverse) (Stop) (Reverse)

Note: When Pn536 (Number of Times of Program JOG Movement) is set to 0, infinite time operation is enabled. To stop infinite time operation, press the JOG/SVON Key of digital operator to turn OFF the servomotor power.

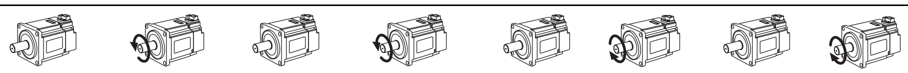
Pn530.0 = 2

(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536
(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536

Speed Diagram



Servomotor Run Status



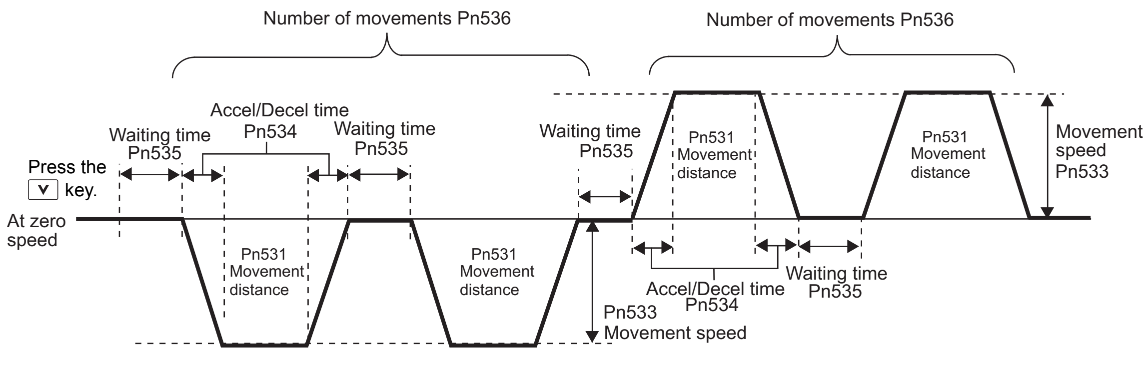
(Stop) (Forward) (Stop) (Forward) (Stop) (Reverse) (Stop) (Reverse)

Note: When Pn530.0 is set to 2, infinite time operation is disabled.

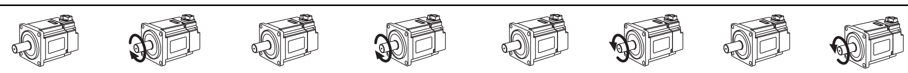
Pn530.0 = 3

(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536
(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536

Speed Diagram

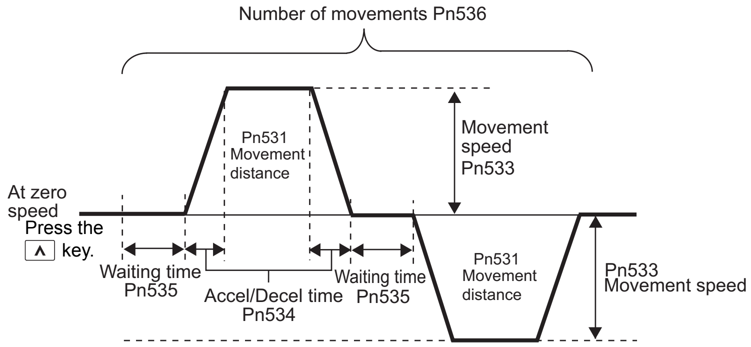
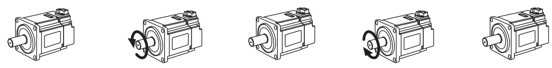


Servomotor Run Status

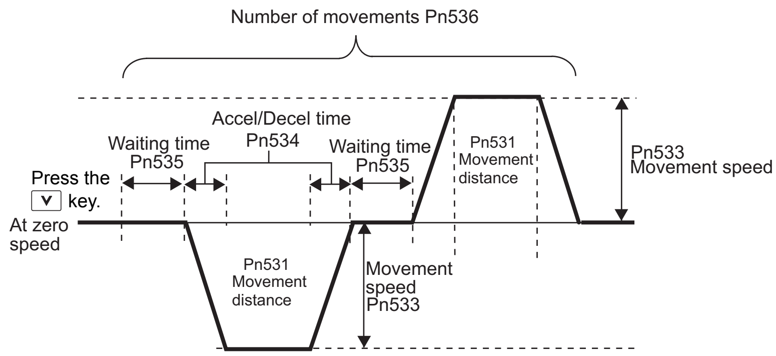
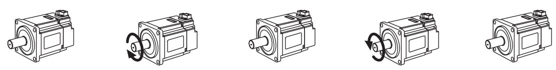


(Stop) (Reverse) (Stop) (Reverse) (Stop) (Forward) (Stop) (Forward)

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

Pn530.0 = 4	
(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reserve movement Pn531) × Number of movements Pn536	
Speed Diagram	
Servomotor Run Status	 (Stop) (Forward) (Stop) (Reverse) (Stop)

Note: When Pn536 (number of times of program JOG movement) is set to 0, infinite time operation is enabled. To stop infinite time operation, press the JOG/SVON Key of digital operator to turn OFF the servomotor power.

Pn530.0 = 5	
(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536	
Speed Diagram	
Servomotor Run Status	 (Stop) (Reverse) (Stop) (Forward) (Stop)

Note: When Pn536 (number of times of program JOG movement) is set to 0, infinite time operation is enabled. To stop infinite time operation, press the JOG/SVON Key of digital operator to turn OFF the servomotor power.

(4) Related Parameters

The following parameters set the program JOG operation pattern. Do not change the settings while the program JOG operation is being executed.

Pn530	Program JOG Operation Related Switch Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0000 to 0005	–	0000	Immediately	Setup

Pn531	Program JOG Movement Distance Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 1073741824	1 reference unit	32768	Immediately	Setup

(cont'd)

Pn533	Program JOG Movement Speed			Speed Position Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	1 to 10000	1 min^{-1}	500	Immediately	Setup
Pn534	Program JOG Acceleration/Deceleration Time			Speed Position Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	2 to 10000	1 ms	100	Immediately	Setup
Pn535	Program JOG Waiting Time			Speed Position Torque	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 Torque	Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	0 to 1000	1 time	1	Immediately	Setup

(5) Operating Procedure

Use the following procedure to perform the program JOG operation after setting a program JOG operation pattern.

Step	Display after Operation	Keys	Operation
1	BB –FUNCTION– Fn003:Z–Search Fn004:Program JOG Fn005:Prm Init Fn006:AlmHist Clr	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn004.
2	BB –PRG JOG– Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00010	DATA	Press the DATA Key. The display changes to the Fn004 execution display.
3*	BB –PRG JOG– Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00010	∧ ∨	Confirm that the parameters have been set. Press the ∨ Key to view Pn530. Press the ∧ Key to view the parameters in the following order: Pn530 → Pn531 → Pn533 → Pn534 → Pn535 → Pn536.
4	RUN –PRG JOG– Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00010	JOG SVON	Press the JOG SVON Key. The status display changes from "BB" to "RUN", and the servomotor power turns ON.
5	RUN –PRG JOG– Pn531=00032768 Pn533=00500 Pn534=00100 Pn536=00010	∧ ∨	Press the ∧ (forward movement start) or ∨ (reverse movement start) Key according to the first movement direction of the preset operation pattern. The servomotor starts moving after the preset waiting time in Pn535. Note: Pressing the JOG SVON Key again changes the status to "BB" (baseblocked status) and stops movement even during operation.
6	RUN –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 baseblocked status. The display returns to the main menu of the utility function.
7	To enable the change in the setting, restart the SERVOPACK.		

* The settings can be changed for a parameter.

Utility Functions (Fn□□□)

7

7.6 Initializing Parameter Settings (Fn005)

This function is used when returning to the factory settings after changing parameter settings.

IMPORTANT
- Be sure to initialize the parameter settings while the servo ON (/S-ON) signal is OFF.
- After initialization, restart the SERVOPACK to validate the settings.

Note: Any value adjusted with Fn009, Fn00A, Fn00B, Fn00C, Fn00D, Fn00E, and Fn00F cannot be initialized by Fn005.

(1) Preparation

The following conditions must be met to initialize the parameter values.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The servo ON signal (/S-ON) must be OFF.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	BB −FUNCTION− Fn004:Program JOG Fn005:Prm Init Fn006:AlmHist Clr Fn008:Mturn Clr	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn005.
2	BB Parameter Init Start : [DATA] Return: [SET]	DATA	Press the DATA Key. The display changes to the Fn005 execution display.
3	BB Parameter Init Start : [DATA] Return: [SET]	DATA MODE/SET	Press the DATA Key to initialize parameters. During initialization, "Parameter Init" is flashing in the display. After the initialization is completed, "Parameter Init" stops flashing and the status display changes as follows: "BB" to "DONE" to "A.941." Note: Press the MODE/SET Key not to initialize parameters. The display returns to the main menu of the utility function.
4	To enable the change in the setting, restart the SERVOPACK.		

7.7 Clearing Alarm History (Fn006)

The clear alarm history function deletes all of the alarm history recorded in the SERVOPACK.

Note: The alarm history is not deleted when the alarm reset is executed or the main circuit power supply of the SERVOPACK is turned OFF.

(1) Preparation

The follow conditions must be met to clear the alarm history.

• The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

(2) Operating Procedure

Use the following procedure.

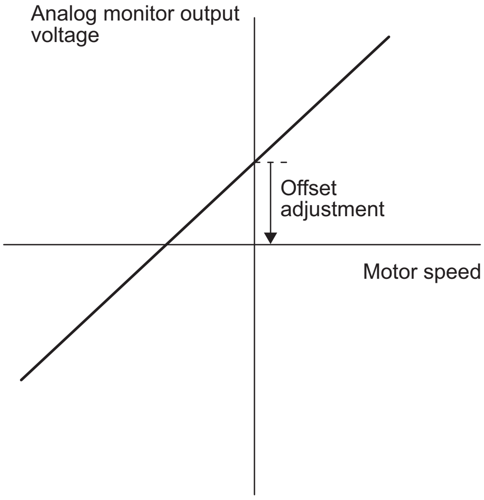
Step	Display after Operation	Keys	Operation
1	BB −FUNCTION− Fn005:Prm Init Fn006:AlmHist Clr Fn008:Mturn Clr Fn009:Ref Adj	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn006.
2	BB Alarm History Data Clear Start : [DATA] Return: [SET]	DATA	Press the DATA Key. The display changes to the Fn006 execution display.
3	BB Alarm History Data Clear Start : [DATA] Return: [SET]	DATA MODE/SET	Press the DATA Key to clear the alarm history. 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 main menu of the utility function.

7.8 Offset Adjustment of Analog Monitor Output (Fn00C)

If connecting an analog monitor unit, the analog monitor signal output (factory setting: torque monitor or motor speed monitor) can be monitored. The offset is adjusted in the analog monitor unit at the factory. The user need not usually use this function. To adjust the offset manually, use this function.

(1) Adjustment Example

An example of offset adjustment to the motor speed monitor is shown below.



Item	Specifications
Offset Adjustment Range	-2.4 V to + 2.4 V
Adjustment Unit	18.9 mV/LSB

Note:
- 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 servomotor is not turned ON, set the monitor signal to the torque reference.
  - In speed control, set the monitor signal to the position error.

(2) Preparation

The following condition must be met to adjust the offsets of the analog monitor output.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

(3) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	BB −FUNCTION− Fn00B:Trq Adj Fn00C:MonZero Adj Fn00D:MonGain Adj Fn00E:Cur AutoAdj	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn00C.
2	BB −Zero ADJ− CH1=−00002 CH2= 00001 Un002= 00000 Un000= 00000	DATA	Press the DATA Key. The display changes to the Fn00C execution display.

(cont'd)

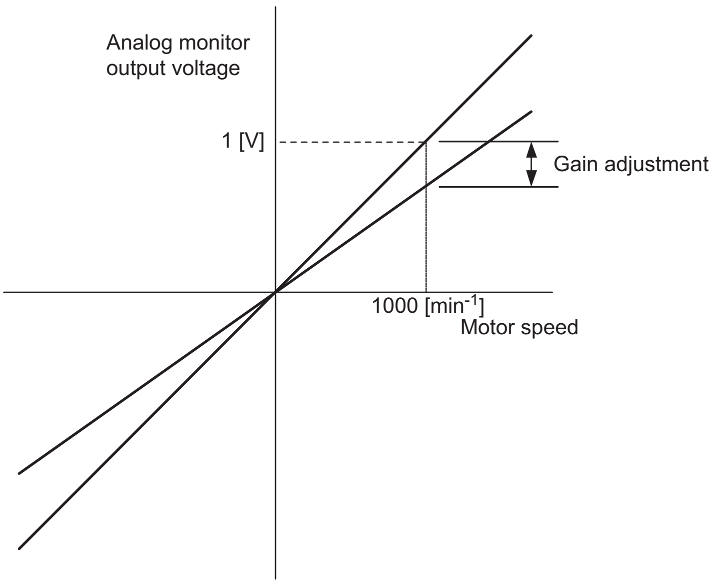
Step	Display after Operation	Keys	Operation
3	BB –Zero ADJ– CH1=–00005 CH2= 00001 Un002= 00000 Un000= 00000	∧ ∨	Press the ∧ or ∨ Key to adjust the offset of CH1 (torque reference monitor). Adjust the offset so that the measurement instrument reading is as close to 0 V as possible.
4	BB –Zero ADJ– CH1=–00005 CH2= 00001 Un002= 00000 Un000= 00000	SCROLL	After the offset adjustment of CH1 has completed, adjust the offset of CH2 (motor rotating 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	BB –Zero ADJ– CH1=–00005 CH2= 00006 Un002= 00000 Un000= 00000	DATA	After having completed the offset adjustment both for CH1 and CH2, press the DATA Key. The adjustment results are saved in the SERVOPACK, and the status display shows "DONE" for one second. The status display then returns to show "BB" again.
7	BB –FUNCTION– Fn00B:Trq Adj Fn00C:MonZero Adj Fn00D:MonGain Adj Fn00E:Cur AutoAdj	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function.

7.9 Gain Adjustment of Analog Monitor Output (Fn00D)

If connecting an analog monitor unit, the analog monitor signal output (factory setting: torque monitor or motor speed monitor) can be monitored. The gain is adjusted in the analog monitor unit at the factory. The user need not usually use this function. To adjust the gain manually, use this function.

(1) Adjustment Example

An example of gain adjustment to the motor rotating speed monitor is shown below.



Item	Specifications
Gain-adjustment Range	100±50%
Adjustment Unit	0.4%/LSB

The gain adjustment range is made with a 100% output set as a center value (adjustment range: 50% to 150%). The following is a setting example.

<Setting the Set Value to –125>
100% + (–125 × 0.4) = 50%
Therefore, the monitor output voltage is 0.5 time as high.

<Setting the Set Value to 125>
100% + (125 × 0.4) =150%
Therefore, the monitor output voltage is 1.5 times as high.

Note: The adjustment value will not be initialized when parameter settings are initialized using Fn005.

(2) Preparation

The following condition must be met to adjust the gain of the analog monitor output.

• The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

(3) Operating Procedure

Use the following procedure to perform the gain adjustment of analog monitor output.

Step	Display after Operation	Keys	Operation
1	BB −FUNCTION− Fn00C:MonZero Adj Fn00D:MonGain Adj Fn00E:Cur AutoAdj Fn00F:Cur ManuAdj	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn00D.
2	BB −Gain ADJ− CH1=−00001 CH2=−00001 Un002= 00000 Un000= 00000	DATA	Press the DATA Key. The display changes to the Fn00D execution display.
3	BB −Gain ADJ− CH1= 00125 CH2=−00001 Un002= 00000 Un000= 00000	∧ ∨	Press the ∨ or ∧ Key to adjust the gain adjustment width of CH1 (torque reference monitor).
4	BB −Gain ADJ− CH1= 00125 CH2=−00001 Un002= 00000 Un000= 00000	SCROLL	After the gain adjustment of CH1 has completed, adjust the gain adjustment width of CH2 (motor rotating speed monitor). Press the SCROLL Key. The cursor moves to CH2 side.
5	BB −Gain ADJ− CH1= 00125 CH2=−00125 Un002= 00000 Un000= 00000	∧ ∨	Adjust the gain of CH2 in the same way as for CH1. Press the ∧ or ∨ Key to adjust the gain adjustment width of CH2.
6	BB −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, and the status display shows "DONE" for one second. The status display then returns to show "BB" again.
7	BB −FUNCTION− Fn00C:MonZero Adj Fn00D:MonGain Adj Fn00E:Cur AutoAdj Fn00F:Cur ManuAdj	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function.

7.10 Automatic Offset-Signal Adjustment of the Motor Current Detection Signal (Fn00E)

Perform this adjustment only if highly accurate adjustment is required for reducing torque ripple caused by current offset. The user need not usually use this function.

IMPORTANT

- Be sure to perform this function while the servo ON signal (/S-ON) is OFF.
- Execute the automatic offset adjustment if the torque ripple is too big when compared with those of other SERVOPACKs.

Note: The adjusted value is not initialized by executing the Fn005 function (Initializing Parameter Settings).

(1) Preparation

The following conditions must be met to automatically adjust the offset of the motor current detection signal.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The SERVOPACK must be in Servo Ready status (Refer to *5.10.4*).
- The servo ON signal (/S-ON) must be OFF.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	BB –FUNCTION– Fn00D:MonGain Adj <u>Fn00E</u>:Cur AutoAdj Fn00F:Cur ManuAdj Fn010:Prm Protect	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn00E.
2	BB Auto Offset–ADJ of Motor Current Start : [DATA] Return: [SET]	DATA	Press the DATA Key. The display changes to the Fn00E execution display.
3	BB Auto Offset–ADJ of Motor Current Start : [DATA] Return: [SET]	DATA MODE/SET	Press the DATA Key to start the automatic offset-signal adjustment of motor current detection. When the adjustment is completed, the status display shows "DONE" for one second. The status display then returns to show "BB" again. Note: Press the MODE/SET Key to cancel the automatic adjustment. The display returns to the main menu of the utility function.

7.11 Manual Offset-Signal Adjustment of the Motor Current Detection Signal (Fn00F)

Use this function only if the torque ripple is still high after the automatic offset-signal adjustment of the motor current detection signal (Fn00E).

> **IMPORTANT**
>
> If offset is adjusted incorrectly and then executed using this function, characteristics of the servomotor performance could be affected.
>
> Observe the following precautions when performing manual servo tuning.
>
> - Run the servomotor at a speed of approximately 100 min^{-1}.
> - Adjust the offset while monitoring the torque reference with the analog monitor until the ripple of torque reference monitor's waveform is minimized.
> - Adjust the phase-U and phase-V offset amounts alternately several times until these offsets are well balanced.

Note: The adjusted value is not initialized by executing the Fn005 function (Initializing Parameter Settings).

(1) Preparation

The following condition must be met to manually adjust the offset of the motor current detection signal.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	BB −FUNCTION− Fn00F:Cur ManuAdj Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn00F.
2	BB Manual Offset−ADJ of Motor Current ZADJIU=-00009 ZADJIV=-00006	DATA	Press the DATA Key. The display changes to the Fn00F execution display.
3	RUN Manual Offset−ADJ of Motor Current ZADJIU=-00009 ZADJIV=-00006	–	Send an SV_ON command from the host controller.
4	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 torque ripple is reduced. Adjustment range: -512 to +511 (ZADJIU: Offset value of phase-U current)
5	RUN Manual Offset−ADJ of Motor Current ZADJIU=-00019 ZADJIV=-00006	SCROLL	Adjust the phase-V offset. Press the SCROLL Key. The cursor moves to the phase-V side.
6	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 torque ripple is reduced. Adjustment range: -512 to +511 (ZADJIV: Offset value of phase-V current)

(cont'd)

Step	Display after Operation	Keys	Operation
7	RUN Manual Offset−ADJ of Motor Current ZADJIU=-00019 ZADJIV=-00016	DATA	Press the DATA Key to save the result of adjustment in the SERVOPACK. When the saving is completed, the status display shows "DONE" for one second. The status display then returns to show "RUN" again.
8	RUN −FUNCTION− Fn00F:Cur ManuAdj Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function.

Note: Repeat the operations of steps 4 to 6 (phase-U and-V alternately) until adjusting the offset amounts both for phase-U and -V in both directions cannot reduce the torque ripple any more.
Then, perform the same operation by adjusting by smaller amount.

7.12 Write Prohibited Setting (Fn010)

This function prevents changing parameters by mistake and sets restrictions on the execution of the utility function.

Parameter changes and execution of the utility function become restricted in the following manner when Write prohibited (P.0001) is assigned to the write prohibited setting parameter (Fn010).

- Parameters: The digital operator cannot be used to change parameters. If attempting to change a parameter, “NO-OP” will flash on the display and the main menu appears again. Parameters can be changed from the SigmaWin+.
- Utility Function: Some functions cannot be executed. (Refer to the following table.) If you attempt to execute these utility functions, “NO-OP” will flash on the display and the screen will return to the main menu.

Parameter No.	Function	Write Prohibited Setting	Reference Section
Fn000	Alarm history display	Executable	7.2
Fn002	JOG operation	Cannot be executed	7.3
Fn003	Origin search	Cannot be executed	7.4
Fn004	Program JOG operation	Cannot be executed	7.5
Fn005	Initializing parameter settings	Cannot be executed	7.6
Fn006	Clearing alarm history	Cannot be executed	7.7
Fn008	Absolute encoder multiturn reset and encoder alarm reset	Cannot be executed	5.9.4
Fn009*1	Automatic tuning of analog (speed, torque) reference offset	Cannot be executed	5.3.2 5.5.2
Fn00A*1	Manual servo tuning of speed reference offset	Cannot be executed	5.3.2
Fn00B*1	Manual servo tuning of torque reference offset	Cannot be executed	5.5.2
Fn00C	Offset adjustment of analog monitor output	Cannot be executed	7.8
Fn00D	Gain adjustment of analog monitor output	Cannot be executed	7.9
Fn00E	Automatic offset-signal adjustment of the motor current detection signal	Cannot be executed	7.10
Fn00F	Manual offset-signal adjustment of the motor current detection signal	Cannot be executed	7.11
Fn010	Write prohibited setting	–	7.12
Fn011	Servomotor model display	Executable	7.13
Fn012	Software version display	Executable	7.14
Fn013	Multiturn limit value setting change when a multiturn limit disagreement alarm occurs	Cannot be executed	5.9.7
Fn01B	Vibration detection level initialization	Cannot be executed	7.15
Fn01E	Display of SERVOPACK and servomotor ID	Executable	7.16
Fn030	Software reset	Executable	7.17
Fn200	Tuning-less levels setting	Cannot be executed	6.2.2
Fn201	Advanced autotuning	Cannot be executed	6.3.2
Fn202*2	Advanced autotuning by reference	Cannot be executed	6.4.2
Fn203	One-parameter tuning	Cannot be executed	6.5.2
Fn204	Anti-resonance control adjustment function	Cannot be executed	6.6.2
Fn205*2	Vibration suppression function	Cannot be executed	6.7.2
Fn206	EasyFFT	Cannot be executed	7.18
Fn207	Online vibration monitor	Cannot be executed	7.19

∗1. This function can be used only with a SERVOPACK for analog voltage references.
∗2. This function can be used only with a SERVOPACK for pulse train references.

(1) Preparation

There are no tasks that must be performed before the execution.

(2) Operating Procedure

Follow the steps to set enable or disable writing.
Setting values are as follows:

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

Step	Display after Operation	Keys	Operation
1	BB –FUNCTION– Fn00F:Cur ManuAdj Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn010.
2	BB Parameter Write Protect P. 0000	DATA	Press the DATA Key. The display changes to the Fn010 execution display.
3	BB Parameter Write Protect P. 0001	∧ ∨	Press the ∧ or ∨ Key to select one of the following settings. P.0000: Write permitted [Factory setting] P.0001: Write prohibited
4	BB 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 "BB." Note: Saved settings will be enabled after the SERVOPACK is restarted.
5	To enable the change in the setting, restart the SERVOPACK.		

Note: To make the setting available, change the setting to P.0000 as shown in step 3.

7.13 Servomotor Model Display (Fn011)

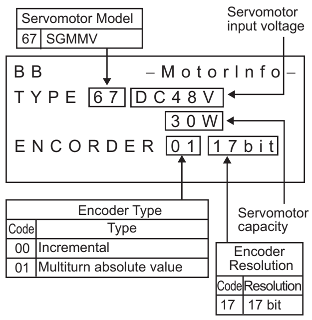
This function is used to check the servomotor model, encoder type, and encoder resolution. If the SERVOPACK has been custom-made, you can also check the specification codes of SERVOPACKs.

(1) Preparation

There are no tasks that must be performed before the execution.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	BB —FUNCTION— Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver Fn013:MturnLmSet	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn011.
2		DATA	Press the DATA Key. The display changes to the Fn011 execution display and shows the information about the servomotor and encoder being used.
3	BB —FUNCTION— Fn010:Prm Protect Fn011:Motor Info Fn012:Soft Ver Fn013:MturnLmSet	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function.

7.14 Software Version Display (Fn012)

Select Fn012 to check the SERVOPACK and encoder software version numbers.

(1) Preparation

There are no tasks that must be performed before the execution.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	BB –FUNCTION– Fn011:Motor Info Fn012:Soft Ver Fn013:MturnLmSet Fn014:Opt Init	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn012.
2	BB –Soft Ver– DRIVER Ver.=0001 ENCODER Ver.=0003	DATA	Press the DATA Key. The display changes to the Fn012 execution display. The software versions of the SERVOPACK and the connected encoder will appear. Note: If the servomotor is not connected, "Not connect" is displayed.
3	BB –FUNCTION– Fn011:Motor Info Fn012:Soft Ver Fn013:MturnLmSet Fn014:Opt Init	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function.

7.15 Vibration Detection Level Initialization (Fn01B)

This function detects vibration when servomotor is connected to a machine in operation and automatically adjusts the vibration detection level (Pn312) to output more exactly the vibration alarm (A.520) and the vibration warning (A.911).

The vibration detection function detects vibration elements according to the motor speed.

Parameter		Meaning	When Enabled	Classification
Pn310	n.□□□0 [Factory setting]	Does not detect vibration.	Immediately	Setup
	n.□□□1	Outputs the warning (A.911) when vibration is detected.		
	n.□□□2	Outputs the alarm (A.520) when vibration is detected.		

If the vibration exceeds the detection level calculated by the following formula, the alarm or warning will be output according to the setting of vibration detection switch (Pn310).

$$\text{Detection level} = \frac{\text{Vibration detection level (Pn312 [min}^{-1}\text{])} \times \text{Vibration detection sensitivity (Pn311 [\%])}}{100}$$

- Use this function if the vibration alarm (A.520) or the vibration warning (A.911) is not output correctly when a vibration at the factory setting of the vibration detection level (Pn312) is detected. In other cases, it is not necessary to use this function.
- The vibration alarm or warning detection sensibility differs depending on the machine conditions. In this case, fine-tune the setting of the vibration detection sensitivity (Pn311) using the above detection level formula as a guide.

Pn311	Vibration Detection Sensitivity Speed Position Torque				Classification
	Setting Range	Setting Unit	Factory Setting	When Enabled	
	50 to 500	1%	100	Immediately	Tuning

IMPORTANT

- The vibration may not be detected because of improper servo gains. Also, not all kinds of vibrations can be detected. Use the detection result as a guideline.
- Set a proper moment of inertia ratio (Pn103). Improper setting may result in the vibration alarm, warning misdetection, or non-detection.
- The references that are used to operate your system must be input to execute this function.
- Execute this function under the operating condition for which the vibration detection level should be set.
- Execute this function while the motor speed reaches at least 10% of its maximum.

(1) Preparation

The following conditions must be met to initialize the vibration detection level.
- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The test without a motor function must be disabled (Pn00C.0 = 0).

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	RUN –FUNCTION– Fn014:Opt Init Fn01B:Viblvl Init Fn01E:SvMotOp ID Fn01F:FBOpMot ID	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn01B.
2	RUN Vibration Detect Level Init Start : [DATA] Return: [SET]	DATA	Press the DATA Key. The display changes to the Fn01B execution display.
3	RUN Vibration Detect Level Init Init	DATA	Press the DATA Key. "Init" is displayed flashing, and the vibration level is detected and initialized. Note: Continues initialization until the DATA Key is pressed again.
4	RUN Vibration Detect Level Init DONE	DATA	Press the DATA Key. The display changes from "Init" to "DONE," for one second and the new setting of Pn312 becomes enabled.
5	RUN –FUNCTION– Fn014:Opt Init Fn01B:Viblvl Init Fn01E:SvMotOp ID Fn01F:FBOpMot ID	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function.

(3) Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.

- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
  No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn311	Vibration Detection Sensitivity	Yes	No
Pn312	Vibration Detection Level	No	Yes

7.16 Display of SERVOPACK and Servomotor ID (Fn01E)

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

The digital operator or SigmaWin+ is required to perform this function.

Refer to *Σ-V Series User's Manual, Operation of Digital Operator* (Manual No.: SIEP S800000 55) for the operating procedure of the digital operator.

The following items can be displayed.

ID	Items to be Displayed
SERVOPACK ID	• SERVOPACK model • SERVOPACK serial number • SERVOPACK manufacturing date • SERVOPACK input voltage (V) • Maximum applicable motor capacity (W) • Maximum applicable motor rated current (Arms)
Servomotor ID	• Servomotor model • Servomotor serial number • Servomotor manufacturing date • Servomotor input voltage (V) • Servomotor capacity (W) • Servomotor rated current (Arms)
Encoder ID	• Encoder model • Encoder serial number • Encoder manufacturing date • Encoder type/resolution

(1) Preparation

There are no tasks that must be performed before the execution.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	RUN -FUNCTION- Fn01B:Viblvl Init Fn01E:SvMotOp ID Fn030:Soft Reset Fn200:TuneLv1 Set	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn01E.
2	Serial number SERVOPACK model BB –SvMotOp ID– Driver SGDV–2R9ES1A D0024123459000 1 11. 07 48V, 30W Manufacturing date / Motor input voltage / Motor capacity	DATA < >	Press the DATA Key. The display changes to the Fn01E execution display. The SERVOPACK ID information is displayed. Use the < or > Key to scroll left and right and to view other information.
3	Serial number Servomotor model BB –SvMotOp ID– Motor SGMMV–A3E2A21 D0024578909000 1 11. 07 48V, 30W Manufacturing date / Motor input voltage / Motor capacity	DATA < >	Press the DATA Key. The servomotor ID information is displayed. Use the < or > Key to scroll left and right and to view other information.

(cont'd)

Step	Display after Operation	Keys	Operation
4	Serial number Encoder model B B −S v M o t O p I D − E n c o d e r U T T A I − B 1 7 G C K 2 4 7 − 0 2 2 5 E 0 0 2 0 0 1 1 . 0 7 1 7 b i t − A B S Manufacturing date Encoder resolution Encoder type	DATA < >	Press the DATA Key. The encoder ID information is displayed. Use the < or > Key to scroll left and right and to view other information.
5	R U N −F U N C T I O N − F n 0 1 B : V i b l v l I n i t F n 0 1 E : S v M o t O p I D F n 0 3 0 : S o f t R e s e t F n 2 0 0 : T u n e L v 1 S e t	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function.

7.17 Software Reset (Fn030)

This function enables resetting the SERVOPACK internally from software. This function is used when resetting alarms and changing the settings of parameters that normally require restarting the SERVOPACK. This function can be used to change those parameters without restarting the SERVOPACK.

IMPORTANT	
	• Start software reset operation after the servo ON signal (/S-ON) is OFF. • This function resets the SERVOPACK independently of host controller. The SERVOPACK carries out the same processing as when the power supply is turned ON and outputs the ALM signal. The status of other output signals may be forcibly changed. • The SERVOPACK will not respond for 5 seconds after the reset begins. Always check the status of the SERVOPACK and motor before you execute a reset.

(1) Preparation

The following condition must be met to perform a software reset.
• The servo ON signal (/S-ON) must be OFF.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	BB −FUNCTION− Fn020:S−Orig Set Fn030:Soft Reset Fn080:Pole Detect Fn200:TuneLvl Set	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn030.
2	BB Software Reset RESET1	DATA	Press the DATA Key. The display changes to the Fn030 execution display.
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. After the software reset starts, "RESET5" will no longer be 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. The screen will then show parameters or monitor displays.
6	BB −FUNCTION− Fn020:S−Orig Set Fn030:Soft Reset Fn080:Pole Detect Fn200:TuneLvl Set	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function.

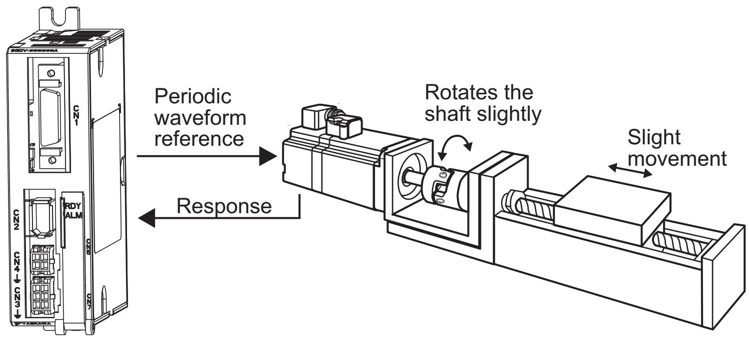
7.18 EasyFFT (Fn206)

EasyFFT sends a frequency waveform reference from the SERVOPACK to the servomotor and slightly rotates the servomotor several 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.

Execute this function after the servo ON signal (/S-ON) is turned OFF if operation of the SERVOPACK results in high-frequency noise and vibration.

⚠ WARNING
• The servomotor automatically will move less than a quarter of a turn several times in the specified direction 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.



SERVOPACK

In addition to this function, online vibration monitor (Fn207) can be used to detect machine vibration and automatically make notch filter settings.

If a DC Power Input Σ-V Series SERVOPACK is used to make adjustments, it is recommended to use advanced autotuning. This built-in EasyFFT function is used to maintain interchangeability with previous models. There is normally no need to use it.

(1) Preparation

The following conditions must be met to perform EasyFFT.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The main circuit power supply must be ON.
- All alarms must be cleared.
- The servo ON signal (/S-ON) must be OFF.
- There must be no overtravel.
- The test without a motor function must be disabled (Pn00C.0 = 0).
- An external reference must not be input.

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	B B –F U N C T I O N– F n 2 0 5 : V i b S u p F n 2 0 6 : E a s y F F T F n 2 0 7 : V - M o n i t o r F n 0 0 0 : A l m H i s t o r y	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn206.
2	B B –E a s y F F T– S e t t i n g I n p u t = 0 1 5 %	DATA	Press the DATA Key. The display changes to the Fn206 execution display.
3	B B –E a s y F F T– S e t t i n g I n p u t = 0 1 5 %	∧ ∨	The cursor is on the setting of "Input." Press the ∧ or ∨ Key to set the sweep torque 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	R U N –E a s y F F T– R e a d y I n p u t = 0 1 5 %	JOG SVON	Press the JOG SVON Key to turn the servomotor power ON. The display “BB” and “Setting” changes to “RUN” and “Ready.”
5	R U N –E a s y F F T– M e a s u r e I n p u t = 0 1 5 %	∧ ∨	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 a quarter turn, the servomotor will move forward and then in reverse several times. Note: • Press the MODE/SET Key to cancel the measurement. The servomotor stops moving and the power turns OFF. The detection of the resonance frequency is not completed. • 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	B B –E a s y F F T– R e s u l t I n p u t = 0 1 5 % R e s = 1 2 5 0 H z F i l t e r 1 1 2 5 0 H z	JOG SVON	When the detection processing is successfully completed, "Measure" stops flashing and the results and the notch filter value to be set are displayed. If the processing was not completed, "No Measure" is displayed. To check the results, go to step 8. <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.

(cont'd)

Step	Display after Operation	Keys	Operation
7	BB –Easy FFT– Ready Input = 015%	MODE/SET, <	To exit the EasyFFT function at this stage, press the MODE/SET Key. The power to the servomotor is turned OFF and the display returns to the main menu of the utility function. To remeasure the vibration frequency, press the < Key to return to step 4. Execute steps 5 to 7.
8	DONE –Easy FFT– Result Input = 015% Res = 1250 Hz Filter1 1250 Hz	DATA	Press the DATA Key after the normal completion of frequency detection. The notch filter frequencies are automatically updated to the optimum values. The status display shows "DONE" and the display shown on the left appears. If the first stage notch filter frequency has been set (Pn408.0 = 1), the second stage notch filter frequency (Pn 40C) will automatically be updated. Notes: • If the first stage or the second stage notch filter frequency has already been set (Pn408 = n.□1□1), the notch filter frequency cannot be set. • If the frequency detected by this function is not used, set the notch filter to be invalid (Pn408.0 = 0).
9	BB –FUNCTION– Fn205:Vib Sup Fn206:Easy FFT Fn207:V-Monitor Fn000:Alm History	MODE/SET	Press the MODE/SET Key. The servomotor enters a baseblocked status. The display returns to the main menu of the utility function.
10	To enable the change in the setting, restart the SERVOPACK.		

(3) Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

• Parameters related to this function
These are parameters that are used or referenced when executing this function.

• Allowed changes during execution of this function
Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

• Automatic changes after execution of this function
Yes : Parameter set values are automatically set or adjusted after execution of this function.
No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn408	Torque Related Function Switch	Yes	Yes
Pn409	1st Notch Filter Frequency	No	Yes
Pn40A	1st Notch Filter Q Value	No	No
Pn40C	2nd Notch Filter Frequency	No	Yes
Pn40D	2nd Notch Filter Q Value	No	No
Pn456	Sweep Torque Reference Amplitude	No	No

7.19 Online Vibration Monitor (Fn207)

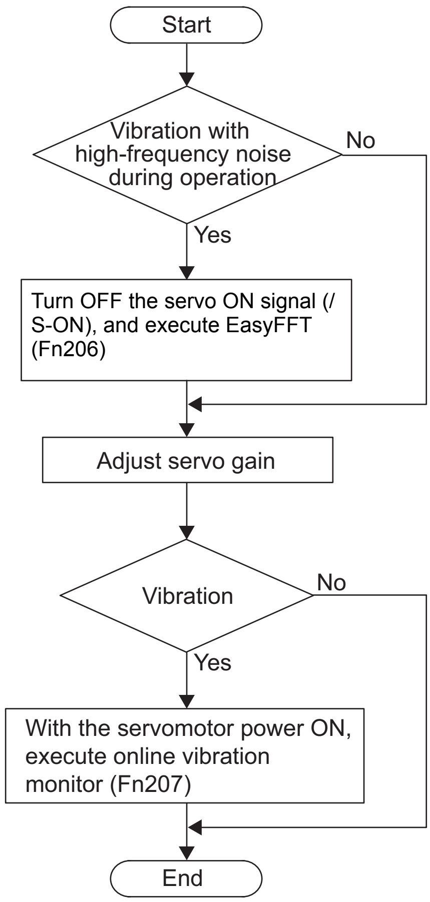
If vibration is generated during operation and this function is executed while the servo ON signal (/S-ON) is still ON, the machine vibration can sometimes be suppressed by setting a notch filter or torque reference filter for the vibration frequencies.

When online, vibration frequency caused by machine resonance will be detected and the frequency that has the highest peak will be displayed on the panel operator. The effective torque reference filter or notch filter frequency for the vibration frequencies will be automatically selected and the related parameters will be automatically set.

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 how these functions should be used.

If a DC Power Input Σ-V Series SERVOPACK is used to make adjustments, it is recommended that you use advanced autotuning. This built-in function is used to maintain interchangeability with previous models. There is normally no need to use it.

How to use EasyFFT (Fn206) and online vibration monitor (Fn207), when they are mainly used for servo gain adjustment.



(1) Preparation

The following conditions must be met to perform online vibration monitoring.

- The write prohibited setting parameter (Fn010) must be set to Write permitted (P.0000).
- The servo ON signal (/S-ON) must be ON.
- There must be no overtravel.
- The correct moment of inertia (Pn103) must be set.
- The test without a motor function must be disabled (Pn00C.0 = 0).

(2) Operating Procedure

Use the following procedure.

Step	Display after Operation	Keys	Operation
1	RUN –FUNCTION– Fn206:Easy FFT Fn207:V–Monitor Fn000:Alm History Fn001:JOG	MODE/SET ∧ ∨	Press the MODE/SET Key to view the main menu for the utility function. Use the ∧ or ∨ Key to move through the list and select Fn207.
2	RUN –V–MONITOR– Measure F1=–––– F2=–––– F3=––––	DATA	Press the DATA Key. The display changes to the Fn207 execution display.
3	RUN –V–MONITOR– Measure F1=–––– F2=–––– F3=––––	DATA	Press the DATA Key for at least one second to start vibration detection. The DATA Key must be pressed until "Measure" flashes on the display. After this message appears, the DATA Key does not have to be pressed and the detection continues automatically.
4	RUN –V–MONITOR– Measure F1= 0850[Hz] F2= 1600[Hz] F3= 0225[Hz]	MODE/SET	When the vibration detection has completed, "Measure" stops flashing 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 for F1, F2, and F3. Notes: • Press the MODE/SET Key to quit the online vibration monitor function. The display returns to the main menu of the utility function. • A detected frequency can be displayed. For a vibration with undetectable peak frequency, "----" is displayed. If no frequency was detected, "----" is displayed for F1, F2, and F3. • If the frequency could not be successfully detected, "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 torque 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 torque reference filter. After the setting is successfully completed, "DONE" flashes.
6	RUN –FUNCTION– Fn206:Easy FFT Fn207:V–Monitor Fn000:Alm History Fn001:JOG	MODE/SET	Press the MODE/SET Key. The display returns to the main menu of the utility function.

(3) Related Parameters

The following table lists parameters related to this function and their possibility of being changed while executing this function or of being changed automatically after executing this function.

- Parameters related to this function
  These are parameters that are used or referenced when executing this function.

- Allowed changes during execution of this function
  Yes : Parameters can be changed using SigmaWin+ while this function is being executed.
  No : Parameters cannot be changed using SigmaWin+ while this function is being executed.

- Automatic changes after execution of this function
  Yes : Parameter set values are automatically set or adjusted after execution of this function.
  No : Parameter set values are not automatically set or adjusted after execution of this function.

Parameter	Name	Mid-execution changes	Automatic changes
Pn401	Torque Reference Filter Time Constant	No	Yes
Pn408	Torque Related Function Switch	Yes	Yes
Pn409	1st Notch Filter Frequency	No	Yes
Pn40A	1st Notch Filter Q Value	No	No
Pn40C	2nd Notch Filter Frequency	No	No
Pn40D	2nd Notch Filter Q Value	No	No

8

Monitor Displays (Un□□□)

8.1 List of Monitor Displays

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

Refer to the following table.

Parameter No.	Description	Unit
Un000	Motor rotating speed	min^{-1}
Un001	Speed reference	min^{-1}
Un002	Internal torque reference (in percentage to the rated torque)	%
Un003	Rotational angle 1 (encoder pulses from the phase-C origin: decimal display)	encoder pulse*3
Un004	Rotational angle 2 (from polarity origin (electric angle))	deg
Un005*1	Input signal monitor	–
Un006*2	Output signal monitor	–
Un007*4	Input reference pulse speed (valid only in position control)	min^{-1}
Un008*4	Position error amount (valid only in position control)	reference unit
Un009	Accumulated load ratio (in percentage to the rated torque: effective torque in cycle of 10 seconds)	%
Un00C*4	Input reference pulse counter	reference unit
Un00D	Feedback pulse counter	encoder pulse*3
Un012	Total operation time	100 ms
Un013	Feedback pulse counter	reference unit
Un014	Effective gain monitor (gain settings 1 = 1, gain settings 2 = 2)	–
Un020	Motor rated speed	min^{-1}
Un021	Motor maximum speed	min^{-1}

∗1. For details, refer to *8.3 Monitoring Input Signals*.
∗2. For details, refer to *8.4 Monitoring Output Signals*.
∗3. For details, refer to *5.4.4 Electronic Gear*.
∗4. If the reference pulse input multiplication switching function is enabled, the reference pulse will be multiplied by n to obtain the reference.

8.2 Viewing Monitor Displays

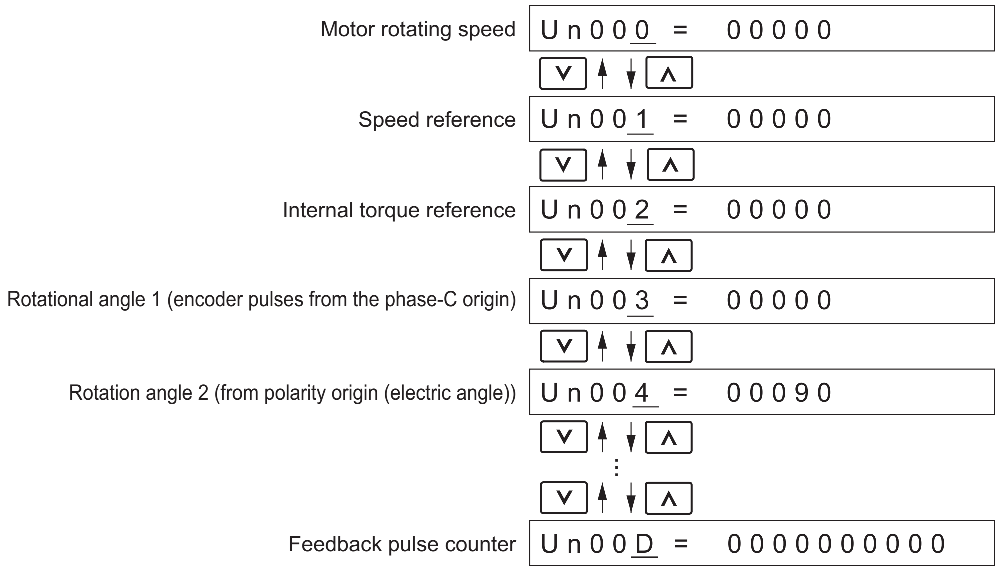
The monitor display can be checked or viewed in the Parameter/Monitor (-PRM/MON-) window of the digital operator.

The following figure shows four factory settings that are first displayed if viewing monitor displays.

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

Indicates that the value of Un000 (motor rotating speed) is 0 min^{-1}.

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



8.3 Monitoring Input Signals

The status of input signals can be checked with the input signal monitor (Un005). The method of interpreting the display and a display example are shown below.

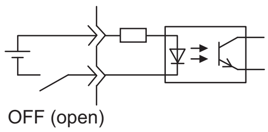
8.3.1 Interpreting Input Signal Display Status

The input signal monitor (Un005) can be read in the following way. The upper level indicates OFF, and the lower level indicates ON. All undefined digits are shown in the lower level (ON).

Display LED Number	Input Terminal Name	Signal Name (Factory Setting)
1	CN1-15	/S-ON
2	CN1-16	/P-CON
3	CN1-17	P-OT
4	CN1-18	N-OT
5	CN1-25	/ALM-RST
6	CN1-26	/P-CL
7	CN1-12	/N-CL
8	–	Reserved

Note: Input signals use the following circuit configuration.
- OFF: Open
- ON: Short-circuited

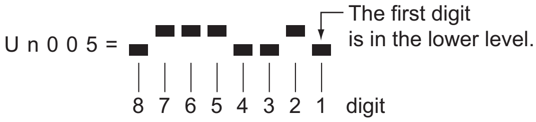
Example



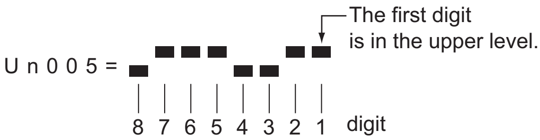
8.3.2 Input Signal Display Example

Input signals are displayed as shown below.

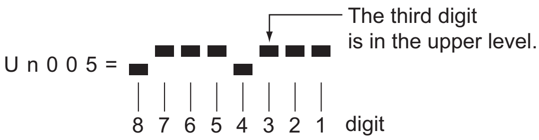
- When the /S-ON signal is ON



- When the /S-ON signal is OFF



- When the P-OT signal is activated

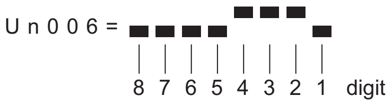


8.4 Monitoring Output Signals

The status of output signals can be checked with the output signal monitor (Un006). The method of interpreting the display and a display example are shown below.

8.4.1 Interpreting Output Signal Display Status

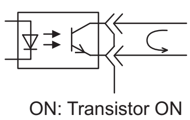
The output signal monitor (Un006) can be read in the following way. The upper level indicates OFF, and the lower level indicates ON. All undefined digits are shown in the lower level (ON).



Display LED Number	Output Terminal Name	Signal Name (Factory Setting)
1	CN1-8 (cannot be allocated)	ALM
2	CN1-7 (can be allocated)	/COIN or /V-CMP
3	CN1-9 (can be allocated)	/TGON
4	CN1-10 (can be allocated)	/S-RDY
5	–	Reserved
6	–	Reserved
7	–	Reserved
8	–	Reserved

Note: Output signals use the following circuit configuration.
- OFF: Transistor OFF
- ON: Transistor ON

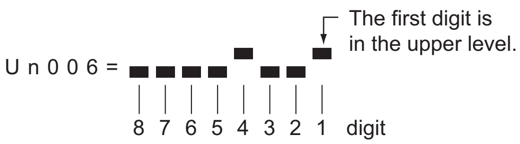
Example



8.4.2 Output Signal Display Example

Output signals are displayed as shown below.

- When the ALM signal is OFF



9

Troubleshooting

9.1 Alarm Displays

The following sections describe troubleshooting in response to alarm displays.

The alarm name, alarm meaning, alarm stopping method, and alarm reset capability are listed in order of the alarm numbers in *9.1.1 List of Alarms*.

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

9.1.1 List of Alarms

This section provides list of alarms.

■ Servomotor Stopping Method

If an alarm occurs, the servomotor can be stopped by doing either of the following operations.

Gr.1: The servomotor coasts to a stop when an alarm occurs.

Gr.2: The servomotor is stopped according to the setting in Pn00B.1 if an alarm occurs. Pn00B.1 is factory-set to stop the servomotor by setting the speed reference to "0." The servomotor under torque control will always use the Gr.1 method to stop. By setting Pn00B.1 to 1, the servomotor stops using the same method as Gr.1. When coordinating a number of servomotors, use this stopping method to prevent machine damage that may result due to differences in the stop method.

■ Alarm Reset

Available: Removing the cause of alarm and then executing the alarm reset can clear the alarm.
N/A: Executing the alarm reset cannot clear the alarm.

Alarm Number	Alarm Name	Meaning	Servo-motor Stopping Method	Alarm Reset
A.020	Parameter Checksum Error 1	The data of the parameter in the SERVOPACK is incorrect.	Gr.1	N/A
A.021	Parameter Format Error 1	The data of the parameter in the SERVOPACK is incorrect.	Gr.1	N/A
A.022	System Checksum Error 1	The data of the parameter in the SERVOPACK is incorrect.	Gr.1	N/A
A.030	Main Circuit Detector Error	Detection data for main circuit is incorrect.	Gr.1	Available
A.040	Parameter Setting Error 1	The parameter setting is outside the setting range.	Gr.1	N/A
A.041	Encoder Output Pulse Setting Error	The encoder output pulse (Pn212) is outside the setting range or does not satisfy 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.050	Combination Error	The SERVOPACK and the servomotor capacities do not match each other.	Gr.1	Available
A.051	Unsupported Device Alarm	The device unsupported was connected.	Gr.1	N/A
A.0b0	Cancelled Servo ON Command Alarm	The servo ON signal (/S-ON) was sent from the host controller after executing a utility function that turns ON servomotor.	Gr.1	Available
A.100	Overcurrent or Heat Sink Overheated	An overcurrent flowed through the IGBT or the heat sink of the SERVOPACK was overheated.	Gr.1	N/A
A.400	Overvoltage	Main circuit DC voltage is excessively high.	Gr.1	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 above the maximum rotational speed.	Gr.1	Available

(cont'd)

Alarm Number	Alarm Name	Meaning	Servo-motor Stopping Method	Alarm Reset
A.511	Overspeed of Encoder Output Pulse Rate	The pulse output speed upper limit of the set encoder output pulse (Pn212) is exceeded.	Gr.1	Available
A.520	Vibration Alarm	Incorrect vibration at the motor speed was detected.	Gr.1	Available
A.521	Autotuning Alarm	Vibration was detected while performing tuning-less function.	Gr.1	Available
A.710	Overload: High Load	The servomotor was operating for several seconds to several tens of seconds under a torque largely exceeding ratings.	Gr.2	Available
A.720	Overload: Low Load	The servomotor was operating continuously under a torque exceeding ratings.	Gr.1	Available
A.7A0	Heat Sink Overheated	The heat sink of the SERVOPACK exceeded 90°C.	Gr.2	Available
A.810	Encoder Backup Error	The power supplies to the encoder all failed and position data was lost.	Gr.1	N/A
A.820	Encoder Checksum Error	The checksum results of encoder memory is incorrect.	Gr.1	N/A
A.830	Absolute Encoder Battery Error	The battery voltage was lower than the specified value after the control power supply was turned ON.	Gr.1	Available
A.840	Encoder Data Error	Data in the encoder is incorrect.	Gr.1	N/A
A.850	Encoder Overspeed	The encoder was rotating at high speed when the power was turned ON.	Gr.1	N/A
A.860	Encoder Overheated	The internal temperature of encoder is too high.	Gr.1	N/A
A.b10[*1]	Speed Reference A/D Error	The A/D converter for speed reference input is faulty.	Gr.2	Available
A.b11[*1]	Speed Reference A/D Data Error	A/D conversion data of speed reference input is incorrect.	Gr.2	Available
A.b20[*1]	Reference Torque Input Read Error	The A/D converter for torque reference input is faulty.	Gr.2	Available
A.b31	Current Detection Error 1	The current detection circuit for phase U is faulty.	Gr.1	N/A
A.b32	Current Detection Error 2	The current detection circuit for phase V is faulty.	Gr.1	N/A
A.b33	Current Detection Error 3	The detection circuit for the current is faulty.	Gr.1	N/A
A.bE0	Firmware Error	An internal program error occurred in the SERVOPACK.	Gr.1	N/A
A.bF0	System Alarm 0	"Internal program error 0" of the SERVOPACK occurred.	Gr.1	N/A
A.bF1	System Alarm 1	"Internal program error 1" of the SERVOPACK occurred.	Gr.1	N/A
A.bF2	System Alarm 2	"Internal program error 2" of the SERVOPACK occurred.	Gr.1	N/A
A.bF3	System Alarm 3	"Internal program error 3" of the SERVOPACK occurred.	Gr.1	N/A
A.bF4	System Alarm 4	"Internal program error 4" of the SERVOPACK occurred.	Gr.1	N/A
A.C10	Servo Overrun Detected	The servomotor ran out of control.	Gr.1	Available
A.C80	Absolute Encoder Clear Error and Multiturn Limit Setting Error	The multiturn for the absolute encoder was not properly cleared or set.	Gr.1	N/A

∗1. This alarm will occur only for a SERVOPACK for analog voltage references.

(cont'd)

Alarm Number	Alarm Name	Meaning	Servo-motor Stopping Method	Alarm Reset
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 are incorrect.	Gr.1	N/A
A.CC0	Multiturn Limit Disagreement	Different multiturn limits have been set in the encoder and the SERVOPACK.	Gr.1	N/A
A.d00*2	Position Error Overflow	Position error exceeded the value of excessive position error alarm level (Pn520) when the servomotor power is ON.	Gr.1	Available
A.d01*2	Position Error Overflow Alarm at Servo ON	This alarm occurs if the servomotor power is turned ON when the position error is greater than the set value of Pn526 while the servomotor power is OFF.	Gr.1	Available
A.d02*2	Position Error Overflow Alarm by Speed Limit at Servo ON	When the position errors remain in the error counter, Pn529 limits the speed if the servomotor power is turned ON. If Pn529 limits the speed in such a state, this alarm occurs when reference pulses are input and the number of position errors exceeds the value set for the excessive position error alarm level (Pn520).	Gr.2	Available
A.F50	Servomotor Main Circuit Cable Disconnection	The servomotor did not operate or power was not supplied to the servomotor even though the /S-ON (Servo ON) signal was input when the servomotor was ready to receive it.	Gr.1	Available
CPF00	Digital Operator Transmission Error 1	Digital operator 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	–	–

*2. This alarm will occur only for a SERVOPACK for pulse train references.

9.1.2 Troubleshooting of Alarms

If an error occurs in the servo drive, the SERVOPACK will output an alarm signal and the alarm number will be displayed on the digital operator or SigmaWin+.

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 Number: Alarm Name (Alarm Description)	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.	Check 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.	Check to see if the parameters were frequently changed through the host controller.	The SERVOPACK may be faulty. 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.	Restart the SERVOPACK 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. Replace the SERVOPACK.
	A SERVOPACK fault occurred.	Restart the SERVOPACK several times. If the alarm still occurs, the SERVOPACK may be faulty.	The SERVOPACK may be faulty. 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. Restart the SERVOPACK.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. 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. Replace the SERVOPACK.
	The power supply went OFF while setting a utility function.	Check the circumstances when the power supply went OFF.	The SERVOPACK may be faulty. Replace the SERVOPACK.
	A SERVOPACK fault occurred.	Restart the SERVOPACK several times. If the alarm still occurs, the SERVOPACK may be faulty.	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.030: Main Circuit Detector Error	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.040: Parameter Setting Error 1 (The parameter setting was out of the 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. Replace the SERVOPACK.
	The parameter setting is out of the setting range.	Check the setting ranges of the parameters that have been changed.	Set the parameter to a value within the setting range.
	The electronic 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 (Pn212) is out of the setting range and does not satisfy the setting conditions.	Check the parameter Pn212.	Set Pn212 to a correct value.

Troubleshooting

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(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
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 if the detection conditions[*1] are satisfied.	Decrease the setting of 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 the program JOG movement speed (Pn533).	Check if the detection conditions[*1] are satisfied.	Increase the setting of the program JOG movement speed (Pn533).
	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 if the detection conditions[*2] are satisfied.	Decrease the setting of the electronic gear ratio (Pn20E/Pn210).
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: $\frac{1}{4} \leq \frac{\text{Servomotor capacity}}{\text{SERVOPACK capacity}} \leq 4$	Select the proper combination of SERVOPACK and servomotor capacities.
	An encoder fault occurred.	Replace the servomotor and see if the alarm occurs again.	Replace the servomotor (encoder).
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.051: Unsupported Device Alarm	An unsupported encoder is connected to the SERVOPACK.	Check the product specifications, and select the correct model.	Select the correct combination of units.
A.0b0: Cancelled Servo ON Command Alarm	After executing the utility function to turn ON the power to the motor, the servo ON signal (/S-ON) was sent from the host controller.	–	Restart the SERVOPACK or execute a software reset.

∗1. Detection conditions
If one of the following conditions detected, an alarm occurs.

- $\text{Pn533 [min}^{-1}] \times \frac{\text{Encoder resolution}}{6 \times 10^5} \leq \frac{\text{Pn20E}}{\text{Pn210}}$
- $\text{Max Motor Speed [min}^{-1}] \times \frac{\text{Encoder resolution}}{\text{About } 3.66 \times 10^{12}} \geq \frac{\text{Pn20E}}{\text{Pn210}}$

∗2. Detection conditions
If one of the following conditions detected, an alarm occurs.

- $\text{Rated Motor Speed [min}^{-1}] \times \frac{1}{3} \times \frac{\text{Encoder resolution}}{6 \times 10^5} \leq \frac{\text{Pn20E}}{\text{Pn210}}$
- $\text{Max Motor Speed [min}^{-1}] \times \frac{\text{Encoder resolution}}{\text{About } 3.66 \times 10^{12}} \geq \frac{\text{Pn20E}}{\text{Pn210}}$

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
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 servomotor main circuit cables.	Check the wiring. Refer to *3.1 Main Circuit Wiring*.	Correct the wiring.
	Short-circuit or ground fault of servomotor main circuit cables.	Check for short-circuits across the servomotor terminal phases U, V, and W, or between the grounding and servomotor terminal phases U, V, or W. Refer to *3.1 Main Circuit Wiring*.	The cable may be short-circuited. Replace the cable.
	Short-circuit or ground fault inside the servomotor.	Check for short-circuits across the servomotor terminal phases U, V, and W, or between the grounding and servomotor terminal phases U, V, or W. Refer to *3.1 Main Circuit Wiring*.	The servomotor may be faulty. 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. Replace the SERVOPACK.
	A heavy load was applied while the servomotor was stopped or running at a low speed.	Check to see if the operating conditions are outside servo drive specifications.	Reduce the load applied to the servomotor or increase the operating speed.
	Malfunction caused by noise interference.	Improve the wiring or installation environment, such as by reducing noise, and check to see if the alarm recurs.	Take countermeasures for noise, such as correct wiring of the FG. Use an FG wire size equivalent to the SERVOPACK main circuit wire size.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.400: Overvoltage (Detected in the SERVOPACK main circuit power supply section.)	The DC power supply voltage exceeded 60 V.	Measure the power supply voltage.	Set DC 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, restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
	Voltage for DC power supply was too high during acceleration or deceleration.	Check the power supply voltage and the speed and torque during operation.	Set DC power supply voltage within the specified range.
	The moment of inertia ratio exceeded the allowable value.	Confirm that the moment of inertia ratio 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. Replace the SERVOPACK.
A.450: Main-Circuit Capacitor Overvoltage	A SERVOPACK fault occurred.	–	Replace the SERVOPACK.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
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 motor 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 exceeded the maximum.	Check the motor speed waveform.	Reduce the speed reference input gain, adjust the servo gain, or reconsider the operating conditions.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.511: Overspeed of Encoder Output Pulse Rate	The encoder output pulse frequency exceeded the limit.	Check the encoder output pulse setting.	Decrease the setting of the encoder output pulse (Pn212).
	The encoder output pulse output frequency exceeded the limit because the motor speed was too high.	Check the encoder output pulse output setting and motor speed.	Decrease the motor speed.
A.520: Vibration Alarm	Abnormal vibration was detected at the motor speed.	Check for abnormal noise from the servomotor, and check the speed and torque waveforms during operation.	Reduce the motor speed or reduce the speed loop gain (Pn100).
	The moment of inertia ratio (Pn103) value is greater than the actual value or is greatly changed.	Check the moment of inertia ratio.	Set the moment of inertia ratio (Pn103) to an appropriate value.
A.521: Autotuning Alarm (Vibration was detected while executing the one-parameter tuning, EasyFFT, or tuning-less function.)	The servomotor vibrated considerably while performing tuning-less function.	Check the motor speed waveform.	Reduce the load so that the moment of inertia ratio falls within the allowable value, or raise the load level using the tuning-less levels setting (Fn200) or reduce the rigidity level.
	The servomotor vibrated considerably during one-parameter tuning or EasyFFT.	Check the motor speed waveform.	Check the operation procedure of corresponding function and take a corrective action.
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 operating conditions. Or, increase the motor capacity.
	Excessive load was applied during operation because the servomotor was not driven due to mechanical problems.	Check the executed operation reference and motor speed.	Remove the mechanical problems.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.7A0: Heat Sink Overheated (Detected when the heat sink temperature exceeds 90°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 history display (Fn000) to see if the overload alarm was reported.	Change the method for resetting the alarm.
	Excessive load was applied during operation.	Check the accumulated load ratio (Un009) to see the load during operation.	Reconsider the load conditions and operating 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. Replace the SERVOPACK.
A.810: Encoder Backup Error (Only when an absolute encoder is connected.) (Detected on the encoder side.)	Alarm occurred when the power to the absolute encoder was initially turned ON.	Check to see if the power was turned ON initially.	Set up the encoder (Fn008).
	The encoder cable disconnected, and connected again.	Check to see if the power was turned ON initially.	Confirm the connection and set up the encoder (Fn008).
	The power from both the control power supply (+5 V) from the SERVOPACK and the battery power supply is not being supplied.	Check the encoder connector battery or the connector contact status.	Replace the battery or take similar measures to supply power to the encoder, and set up the encoder (Fn008).
	An absolute encoder fault occurred.	–	If the alarm cannot be reset by setting up the encoder again, replace the servomotor.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.820: Encoder Checksum Error (Detected on the encoder side.)	An encoder fault occurred.	–	• Absolute encoder Set up the encoder again using Fn008. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor. • One-turn absolute encoder or incremental encoder The servomotor may be faulty. Replace the servomotor.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.830: Absolute Encoder Battery Error (The absolute encoder battery voltage is lower than the specified value.)	The battery connection is incorrect.	Check the battery connection.	Reconnect the battery.
	The battery voltage is lower than the specified value 2.7 V.	Measure the battery voltage.	Replace the battery.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.840: Encoder Data Error (Detected on the encoder side.)	An encoder malfunctioned.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	Malfunction of encoder because of noise interference, etc.	–	Correct the wiring around the encoder by separating the encoder cable from the servomotor main circuit cable or by checking the grounding and other wiring.

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.850: Encoder Overspeed (Detected when the control power supply was turned ON.) (Detected on the encoder side.)	The servomotor speed is higher than 200 min^{-1} when the control power supply was turned ON.	Check the motor rotating speed (Un000) to confirm the servomotor speed when the power is turned ON.	Reduce the servomotor speed to a value less than 200 min^{-1}, and turn ON the control power supply.
	An encoder fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.860: Encoder Overheated (Only when an absolute encoder is connected.) (Detected on the encoder side.)	The ambient operating temperature around the servomotor is too high.	Measure the ambient operating temperature around the servomotor.	The ambient operating temperature must be 40°C or less.
	The motor load is greater than the rated load.	Check the accumulated load ratio (Un009) to see the load.	The motor load must be within the specified range.
	An encoder fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b10*3: Speed Reference A/D Error (Detected when the servo is ON.)	A malfunction occurred in the speed reference input section.	–	Clear and reset the alarm and restart the operation.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b11*3: Speed Reference A/D Data Error	A malfunction occurred in the speed reference input section.	–	Clear and reset the alarm and restart the operation.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b20*3: Reference Torque Input Read Error (Detected when the servo is ON.)	A malfunction occurred in the reading section of the torque reference input.	–	Clear and reset the alarm and restart the operation.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b31: Current Detection Error 1	The current detection circuit for phase U is faulty.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b32: Current Detection Error 2	The current detection circuit for phase V is faulty.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.b33: Current Detection Error 3	The detection circuit for the current is faulty.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
	The servomotor main circuit cable is disconnected.	Check for disconnection of the servomotor main circuit cable.	Correct the servomotor wiring.

∗3. This alarm will occur only for a SERVOPACK for analog voltage references.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.bE0: Firmware Error	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.bF0: System Alarm 0	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.bF1: System Alarm 1	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.bF2: System Alarm 2	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.bF3: System Alarm 3	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.bF4: System Alarm 4	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.C10: Servo Overrun Detected (Detected when the servomotor power is ON.)	The order of phases U, V, and W in the servomotor wiring is incorrect.	Check the motor wiring.	Confirm that the servomotor is correctly wired.
	An encoder fault occurred.	–	If the alarm still occurs after restarting the SERVOPACK, even though the servomotor is correctly wired, the servomotor may be faulty. Replace the servomotor.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.C80: Absolute Encoder Clear Error and Multi-turn Limit Setting Error	An encoder fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.C90: Encoder Communications Error	Contact fault of connector or incorrect wiring for encoder cable.	Check the connector contact status for encoder cable.	Re-insert the connectors and confirm that the encoder is correctly wired.
	Cable disconnection for encoder cable or short-circuit. Or, incorrect cable impedance.	Check the encoder cable.	Use the cables with the specified rating.
	Corrosion caused by improper temperature, humidity, or gas, short-circuit caused by intrusion of water drops or cutting oil, or connector contact fault caused by vibration.	Check the operating environment.	Improve the operating environmental conditions, and replace the cable. If the alarm still occurs, replace the SERVOPACK.
	Malfunction caused by noise interference.	–	Correct the wiring around the encoder by separating the encoder cable from the servomotor main circuit cable or by checking the grounding and other wiring.
	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. Replace the SERVOPACK.
A.C91: Encoder Communications Position Data Error	Noise interference occurred on the I/O 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 cable layout.
	The encoder cable is bundled with a high-current line or near a high-current line.	Check the cable layout for encoder cable.	Confirm that there is no surge voltage on the cables.
	The FG potential varies because of influence from machines on the servomotor side, such as the welder.	Check the cable layout for encoder cable.	Properly ground the machines to separate from the encoder FG.
A.C92: Encoder Communications Timer Error	Noise interference occurred on the I/O signal line from the encoder.	–	Take countermeasures against noise for the encoder wiring.
	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.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.CA0: Encoder Parameter Error	An encoder fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.

(cont'd)

Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.Cb0: Encoder Echoback Error	The wiring and contact for encoder cable are incorrect.	Check the wiring.	Correct the wiring.
	Noise interference occurred due to incorrect cable specifications of encoder cable.	–	Use tinned annealed copper shielded twisted-pair or screened unshielded 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 50 m max.
	The FG potential varies because of influence from machines on the servomotor side, such as the welder.	Check the cable layout for encoder cable.	Properly ground the machines to separate from encoder 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.	–	Restart the SERVOPACK. If the alarm still occurs, the servomotor may be faulty. Replace the servomotor.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.CC0: Multiturn Limit Disagreement	The multiturn limit value of the encoder is different from that of the SERVOPACK. Or, the multiturn limit value of the SERVOPACK has been changed.	Check the value of the Pn205 of the SERVOPACK.	Execute Fn013 at the occurrence of alarm.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.d00*4: Position Error Overflow (Position error exceeded the value set in the excessive position error alarm level (Pn520).)	The servomotor U, V, and W wirings is faulty.	Check the servomotor main circuit cable connection.	Confirm that there is no contact fault in the motor wiring or encoder wiring.
	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 acceleration of position reference. Or, reconsider the electronic gear ratio.
	The acceleration of the position reference is too high.	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 excessive position error alarm level (Pn520) 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.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.d01*4: Position Error Overflow Alarm at Servo ON	This alarm occurs if the servomotor power is turned ON when the position error is greater than the set value of Pn526 while the servomotor power is OFF.	Check the position error amount (Un008) while the servomotor power is OFF.	Set position error to be cleared while the servomotor power is OFF. Or, correct the excessive position error alarm level at servo ON (Pn526).

*4. This alarm will occur only for a SERVOPACK for pulse train references.

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Alarm Number: Alarm Name (Alarm Description)	Cause	Investigative Actions	Corrective Actions
A.d02*4: Position Error Overflow Alarm by Speed Limit at Servo ON	When the position errors remain in the error counter, Pn529 limits the speed if the servomotor power is ON. If Pn529 limits the speed in such a state, this alarm occurs when reference pulses are input and the number of position errors exceeds the value set for the excessive position error alarm level (Pn520).	–	Set position error to be cleared while the servomotor power is OFF. Or, correct the excessive position error alarm level (Pn520). Or, adjust the speed limit level at servo ON (Pn529).
A.F50: Servomotor Main Circuit Cable Disconnection (The servomotor did not operate or power was not supplied to the servomotor even though the /S-ON (Servo ON) signal was input when the servomotor was ready to receive it.)	A SERVOPACK fault occurred.	–	The SERVOPACK may have failed. Replace the SERVOPACK.
	The wiring is not correct or there is a faulty contact in the motor wiring.	Check the wiring.	Make sure that the servomotor is correctly wired.
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. Replace the digital operator.
	A SERVOPACK fault occurred.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.

*4. This alarm will occur only for a SERVOPACK for pulse train references.

9.2 Warning Displays

The following sections describe troubleshooting in response to warning displays.

The warning name and warning meaning are listed in order of the warning numbers in *9.2.1 List of Warnings*.

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

9.2.1 List of Warnings

This section provides list of warnings.

Warning Number	Warning Name	Meaning
A.900	Position Error Overflow	Position error exceeded the parameter setting (Pn520×Pn51E/100).
A.901	Position Error Overflow Alarm at Servo ON	When the servomotor power is ON, the position error 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 the vibration detection switch (Pn310).
A.930	Absolute Encoder Battery Error	This warning occurs when the voltage of absolute encoder's battery is lowered.
A.941	Change of Parameters Requires Restart	Parameters that require the restart have been changed.
A.9A0	Overtravel	Overtravel is detected while the servomotor power is ON.

Note: If Pn008.2 = 1 (does not detect warning) is selected, no warnings will be detected.

9.2.2 Troubleshooting of Warnings

Refer to the following table to identity the cause of a warning and the action to be taken. Contact your Yaskawa representative if the problem cannot be solved by the described corrective action.

Warning Number: Warning Name (Warning Description)	Cause	Investigative Actions	Corrective Actions
A.900: Position Error Overflow	The servomotor U, V, and W wirings is faulty.	Check the servomotor main circuit cable connection.	Confirm that there is no contact fault in the motor wiring or encoder wiring.
	The SERVOPACK gain is too low.	Check the SERVOPACK gain.	Increase the servo gain by using the function such as advanced autotuning.
	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 acceleration of position reference. Or, reconsider the electronic gear ratio.
	The acceleration of the position reference is too high.	Reduce the reference acceleration, and operate the SERVOPACK.	Apply the smoothing function, such as using the position reference acceleration/deceleration time constant (Pn216).
	Setting of the excessive position error alarm level (Pn520) 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.	–	Restart the SERVOPACK. If the alarm still occurs, the SERVOPACK may be faulty. Replace the SERVOPACK.
A.901: Position Error Overflow Alarm at Servo ON	When the servomotor power is ON, the position error exceeded the parameter setting (Pn526×Pn528/100).	–	Set Pn200.2 to 0 to clear the number of position error while the servomotor power is OFF. Or set an appropriate value for the excessive position error warning level at servo ON (Pn528).
A.910: Overload (Warning before alarm A.710 or A.720 occurs)	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 motor overload characteristics and executed run command.	Reconsider the load conditions and operating conditions. Or, increase the motor capacity.
	Excessive load was applied during operation because the servomotor was not driven due to mechanical problems.	Check the executed operation reference and motor speed.	Remove the mechanical problems.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.

(cont'd)

Warning Number: Warning Name (Warning Description)	Cause	Investigative Actions	Corrective Actions
A.911: Vibration	Abnormal vibration was detected at the motor speed.	Check for abnormal noise from the servomotor, and check the speed and torque waveforms during operation.	Reduce the motor speed or reduce the servo gain by using the function such as one-parameter tuning.
	The moment of inertia ratio (Pn103) value is greater than the actual value or is greatly changed.	Check the moment of inertia ratio.	Set the moment of inertia ratio (Pn103) to an appropriate value.
A.930: Absolute Encoder Battery Error (The absolute encoder battery voltage is lower than the specified value.) (Only when an absolute encoder is connected.)	The battery connection is incorrect.	Check the battery connection.	Reconnect the battery.
	The battery voltage is lower than the specified value 2.7 V.	Measure the battery voltage.	Replace the battery.
	A SERVOPACK fault occurred.	–	The SERVOPACK may be faulty. Replace the SERVOPACK.
A.941: Change of Parameters Requires Restart	Parameters that require the restart have been changed.	–	Restart the SERVOPACK.
A.9A0: Overtravel (Overtravel status is detected.)	When the servomotor power is ON, overtravel status is detected.	Check the input signal monitor (Un005) to check the status of the overtravel signals.	Refer to *9.3 Troubleshooting Malfunction Based on Operation and Conditions of the Servomotor*. Even if overtravel signals were not shown by the input signal monitor (Un005), momentary overtravel may have been detected. Take the following precautions. • Do not specify movements that would cause overtravel from the host controller. • Check the wiring of the overtravel signals. • Take countermeasures for noise.

9.3 Troubleshooting Malfunction Based on Operation and Conditions of the Servomotor

Troubleshooting for the malfunctions based on the operation and conditions of the servomotor is provided in this section.

Be sure to turn OFF the servo system before troubleshooting items shown in bold lines in the table.

Problem	Probable Cause	Investigative Actions	Corrective Actions
Servomotor Does Not Start	The control power supply is not ON.	Check voltage between control power input terminals.	Correct the wiring.
	The main circuit power supply is not ON.	Check the voltage between main circuit power input terminals.	Correct the wiring.
	Wiring of I/O signal connector CN1 is faulty or disconnected.	Check if the connector CN1 is properly inserted and connected.	Correct the connector CN1 connection.
	Wiring for servomotor main circuit cable or encoder cable is disconnected.	Check the wiring.	Correct the wiring.
	Overloaded	Run under no load and check the load status.	Reduce load or replace with larger capacity servomotor.
	Encoder type differs from parameter setting (Pn002.2).	Check the settings for parameter Pn002.2.	Set parameter Pn002.2 to the encoder type being used.
	Speed/position references not input	Check the allocation status of the input signals.	Allocate input signals so that the speed/position reference is input correctly.
	Settings for the input signal selections (Pn50A to Pn50D) is incorrect.	Check the settings for parameters Pn50A to Pn50D.	Correct the settings for parameter Pn50A to Pn50D.
	Servo ON signal (/S-ON) stays OFF.	Check the settings for parameters Pn50A.0 and Pn50A.1.	Set the parameters Pn50A.0 and Pn50A.1 to turn the /S-ON signal ON.
	/P-CON input function setting is incorrect.	Check the settings for parameter Pn000.1.	Set parameters to match the application.
	/SEN input is OFF.	Check the ON/OFF status of the SEN input.	If you are using an absolute encoder, allocate the SEN signal to an input signal and turn it ON.
	Reference pulse mode selection is incorrect.	Check the Pn200.0 setting and the reference pulse form.	Match the Pn200.0 setting and the reference pulse form.
	Speed control: Speed reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control method selection parameter, and the input signal.
	Torque control: Torque reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control method selection parameter, and the input signal.
	Position control: Reference pulse input is incorrect.	Check Pn200.0 reference pulse form and sign + pulse signal.	Correct the control method selection parameter, and the input signal.
	Position error clear (/CLR) input has not been turned OFF.	Check /CLR input signals (CN1-5 and -6).	Turn /CLR input signals OFF.
	The forward run prohibited (P-OT) and reverse run prohibited (N-OT) input signals are turned OFF.	Check P-OT or N-OT input signal.	Turn P-OT or N-OT input signal ON.
	A SERVOPACK fault occurred.	–	Replace the SERVOPACK.
Servomotor Moves Instantaneously, and then Stops	Servomotor wiring is incorrect.	Check the wiring.	Correct the wiring.
	Encoder wiring is incorrect.	Check the wiring.	Correct the wiring.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
The SERVOPACK suddenly entered baseblock status during servomotor operation.	The main circuit power supply voltage is 13 V or lower.	Check voltage between main circuit power input terminals during operation.	Set the power supply voltage to within the specified range.
			Increase the capacity of the main circuit AC/DC power supply.
	The fuse in the SERVOPACK is blown.	–	Replace the SERVOPACK.
	A SERVOPACK fault occurred.	–	A fault occurred in the SERVOPACK. Replace the SERVOPACK.
Servomotor Speed Unstable	Wiring connection to servomotor is defective.	Check connections of power line (phases U, V, and W) and encoder connectors.	Tighten any loose terminals or connectors and correct the wiring.
Servomotor Rotates Without Reference Input	Speed control: Speed reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control method selection parameter, and the input signal.
	Torque control: Torque reference input is incorrect.	Check V-REF and SG to confirm if the control method and the input are agreed.	Correct the control method selection parameter, and the input signal.
	Speed reference offset is incorrect.	The SERVOPACK offset is adjusted incorrectly.	Adjust the SERVOPACK offset.
	Position control: Reference pulse input is incorrect.	Check the reference pulse form (Pn200.0) and sign + pulse signal.	Correct the control method selection parameter, and the input signal.
	A SERVOPACK fault occurred.	–	Replace the SERVOPACK.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Abnormal Noise from Servomotor	The servomotor largely vibrated during execution of tuning-less function.	Check the motor speed waveform.	Reduce the load so that the moment of inertia ratio becomes within the allowable value, or increase the load level or lower the tuning level for the tuning-less levels setting (Fn200).
	Mounting is not secured.	Check if there are any loose mounting screws.	Tighten the mounting screws.
		Check if there is misalignment of couplings.	Align the couplings.
		Check if there are unbalanced couplings.	Balance the couplings.
	Bearings are defective.	Check for noise and vibration around the bearings.	Replace the servomotor.
	Vibration source at the driven machine.	Check for any foreign matter, damage, or deformations on the machinery's movable parts.	Contact the machine manufacturer.
	Noise interference due to incorrect I/O signal cable specifications.	The I/O signal cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified I/O signal cable.
	Noise interference due to length of I/O signal cable.	Check the length of the I/O signal cable.	The I/O signal cable length must be no more than 3 m.
	Noise interference due to incorrect cable specifications of encoder cable.	The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable.	Check the length of the encoder cable.	The encoder cable must be no more than 50 m.
	Noise interference due to damaged encoder cable.	Check if the encoder cable is bent and the sheath is damaged.	Replace the encoder cable and correct the cable layout.
	Excessive noise to the encoder cable.	Check if the encoder cable is bundled with a high-current line or near a high-current line.	Correct the cable layout so that no surge is applied.
	The FG potential varies because of influence from machines on the servomotor side, such as the welder.	Check if the machines are correctly grounded.	Properly ground the machines to separate from the encoder FG.
	SERVOPACK pulse counting error due to noise interference	Check if there is noise interference on the I/O signal line from the encoder.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce vibration from the machine, or secure the servomotor installation.
	An encoder fault occurred.	–	Replace the servomotor.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Servomotor Vibrates at Frequency of Approx. 200 to 400 Hz.	Unbalanced servo gains	Check to see if the servo gains have been correctly adjusted.	Execute the advanced autotuning.
	Speed loop gain value (Pn100) too high.	Check the speed loop gain (Pn100). Factory setting: Kv = 40.0 Hz	Reduce the speed loop gain (Pn100).
	Position loop gain value (Pn102) too high.	Check the position loop gain (Pn102). Factory setting: Kp = 40.0/s	Reduce the position loop gain (Pn102).
	Incorrect speed loop integral time constant (Pn101)	Check the speed loop integral time constant (Pn101). Factory setting: Ti = 20.0 ms	Correct the speed loop integral time constant (Pn101).
	Incorrect moment of inertia ratio (Pn103)	Check the moment of inertia ratio (Pn103).	Correct the moment of inertia ratio (Pn103).
High Motor Speed Overshoot on Starting and Stopping	Unbalanced servo gains	Check to see if the servo gains have been correctly adjusted.	Execute the advanced autotuning.
	Speed loop gain value (Pn100) too high	Check the speed loop gain (Pn100). Factory setting: Kv = 40.0 Hz	Reduce the speed loop gain (Pn100).
	Position loop gain value (Pn102) too high	Check the position loop gain (Pn102). Factory setting: Kp = 40.0/s	Reduce the position loop gain (Pn102).
	Incorrect speed loop integral time constant (Pn101)	Check the speed loop integral time constant (Pn101). Factory setting: Ti = 20.0 ms	Correct the speed loop integral time constant (Pn101).
	Incorrect moment of inertia ratio data (Pn103)	Check the moment of inertia ratio (Pn103).	Correct the moment of inertia ratio (Pn103).
Absolute Encoder Position Difference Error (The position saved in the host controller when the power was turned OFF is different from the position when the power was next turned ON.)	Noise interference due to incorrect cable specifications of encoder cable.	The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable.	Check the length of the encoder cable.	The encoder cable must be no more than 50 m.
	Noise interference due to damaged encoder cable.	Check if the encoder cable is bent and the sheath is damaged.	Replace the encoder cable and correct the cable layout.
	Excessive noise to the encoder cable.	Check if the encoder cable is bundled with a high-current line or near a high-current line.	Correct the cable layout so that no surge is applied.
	FG potential varies because of influence of machines such as welders at the servomotor.	Check if the machines are correctly grounded.	Ground machines correctly, and prevent diversion to the FG on the encoder side.
	SERVOPACK pulse counting error due to noise interference	Check if there is noise interference on the I/O signal line from the encoder.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce vibration from the machine, or secure the servomotor installation.
	An encoder fault occurred.	–	Replace the servomotor.
	A SERVOPACK fault occurred. (The pulse count does not change.)	–	Replace the SERVOPACK.
	Host controller multiturn data reading error	Check the error detection section of the host controller.	Correct the error detection section of the host controller.
		Check if the host controller is executing data parity checks.	Execute a multiturn data parity check.
		Check noise in the cable between the SERVOPACK and the host controller.	Take measures against noise, and again execute a multiturn data parity check.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Overtravel (OT)	Forward or reverse run prohibited signal is input.	Check the external power supply (+24 V) voltage for the input signal.	Correct the external power supply (+24 V) voltage.
		Check if the overtravel limit switch operates properly.	Correct the overtravel limit switch.
		Check if the overtravel limit switch is wired correctly.	Correct the overtravel limit switch wiring.
		Check the settings for parameters Pn50A and Pn50B.	Correct the settings for parameters Pn50A and Pn50B.
	Forward or reverse run prohibited signal malfunctioning.	Check the fluctuation of the external power supply (+24 V) voltage for the input signal.	Stabilize the external power supply (+24 V) voltage.
		Check if the overtravel limit switch operates correctly.	Correct the overtravel limit switch.
		Check if the overtravel limit switch wiring is correct. (check for damaged cables or loose screws.)	Correct the overtravel limit switch wiring.
	Incorrect forward or reverse run prohibited signal (P-OT/N-OT) allocation (parameters Pn50A.3, Pn50B.0)	Check if the P-OT signal is allocated in Pn50A.3.	If another signal is allocated in Pn50A.3, allocate P-OT.
		Check if the N-OT signal is allocated in Pn50B.0.	If another signal is allocated in Pn50B.0, allocate N-OT.
Improper Stop Position by Overtravel (OT) Signal	Improper limit switch position and dog length	–	Install the limit switch at the appropriate position.
	The overtravel limit switch position is too short for the coasting distance.	–	Install the overtravel limit switch at the appropriate position.

(cont'd)

Problem	Probable Cause	Investigative Actions	Corrective Actions
Position Error (Without Alarm)	Noise interference due to incorrect encoder cable specifications	The encoder cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use the specified encoder cable.
	Noise interference due to length of encoder cable.	Check the length of the encoder cable.	The encoder cable must be no more than 50 m.
	Noise influence due to damaged encoder cable.	Check if the encoder cable is bent and the sheath is damaged.	Replace the encoder cable and modify the cable layout.
	Excessive noise to encoder cable.	Check if the encoder cable is bundled with a high-current line or near a high-current line.	Change the cable layout so that no surge is applied.
	The FG potential varies because of influence from machines on the servomotor side such as the welder.	Check if the machines are correctly grounded.	Properly ground the machines encoder FG.
	SERVOPACK pulse count error due to noise	Check if the I/O signal line from the encoder is influenced by noise.	Take measures against noise in the encoder wiring.
	Excessive vibration and shock to the encoder	Check if vibration from the machine occurred or servomotor installation is incorrect (mounting surface accuracy, fixing, alignment, etc.).	Reduce the machine vibration or mount the servomotor securely.
	Unsecured coupling between machine and servomotor	Check if a position error occurs at the coupling between machine and servomotor.	Secure the coupling between the machine and servomotor.
	Noise interference due to improper I/O signal cable specifications	The I/O signal cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use input signal cable with the specified specifications.
	If the reference pulse input multiplication switching function is being used, noise may be causing the I/O signals (/PSEL and /PSELA) used for this function to be falsely detected.	The I/O signal cable must be tinned annealed copper shielded twisted-pair or screened unshielded twisted-pair cable with a core of 0.12 mm^2 min.	Use input signal cable that satisfy specifications.
	Noise interference due to length of I/O signal cable	Check the I/O signal cable length.	The I/O signal cable length must be no more than 3 m.
	An encoder fault occurred. (The pulse count does not change.)	–	Replace the servomotor.
	A SERVOPACK fault occurred.	–	Replace the SERVOPACK.
Servomotor Overheated	Ambient operating temperature too high	Measure the servomotor ambient operating temperature.	Reduce the ambient operating temperature to 40°C or less.
	Servomotor surface dirty	Visually check the surface.	Clean dust and oil from the surface.
	Servomotor overloaded	Check the load status with monitor.	If overloaded, reduce load or replace with larger capacity SERVOPACK and servomotor.

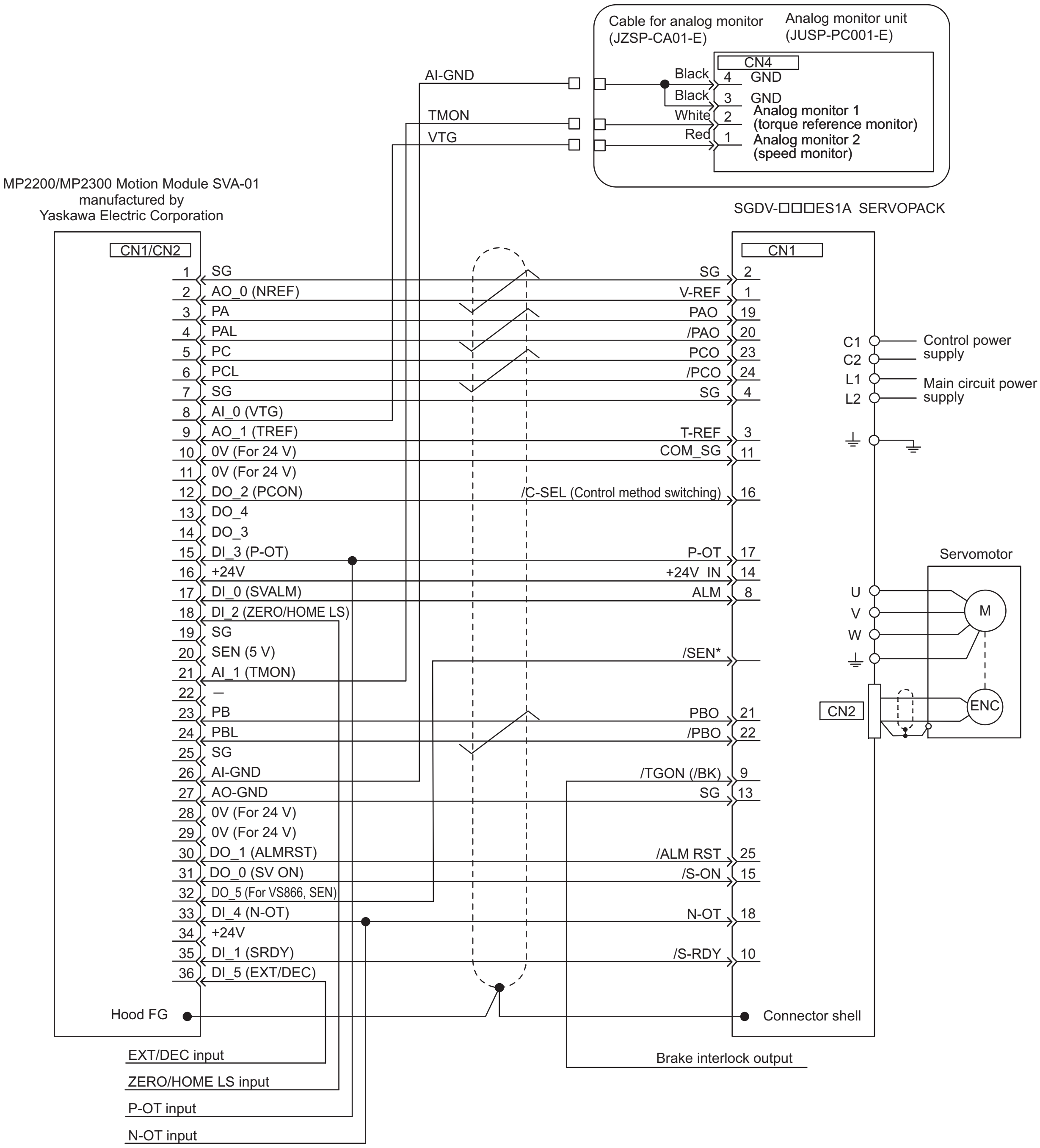
10

Appendix

10.1 Connection to Host Controller

The following figures show the connection examples of DC power input Σ-V Series SERVOPACK to host controllers.

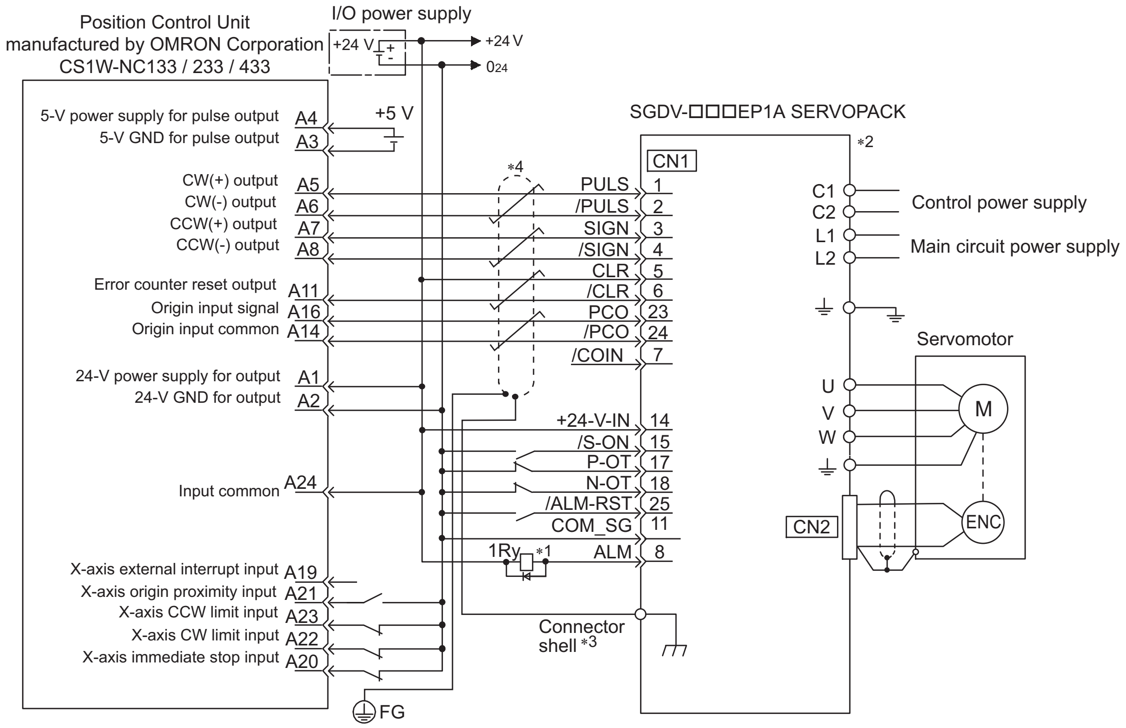
10.1.1 Connection to MP2200/MP2300 Motion Module SVA-01



Note 1. Only signals related to the DC power input Σ-V Series SERVOPACK and MP2200/MP2300 Motion Module SVA-01 are shown in the diagram.
2. Incorrect signal connections will cause damage to the machine controller and SERVOPACK. Wire all connections carefully.
3. Open the signal lines not to be used.
4. The above connection diagram shows the connections for only one axis. When using other axes, make connections to the SERVOPACK in the same way.
5. Short-circuit the normally closed (NC) input terminals that are not used at the I/O connector section of the machine controller.
6. Make the settings so that the servomotor can be turned ON/OFF by the Servo ON signal (/S-ON).

* If using an absolute encoder, allocate the SEN signal to one of the seven input signals. Also, set Pn515.0 so that the input signal is valid when OFF (high level).

10.1.2 Connection to OMRON's Position Control Unit



∗1. The ALM signal is output for about five seconds after the control power is turned ON. Take this into consideration when designing the power ON sequence. Also, use the ALM signal to actuate the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK.

∗2. Set parameter Pn200.0 to "1."

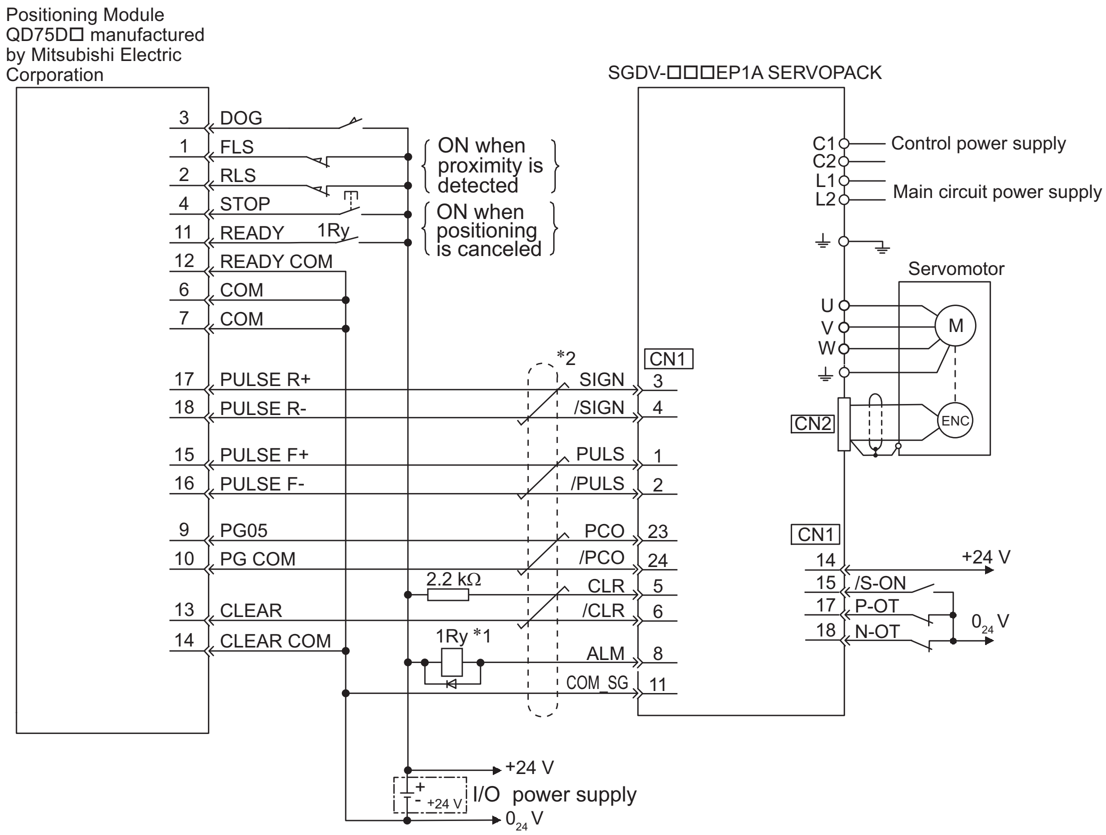
∗3. Connect the shielded wire to the connector shell.

∗4. represents twisted-pair wires.

Note 1. Only the signals related to the DC power input Σ-V Series SERVOPACK and the OMRON Position Control Unit are shown in the diagram.

2. Incorrect signal connections will damage the Position Control Unit or SERVOPACK. Wire all connections carefully.
3. Open the signal lines not to be used.
4. The above connection diagram shows only X-axis connections. When using other axes, make connections to the SERVOPACK in the same way.
5. Short-circuit the normally closed (NC) input terminals that are not used at the I/O connector section of the position control unit.
6. Make the settings so that the servomotor can be turned ON/OFF by the Servo ON (/S-ON) signal.

10.1.3 Connection to MITSUBISHI's QD75D☐ Positioning Module (SERVOPACK in Position Control)



∗1. The ALM signal is output for about five seconds when the control power is turned ON. Take this into consideration when designing the power ON sequence. Also, use the ALM signal to actuate the alarm detection relay 1Ry to stop the main circuit power supply to the SERVOPACK.

∗2. represents twisted-pair wires.

Note 1. Only the signals that are related to the DC power input Σ-V Series SERVOPACK and the QD75D Mitsubishi Positioning Module are shown in the diagram.
2. Incorrect wiring may damage the Positioning Module or SERVOPACK. Wire all connections carefully.
3. Open the signal lines not to be used.
4. The above connection diagram shows the connections for only one axis. When using other axes, make connections to the SERVOPACK in the same way.
5. Short-circuit the normally closed (NC) input terminals that are not used at the I/O connector section of the positioning module.
6. Make the settings so that the servo can be turned ON/OFF by the Servo ON (/S-ON) signal.

10.2 List of Parameters

10.2.1 Utility Functions

The following list shows the available utility functions.

Parameter No.	Function	Reference Section	Comment: SigmaWin+ function names
Fn000	Alarm history display	7.2	Alarm Display
Fn002	JOG operation	7.3	JOG Operation
Fn003	Origin search	7.4	Origin Search
Fn004	Program JOG operation	7.5	Program JOG Operation
Fn005	Initializing parameter settings	7.6	Editing Parameters
Fn006	Clearing alarm history	7.7	Alarm Display
Fn008	Absolute encoder multiturn reset and encoder alarm reset	5.9.4	Setting the Absolute Encoder
Fn009*1	Automatic tuning of analog (speed, torque) reference offset	5.3.2 5.5.2	–
Fn00A*1	Manual servo tuning of speed reference offset	5.3.2	–
Fn00B*1	Manual servo tuning of torque reference offset	5.5.2	–
Fn00C	Offset adjustment of analog monitor output	7.8	Adjusting Analog Monitor Output
Fn00D	Gain adjustment of analog monitor output	7.9	Adjusting Analog Monitor Output
Fn00E	Automatic offset-signal adjustment of the motor current detection signal	7.10	Adjusting Motor Current Detection Offset
Fn00F	Manual offset-signal adjustment of the motor current detection signal	7.11	Adjusting Motor Current Detection Offset
Fn010	Write prohibited setting	7.12	Write Prohibited Setting
Fn011	Servomotor model display	7.13	Product Information
Fn012	Software version display	7.14	Product Information
Fn013	Multiturn limit value setting change when a multiturn limit disagreement alarm occurs	5.9.7	Setting the Multi-Turn Limit
Fn01B	Vibration detection level initialization	7.15	Initializing Vibration Detection Level
Fn01E	Display of SERVOPACK and servomotor ID	7.16	Product Information
Fn030	Software reset	7.17	Resetting the SERVOPACK by Software or MECHATROLINK Communication Reset
Fn200	Tuning-less levels setting	6.2.2	Editing Parameters
Fn201	Advanced autotuning	6.3.2	Tuning
Fn202*2	Advanced autotuning by reference	6.4.2	Tuning
Fn203	One-parameter tuning	6.5.2	Tuning
Fn204	Anti-resonance control adjustment function	6.6.2	Tuning
Fn205*2	Vibration suppression function	6.7.2	Tuning
Fn206	EasyFFT	7.18	EasyFFT
Fn207	Online vibration monitor	7.19	Online Vibration Monitor

Note: Execute the utility function with either a panel operator or SigmaWin+. If they are used together, "no_oP" or "NO-OP" will be displayed when the utility function is executed.

∗1. This function can be used only with a SERVOPACK for analog voltage references.

∗2. This function can be used only with a SERVOPACK for pulse train references.

10.2.2 Parameters

This section contains a tables of parameters.

Note: Do not change the following parameters from the factory settings.
- Reserved parameters
- Parameters not described in this manual

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn000	2	Basic Function Select Switch 0	0000 to 00B3	–	0000	After restart	Setup	–

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

1st digit:

Direction Selection		Reference Section
0	Sets CCW as forward direction.	5.2.2
1	Sets CW as forward direction. (Reverse Rotation Mode)	
2 and 3	Reserved (Do not use.)	

2nd digit:

Control Method Selection		Reference Section
0	Speed control (analog reference)	5.7
1	Position control (pulse train reference)	
2	Torque control (analog reference)	
3	Internal set speed control (contact reference)	
4	Internal set speed control (contact reference) ↔ Speed control (analog reference)	
5	Internal set speed control (contact reference) ↔ Position control (pulse train reference)	
6	Internal set speed control (contact reference) ↔ Torque control (analog reference)	
7	Reserved (Do not use.)	
8	Reserved (Do not use.)	
9	Torque control (analog reference) ↔ Speed control (analog reference)	
A	Speed control (analog reference) ↔ Speed control with zero clamp function	
B	Position control (pulse train reference) ↔ Position control with reference pulse inhibit function	

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn001	2	Application Function Select Switch 1	0000 to 1122	–	0000	After restart	Setup	–

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

1st digit: Reserved (Do not change.)

2nd digit:

Overtravel (OT) Stop Mode		Reference Section
0	Stops the motor by coasting.	5.2.3
1	Sets the torque of Pn406 to the maximum value, decelerates the servomotor to a stop, and then sets it to servolock state.	
2	Sets the torque of Pn406 to the maximum value, decelerates the servomotor to a stop, and then sets it to coasting state.	

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn002	2	Application Function Select Switch 2	0000 to 4113	–	0000	After restart	Setup	–

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

1st digit:

Speed/Position Control Option (T-REF Terminal Allocation)		Reference Section
0	T-REF not allocated	–
1	Uses T-REF as an external torque limit input.	5.8.3
2	Uses T-REF as a torque feedforward input.	6.9.2
3	Uses T-REF as an external torque limit input when /P-CL and /N-CL are ON.	5.8.4

2nd digit:

Torque Control Option (V-REF Terminal Allocation)		Reference Section
0	V-REF not allocated	5.5.4
1	Uses V-REF as an external speed limit input.	

3rd digit:

Absolute Encoder Usage		Reference Section
0	Uses absolute encoder as an absolute encoder.	5.9
1	Uses absolute encoder as an incremental encoder.	

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn006	2	Application Function Select Switch 6	0000 to 005F	–	0002	Immediately	Setup	6.1.3

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

1st and 2nd digits:

Analog Monitor 1 Signal Selection	
00	Motor rotating speed (1 V / 1000 min^{-1})
01	Speed reference (1 V / 1000 min^{-1})
02	Torque reference (1 V/100% rated torque)
03	Position error (0.05 V/1 reference unit)
04	Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit)
05	Position reference speed (1 V / 1000 min^{-1})
06	Reserved (Do not use.)
07	Reserved (Do not use.)
08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)
09	Reserved (Do not use.)
0A	Torque feedforward (1 V/100% rated torque)
0B	Active gain (1st gain: 1 V, 2nd gain: 2 V)
0C	Completion of position reference (completed: 5 V, not completed: 0 V)
0D	Reserved (Do not use.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Appendix

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn007	2	Application Function Select Switch 7	0000 to 005F	–	0000	Immediately	Setup	6.1.3

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

1st and 2nd digits: Analog Monitor 2 Signal Selection

Analog Monitor 2 Signal Selection	
00	Motor rotating speed (1 V / 1000 min^{-1})
01	Speed reference (1 V / 1000 min^{-1})
02	Torque reference (1 V/100% rated torque)
03	Position error (0.05 V/1 reference unit)
04	Position amplifier error (after electronic gears) (0.05 V/ 1 encoder pulse unit)
05	Position reference speed (1 V / 1000 min^{-1})
06	Reserved (Do not use.)
07	Reserved (Do not use.)
08	Positioning completion (positioning completed: 5 V, positioning not completed: 0 V)
09	Reserved (Do not use.)
0A	Torque feedforward (1 V/100% rated torque)
0B	Active gain (1st gain: 1 V, 2nd gain: 2 V)
0C	Completion of position reference (completed: 5 V not completed: 0 V)
0D	Reserved (Do not use.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn008	2	Application Function Select Switch 8	0000 to 7121	–	0000	After restart	Setup	–

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

1st digit:

Lowered Battery Voltage Alarm/Warning Selection		Reference Section
0	Outputs alarm (A.830) for lowered battery voltage.	5.9.3
1	Outputs warning (A.930) for lowered battery voltage.	

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit:

Warning Detection Selection		Reference Section
0	Detects warning.	9.2.1
1	Does not detect warning.	

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn009	2	Application Function Select Switch 9	0000 to 0111	–	0010	After restart	Tuning	–
Pn00B	2	Application Function Select Switch B	0000 to 1111	–	0000	After restart	Setup	–

Pn009

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

1st digit: Reserved (Do not change.)

2nd digit:

Current Control Method Selection		Reference Section
0	Current control method 1	6.8.3
1	Current control method 2	

3rd digit:

Speed Detection Method Selection		Reference Section
0	Speed detection 1	6.8.5
1	Speed detection 2	

4th digit: Reserved (Do not change.)

Pn00B

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

1st digit:

Parameter Display Selection		Reference Section
0	Setup parameters	2.5.1
1	All parameters	

2nd digit:

Alarm Gr.2 Stop Method Selection		Reference Section
0	Stops the motor by setting the speed reference to "0".	5.2.5
1	Stops the motor by coasting.	

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn00C	2	Application Function Select Switch C	0000 to 0111	–	0000	After restart	Setup	4.6

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

1st digit:

Selection of Test without a Motor	
0	Disables test without a motor.
1	Enables test without a motor.

2nd digit:

Encoder Resolution for Test without a Motor	
0	13 bits
1	20 bits

3rd digit:

Encoder Type for Test without a Motor	
0	Incremental encoder
1	Absolute encoder

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn00D	2	Application Function Select Switch D	0000 to 1001	–	0000	Immediately	Setup	–

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

1st digit: Reserved (Do not change.)

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit:

Overtravel Warning Detection Selection		Reference Section
0	Does not detect overtravel warning.	5.2.3
1	Detects overtravel warning.	

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn00F	2	Reserved (Do not change.)	–	–	0000	–	–	–
Pn010	2	Axis Address Selection (for UART/USB communications)	0000 to 007F	–	0001	After restart	Setup	–
Pn100	2	Speed Loop Gain	10 to 20000	0.1 Hz	400	Immediately	Tuning	6.8.1
Pn101	2	Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately	Tuning	6.8.1
Pn102	2	Position Loop Gain	10 to 20000	0.1/s	400	Immediately	Tuning	6.8.1
Pn103	2	Moment of Inertia Ratio	0 to 20000	1%	100	Immediately	Tuning	6.8.1
Pn104	2	2nd Speed Loop Gain	10 to 20000	0.1 Hz	400	Immediately	Tuning	6.8.1
Pn105	2	2nd Speed Loop Integral Time Constant	15 to 51200	0.01 ms	2000	Immediately	Tuning	6.8.1
Pn106	2	2nd Position Loop Gain	10 to 20000	0.1/s	400	Immediately	Tuning	6.8.1
Pn109	2	Feedforward Gain	0 to 100	1%	0	Immediately	Tuning	6.9.1
Pn10A	2	Feedforward Filter Time Constant	0 to 6400	0.01 ms	0	Immediately	Tuning	6.9.1

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn10B	2	Application Function for Gain Select Switch	0000 to 5334	–	0000	–	–	–

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

1st digit:

Mode Switch Selection		When Enabled	Classification	Reference Section
0	Uses internal torque reference as the condition (Level setting: Pn10C).	Immediately	Setup	6.9.4
1	Uses speed reference as the condition (Level setting: Pn10D).			
2	Uses acceleration as the condition (Level setting: Pn10E).			
3	Uses position error as the condition (Level setting: Pn10F).			
4	No mode switch function available.			

2nd digit:

Speed Loop Control Method		When Enabled	Classification	Reference Section
0	PI control	After restart	Setup	–
1	I-P control			
2 and 3	Reserved (Do not use.)			

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn10C	2	Mode Switch (torque reference)	0 to 800	1%	200	Immediately	Tuning	6.9.4
Pn10D	2	Mode Switch (speed reference)	0 to 10000	1 min^{-1}	0	Immediately	Tuning	6.9.4
Pn10E	2	Mode Switch (acceleration)	0 to 30000	1 min^{-1}/s	0	Immediately	Tuning	6.9.4
Pn10F	2	Mode Switch (position error)	0 to 10000	1 reference unit	0	Immediately	Tuning	6.9.4
Pn11F	2	Position Integral Time Constant	0 to 50000	0.1 ms	0	Immediately	Tuning	6.9.6
Pn121	2	Friction Compensation Gain	10 to 1000	1%	100	Immediately	Tuning	6.8.2
Pn122	2	2nd Gain for Friction Compensation	10 to 1000	1%	100	Immediately	Tuning	6.8.2
Pn123	2	Friction Compensation Coefficient	0 to 100	1%	0	Immediately	Tuning	6.8.2
Pn124	2	Friction Compensation Frequency Correction	-10000 to 10000	0.1 Hz	0	Immediately	Tuning	6.8.2
Pn125	2	Friction Compensation Gain Correction	1 to 1000	1%	100	Immediately	Tuning	6.8.2
Pn131	2	Gain Switching Time 1	0 to 65535	1 ms	0	Immediately	Tuning	6.8.1
Pn132	2	Gain Switching Time 2	0 to 65535	1 ms	0	Immediately	Tuning	6.8.1
Pn135	2	Gain Switching Waiting Time 1	0 to 65535	1 ms	0	Immediately	Tuning	6.8.1
Pn136	2	Gain Switching Waiting Time 2	0 to 65535	1 ms	0	Immediately	Tuning	6.8.1

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn139	2	Automatic Gain Change-over Related Switch 1	0000 to 0052	–	0000	Immediately	Tuning	6.8.1

Pn139: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Gain Switching Selection Switch

0	Manual gain switching Changes gain manually using external input signal (/G-SEL).
1	Reserved (Do not use.)
2	Automatic gain switching pattern 1 Changes automatically 1st gain to 2nd gain when the switching condition A is satisfied. Changes automatically 2nd gain to 1st gain when the switching condition A is not satisfied.

2nd digit: Gain Switching Condition A

0	Positioning completion signal (/COIN) ON
1	Positioning completion signal (/COIN) OFF
2	Positioning near signal (/NEAR) ON
3	Positioning near signal (/NEAR) OFF
4	Position reference filter output = 0 and reference pulse input OFF
5	Position reference pulse input ON

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn13D	2	Current Gain Level	100 to 2000	1%	2000	Immediately	Tuning	6.8.4
Pn140	2	Model Following Control Related Switch	0000 to 1121	–	0100	Immediately	Tuning	–

Pn140: n.□□□□ (4th digit, 3rd digit, 2nd digit, 1st digit)

1st digit: Model Following Control Selection

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

2nd digit: Vibration Suppression Selection

0	Does not perform vibration suppression.
1	Performs vibration suppression over the specified frequency.
2	Performs vibration suppression over two different kinds of frequencies.

3rd digit: Vibration Suppression Adjustment Selection

		Reference Section
0	Does not adjust vibration suppression automatically using utility function.	6.3.1, 6.4.1, 6.5.1, 6.7.1
1	Adjusts vibration suppression automatically using utility function.	

4th digit: Selection of Speed Feedforward (VFF) / Torque Feedforward (TFF)

		Reference Section
0	Does not use model following control and speed/torque feedforward together.	6.3.1, 6.4.1
1	Uses model following control and speed/torque feedforward together.	

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn141	2	Model Following Control Gain	10 to 20000	0.1/s	500	Immediately	Tuning	–
Pn142	2	Model Following Control Gain Compensation	500 to 2000	0.1%	1000	Immediately	Tuning	–

(cont'd)

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

Pn14F

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

1st digit:

Model Following Control Type Selection		Reference Section
0	Model Following Control 1	6.3.1, 6.4.1, 6.5.1
1	Model Following Control 2	

2nd digit:

Tuning-less Type Selection		Reference Section
0	Tuning-less type 1	6.2.2
1	Tuning-less type 2	

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn160	2	Anti-Resonance Control Related Switch	0000 to 0011	–	0010	Immediately	Tuning	6.3.1, 6.4.1, 6.5.1, 6.7.1

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

1st digit:

Anti-Resonance Control Selection	
0	Does not use anti-resonance control.
1	Uses anti-resonance control.

2nd digit:

Anti-Resonance Control Adjustment Selection	
0	Does not adjust anti-resonance control automatically using utility function.
1	Adjusts anti-resonance control automatically using utility function.

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn161	2	Anti-Resonance Frequency	10 to 20000	0.1 Hz	1000	Immediately	Tuning	–
Pn162	2	Anti-Resonance Gain Compensation	1 to 1000	1%	100	Immediately	Tuning	–
Pn163	2	Anti-Resonance Damping Gain	0 to 300	1%	0	Immediately	Tuning	–
Pn164	2	Anti-Resonance Filter Time Constant 1 Compensation	-1000 to 1000	0.01 ms	0	Immediately	Tuning	–
Pn165	2	Anti-Resonance Filter Time Constant 2 Compensation	-1000 to 1000	0.01 ms	0	Immediately	Tuning	–
Pn170	2	Tuning-less Function Related Switch	0000 to 2411	–	1401	–	–	–

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

1st digit:

Tuning-less Function Selection		When Enabled	Classification	Reference Section
0	Disables tuning-less function.	After restart	Setup	6.2
1	Enables tuning-less function.			

2nd digit:

Control Method during Speed Control		When Enabled	Classification	Reference Section
0	Uses as speed control.	After restart	Setup	6.2
1	Uses as speed control and uses the host controller for position control.			

3rd digit:

Tuning-less Tuning Level		When Enabled	Classification	Reference Section
0 to 4	Sets tuning-less tuning level.	Immediately	Setup	6.2

4th digit:

Tuning-less Load Level		When Enabled	Classification	Reference Section
0 to 2	Sets tuning-less load level.	Immediately	Setup	6.2

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn190	2	Reserved (Do not change.)	–	–	0010	–	–	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn200	2	Position Control Reference Form Selection Switch	0000 to 2236	–	0000	After restart	Setup	–

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

1st digit:

Reference Pulse Form		Reference Section
0	Sign + Pulse train, positive logic	5.4.1
1	CW + CCW pulse train, positive logic	
2	Two-phase pulse train with 90° phase differential (phase A + phase B) ×1, positive logic	
3	Two-phase pulse train with 90° phase differential (phase A + phase B) ×2, positive logic	
4	Two-phase pulse train with 90° phase differential (phase A + phase B) ×4, positive logic	
5	Sign + Pulse train, negative logic	
6	CW + CCW pulse train, negative logic	

2nd digit:

Clear Signal Form		Reference Section
0	Clears position error when the signal is at high level.	5.4.2
1	Clears position error at the rising edge of the signal.	
2	Clears position error when the signal is at low level.	
3	Clears position error at the falling edge of the signal.	

3rd digit:

Clear Operation		Reference Section
0	Clears position error at the baseblock (servomotor power OFF or alarm occurred).	5.4.2
1	Does not clear position error (possible to clear error counter only with CLR signal).	
2	Clears position error when an alarm occurs.	

4th digit:

Filter Selection		Reference Section
0	Uses reference input filter 1 for line driver signal (to 1 Mpps).	5.4.1
1	Uses reference input filter for open collector signal (to 200 kpps).	
2	Uses reference input filter 2 for line driver signal (1 Mpps to 4 Mpps).	

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn205	2	Multiturn Limit Setting	0 to 65535	1 rev	65535	After restart	Setup	5.9.6

Appendix

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(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn207	2	Position Control Function Switch	0000 to 2210	–	0000	After restart	Setup	–

4th digit 3rd digit 2nd digit 1st digit

n.□□□□

1st digit: Reserved (Do not change.)

2nd digit:

Position Control Option		Reference Section
0	V-REF not allocated	–
1	Uses V-REF as a speed feedforward input.	

3rd digit: Reserved (Do not change.)

4th digit:

/COIN Output Timing		Reference Section
0	Outputs when the position error absolute value is the same or less than the positioning completed width (Pn522).	5.4.6
1	Outputs when the position error absolute value is the same or less than the positioning completed width (Pn522), and the reference after position reference filtering is 0.	
2	Outputs when the position error absolute value is the same or less than the positioning completed width (Pn522), and the position reference input is 0.	

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn20A	4	Reserved (Do not change.)	–	–	32768	–	–	–
Pn20E	4	Electronic Gear Ratio (Numerator)	1 to 1073741824	1	4	After restart	Setup	5.4.4
Pn210	4	Electronic Gear Ratio (Denominator)	1 to 1073741824	1	1	After restart	Setup	5.4.4
Pn212	4	Encoder Output Pulses	16 to 1073741824	1 P/rev	2048	After restart	Setup	5.3.7
Pn216	2	Position Reference Acceleration/Deceleration Time Constant	0 to 65535	0.1 ms	0	Immediately after the servomotor stops	Setup	5.4.5
Pn217	2	Average Movement Time of Position Reference	0 to 10000	0.1 ms	0	Immediately after the servomotor stops	Setup	5.4.5
Pn218	2	Reference Pulse Input Multiplication	1 to 100	1 time	1	Immediately	Setup	5.4.3
Pn22A	2	Reserved (Do not change.)	–	–	0000	–	–	–
Pn281	2	Reserved (Do not change.)	–	–	20	–	–	–
Pn300	2	Speed Reference Input Gain	150 to 3000	0.01V	600	Immediately	Setup	5.3.1 5.5.4
Pn301	2	Internal Set Speed 1	0 to 10000	1 min^{-1}	100	Immediately	Setup	5.6.1
Pn302	2	Internal Set Speed 2	0 to 10000	1 min^{-1}	200	Immediately	Setup	5.6.1
Pn303	2	Internal Set Speed 3	0 to 10000	1 min^{-1}	300	Immediately	Setup	5.6.1
Pn304	2	JOG Speed	0 to 10000	1 min^{-1}	500	Immediately	Setup	7.3
Pn305	2	Soft Start Acceleration Time	0 to 10000	1 ms	0	Immediately	Setup	5.3.3
Pn306	2	Soft Start Deceleration Time	0 to 10000	1 ms	0	Immediately	Setup	5.3.3
Pn307	2	Speed Reference Filter Time Constant	0 to 65535	0.01 ms	40	Immediately	Setup	5.3.4

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn310	2	Vibration Detection Switch	0000 to 0002	–	0000	Immediately	Setup	–

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

1st digit:

Vibration Detection Selection		Reference Section
0	Does not detect vibration.	7.15
1	Outputs warning (A.911) when vibration is detected.	
2	Outputs alarm (A.520) when vibration is detected.	

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn311	2	Vibration Detection Sensibility	50 to 500	1%	100	Immediately	Tuning	7.15
Pn312	2	Vibration Detection Level	0 to 5000	1 min^{-1}	50	Immediately	Tuning	7.15
Pn324	2	Moment of Inertia Calculating Start Level	0 to 20000	1%	300	Immediately	Setup	6.3.2
Pn400	2	Torque Reference Input Gain	10 to100	0.1 V	30	Immediately	Setup	5.5.1 6.9.2
Pn401	2	Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	Tuning	6.9.5
Pn402	2	Forward Torque Limit	0 to 800	1%	800	Immediately	Setup	5.8.1
Pn403	2	Reverse Torque Limit	0 to 800	1%	800	Immediately	Setup	5.8.1
Pn404	2	Forward External Torque Limit	0 to 800	1%	100	Immediately	Setup	5.8.2, 5.8.4
Pn405	2	Reverse External Torque Limit	0 to 800	1%	100	Immediately	Setup	5.8.2, 5.8.4
Pn406	2	Emergency Stop Torque	0 to 800	1%	800	Immediately	Setup	5.2.3
Pn407	2	Speed Limit during Torque Control	0 to 10000	1 min^{-1}	10000	Immediately	Setup	5.5.4

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn408	2	Torque Related Function Switch	0000 to 1111	–	0000	–	–	–

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

1st digit:

1st Step Notch Filter Selection		When Enabled	Classification	Reference Section
0	N/A	Immediately	Setup	6.9.5
1	Uses 1st step notch filter for torque reference.			

2nd digit:

Speed Limit Selection		When Enabled	Classification	Reference Section
0	Uses the smaller of the maximum motor speed and the value of Pn407 as the speed limit value.	After restart	Setup	5.5.4
1	Uses the smaller of the overspeed detection speed and the value of Pn407 as the speed limit value.			

3rd digit:

2nd Step Notch Filter Selection		When Enabled	Classification	Reference Section
0	N/A	Immediately	Setup	6.9.5
1	Uses 2nd step notch filter for torque reference.			

4th digit:

Friction Compensation Function Selection		When Enabled	Classification	Reference Section
0	Disables friction compensation function.	Immediately	Setup	6.8.2
1	Enables friction compensation function.			

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn409	2	1st Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning	6.9.5
Pn40A	2	1st Notch Filter Q Value	50 to 1000	0.01	70	Immediately	Tuning	6.9.5
Pn40B	2	1st Notch Filter Depth	0 to 1000	0.001	0	Immediately	Tuning	6.9.5
Pn40C	2	2nd Notch Filter Frequency	50 to 5000	1 Hz	5000	Immediately	Tuning	6.9.5
Pn40D	2	2nd Notch Filter Q Value	50 to 1000	0.01	70	Immediately	Tuning	6.9.5
Pn40E	2	2nd Notch Filter Depth	0 to 1000	0.001	0	Immediately	Tuning	6.9.5
Pn40F	2	2nd Step 2nd Torque Reference Filter Frequency	100 to 5000	1 Hz	5000	Immediately	Tuning	6.9.5
Pn410	2	2nd Step 2nd Torque Reference Filter Q Value	50 to 100	0.01	50	Immediately	Tuning	6.9.5
Pn412	2	1st Step 2nd Torque Reference Filter Time Constant	0 to 65535	0.01 ms	100	Immediately	Tuning	6.8.1
Pn415	2	T-REF Filter Time Constant	0 to 65535	0.01 ms	0	Immediately	Setup	5.5.3
Pn424	2	Reserved (Do not change.)	–	–	50	–	–	–
Pn425	2	Reserved (Do not change.)	–	–	100	–	–	–
Pn456	2	Sweep Torque Reference Amplitude	1 to 800	1%	15	Immediately	Tuning	7.18

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn460	2	Notch Filter Adjustment Switch	0000 to 0101	–	0101	Immediately	Tuning	6.2.1, 6.3.1, 6.5.1
		4th digit 3rd digit 2nd digit 1st digit n.□□□□ 1st digit: Notch Filter Adjustment Selection 1 0: Does not adjust 1st step notch filter automatically using utility function. 1: Adjust 1st step notch filter automatically using utility function. 2nd digit: Reserved (Do not change.) 3rd digit: Notch Filter Adjustment Selection 2 0: Does not adjust 2nd step notch filter automatically using utility function. 1: Adjust 2nd step notch filter automatically using utility function. 4th digit: Reserved (Do not change.)						
Pn501	2	Zero Clamp Level	0 to 10000	1 min^{-1}	10	Immediately	Setup	5.3.5
Pn502	2	Rotation Detection Level	1 to 10000	1 min^{-1}	20	Immediately	Setup	5.10.3
Pn503	2	Speed Coincidence Signal Output Width	0 to 100	1 min^{-1}	10	Immediately	Setup	5.3.8
Pn506	2	Brake Reference - Servo OFF Delay Time	0 to 50	10 ms	0	Immediately	Setup	5.2.4
Pn507	2	Brake Reference Output Speed Level	0 to 10000	1 min^{-1}	100	Immediately	Setup	5.2.4
Pn508	2	Waiting Time for Brake Signal When Motor Running	10 to 100	10 ms	50	Immediately	Setup	5.2.4
Pn509	2	Reserved (Do not change.)	–	–	20	–	–	–

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50A	2	Input Signal Selection 1	0000 to FFF1	–	2100	After restart	Setup	–

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

1st digit:

Input Signal Allocation Mode		Reference Section
0	Uses the sequence input signal terminals with the factory-set allocations.	3.3.1
1	Changes the sequence input signal allocation for each signal.	

2nd digit:

Servo ON (/S-ON) Signal Mapping Signal Polarity: Normal; Servomotor power ON when ON (L-level) Signal Polarity: Reverse; Servomotor power OFF when OFF (H-level)		Reference Section
0	Active when CN1-15 input signal is ON (L-level).	5.2.1
1	Active when CN1-16 input signal is ON (L-level).	
2	Active when CN1-17 input signal is ON (L-level).	
3	Active when CN1-18 input signal is ON (L-level).	
4	Active when CN1-25 input signal is ON (L-level).	
5	Active when CN1-26 input signal is ON (L-level).	
6	Active when CN1-12 input signal is ON (L-level).	
7	Always active (fixed).	
8	Not active (fixed).	
9	Active when CN1-15 input signal is OFF (H-level).	
A	Active when CN1-16 input signal is OFF (H-level).	
B	Active when CN1-17 input signal is OFF (H-level).	
C	Active when CN1-18 input signal is OFF (H-level).	
D	Active when CN1-25 input signal is OFF (H-level).	
E	Active when CN1-26 input signal is OFF (H-level).	
F	Active when CN1-12 input signal is OFF (H-level).	

3rd digit:

/P-CON Signal Mapping (P control when ON (L-level))		Reference Section
0 to F	Same as Servo ON Signal (/S-ON) Mapping.	6.9.3

4th digit:

P-OT Signal Mapping (Forward run prohibited when OFF (H-level))		Reference Section
0	Forward run allowed when CN1-15 input signal is ON (L-level).	5.2.3
1	Forward run allowed when CN1-16 input signal is ON (L-level).	
2	Forward run allowed when CN1-17 input signal is ON (L-level).	
3	Forward run allowed when CN1-18 input signal is ON (L-level).	
4	Forward run allowed when CN1-25 input signal is ON (L-level).	
5	Forward run allowed when CN1-26 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 CN1-15 input signal is OFF (H-level).	
A	Forward run allowed when CN1-16 input signal is OFF (H-level).	
B	Forward run allowed when CN1-17 input signal is OFF (H-level).	
C	Forward run allowed when CN1-18 input signal is OFF (H-level).	
D	Forward run allowed when CN1-25 input signal is OFF (H-level).	
E	Forward run allowed when CN1-26 input signal is OFF (H-level).	
F	Forward run allowed when CN1-12 input signal is OFF (H-level).	

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50B	2	Input Signal Selection 2	0000 to FFFF	–	6543	After restart	Setup	–

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

1st digit:

N-OT Signal Mapping (Reverse run prohibited when OFF (H-level))		Reference Section
0	Reverse run allowed when CN1-15 input signal is ON (L-level).	5.2.3
1	Reverse run allowed when CN1-16 input signal is ON (L-level).	
2	Reverse run allowed when CN1-17 input signal is ON (L-level).	
3	Reverse run allowed when CN1-18 input signal is ON (L-level).	
4	Reverse run allowed when CN1-25 input signal is ON (L-level).	
5	Reverse run allowed when CN1-26 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 CN1-15 input signal is OFF (H-level).	
A	Reverse run allowed when CN1-16 input signal is OFF (H-level).	
B	Reverse run allowed when CN1-17 input signal is OFF (H-level).	
C	Reverse run allowed when CN1-18 input signal is OFF (H-level).	
D	Reverse run allowed when CN1-25 input signal is OFF (H-level).	
E	Reverse run allowed when CN1-26 input signal is OFF (H-level).	
F	Reverse run allowed when CN1-12 input signal is OFF (H-level).	

2nd digit:

/ALM-RST Signal Mapping (Alarm reset when OFF (H-level) to ON (L-level))		Reference Section
0	Active on the falling edge of CN1-15 input signal.	5.10.1
1	Active on the falling edge of CN1-16 input signal.	
2	Active on the falling edge of CN1-17 input signal.	
3	Active on the falling edge of CN1-18 input signal.	
4	Active on the falling edge of CN1-25 input signal.	
5	Active on the falling edge of CN1-26 input signal.	
6	Active on the falling edge of CN1-12 input signal.	
7	Reserved (Do not use.)	
8	Not active (fixed).	
9	Active on the rising edge of CN1-15 input signal.	
A	Active on the rising edge of CN1-16 input signal.	
B	Active on the rising edge of CN1-17 input signal.	
C	Active on the rising edge of CN1-18 input signal.	
D	Active on the rising edge of CN1-25 input signal.	
E	Active on the rising edge of CN1-26 input signal.	
F	Active on the rising edge of CN1-12 input signal.	

3rd digit:

/P-CL Signal Mapping (Torque Limit when ON (L-level))		Reference Section
0 to F	Same as Servo ON Signal (/S-ON) Mapping.	5.8.2

4th digit:

/N-CL Signal Mapping (Torque Limit when ON (L-level))		Reference Section
0 to F	Same as Servo ON Signal (/S-ON) Mapping.	5.8.2

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50C	2	Input Signal Selection 3	0000 to FFFF	–	8888	After restart	Setup	–

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

1st digit:

/SPD-D Signal Mapping (Refer to *5.6 Internal Set Speed Control*.)		Reference Section
0	Active when CN1-15 input signal is ON (low level).	5.6.1
1	Active when CN1-16 input signal is ON (low level).	
2	Active when CN1-17 input signal is ON (low level).	
3	Active when CN1-18 input signal is ON (low level).	
4	Active when CN1-25 input signal is ON (low level).	
5	Active when CN1-26 input signal is ON (low level).	
6	Active when CN1-12 input signal is ON (low level).	
7	Reserved (Do not use.)	
8	Not active (fixed).	
9	Active when CN1-15 input signal is OFF (high level).	
A	Active when CN1-16 input signal is OFF (high level).	
B	Active when CN1-17 input signal is OFF (high level).	
C	Active when CN1-18 input signal is OFF (high level).	
D	Active when CN1-25 input signal is OFF (high level).	
E	Active when CN1-26 input signal is OFF (high level).	
F	Active when CN1-12 input signal is OFF (high level).	

2nd digit:

/SPD-A Signal Mapping (Refer to *5.6 Internal Set Speed Control*.)		Reference Section
0 to F	Same as /SPD-D Signal Mapping.	5.6.1

3rd digit:

/SPD-B Signal Mapping (Refer to *5.6 Internal Set Speed Control*.)		Reference Section
0 to F	Same as /SPD-D Signal Mapping.	5.6.1

4th digit:

/C-SEL Signal Mapping (Control method change when ON (L-level))		Reference Section
0 to F	Same as /SPD-D Signal Mapping.	5.7.1

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50D	2	Input Signal Selection 4	0000 to FFFF	–	8888	After restart	Setup	–

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

1st digit:

/ZCLAMP Signal Mapping (Zero clamp when ON (L-level))		Reference Section
0	Active when CN1-15 input signal is ON (L-level).	5.3.5
1	Active when CN1-16 input signal is ON (L-level).	
2	Active when CN1-17 input signal is ON (L-level).	
3	Active when CN1-18 input signal is ON (L-level).	
4	Active when CN1-25 input signal is ON (L-level).	
5	Active when CN1-26 input signal is ON (L-level).	
6	Active when CN1-12 input signal is ON (L-level).	
7	Always active (fixed).	
8	Not active (fixed).	
9	Active when CN1-15 input signal is OFF (H-level).	
A	Active when CN1-16 input signal is OFF (H-level).	
B	Active when CN1-17 input signal is OFF (H-level).	
C	Active when CN1-18 input signal is OFF (H-level).	
D	Active when CN1-25 input signal is OFF (H-level).	
E	Active when CN1-26 input signal is OFF (H-level).	
F	Active when CN1-12 input signal is OFF (H-level).	

2nd digit:

/INHIBIT Signal Mapping (Reference pulse inhibit when ON (L-level))		Reference Section
0 to F	Same as /ZCLAMP Signal Mapping.	5.4.8

3rd digit:

/G-SEL1 Signal Mapping (Gain change when ON (L-level))		Reference Section
0 to F	Same as /ZCLAMP Signal Mapping.	6.9.5

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50E	2	Output Signal Selection 1	0000 to 3333	–	3211	After restart	Setup	–

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

1st digit:

Positioning Completion Signal Mapping (/COIN)		Reference Section
0	Disabled (the above signal is not used.)	5.4.6
1	Outputs the signal from CN1-7 output terminal.	
2	Outputs the signal from CN1-9 output terminal.	
3	Outputs the signal from CN1-11 output terminal.	

2nd digit:

Speed Coincidence Detection Signal Mapping (/V-CMP)		Reference Section
0 to 3	Same as /COIN Signal Mapping.	5.3.8

3rd digit:

Servomotor Rotation Detection Signal Mapping (/TGON)		Reference Section
0 to 3	Same as /COIN Signal Mapping.	5.10.3

4th digit:

Servo Ready Signal Mapping (/S-RDY)		Reference Section
0 to 3	Same as /COIN Signal Mapping.	5.10.4

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn50F	2	Output Signal Selection 2	0000 to 3333	–	0000	After restart	Setup	–
Pn510	2	Output Signal Selection 3	0000 to 0333	–	0000	After restart	Setup	–
Pn511	2	Input Signal Selection 5	0000 to FFFF	–	8888	After restart	Setup	–

Pn50F

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

1st digit:

Torque Limit Detection Signal Mapping (/CLT)		Reference Section
0	Disabled (the above signal is not used.)	5.8.5
1	Outputs the signal from CN1-7 output terminal.	
2	Outputs the signal from CN1-9 output terminal.	
3	Outputs the signal from CN1-11 output terminal.	

2nd digit:

Speed Limit Detection Signal Mapping (/VLT)		Reference Section
0 to 3	Same as /CLT Signal Mapping.	5.5.4

3rd digit:

Brake Signal Mapping (/BK)		Reference Section
0 to 3	Same as /CLT Signal Mapping.	5.2.4

4th digit:

Warning Signal Mapping (/WARN)		Reference Section
0 to 3	Same as /CLT Signal Mapping.	5.10.2

Pn510

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

1st digit:

Near Signal Mapping (/NEAR)		Reference Section
0	Disabled (the above signal is not used.)	5.4.7
1	Outputs the signal from CN1-7 terminal.	
2	Outputs the signal from CN1-9 terminal.	
3	Outputs the signal from CN1-10 terminal.	

2nd digit: Reserved (Do not change.)

3rd digit:

Reference Pulse Input Multiplication Switching Output Signal Mapping (/PSELA)		Reference Section
0 to 3	Same as /NEAR Signal Mapping.	5.4.3

4th digit: Reserved (Do not change.)

Pn511

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

1st digit: Reserved (Do not change.)

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn512	2	Output Signal Inverse Setting	0000 to 0111	–	0000	After restart	Setup	3.3.2

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

1st digit: Output Signal Inversion for CN1-7 Terminal

0	Does not inverse outputs.
1	Inverses outputs.

2nd digit: Output Signal Inversion for CN1-9 Terminal

0	Does not inverse outputs.
1	Inverses outputs.

3rd digit: Output Signal Inversion for CN1-10 Terminal

0	Does not inverse outputs.
1	Inverses outputs.

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn513	2	Output Signal Selection 4	0000 to 0333	–	0000	After restart	Setup	–

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

1st digit: Reserved (Do not change.)

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn514	2	Reserved (Do not change.)	–	–	0000	–	–	–

Appendix

10

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn515	2	Input Signal Selection 6	0000 to FFFF	–	8888	After restart	Setup	–

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

1st digit:

Absolute Data Request Signal Mapping (/SEN)	
0	Active when CN1-15 input signal is ON (low level).
1	Active when CN1-16 input signal is ON (low level).
2	Active when CN1-17 input signal is ON (low level).
3	Active when CN1-18 input signal is ON (low level).
4	Active when CN1-25 input signal is ON (low level).
5	Active when CN1-26 input signal is ON (low level).
6	Active when CN1-12 input signal is ON (low level).
7	Always active (fixed).
8	Not active (fixed).
9	Active when CN1-15 input signal is OFF (high level).
A	Active when CN1-16 input signal is OFF (high level).
B	Active when CN1-17 input signal is OFF (high level).
C	Active when CN1-18 input signal is OFF (high level).
D	Active when CN1-25 input signal is OFF (high level).
E	Active when CN1-26 input signal is OFF (high level).
F	Active when CN1-12 input signal is OFF (high level).

2nd digit:

Reference Pulse Input Multiplication Switching Input Signal Mapping (/PSEL)		Reference Section
0 to F	Same as SEN Signal Mapping.	5.4.3

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn517	2	Reserved (Do not change.)	–	–	0000	–	–	–
Pn51B	4	Reserved (Do not change.)	–	–	1000	–	–	–
Pn51E	2	Excessive Position Error Warning Level	10 to 100	1%	100	Immediately	Setup	9.2.1
Pn520	4	Excessive Position Error Alarm Level	1 to 1073741823	1 reference unit	5242880	Immediately	Setup	6.1.4, 9.1.1
Pn522	4	Positioning Completed Width	0 to 1073741824	1 reference unit	7	Immediately	Setup	5.4.6
Pn524	4	NEAR Signal Width	1 to 1073741824	1 reference unit	1073741824	Immediately	Setup	5.4.7
Pn526	4	Excessive Position Error Alarm Level at Servo ON	1 to 1073741823	1 reference unit	5242880	Immediately	Setup	6.1.4
Pn528	2	Excessive Position Error Warning Level at Servo ON	10 to 100	1%	100	Immediately	Setup	6.1.4
Pn529	2	Speed Limit Level at Servo ON	0 to 10000	1 min^{-1}	10000	Immediately	Setup	6.1.4
Pn52A	2	Reserved (Do not change.)	–	–	20	–	–	–
Pn52B	2	Overload Warning Level	1 to 100	1%	20	Immediately	Setup	5.2.6
Pn52C	2	Derating of Base Current at Detecting Overload of Motor	10 to 100	1%	100	After restart	Setup	5.2.6

(cont'd)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn52D	2	Reserved (Do not change.)	–	–	50	–	–	–
Pn52F	2	Reserved (Do not change.)	–	–	0FFF	–	–	–
Pn530	2	Program JOG Operation Related Switch	0000 to 0005	–	0000	Immediately	Setup	7.5

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

1st digit: Program JOG Operation Switch

0	(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536
1	(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536
2	(Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536 (Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536
3	(Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536 (Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536
4	(Waiting time Pn535 → Forward movement Pn531 → Waiting time Pn535 → Reverse movement Pn531) × Number of movements Pn536
5	(Waiting time Pn535 → Reverse movement Pn531 → Waiting time Pn535 → Forward movement Pn531) × Number of movements Pn536

2nd digit: Reserved (Do not change.)

3rd digit: Reserved (Do not change.)

4th digit: Reserved (Do not change.)

Parameter No.	Size	Name	Setting Range	Units	Factory Setting	When Enabled	Classification	Reference Section
Pn531	4	Program JOG Movement Distance	1 to 1073741824	1 reference unit	32768	Immediately	Setup	7.5
Pn533	2	Program JOG Movement Speed	1 to 10000	1 min^{-1}	500	Immediately	Setup	7.5
Pn534	2	Program JOG Acceleration/ Deceleration Time	2 to 10000	1 ms	100	Immediately	Setup	7.5
Pn535	2	Program JOG Waiting Time	0 to 10000	1 ms	100	Immediately	Setup	7.5
Pn536	2	Number of Times of Program JOG Movement	0 to 1000	1 time	1	Immediately	Setup	7.5
Pn550	2	Analog Monitor 1 Offset Voltage	-10000 to 10000	0.1 V	0	Immediately	Setup	6.1.3
Pn551	2	Analog Monitor 2 Offset Voltage	-10000 to 10000	0.1 V	0	Immediately	Setup	6.1.3
Pn552	2	Analog Monitor Magnification (×1)	-10000 to 10000	×0.01	100	Immediately	Setup	6.1.3
Pn553	2	Analog Monitor Magnification (×2)	-10000 to 10000	×0.01	100	Immediately	Setup	6.1.3
Pn560	2	Remained Vibration Detection Width	1 to 3000	0.1%	400	Immediately	Setup	6.7.1
Pn561	2	Overshoot Detection Level	0 to 100	1%	100	Immediately	Setup	6.3.1 6.4.1
Pn600	2	Reserved (Do not change.)	–	–	0	–	–	–
Pn601	2	Reserved (Do not change.)	–	–	0	–	–	–
Pn612	2	Reserved (Do not change.)	–	–	30	–	–	–
Pn614	2	Reserved (Do not change.)	–	–	500	–	–	–
Pn615	2	Reserved (Do not change.)	–	–	2000	–	–	–

10.3 List of Monitor Displays

The following list shows the available monitor displays.

Parameter No.	Description	Unit
Un000	Motor rotating speed	min^{-1}
Un001	Speed reference	min^{-1}
Un002	Internal torque reference (in percentage to the rated torque)	%
Un003	Rotational angle 1 (encoder pulses from the phase-C origin: decimal display)	encoder pulse*3
Un004	Rotational angle 2 (from polarity origin (electric angle))	deg
Un005*1	Input signal monitor	–
Un006*2	Output signal monitor	–
Un007*4	Input reference pulse speed (valid only in position control)	min^{-1}
Un008*4	Position error amount (valid only in position control)	reference unit
Un009	Accumulated load ratio (in percentage to the rated torque: effective torque in cycle of 10 seconds)	%
Un00C*4	Input reference pulse counter	reference unit
Un00D	Feedback pulse counter	encoder pulse*3
Un012	Total operation time	100 ms
Un013	Feedback pulse counter	reference unit
Un014	Effective gain monitor (gain settings 1 = 1, gain settings 2 = 2)	–
Un020	Motor rated speed	min^{-1}
Un021	Motor maximum speed	min^{-1}

∗1. For details, refer to *8.3 Monitoring Input Signals*.
∗2. For details, refer to *8.4 Monitoring Output Signals*.
∗3. For details, refer to *5.4.4 Electronic Gear*.
∗4. If the reference pulse input multiplication switching function is enabled, the reference pulse will be multiplied by n to obtain the reference.

10.4 Parameter Recording Table

Use the following table for recording parameters.

Note: Pn10B, Pn170, and Pn408 have two kinds of digits: the digit which does not need the restart after changing the settings and the digit which needs the restart. The underlined digits of the factory setting in the following table show the digit which needs the restart.

Parameter	Factory Setting						Name	When Enabled
Pn000	0000						Basic Function Select Switch 0	After restart
Pn001	0102						Application Function Select Switch 1	After restart
Pn002	0000						Application Function Select Switch 2	After restart
Pn006	0002						Application Function Select Switch 6	Immediately
Pn007	0000						Application Function Select Switch 7	Immediately
Pn008	0000						Application Function Select Switch 8	After restart
Pn009	0010						Application Function Select Switch 9	After restart
Pn00B	0000						Application Function Select Switch B	After restart
Pn00C	0000						Application Function Select Switch C	After restart
Pn00D	0000						Application Function Select Switch D	After restart
Pn00F	0000						Reserved	–
Pn010	0001						Axis Address Selection (for UART/ USB communications)	After restart
Pn100	400						Speed Loop Gain	Immediately
Pn101	2000						Speed Loop Integral Time Constant	Immediately
Pn102	400						Position Loop Gain	Immediately
Pn103	100						Moment of Inertia Ratio	Immediately
Pn104	400						2nd Speed Loop Gain	Immediately
Pn105	2000						2nd Speed Loop Integral Time Constant	Immediately
Pn106	400						2nd Position Loop Gain	Immediately
Pn109	0						Feedforward Gain	Immediately
Pn10A	0						Feedforward Filter Time Constant	Immediately
Pn10B	0000						Application Function for Gain Select Switch	–
Pn10C	200						Mode Switch (torque reference)	Immediately
Pn10D	0						Mode Switch (speed reference)	Immediately
Pn10E	0						Mode Switch (acceleration)	Immediately
Pn10F	0						Mode Switch (position error)	Immediately
Pn11F	0						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						Friction Compensation Frequency Correction	Immediately
Pn125	100						Friction Compensation Gain Correction	Immediately
Pn131	0						Gain Switching Time 1	Immediately
Pn132	0						Gain Switching Time 2	Immediately
Pn135	0						Gain Switching Waiting Time 1	Immediately
Pn136	0						Gain Switching Waiting Time 2	Immediately

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn139	0000						Automatic Gain Changeover Related Switch 1	Immediately
Pn13D	2000						Current Gain Level	Immediately
Pn140	0100						Model Following Control Related Switch	Immediately
Pn141	500						Model Following Control Gain	Immediately
Pn142	1000						Model Following Control Gain Compensation	Immediately
Pn143	1000						Model Following Control Bias (Forward Direction)	Immediately
Pn144	1000						Model Following Control Bias (Reverse Direction)	Immediately
Pn145	500						Vibration Suppression 1 Frequency A	Immediately
Pn146	700						Vibration Suppression 1 Frequency B	Immediately
Pn147	1000						Model Following Control Speed Feedforward Compensation	Immediately
Pn148	500						2nd Model Following Control Gain	Immediately
Pn149	1000						2nd Model Following Control Gain Compensation	Immediately
Pn14A	800						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	1000						Anti-Resonance Frequency	Immediately
Pn162	100						Anti-Resonance Gain Compensation	Immediately
Pn163	0						Anti-Resonance Damping Gain	Immediately
Pn164	0						Anti-Resonance Filter Time Constant 1 Compensation	Immediately
Pn165	0						Anti-Resonance Filter Time Constant 2 Compensation	Immediately
Pn170	1401						Tuning-less Function Related Switch	–
Pn190	0010						Reserved	–
Pn200	0000						Position Control Reference Form Selection Switch	After restart
Pn205	65535						Multiturn Limit Setting	After restart
Pn207	0000						Position Control Function Switch	After restart
Pn20A	32768						Reserved	–
Pn20E	4						Electronic Gear Ratio (Numerator)	After restart
Pn210	1						Electronic Gear Ratio (Denominator)	After restart
Pn212	2048						Encoder Output Pulses	After restart
Pn216	0						Position Reference Acceleration/ Deceleration Time Constant	Immediately after the motor stops
Pn217	0						Average Movement Time of Position Reference	Immediately after the motor stops
Pn218	1						Reference Pulse Input Multiplication	Immediately
Pn22A	0000						Reserved	–

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn281	20						Reserved	–
Pn300	600						Speed Reference Input Gain	Immediately
Pn301	100						Internal Set Speed 1	Immediately
Pn302	200						Internal Set Speed 2	Immediately
Pn303	300						Internal Set Speed 3	Immediately
Pn304	500						JOG Speed	Immediately
Pn305	0						Soft Start Acceleration Time	Immediately
Pn306	0						Soft Start Deceleration Time	Immediately
Pn307	40						Speed Reference Filter Time Constant	Immediately
Pn310	0000						Vibration Detection Switch	Immediately
Pn311	100						Vibration Detection Sensibility	Immediately
Pn312	50						Vibration Detection Level	Immediately
Pn324	300						Moment of Inertia Calculating Start Level	Immediately
Pn400	30						Torque Reference Input Gain	Immediately
Pn401	100						Torque Reference Filter Time Constant	Immediately
Pn402	800						Forward Torque Limit	Immediately
Pn403	800						Reverse Torque Limit	Immediately
Pn404	100						Forward External Torque Limit	Immediately
Pn405	100						Reverse External Torque Limit	Immediately
Pn406	800						Emergency Stop Torque	Immediately
Pn407	10000						Speed Limit during Torque Control	Immediately
Pn408	0000						Torque Related Function Switch	–
Pn409	5000						1st Notch Filter Frequency	Immediately
Pn40A	70						1st Notch Filter Q Value	Immediately
Pn40B	0						1st Notch Filter Depth	Immediately
Pn40C	5000						2nd Notch Filter Frequency	Immediately
Pn40D	70						2nd Notch Filter Q Value	Immediately
Pn40E	0						2nd Notch Filter Depth	Immediately
Pn40F	5000						2nd Step 2nd Torque Reference Filter Frequency	Immediately
Pn410	50						2nd Step 2nd Torque Reference Filter Q Value	Immediately
Pn412	100						1st Step 2nd Torque Reference Filter Time Constant	Immediately
Pn415	0						T-REF Filter Time Constant	Immediately
Pn424	50						Reserved	–
Pn425	100						Reserved	–
Pn456	15						Sweep Torque Reference Amplitude	Immediately
Pn460	0101						Notch Filter Adjustment Switch	Immediately
Pn501	10						Zero Clamp Level	Immediately
Pn502	20						Rotation Detection Level	Immediately
Pn503	10						Speed Coincidence Signal Output Width	Immediately

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn506	0						Brake Reference - Servo OFF Delay Time	Immediately
Pn507	100						Brake Reference Output Speed Level	Immediately
Pn508	50						Waiting Time for Brake Signal When Motor Running	Immediately
Pn509	20						Reserved	–
Pn50A	2100						Input Signal Selection 1	After restart
Pn50B	6543						Input Signal Selection 2	After restart
Pn50C	8888						Input Signal Selection 3	After restart
Pn50D	8888						Input Signal Selection 4	After restart
Pn50E	3211						Output Signal Selection 1	After restart
Pn50F	0000						Output Signal Selection 2	After restart
Pn510	0000						Output Signal Selection 3	After restart
Pn511	8888						Input Signal Selection 5	After restart
Pn512	0000						Output Signal Inverse Setting	After restart
Pn513	0000						Output Signal Selection 4	After restart
Pn514	0000						Reserved	–
Pn515	8888						Input Signal Selection 6	After restart
Pn517	0000						Reserved	–
Pn51B	1000						Reserved	–
Pn51E	100						Excessive Position Error Warning Level	Immediately
Pn520	5242880						Excessive Position Error Alarm Level	Immediately
Pn522	7						Positioning Completed Width	Immediately
Pn524	1073741824						NEAR Signal Width	Immediately
Pn526	5242880						Excessive Position Error Alarm Level at Servo ON	Immediately
Pn528	100						Excessive Position Error Warning Level at Servo ON	Immediately
Pn529	10000						Speed Limit Level at Servo ON	Immediately
Pn52A	20						Reserved	–
Pn52B	20						Overload Warning Level	Immediately
Pn52C	100						Derating of Base Current at Detecting Overload of Motor	After restart
Pn52D	50						Reserved	–
Pn52F	0FFF						Reserved	–
Pn530	0000						Program JOG Operation Related Switch	Immediately
Pn531	32768						Program JOG Movement Distance	Immediately
Pn533	500						Program JOG Movement Speed	Immediately
Pn534	100						Program JOG Acceleration/Deceleration Time	Immediately
Pn535	100						Program JOG Waiting Time	Immediately
Pn536	1						Number of Times of Program JOG Movement	Immediately
Pn550	0						Analog Monitor 1 Offset Voltage	Immediately
Pn551	0						Analog Monitor 2 Offset Voltage	Immediately

(cont'd)

Parameter	Factory Setting						Name	When Enabled
Pn552	100						Analog Monitor Magnification (×1)	Immediately
Pn553	100						Analog Monitor Magnification (×2)	Immediately
Pn560	400						Remained Vibration Detection Width	Immediately
Pn561	100						Overshoot Detection Level	Immediately
Pn600	0						Reserved	–
Pn601	0						Reserved	–
Pn612	30						Reserved	–
Pn614	500						Reserved	–
Pn615	2000						Reserved	–

Index

Symbols

Revision History

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

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Date of Publication	Rev. No.	WEB Rev. No.	Section	Revised Content
January 2020	<2>	1	Preface	Revision: ■ Disposal precaution
			Back cover	Revision: Address
November 2017		0	All chapters	Partly revised
October 2016	<1>	1	3.1.7	Addition: Precaution when wiring a magnetic contactor on the DC side of the main circuit power supply
			Back cover	Revision: Address
July 2015		0	–	Same revisions made as Web version SIEP S800000 81A<0>-1.
			3.4.1	Revision: Information on analog voltage input circuit (wiring example)
			3.5.2, 5.9.1	Revision: Information on battery for encoder
			4.6.1 (2)	Addition: Information on rated motor speed and maximum motor speed
			9.1.1, 9.1.2	Addition: Information on A.bE0 and A.F50
			10.2.2	Revision: Information on reserved parameters
			10.2.2, 10.4	Addition: Information on Pn52D
			Front cover	Revision: Format
			Back cover	Revision: Address, format
April 2012	<0>	1	3.1.4, 3.1.5	Revision: Values of power supply capacity and input current capacity
			9.1.2	Revision: Detection conditions calculation formula
			Back cover	Revision: Address
November 2011	–	–	–	First edition

AC Servo Drives

DC Power Input Σ-V Series

USER'S MANUAL
Design and Maintenance

Rotational Motor
Analog Voltage Reference and Pulse Train Reference

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In the event that the end user of this product is to be the military and said product is to be employed in any weapons systems or the manufacture thereof, the export will fall under the relevant regulations as stipulated in the Foreign Exchange and Foreign Trade Regulations. Therefore, be sure to follow all procedures and submit all relevant documentation according to any and all rules, regulations and laws that may apply.

Specifications are subject to change without notice for ongoing product modifications and improvements.

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